

Blockchain technology as a platform for digitization

Implications for the insurance industry

The EY logo consists of the letters 'EY' in a bold, white, sans-serif font. A yellow chevron shape is positioned above the 'Y', pointing to the right. The background of the entire page is a blue bokeh effect with light rays and fiber optic lines.

Building a better
working world

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Foreword

Digitization has moved far beyond machine-to-machine (M2M) process automation. We are witnessing a gradual convergence of technologies, processes, data, assets and people across an integrated ecosystem. Smart life, mobility, agriculture, manufacturing and financial services are all underpinned by sophisticated web interplay between data and capital. As the digital trend continues, business models are forced to evolve or to disrupt in order to survive.

Insurance is experiencing an evolution in products, services and infrastructure in response to the connected world. Progress in the insurance digital space will be driven by successful innovation, including the adoption of disruptive technologies such as mobile, analytics, big data and payment platforms.

The initial drivers for insurance innovation were related to cost reduction and process efficiencies. These now have been superseded by coveted client-centric principles including customer experience and service quality, particularly in claims. As digitization continues its pervasive path, the need for customer intimacy, transparency and security (of personal data) are becoming essential to an insurer's infrastructure. Without these cornerstones in place to build a customer-centric organization, the value of businesses can easily be eroded as quickly as customers can be attracted.

Fast-emerging disruptive technologies such as blockchain and next generation iterations such as Ethereum are evolving rapidly and underpinning many aspects of innovation. Initially, these were created to orchestrate Bitcoin payment technologies via distributed secure ledger systems. With continued investments in development, they are now building industrial strength platforms¹ using industry standards to cover the entire value chain from customer wallets and client-driven applications to transaction and money exchanges.

There are obvious benefits to driving the adoption of these global technologies. Blockchain is one innovation whose architectural properties increasingly provide essential foundations to the digital landscape where there is an appetite to define greater levels of autonomy and attribution. This includes increasing use of mobile-to-mobile transactions and swifter, secure payment models, client data provenance, registers of assets, fraud detection and reduced risk of duplication or exposure management.

While there are obvious rewards associated with an innovation architecture, there are also industry challenges for insurers to consider:

- 1. Innovation isn't perfect.** Many of these technologies are still in their infancy and rapidly innovating, so timing and adoptions are unclear. Insurers need to examine the attributes and benefits of blockchain and the potential client adoption curve.
- 2. Transparency is a coveted commodity.** The digital world and demand for data privacy are driving changes in market focus and regulation. This has caused a significant ripple effect for businesses in enterprise risk management, data protection and consumer legislation. Proactive engagement in compliance and regulatory frameworks to fit the new model is critical.
- 3. Markets need infrastructure.** Insurers and their ecosystem providers need to design and build their organizations to cope with disruptive innovation. This requires meeting future customer needs and expanding in areas such as governance and cyber risk. Today's insurance markets and prudential system will need to continue to exercise adequate controls and stimulate the innovation curve in achievable and scalable ways.

These are just some of the themes that are being examined in a series of EY innovation white papers based on analysis currently underway with our financial services and fintech teams.

We hope readers find these reports of value in identifying key opportunities and benefits of blockchain technology and leveraging the platform to drive innovation in the insurance industry.



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¹ For example, KSI-enabled blockchain, an open standard recently deployed using international security standards to industrialize the core blockchain technology. Guardtime is one company that has driven this approach.

Executive summary

Examples of web interplay:

- ▶ 104 million estimated new cars expected to have some form of connectivity by 2025 as telematics grows
- ▶ Google and Novartis are jointly working on a smart contact lens that monitors blood-sugar levels and corrects vision

A connected insurance world:

- ▶ Insurers are using bancassurance as a channel to cross-sell new products and services that promote the use of connected devices
- ▶ There is ongoing discussion in the insurance markets about the impact of connected infrastructure, driverless cars and other forms of digital ecosystems - in many instances products will decline and be replaced by new markets and new product lines
- ▶ The emergence of cyber liability and new products that need to respond to the connected world are being researched by most global insurance companies
- ▶ Brokers are moving toward improved platforms to support their global clients based on new ways of governing data, financing risk and supporting "24/7" and "always connected" business models
- ▶ Motor and other transport-driven markets appear positioned for change over the next five years, enabled by platforms, services and automated underwriting and claims

The application of insurance in today's transparent society is based on a chain of trust between clients and insurers. This is an age-old principle that applies to consumer insurance and protecting commercial entities and governments from natural catastrophes or specialty risks.

This bond of trust is founded upon an intangible "promise to pay," and a unique combination of expertise, service quality, capital and security. This is based on disclosure of accurate personal data describing the insurable interests of the client, the agreement to a contract between two legal and consenting parties, and timely exchange of payment.

If there is a vulnerability in the transaction chain, particularly resulting from the increasing use of technology, then trust is severely weakened, diluting brand, eroding confidence and potentially losing business and shareholder value.

As society becomes increasingly digital and distribution channels more varied and complex, customers have higher expectations in choice of product or insurer. When certain aspects of the value chain become more commoditized, as a result, a customer bases a choice entirely on the availability of brand information and transparency of the insurer's performance. The integrity, controls and transparency of insurers' business processes, reinforced by recent trends in regulation, must be geared toward protecting the customer experience. Unless insurers are prepared to innovate, either customers or regulators will force them to change.

In this report, we discuss how innovation in the insurance marketplace (in particular the arrival of blockchain technology) may contribute to the future infrastructure the industry needs and how it can be applied to reinforce the chain of trust.

We identify the key attributes and opportunities that blockchain presents and examine insurance company readiness for digitization; How will the industry respond to its obligations to customers, markets and regulators and what key issues need to be considered?

As part of our discussion, we explore the role blockchain may play in a holistic innovation and risk management strategy, including concepts of cyber liability, big data and telematics. Finally, we look at recent industry trends and advances that companies have made to enable change in the way they will transact business in the future.



What blockchain technology means for insurers

Blockchain, described by leading venture capitalist Marc Andreessen as the most important invention since the internet itself,² can be leveraged to assist the insurance industry to innovate across all functions.

Insurance companies have been traditionally slow to drive adoption in disruptive technologies. These innovation strategies and initiatives are aimed at retaining customers and optimizing pricing and profitability of services.

Insurers who have trust at the heart of their propositions have begun to innovate with technologies such as blockchain because they believe that a “trustless” system (which pushes identity management, ownership and management of data and processes to the customer) may provide genuine long-term strategic benefits:

- ▶ Access to secure, decentralized transactions (with common access to a ledger that has a secure audit trail) provides an improved basis for non-repudiation, governance, fraud prevention, financial data and reporting.
- ▶ Accurate and timely notification of changes drives improvements in aggregated risk and capital opportunities, as well as big data strategies, which are founded on more available and secure information about customer assets, priorities, preferences and third-party information services.
- ▶ On a technical level, insurers see an opportunity to integrate an ecosystem of trusted third parties to reduce the costs of their global platforms, improve customer and market reach and develop new propositions.
- ▶ On a market level, insurers see opportunities in enterprise governance through improved data access, third-party controls and more sophisticated management of the risks associated with their products and services, including resilience services and cyber insurance.

Reinforcing trust is systemic. It requires layers of investment to accelerate customer insight, payments, mobile, data, analytics and automation – all underpinned by a data provenance strategy.

As innovation accelerates and new technologies and connections are achieved, it is becoming apparent that the business processes and activities traditionally governed by insurers will need to adapt to new digital models.

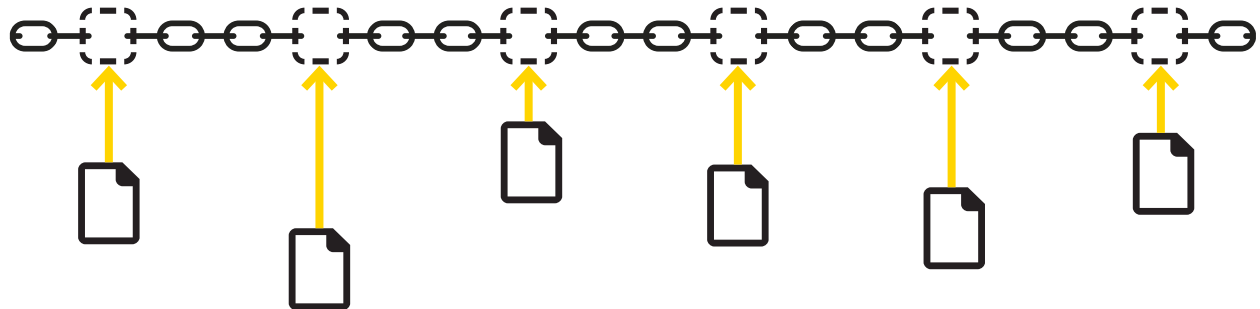
It is also clear that the technical infrastructure (standards, modes of communication, change controls, the protection of data, governance and regulation supporting the insurance marketplace) will need to scale efficiently across time and/or number of participants in a much wider, vulnerable and disparate ecosystem.

² Marc Andreessen, “Why Bitcoin Matters,” *The New York Times*, 21 January 2014, © 2014 The New York Times.

Introducing the blockchain

In 2007, Estonian scientists were challenged to design and build a massive scale tagging system for electronic data that could prove the time, integrity and identity for people and machines without relying on traditional systems.

Figure 1: Transaction registration. KSI-enabled blockchain: a full audit trail of transactions.



- ▶ Registering the electronic transactions in a **global insurance blockchain** makes transaction fraud impossible.
- ▶ Verification of the transaction authenticity is instant and can be performed by anyone, anywhere.
- ▶ **Zero disclosure** of information, all transaction related data **remains confidential** and is never entered into blockchain.

The system (blockchain) is a distributed ledger of transactions, a multi-tiered technology that potentially orchestrates the behavior of consumers and their assets based on a series of transaction ledgers.

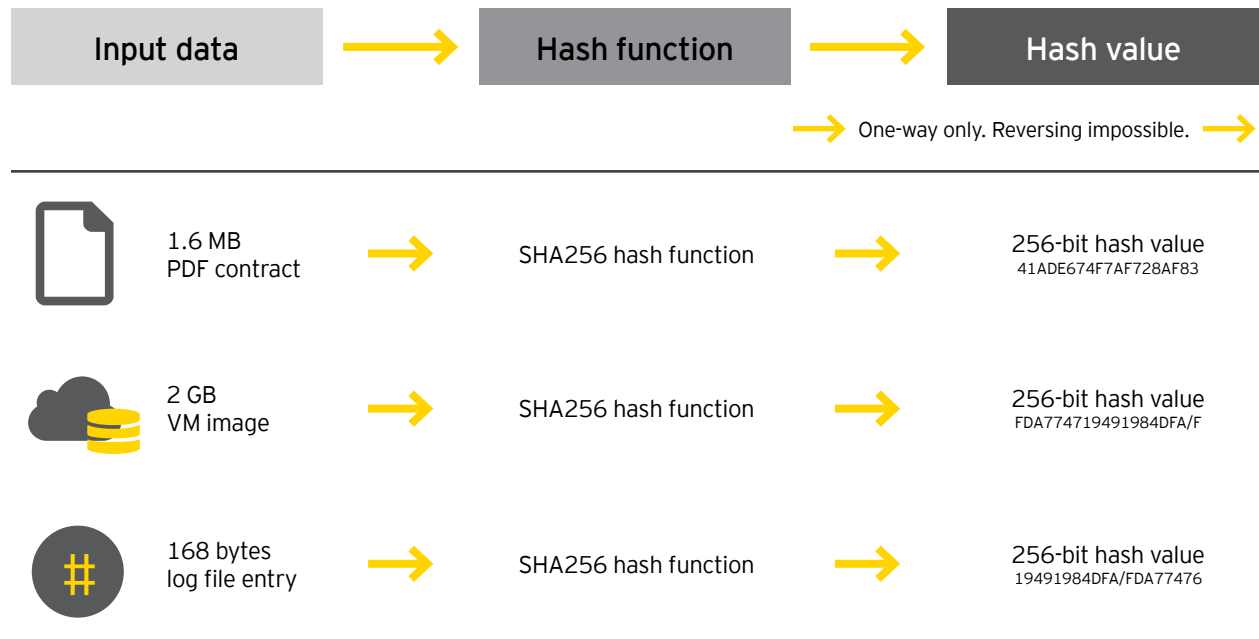
Like a traditional ledger, individual transactions (unique blocks) are added to the ledger (the chain) and never removed. A complete audit trail is maintained. Anyone with the appropriate encryption rights (consumer, insurer, auditor or regulator) can access a copy of that ledger and verify past transactions without having to trust the participants in the original transaction. Therefore, ledgers can virtually exist on a private and/or public basis depending on the needs of the providers.

As a simple example, imagine an insurance policy between two parties. That transaction or collection of identities, confidential data and contract is entered into the blockchain ledger. When a future payment is made, contract amended or claim submitted, the integrity or veracity of that transaction can be immediately verified independently from the participants in the transaction. Similarly, in the case of complex multi-party (re)insurance (where data is aggregated, "re-used" and risks passed from participant to participant in a complex negotiation), there is only a single "view" of the source risk data.

Naturally, there are increasing privacy concerns if the underlying contents of any transaction are entered into a centralized public ledger. Therefore, a mechanism is needed to ensure that the transaction can be recorded so the contents are not revealed.

The technical design of the blockchain has evolved through a number of iterations by using hash-functions and a mathematical operation which creates a trace or digest of the transaction. Like human fingerprints, hash-functions are one way to verify that the fingerprint matches a specific person, but without the ability to create the person from the fingerprint. Equivalently, a hash value (the result of applying a hash-function) uniquely identifies data and has the ability to recreate it. In figure 2, the industry standard SHA-256 hash function is used. This produces a fixed size 256 bit hash value no matter what the size of the original data.

Figure 2: Input data = hash function = hash value



Let's imagine we want to capture insurance application data or a claim into the blockchain. First, we will generate a hash value for each entry or claim and then submit that hash value into the blockchain infrastructure. The infrastructure aggregates all the hash values for the requests and submits a single aggregate hash value into the blockchain, as shown in figure 3.

Figure 3: Diagram of the calendar blockchain and the global aggregation tree

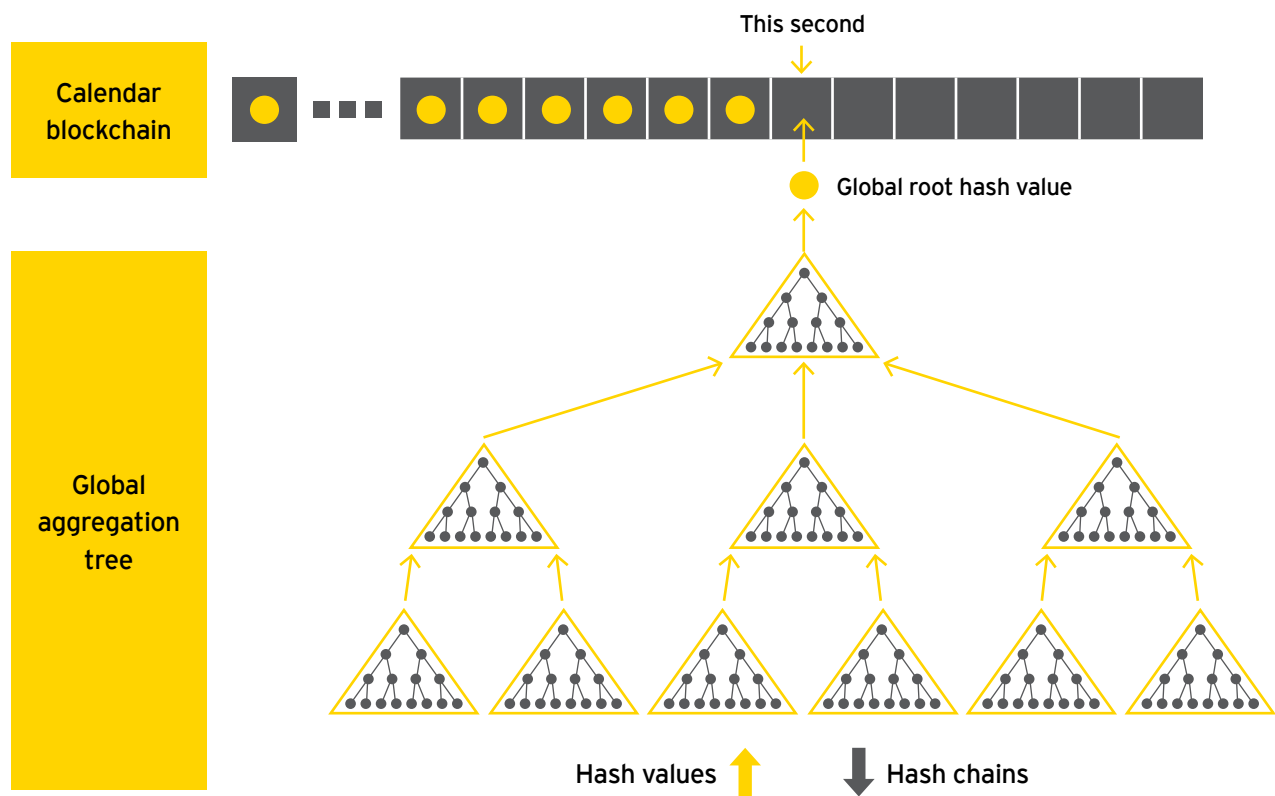




Figure 4: Keyless signature to verify electronic data



If we imagine a commercial fire equivalent where a photograph is used as evidence of the cause of the fire, the blockchain ledger can be used to provide chain of custody for all the evidence related to a single loss event.

Each request is returned a keyless signature which allows a third party to verify the transaction properties (time, identity, integrity) of the data using the blockchain as a reference.

The keyless signature enables the individual properties and attributes of each transaction (including claims) to be verified without reliance on trusted parties and manual intervention. There are no keys to be compromised or to revoke; just mathematical proof of signing time, origin and integrity of the transaction. This, in turn, makes the electronic data tamper evident and verifiable by anyone, helping to ensure that the historical provenance of the claim can be preserved.

Evolution in the blockchain – new dynamics

These new technical dynamics have evolved in ways that provide important implications and opportunities for the insurance industry, ensuring the foundation to manage evidence that can prove non-repudiation or truth. As a result, they have delivered a mechanism to re-architect certain aspects of the business model:

1. First generation: Blockchain technologies (which traditionally supported Bitcoin) based on capturing unique identities, protecting sensitive customer data and maintaining a payments transaction audit trail
2. Second generation: Content (contracts, documents, claims forms, invoices that link end transactions with client and policy or claims documents) and access to third-party information
3. Third generation: Programmable services (indexation of assets - driving third-party automation or verification services) and internet of things data reporting

Intended consequences for blockchain in the insurance market:³

It is often alluded to that blockchain opportunities exist as a consequence of key attributes - mutuality of data and its accessibility across time and space.

Opportunities for insurers	Considerations
Unique digital identity management driving single audit trails and transparency	<ul style="list-style-type: none"> ▸ Provides a public or private ledger (a decentralized, encrypted identity management system) with adequate personal privacy for each transaction ▸ Complements digital identity verification and authentication over web or mobile ▸ Enhances compliance with privacy laws and regulations ▸ Enables data protection and privacy of sensitive data
Decentralized infrastructure	<ul style="list-style-type: none"> ▸ Reduces reliance on centralized market infrastructures ▸ Creates need for new regulation and controls ▸ May increase liability (without clear solutions) for insurers and brokers ▸ Potentially reduces transparency and controls for governments and regulators based on the existing model
Ecosystem scalability	<ul style="list-style-type: none"> ▸ Adapts to local conditions and is globally scalable, accelerating distribution of regionalized or personalized products by region, customer groups, and where no insurance products exist ▸ Peer-to-peer insurance
Fraud and security	<ul style="list-style-type: none"> ▸ Blockchain technology works at the technology agnostic level ▸ Interactions between suppliers, entities, systems and services are transparent and verifiable at any point of time in the data life cycle (even in the past) ▸ Reduces fraud, resulting in faster settlement times for those involved ▸ Eliminates paperwork ▸ Provides easier, improved data access to all parties
Automation	<ul style="list-style-type: none"> ▸ Blockchain technology capable of permitting time-based transactions and services ▸ Digitally native systems that support scripted, programmable transactions
Innovation	<ul style="list-style-type: none"> ▸ Promotes capture of timely and accurate big data resources ▸ Allows introduction of new risk instruments and capital opportunities in the market ▸ Allows for more sophisticated forms of self-insurance and new tailored insurance products ▸ Distributed risk mutualization could support efficient claims management and fraud reduction
Data pooling opportunities	<ul style="list-style-type: none"> ▸ In transactions where data is shared by multiple parties (placements and claims), the ability to access a single and real-time resource of data will change the ways buyers will manage and finance risk, and also enable insurers to price and govern claims recoveries
Technology neutral/agnostic General legal and regulatory compliance	<ul style="list-style-type: none"> ▸ De facto ensures compliance with any international data protection laws and regulations (but, market regulation and levels of trust needed to scale the technology still to be determined)

³ Michael Mainelli and Chiara von Gunten, "Chain of a lifetime. How Blockchain technology might transform personal insurance," December 2014, © 2014 Z/YEN Group.

A night view of a city skyline with server racks in the foreground. The city lights are visible through the windows, and the server racks are illuminated with green lights.

Potential game changer:

Everledger.io, a blockchain start-up, is looking to use a hybrid blockchain to eliminate diamond fraud and is collaborating with international authorities for theft. It has devised a way that insurance companies can utilize the blockchain to ensure the authenticity of the underlying object insured. By mid-2015, the company had received US\$850k in diamonds to catalog and submit to the blockchain, notarizing their ownership.

Opportunity for insurers

There are fewer barriers to adoption for insurers and risk financing models because of easier access to customers and their data via new distribution technologies. Whether these barriers are telematics, health care, life insurance marketing or telecommunications, the blockchain has the potential to create a level of transparency and accountability not previously possible.

For the insurance market there are four cornerstones of opportunity:

1. Fraud detection and risk prevention

- ▶ Blockchain has the potential to eliminate error, negligence and detect fraud by providing a decentralized digital repository to independently verify the veracity of customers, policies and claims (with a complete underlying transaction history). This displaces the roles of a trusted third party, prevents duplicate transactions and provides a verifiable public record of all transactions.
- ▶ Based on blockchain's ability to provide a public ledger and encrypted personal data, many insurers are already exploring its application to reduce fraud and liability associated with immediate payments across borders and multiple currencies.
- ▶ In US Medicare fraud, false billings, tampered documents and fake identities stretch into the billions of dollars. An independent record of all transactions can potentially stop this type of fraudulent activity.
- ▶ In specialty insurance and reinsurance markets, where insurers sit three or four times removed from the end client or service provider, there are equally high degrees of inefficiencies, gaps and errors caused by poor data quality in the front and back offices.



2. Digital claims management

Insurers are looking beyond algorithmic fraud detection to establish a claims model that is claims-centric and customer-focused. Their claims management is based on trust, loss prevention, mitigation and restoration. For claims prevention, they are viewing a combination of new web technologies and big data to enhance the risk selection process by combining location, external risk and analytics. Mobile and digital technology will become the primary solution for improved and effective claims management and customer service if also coupled with these improved compliance controls:

- ▶ Using mobile phone cameras as evidence to make data flows more timely, reduce loss adjuster costs and increase customer satisfaction.
- ▶ Employing mobile technologies in conjunction with satellite images to facilitate claims payments in the event of a natural disaster in a remote area, ensuring disaster recovery services for everyone.
- ▶ Collecting big data from weather stations to pay claims based on the actual weather readings. This eliminates the need for post loss adjusting services to agriculture or commercial businesses who pay based on the accuracy of data. Third-party and subrogation costs, especially in liability contracts, are contained by providing an available claims vault.
- ▶ Providing historical and accurate third-party transaction data for predictive analytics trending.

3. New distribution and disruption

- ▶ A number of leading global insurers are developing alliances with payment business models (and Bitcoin technologies) to achieve capital efficiencies with single global ledgers and to expand their networks. Driving automation to capture risk data in facilities and contracts also offers new opportunities to build market knowledge, automate payments and attract financing risk.



- ▶ Leveraging the blockchain in insurance assures veracity so decisions can be made faster and in full confidence. Telematics or the amount of data being generated by M2M events from a variety of remote devices is a major development in this area.
- ▶ Motor insurance generates large quantities of innovation data and cross-selling opportunities. Invasive black box and mobile devices communicate with GPS devices to calculate premiums through usage-based insurance (UBI). Operating times and distances are used as key encrypted data items to price motor premiums and enable consumers to control their premiums.
- ▶ Blockchain technology will likely power innovations in micro-insurance and micro-finance. These peer-to-peer networks for mobile payments of premiums, claims, loans and other transactions will pass from mobile phone to mobile phone in a smart contract-based cloud environment and require authentication of contracts and customers in new markets to operate distributed authenticated corporations.
- ▶ Insurers are developing the concept of mobile wallets that are restrictive to their offering. With blockchain, these wallets can achieve customer engagement over a wide space and time so that products can be tailored with functionalities and reduce the importance of location. In this case, consumers would have all their identities and insurance information available instantly on a mobile wallet.
- ▶ Big data resources are providing insurers with greater opportunities to zone-in on specific and accurate consumer behavior and to commit research and development resources to the right opportunities. Insurance requires analyzing high volumes of data in order to evaluate, comprehend and mitigate risks. The advent of new technologies has enabled industry risk stakeholders to perform predictive data analytics to gain more insights into the customer, risk assessment, financial risk management and quantification of operational risk.

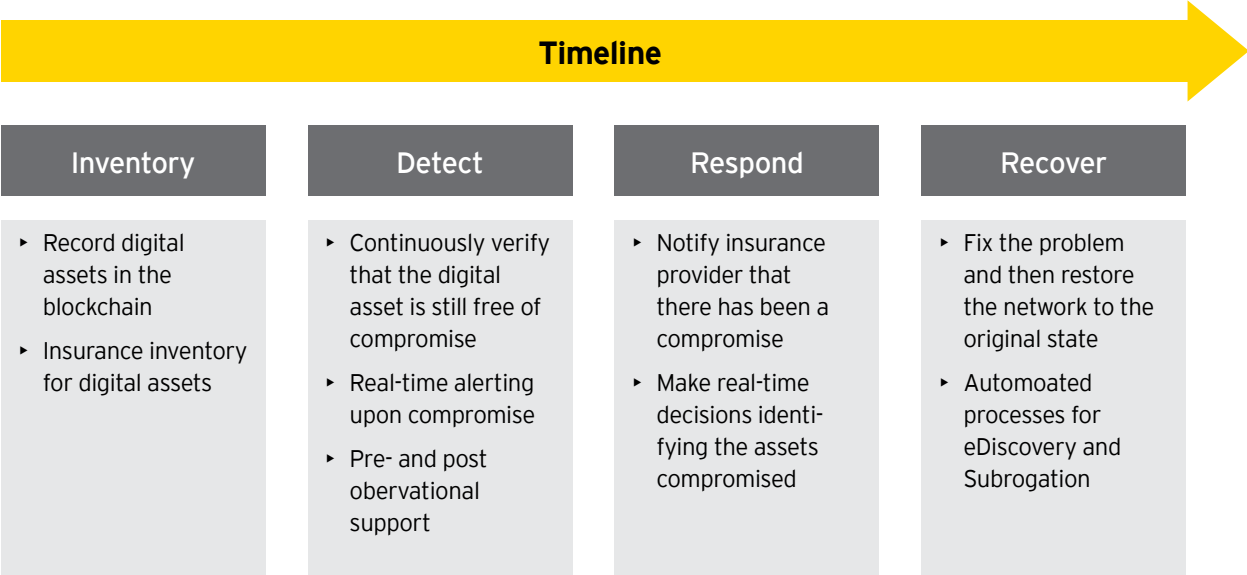
A number of insurers are exploring blockchain capabilities to reduce fraud and drive disruption. A large global insurer is experimenting with blockchain adoption, exploring how it can be used in real estate, wealth management and intellectual property to support insurance sales in emerging markets. A US insurer is actively pursuing blockchain. A dedicated team works on applications to potentially enable the company to track assets, reduce fraud costs and establish new ways to communicate with clients.

Brokers are aligning with new distribution partners as well to drive a new wave in intermediation. Major insurance brokers have formed alliances with telecommunications companies to develop new (re)insurance channels. These will support new markets and demographics and also drive new opportunities in digital, cyber and claims by conducting real-time record-keeping.

4. Cyber liability - new products

The blockchain adds a new real-time capability for security professionals by focusing on the integrity of the digital assets that comprise a network and the configuration of data points, switches, routers, event logs and binaries so the state of the network can be verified independently and in real time (see figure 5).

Figure 5: Blockchain-based cyber resilience



This means policy wordings on cyber solutions will address the blockchain standard as a warranty in a manner similar to what has been used in non-life insurance policies for physical security.

Examples of insurers using blockchain with advanced cyber coverage include:

- ▶ BitGO, a Bitcoin wallet service, has partnered with an insurer to cover all its users up to US\$250,000 for theft claims
- ▶ Coinbase, one of the world’s largest Bitcoin wallet and exchange companies, is insured against employee theft and hacking in the market
- ▶ Other Bitcoin services (Circle, Xapo, BTC Delta) are known to have specific aspects of their technologies covered by cyber insurance

Industry-wide analysis is reviewing the exposures derived from traditional cyber policies, which span property and liability contracts. We expect a new wave of investment into relevant products that can be tailored to deal with measurable exposures to digitally-enabled (or cyber) risk.

Examining other issues

With such areas of promise, there is also a distinct reality associated with blockchain innovation. At this stage, as with all innovations, there are ongoing concerns over scalability, implementation skills, practical integrations with established businesses and governance.

Known areas of concern among regulators are:

- ▶ Critical infrastructure systems have not reached a point of maturity, with significant legacy technologies still intact after years of mergers and acquisitions
- ▶ The maturity of expertise, systems, shared services to protect corporations and their clients from data theft and compromise to networks or systems (including planting Trojans), is a high risk
- ▶ Standardized processes, methods, techniques supporting pre and post-loss control mechanisms are gradually being implemented

Key considerations for insurers:

- ▶ Scalability of the technology and operational integration to existing businesses
- ▶ Understanding the disruptive benefits or effects of blockchain or other technologies
- ▶ Timing, planning and risk management

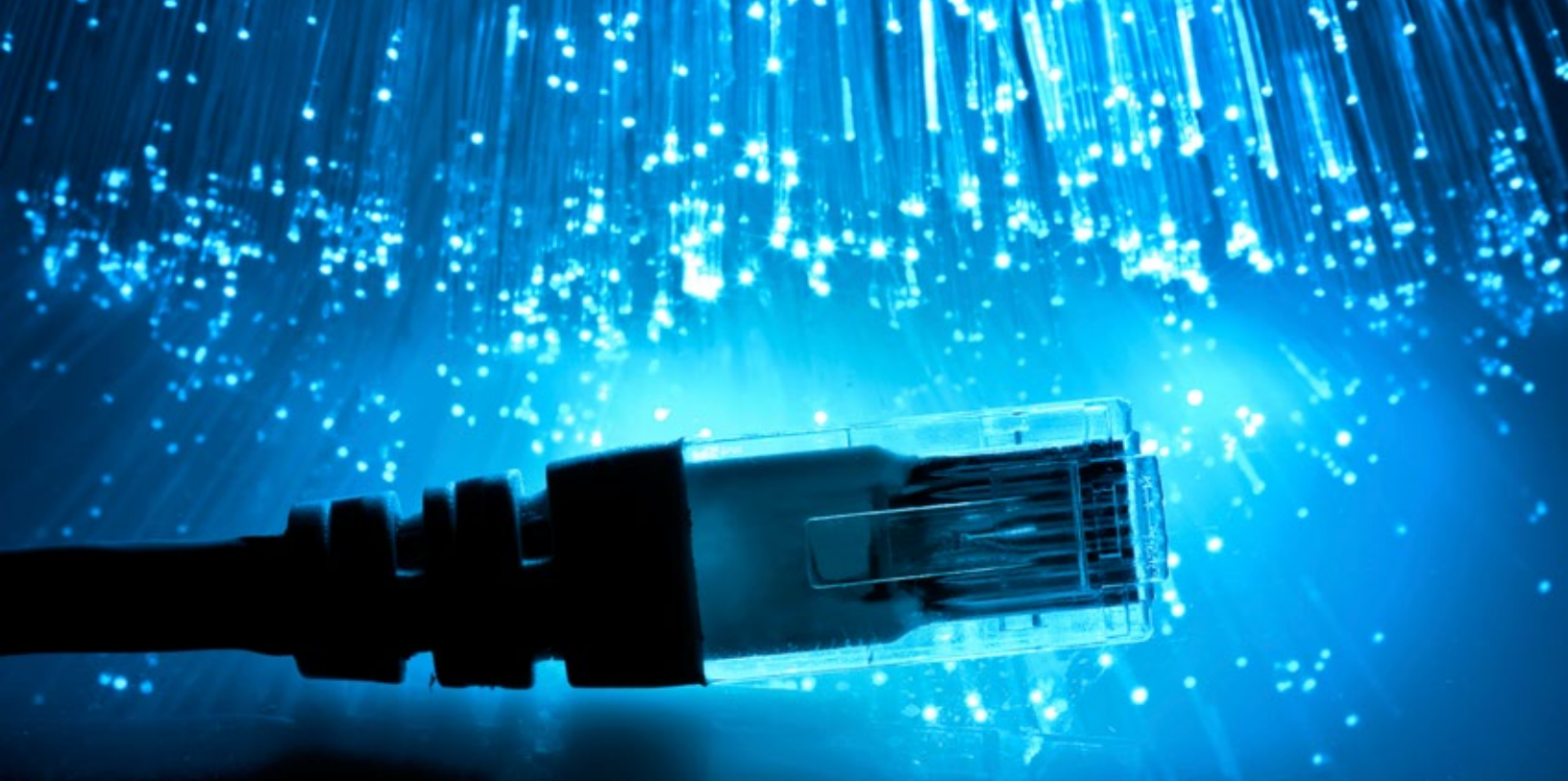
Key considerations for the market:

- ▶ Reduction in centralized infrastructure will make monitoring more costly and complex in the short term for insurers and financial markets
- ▶ Mandatory, prescriptive regulation is unlikely to be effective, since the evolving threat means that it quickly will become obsolete, diverting resources from prescriptive risk management practices
- ▶ Flexibility in the form of prudential regulation is needed to provide a sustainable platform for the future
- ▶ The European Commission plans to overhaul the regulation of data protection and privacy across all member states by creating a single standard for all organizations processing personal data in the EU
- ▶ Changes in how customers control their data; for example, new rules on consent or withdrawal of consent will completely change the cost and ability of (re)insurers to share and update records and reuse information

Next steps:

Financial services organizations continue to innovate in the blockchain space. EY has established a core team dedicating its resources to identifying a number of opportunities for insurers and entrepreneurs to develop a future industry blueprint. We continue to introduce studies and white papers where we ask the right questions to help our clients develop their programs.

- ▶ How can insurers deal with the changing legal and regulatory landscape as they transition toward a digitalized marketplace?
- ▶ How are they positioning their enterprise-trusted networks and controls to govern their risks and data provenance to tackle cyber liability?
- ▶ Is the market ready to put the right governance and standards in place to develop a new infrastructure for a digital marketplace?
- ▶ What level of research, innovation and organizational skills are needed to deal with emerging markets and cyber risks?



Conclusion

We have looked at how blockchain has been implemented by a number of leading insurance companies, how it will change the way they transact business in the future and the implications for bringing three billion people online that do not currently have access to financial services.

There have been several key technology innovations in financial services payments in recent years. And, the payments sector is viewed as the most dynamic in the industry, with the greatest potential for disruption.

In this paper, we have seen how data that affects the lives of customers and the solvency and reputation of corporations can be made immutable and independently auditable by leveraging the blockchain standard.

We have discussed an immediate solution for risk mitigation and resilience for registering and validating digital assets as part of the warranty process in policies and claims, as well as guaranteeing their long-term preservation. Clearly, there is a role for blockchain technology in data-centric security by providing tamper evidence and immediate data breach notification.

Tying big data repositories to the blockchain can enable those repositories to be used for long-term regulatory compliant archiving. This will make them available to customers, while still providing proof of segregation and PII handling for regulators and auditors.

Looking at cyber risk exposure and risk management today, the vision promised by big data and cloud computing is expected to dramatically transform the insurance industry. Emerging risks have a larger role to play than the back office insurance function they are perceived to have today. Increasing cyber attacks and recent natural catastrophe events are challenging the insurance industry to take the lead on global risk management.

Analyzing this data in real time, protected by the blockchain and as part of a strategic, holistic risk management strategy, is now a mandatory requirement for the industry. It is a positive competitive differentiator and will enable insurers to serve the public in utmost good faith.

It is only by harnessing the value of big data technologies that the (re)insurance industry can properly evaluate the financial risk posed by floods, windstorms, hurricanes, earthquakes, volcanoes, cyber, terrorist attacks and fraud. The big data approach allows everyone (catastrophe modelers, risk managers, loss adjusters and underwriters) to access and share insights with the peace of mind that the blockchain provides. This guarantees the veracity of the underlying data and makes it independently verifiable by auditors and regulators.

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