

Blockchain to Distributed Ledger

Baohua Yang

Dec 23, 2017

About Me

- **Interested Areas**

- Fintech, Cloud and Analytics

- **Chief Architect**

- Oracle's Blockchain product

- **Open-Source Contributor**

- [Hyperledger](#), [OpenStack](#), [OpenDaylight](#), etc.

- **Hyperledger Developer**

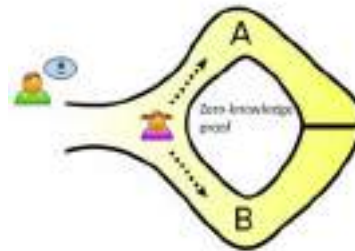
- Core designer & committer of [Fabric](#), [Cello](#), [sdk](#) etc.
- [Hyperledger Technical Steering Committee \(TSC\)](#) Member
- [Hyperledger Technical Working Group China](#) Chair

Outline

- Problem to Solve
- Ledger Technology's History
- Key Techniques and Challenges
- Adoption Scenarios
- Q&A



What is recalled with “Blockchain”?



 **bitcoin**



ethereum



How to Record Transaction with Credit?

- Transaction

- Agreement, communication, or movement carried out between a buyer and a seller to exchange an asset for payment.
- Information processing tasks that is divided into individual, indivisible operations.

- Ledger

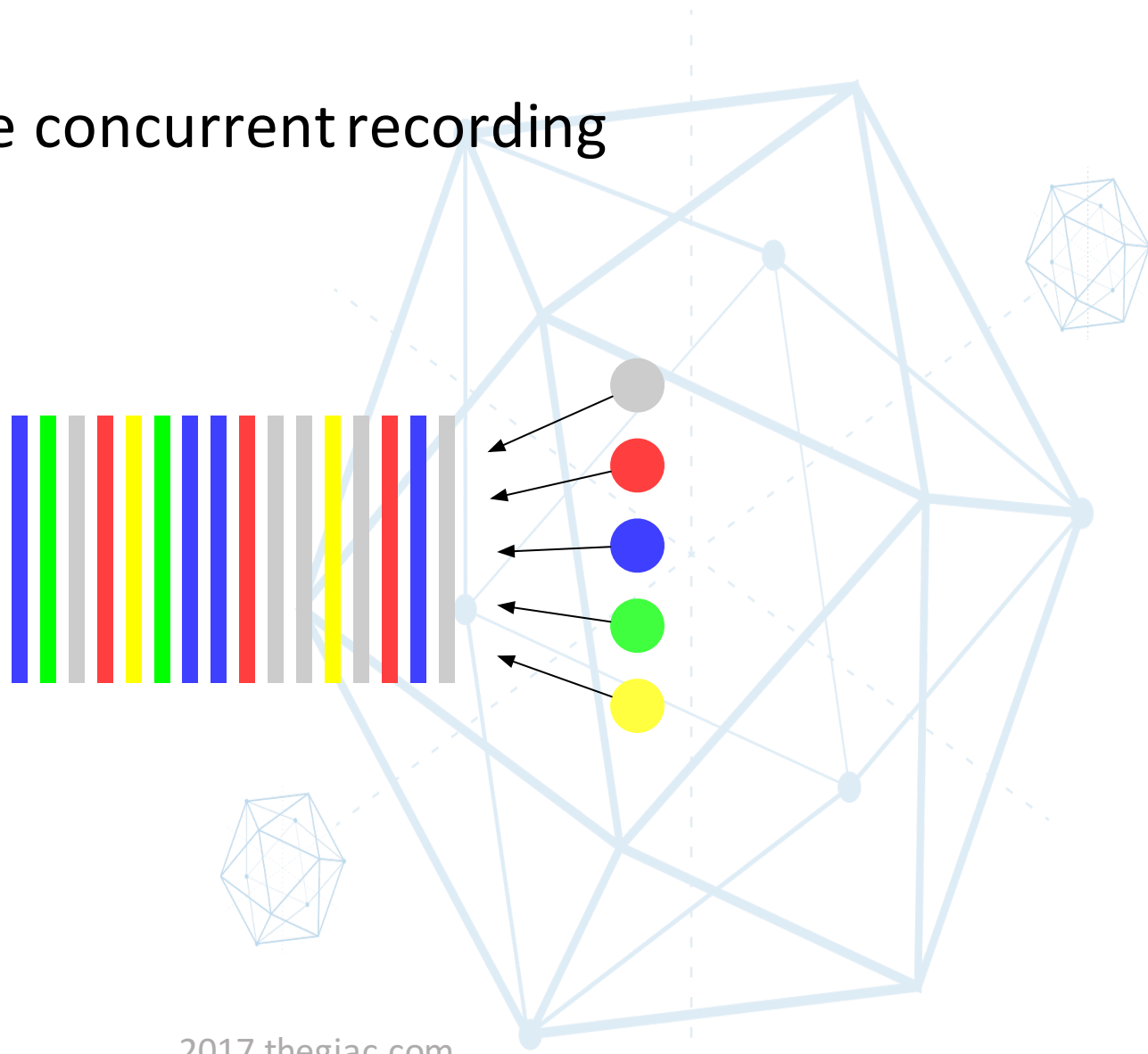
- Record transaction history and the result.

- Distributed Ledger

- Ledger with multiple participants, distributed in deployment and management, and support smart contract to operate the states.

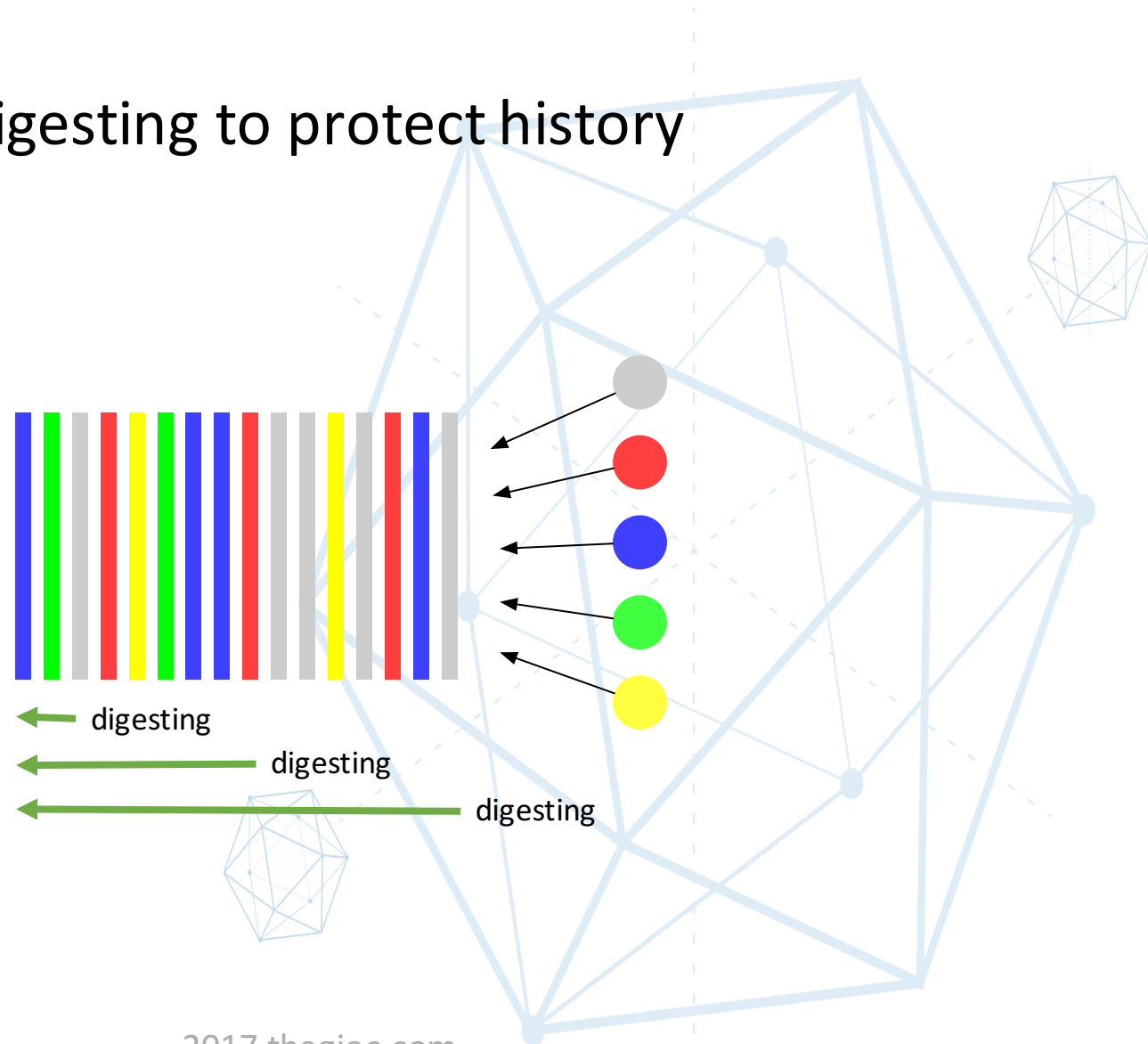
How to Record Transaction with Credit?

- Option 1: Simple concurrent recording



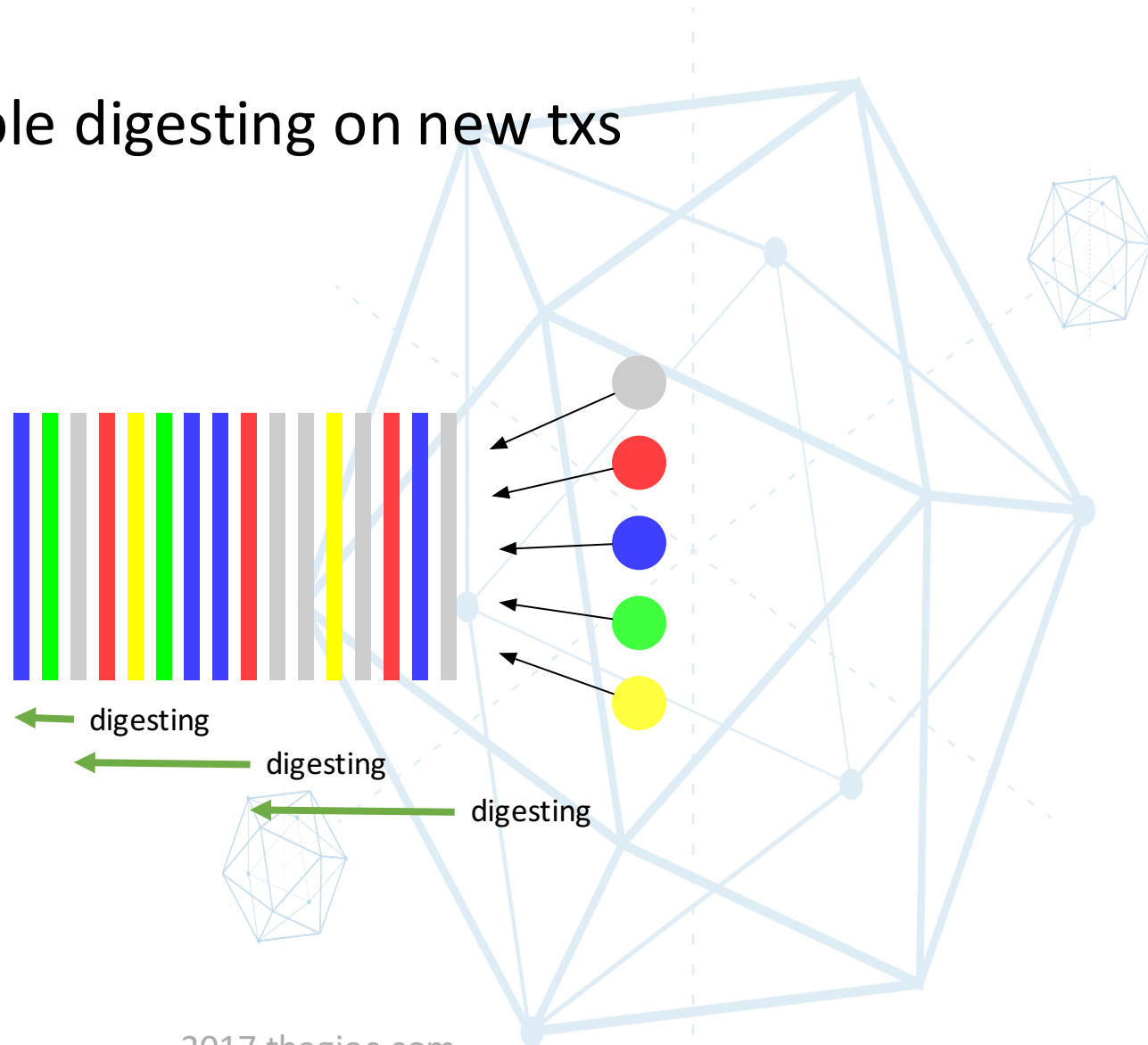
How to Record Transaction with Credit?

- Option 2: Use digesting to protect history

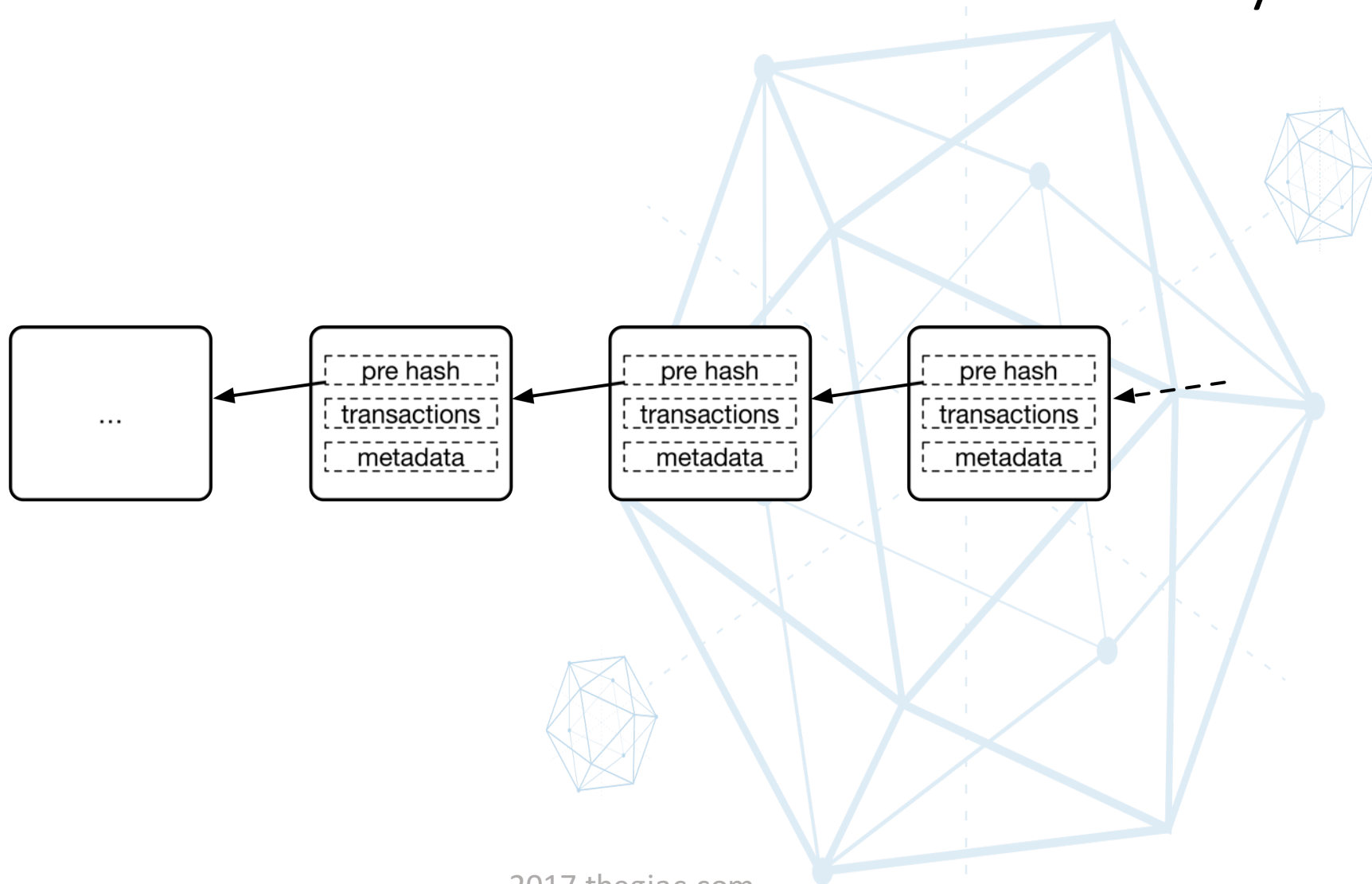


How to Record Transaction with Credit?

- Option 3: Scalable digesting on new txs



Blockchain: A verifiable data structure to record immutable transaction history

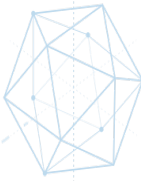


Is Blockchain Enough? Not Really!

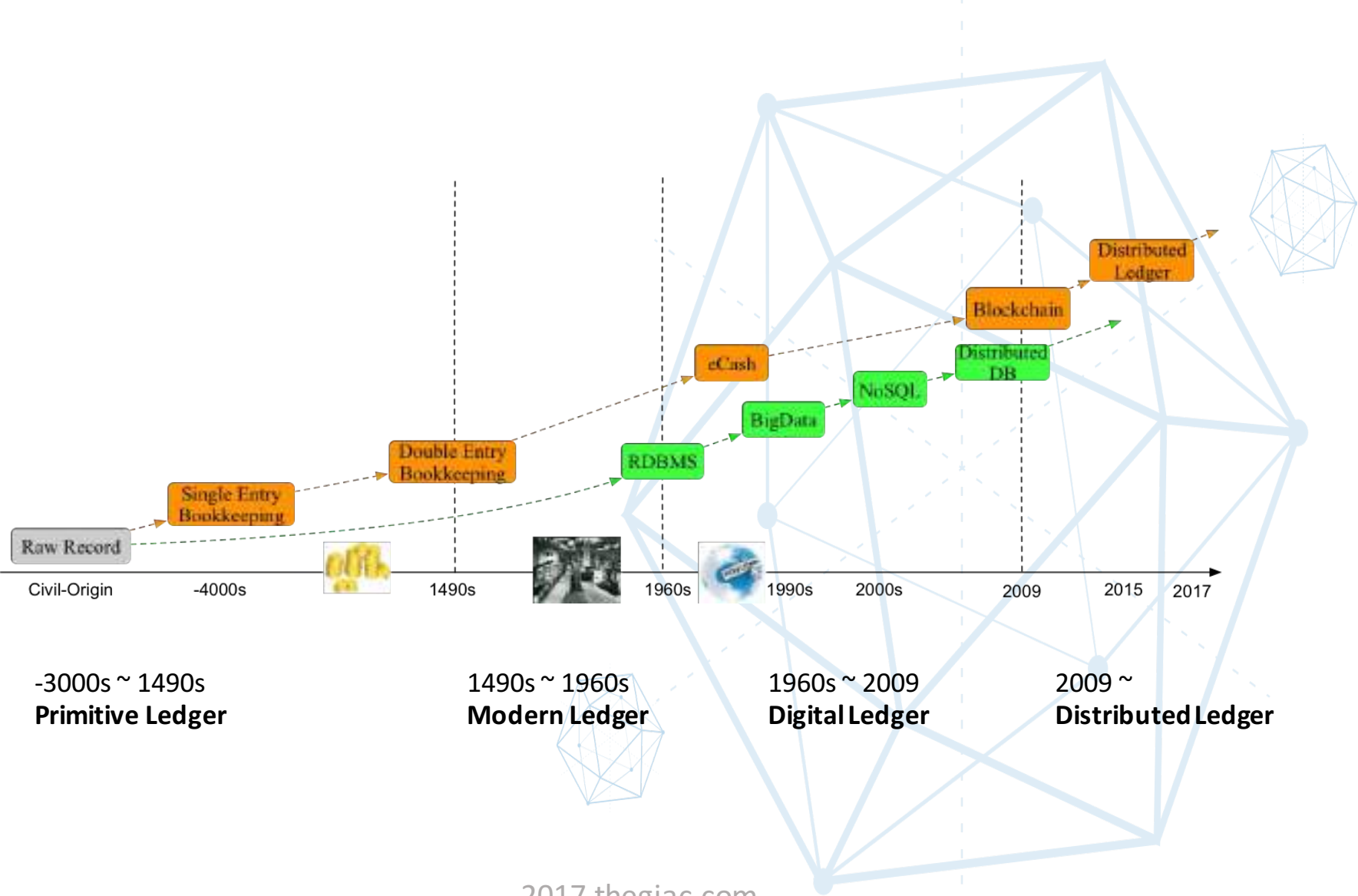
- Who maintains the records?
- Who can use the service?
- Who executes the transactions?
- Who decides what can be recorded?
- ...
- Blockchain != Blockchain based distributed ledger and applications.
- Linux != Linux based OS

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- **Ledger Technology's History**
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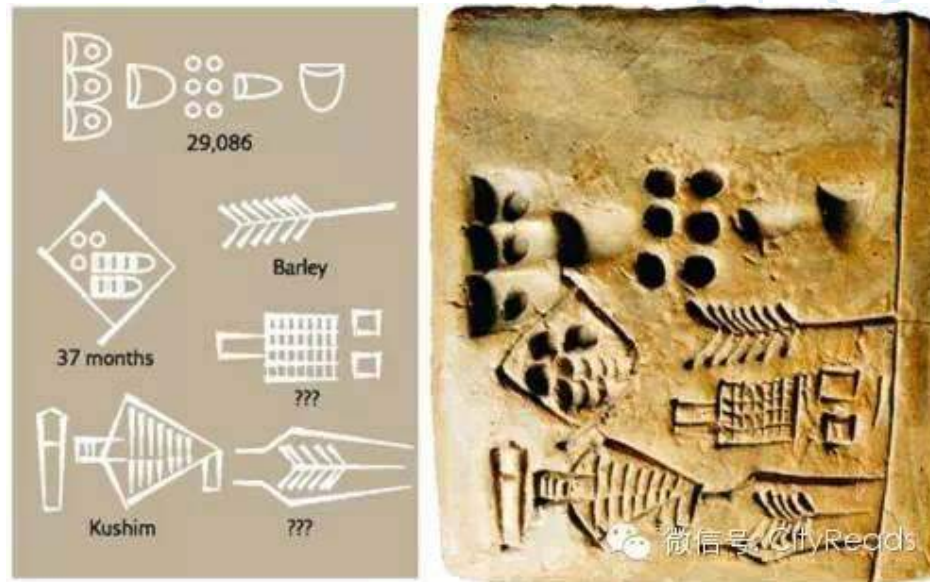


Ledger Technology's History



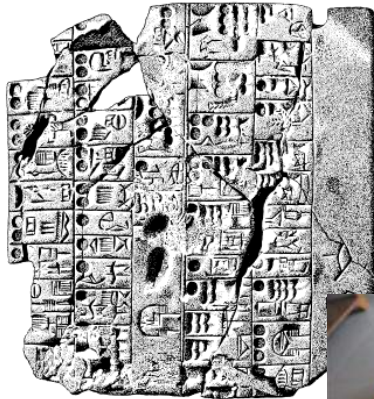
Phase1: Primitive Ledger

- -3000s: Uruk's Kushim Board



Phase1: Primitive Ledger

- All ancient civilizations have ledgers



Phase 2: Modern Ledger

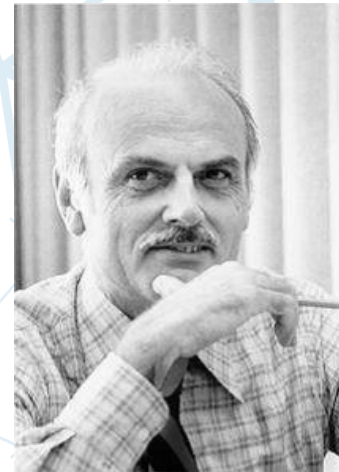
- 1494: Luca Pacioli, Italy



科目	发生日期	借方	贷方	余额	
1001 银行存款				570.00	
1/1/2010	1	商品A销售	6,000.00	6,570.00	
1/1/2010	2	购买商品B	1,800.00	4,770.00	
1/2/2010	4	存款利息	2,600.00	7,370.00	
1/3/2010	5	银行存款-工行	1,800.00	8,570.00	
1/11/2010	6	材料费	600.00	7,970.00	
1/12/2010	7	商品B销售	400.00	8,370.00	
1/13/2010	8	车间管理人员工资	10.00	8,260.00	
1/14/2010	9	商品C销售	200.00	8,460.00	
1/14/2010	10	购买股利	50.00	8,370.00	
		发生额汇总	10,600.00	3,200.00	8,370.00
100201 工商银行				15,200.00	
1/1/2010	5	银行存款-工行	1,600.00	16,200.00	
1/15/2010	11	银行存款支出	1,600.00	15,200.00	
1/16/2010	12	银行存款-工行	2,600.00	17,200.00	
		发生额汇总	3,800.00	1,600.00	17,200.00
100202 建设银行				8,500.00	

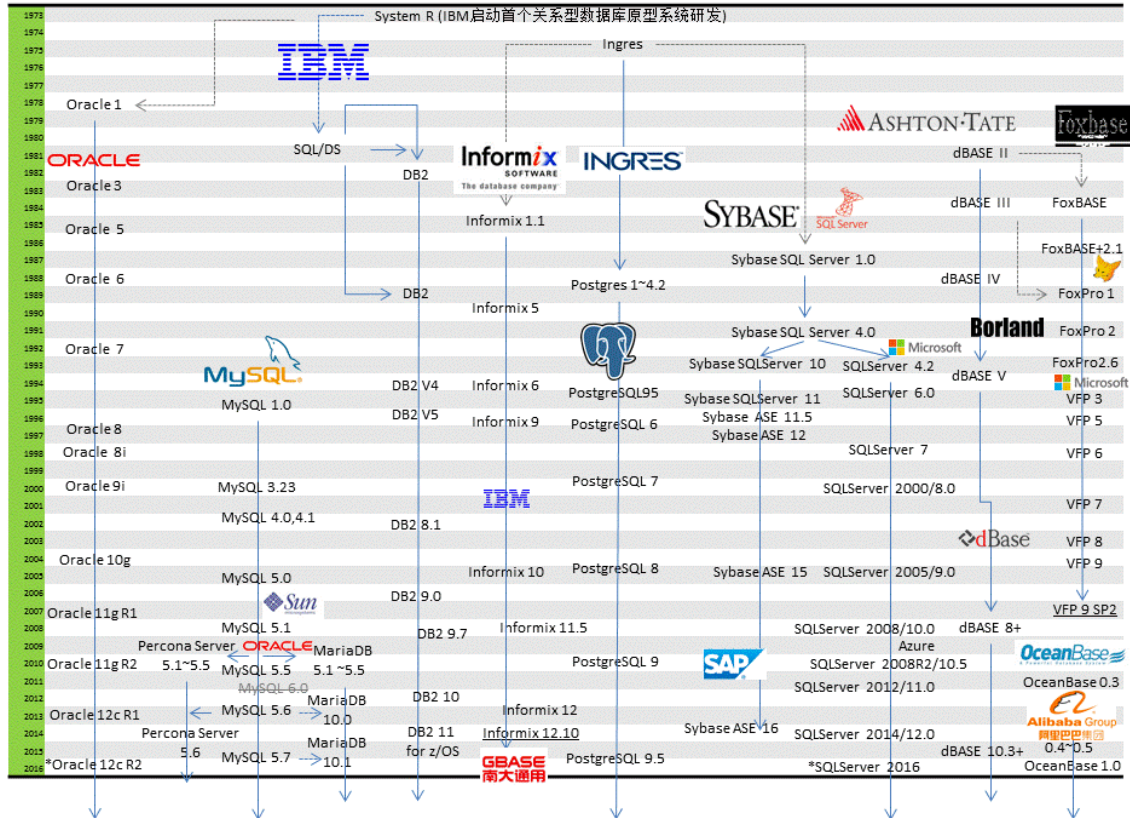
Phase 3: Electronic Ledger

- 1970: " A Relational Model of Data for Large Shared Data Banks", Edgar Frank Codd, IBM
- 1978: Oracle
- 1980s: Internet
- 1983: eCash
- 1990s: BigData
- 2000s: NoSQL
- 2004: keepaccounts.com (Gooot.com)



Phase 3: Electronic Ledger

国际主流通用关系型数据库家谱图



Phase 4: Blockchain to Distributed Ledger

- 2009.1: Bitcoin
- 2015.7: Ethereum
- 2016.2: Hyperledger

Ethereum Launches

Posted by [Stephan Tual](#) on [July 30th, 2015](#).

A few minutes ago, many of you generated and loaded the Ethereum Genesis block, marking the inception of Frontier, the first live release of the Ethereum project.

SAN FRANCISCO, Calif., Feb. 9, 2016 – The Linux Foundation, the nonprofit organization enabling mass innovation through open source, today is announcing new members from across the industry, a formal open governance structure and technical updates to the new [Hyperledger Project](#).

Bitcoin P2P e-cash paper 2008-11-01 19:16:33 UTC

I've been working on a new electronic cash system that's fully peer-to-peer, with no trusted third party.

The paper is available at:
<http://www.bitcoin.org/bitcoin.pdf>

The main properties:
Double-spending is prevented with a peer-to-peer network.
No mint or other trusted parties.
Participants can be anonymous.
New coins are made from Hashcash style proof-of-work.
The proof-of-work for new coin generation also powers the network to prevent double-spending.

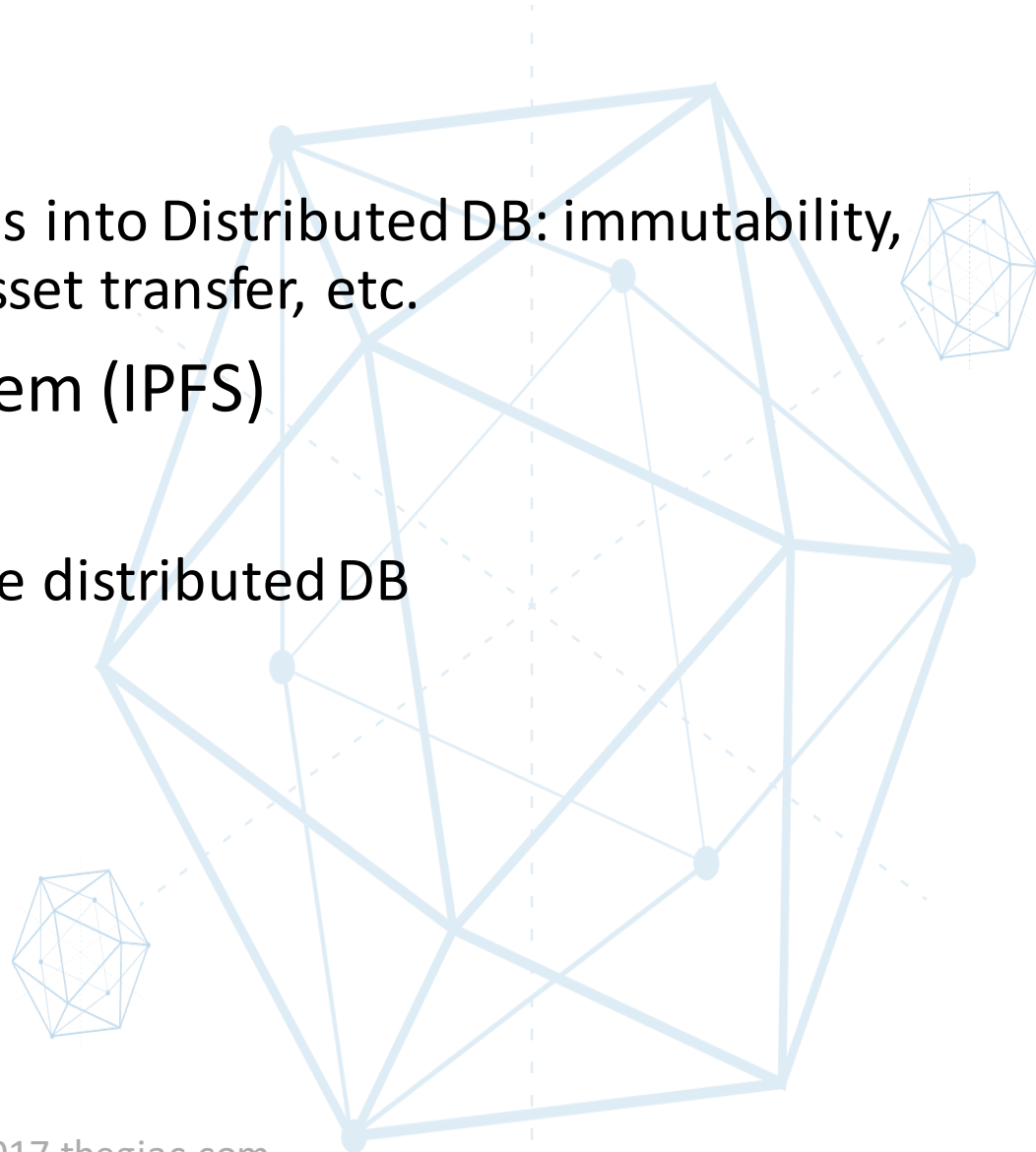
Bitcoin: A Peer-to-Peer Electronic Cash System

Phase 4: Blockchain to Distributed Ledger

- Bitcoin (since 2009)
 - Focus on payment, adopt the blockchain structure
 - Limit in simple smart contracts, performance...
- Ethereum (since 2015)
 - Improve performance
 - More smart contracts
- Hyperledger (since 2016)
 - Enterprise grade ledgers (IBM, Oracle, Intel, Cisco, DTCC, R3, NEC, JP Morgan, DAI, Accenture, SAP, Wanda, Huawei, CMB...)
 - Permission, more consensus, pluggable...
 - Smart contracts in Go, Java, and more

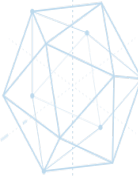
Other Related Projects

- BigChainDB
 - Bring Blockchain features into Distributed DB: immutability, decentralized control, asset transfer, etc.
- Inter Planetary File System (IPFS)
- Corda
 - Financial industry service distributed DB



What We've Learned

- Ledgering is a fundamental requirement
- Technology is still in acceleration
- Blockchain structure has potential for ledgering, but more business value is in the distributed ledger platform, and the on-top applications



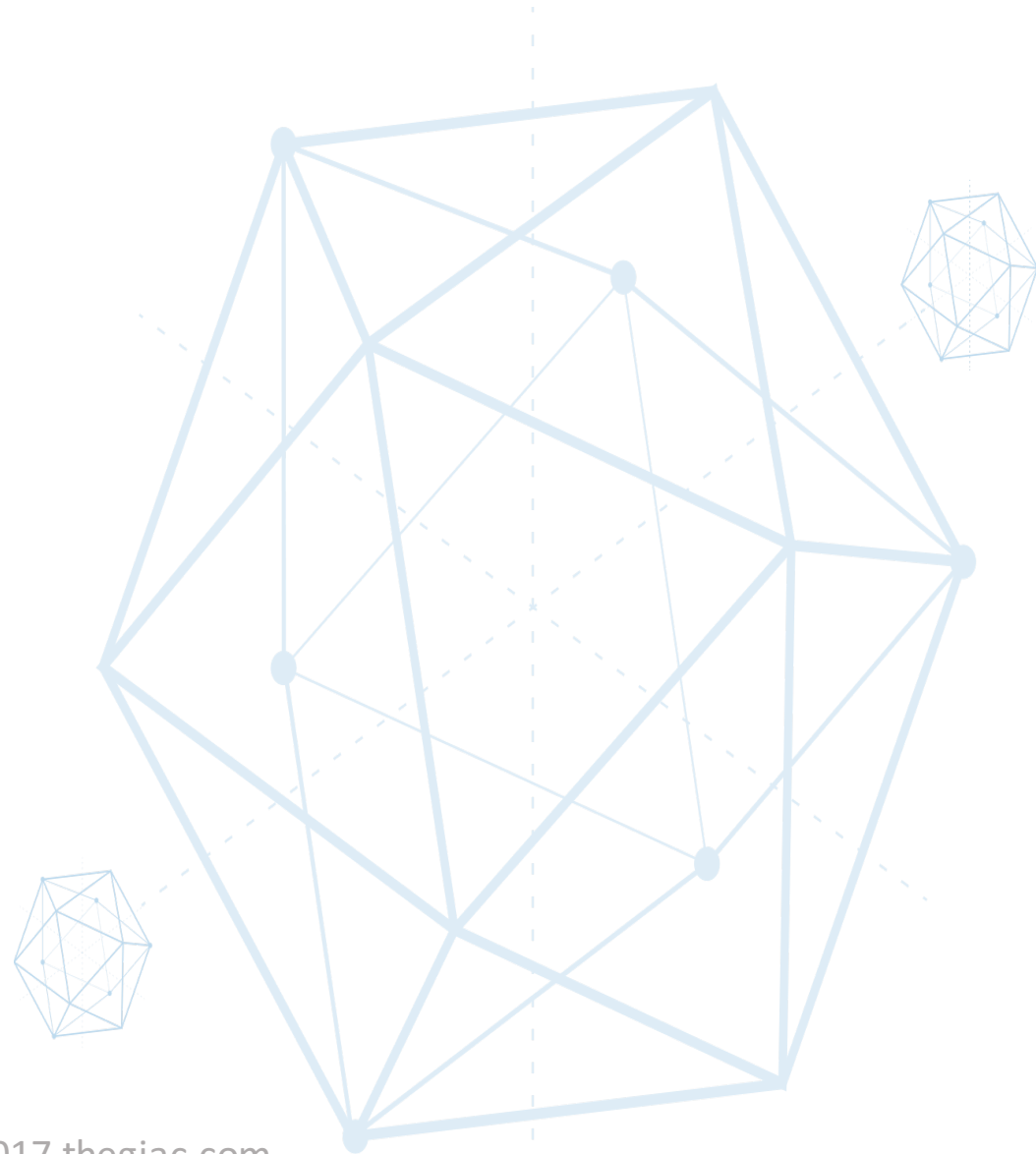
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Key Techniques and Challenges

- Distributed System
- Security
- Performance
- Inter-operability

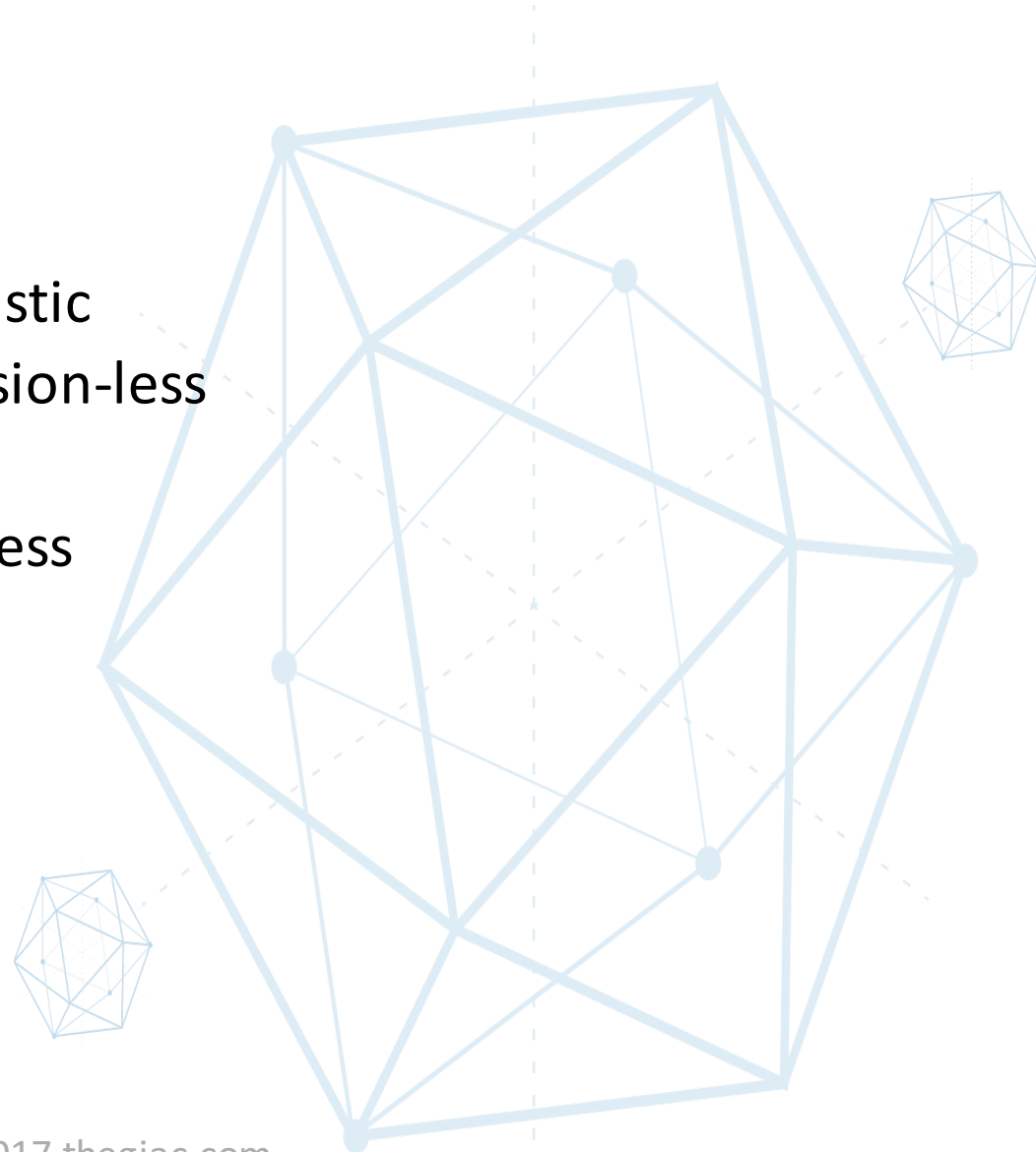


Distributed System

- Distributed ledger is naturally a distributed system
- Why do we need distributed system?
 - Single node cannot be fault-tolerant
 - Performance limit
- Why distributed system is hard to design/implement?
 - The larger the system is, the higher probability to fail
 - Communication is limited in speed/throughput, with failures
 - Relative time/space

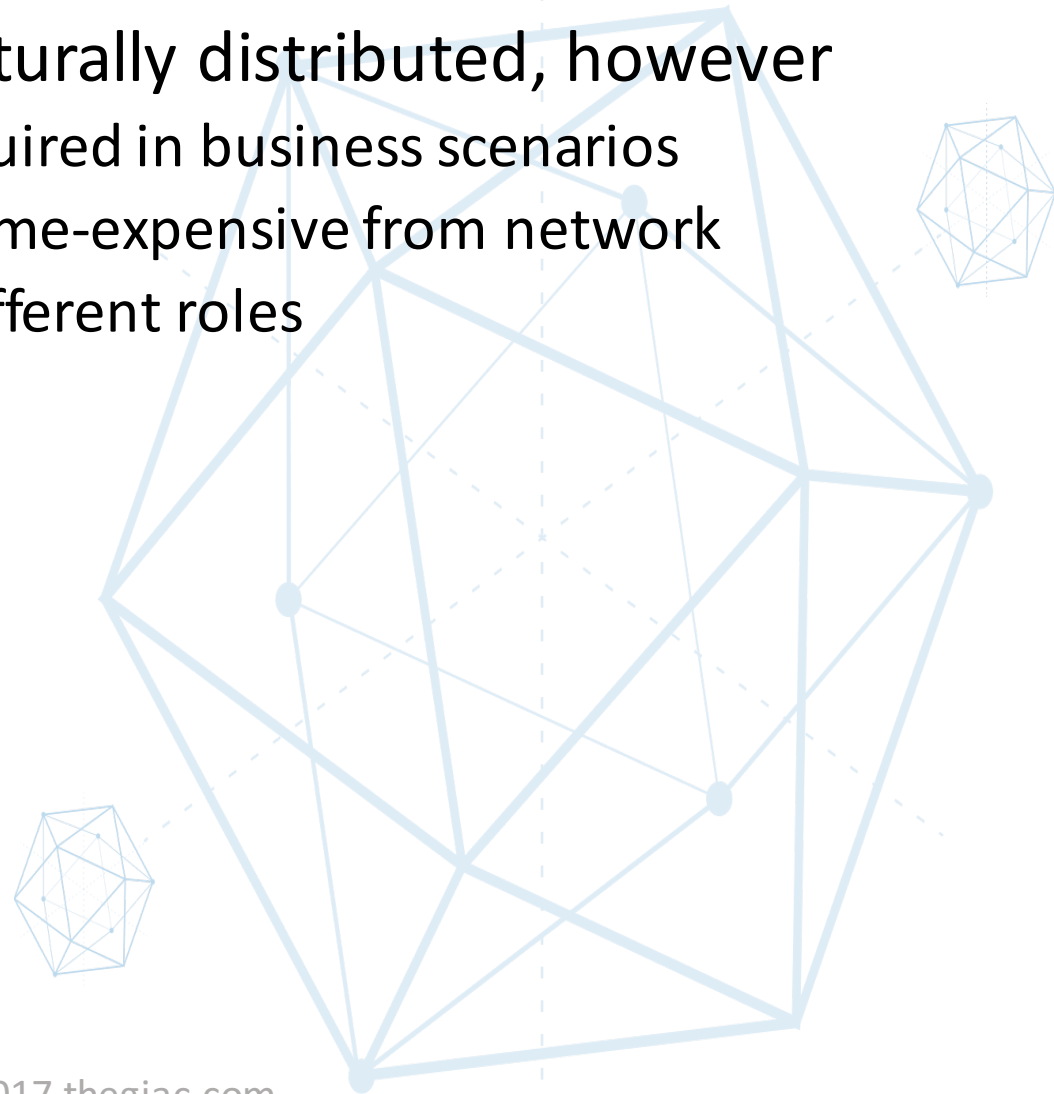
Consensus? More complicated!

- Requirements in DLT
 - CFT vs BFT
 - Probability vs Deterministic
 - Permissioned vs Permission-less
 - Trust vs Trustless
 - Consistency vs Correctness



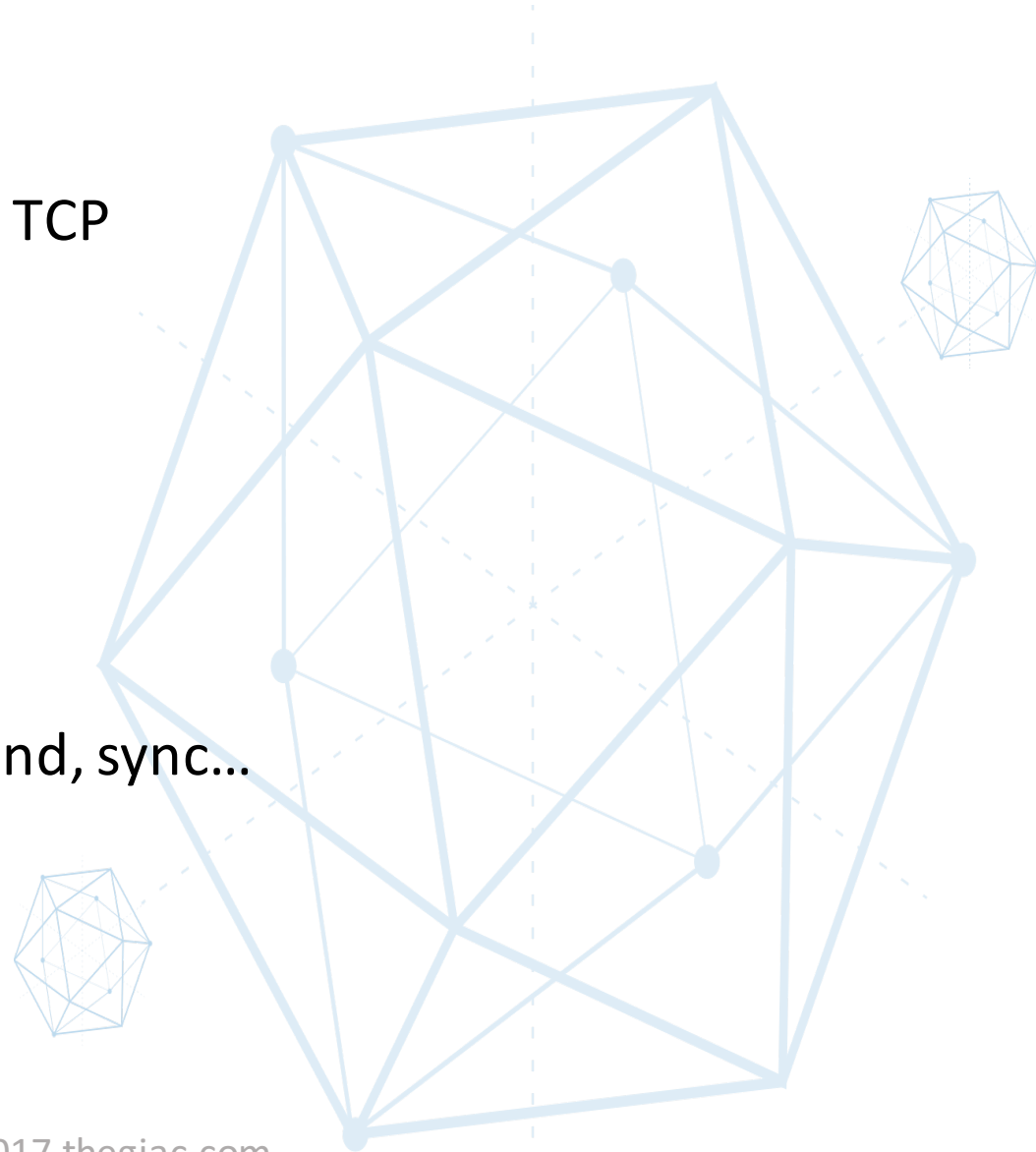
Failure Resilience? More important!

- Blockchain system is naturally distributed, however
 - Availability is highly required in business scenarios
 - Recovery operation is time-expensive from network
 - Nodes may vary with different roles
 - Permission!!!



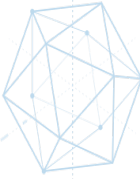
Potential Hot Topics

- Networking
 - Protocols: gRPC, HTTP2, TCP
 - P2P algorithm
- Consensus Service
- Storage
 - Block store, query, append, sync...



Security

- **Permission: Who can do what**
 - Consortium, Organization
 - Admin, Member, Audit
- **Privacy: Data can only be accessed by specific objects**
 - Modern Encryption
 - Hashing
 - Zero Knowledge
- **Quantum Computing**

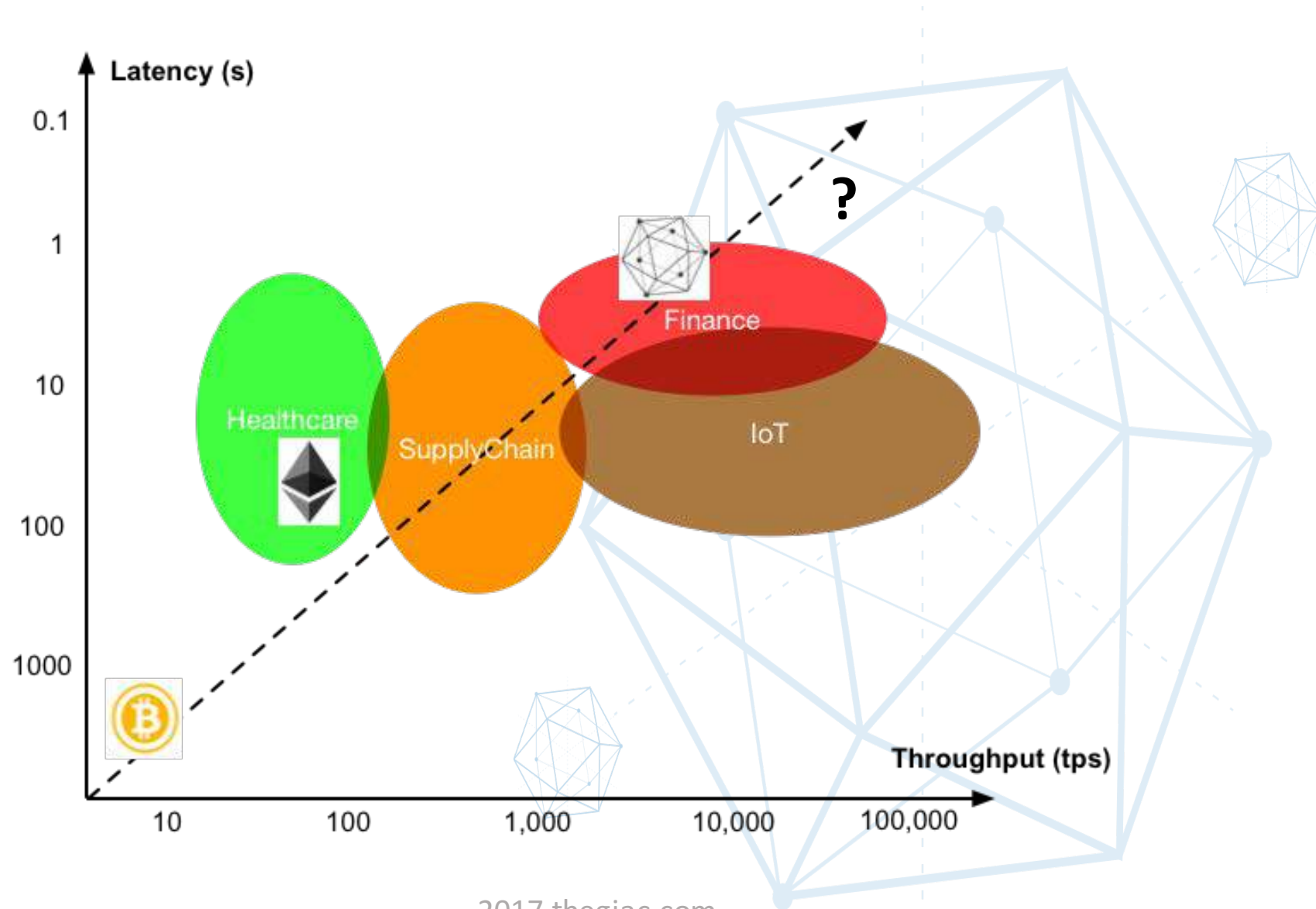


Performance

- **Public Blockchains**
 - 1~100 tps
 - 10s ~ mins
- **Permissioned Blockchain**
 - 1k~10k tps
 - 1~10s
- **Communication & Computing & Storage**



Performance? It depends!



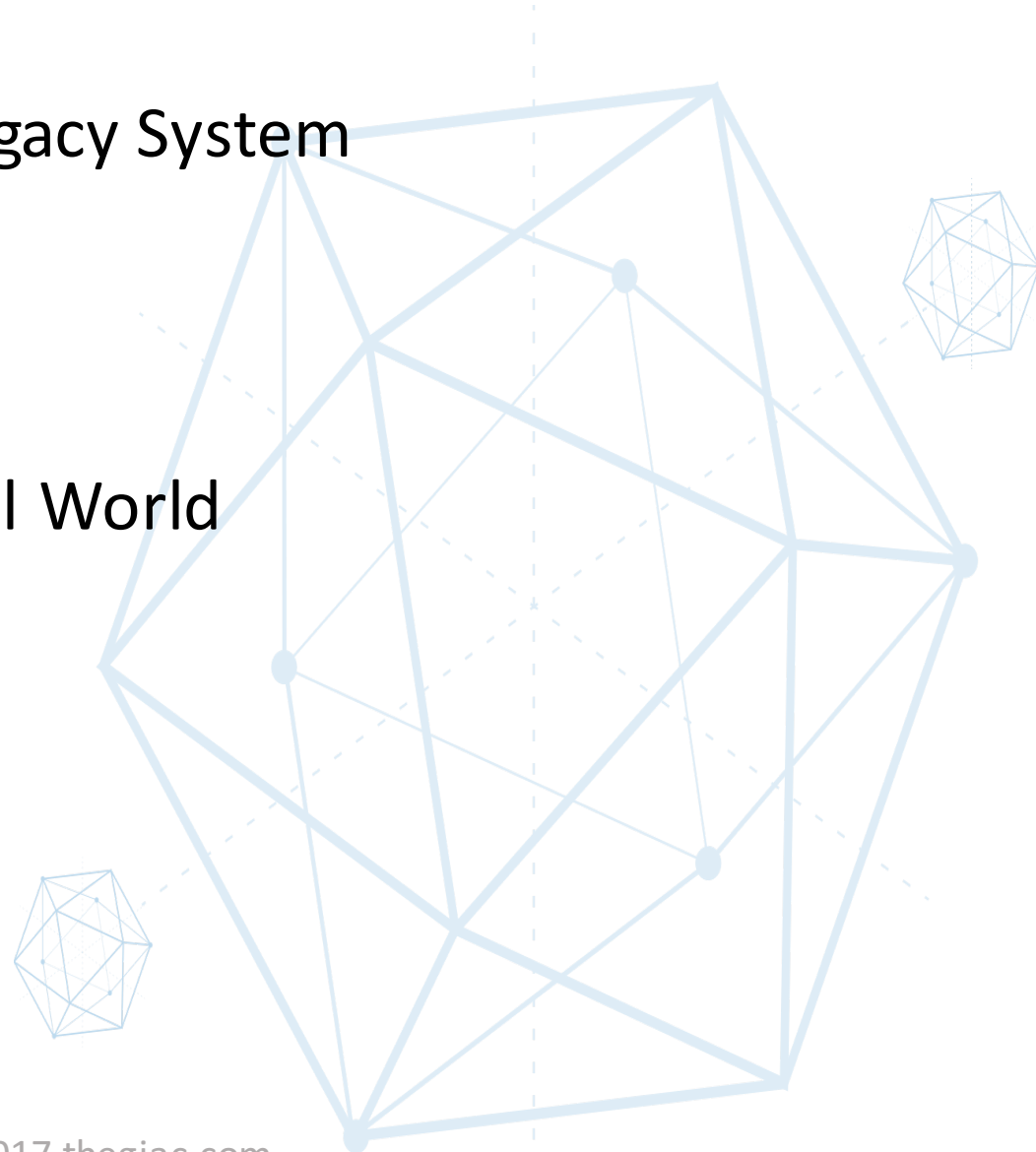
Inter-operability

- Interoperability with Legacy System

- DataStore
- BI

- Interaction with Physical World

- Legal
- Law
- Business Entity



Data Tech and Ledger Tech can Innovate Together!

- Distributed ledger systems heavily adopt data technologies for local process.
- Data Tech can learn something from DLT?
 - Ledger efficient DB
 - Distributed Data storage based on Blockchain
 - BigchainDB

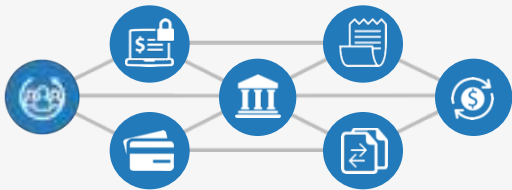
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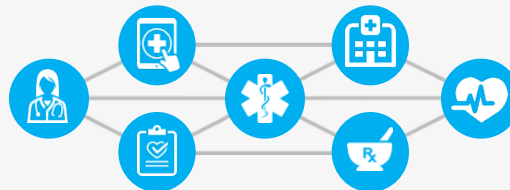
Shared Ledger Database

Blockchain allows multiple different parties to securely interact with the same universal source of truth



Finance

Streamlined settlement, improved liquidity, increased transparency and new products/markets



Healthcare

Unite disparate processes, increase data flow and liquidity, reduce costs and improve patient experience and outcomes



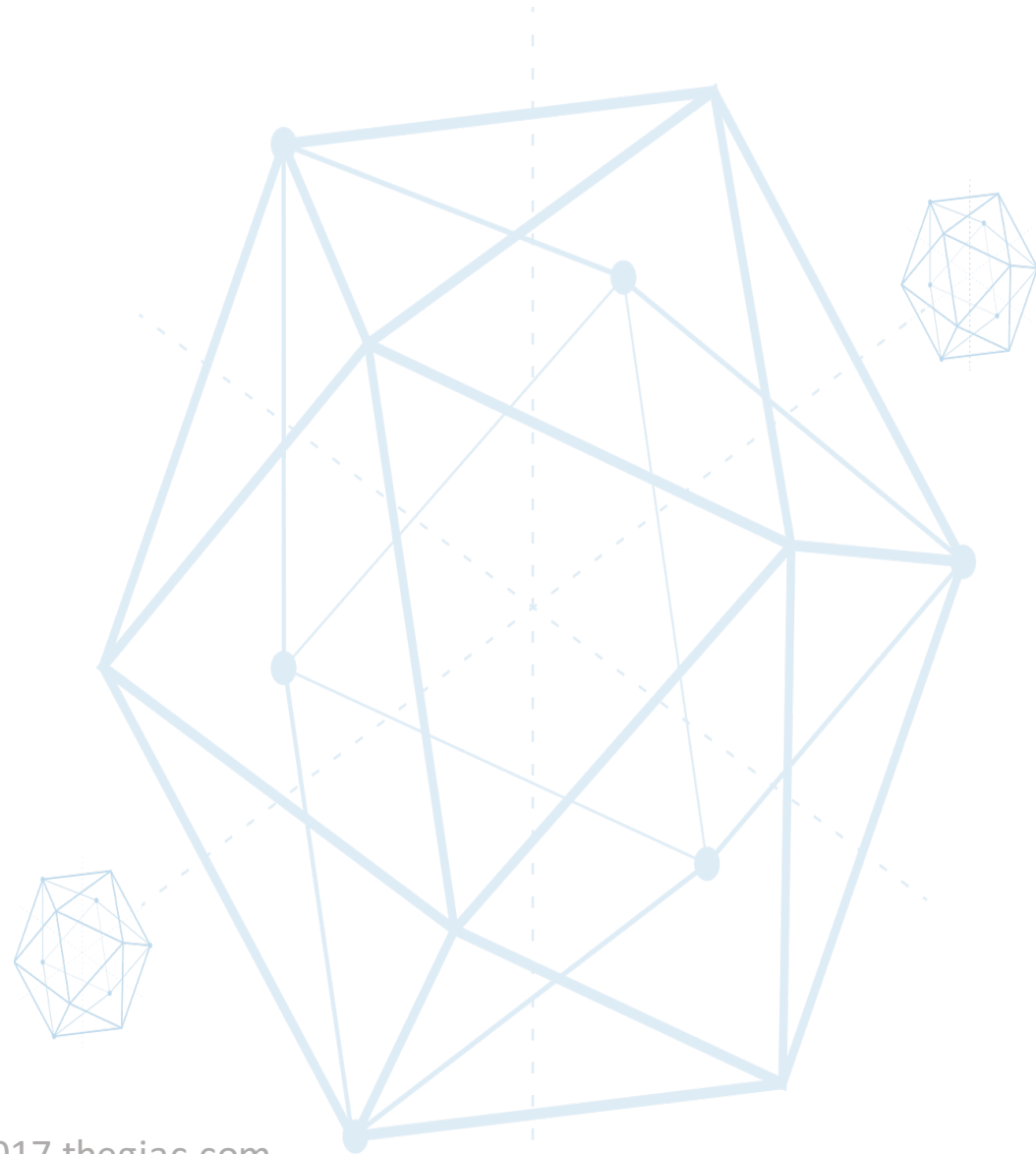
Supply Chain

Track parts and service provenance, ensure authenticity of goods, block counterfeits, reduce conflicts

Potential Scenarios Requirements

- Multiple Parties
- No Trust Base
- Smart Contract

- High Frequency?
- Very low latency?



Financial Service Industry

- Digital Currency
 - Europe, UK
 - Canada
 - Japan
 - China
- Payment
 - Bitwage, Circle, etc.
- Stock Exchange
 - Nasdaq Linq
- CrowdFunding



Cross-Border Payments

Transferring money across international borders is still complicated, time consuming and expensive. Payments routed abroad can take several days to get settled. Existing money transfer systems suffer furthermore from long lines, exchange rate losses, counter-party risks, bureaucracy and extensive paperwork. Cross-border payments have become a critical part of millions of lives as we moved towards a more globalized world and multicultural societies.

After months of work, a global team of developers have completed a cross-border POC built with Hyperledger Fabric. Designed to test whether moving member bank accounts to a distributed ledger could help the inter-bank payments platform Swift reconcile in real time, the blockchain trial is now ready for its next phase of testing with General members ANZ, BNP Paribas, BNY Mellon and Wells Fargo.

Hyperledger Fabric enables real-time visibility on the liquidity of Nostro accounts, easing reconciliation and allowing liquidity savings while meeting key industry requirements such as governance, data privacy, standardisation, and identity.



BNY MELLON



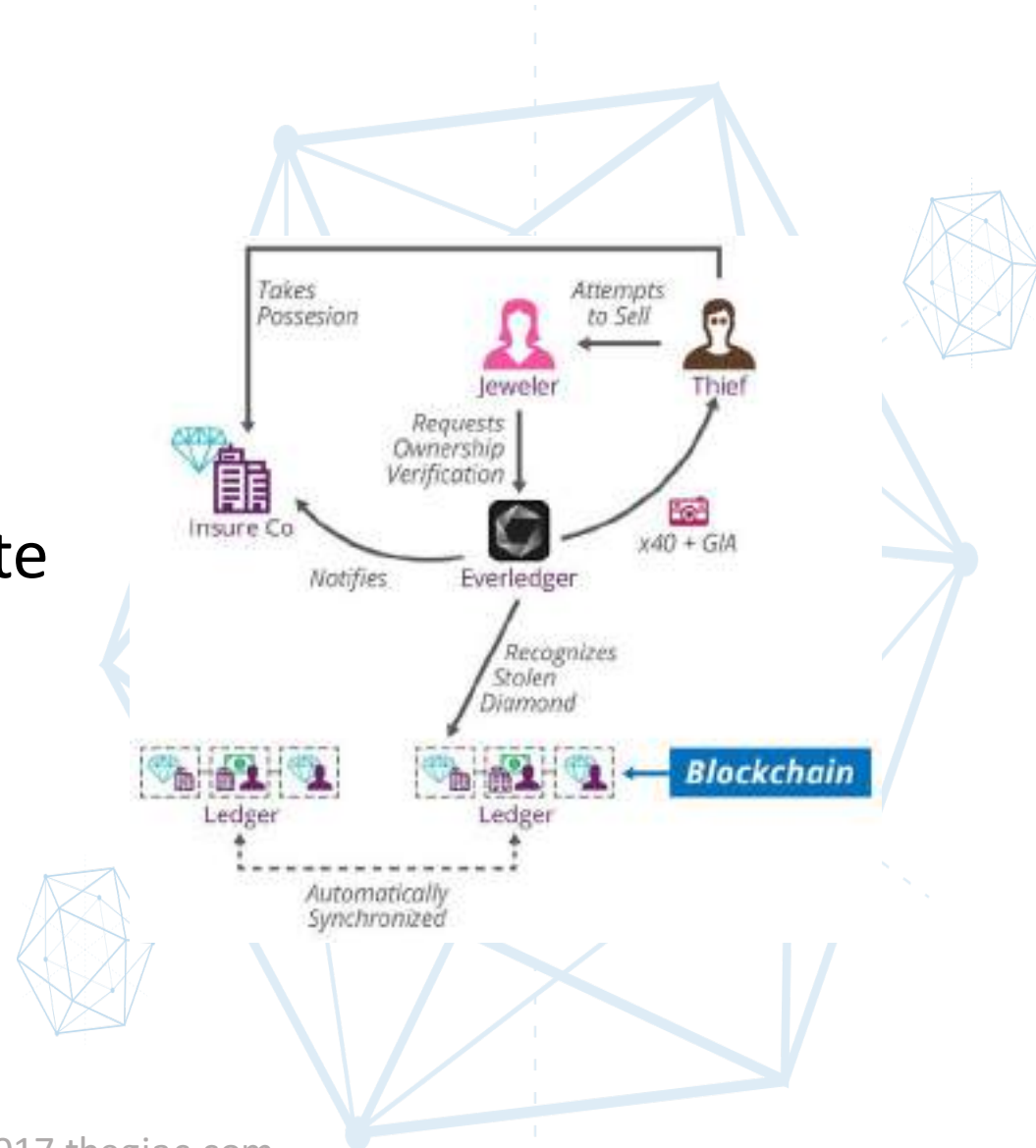
BNP PARIBAS

Read about the POC in [Coindesk](#).

Hear about the collaboration in the [ANZ Community Spotlight video](#).

Digital Asset Management

- Factom
- Everledger
- Food Safety
- Healthcare Records
- MIT Education Certificate



Real Estate Transactions

In the 1990s and 2000s, many international organizations put pressure on emerging countries to digitize land titles to guarantee citizens' legal rights to their properties. In some cases of corruption, the move to government-owned centralized databases backfired, and digital histories of land titles were eradicated, properties seized and handed over to oil companies.

Decentralizing databases and turning to distributed ledger technologies to keep track of land titles could keep governments accountable and create a more trustworthy system, even in instances where the individual actors may not be trusted.

Every transaction such as when a property is sold from one party to another or when a loan is taken out against a property, would be recorded on the public ledger. Financial firms would reference the distributed ledger to decide whether or not to extend the loan to someone looking to buy a property. This permissioned-based, shared system of record will increase trust overall and protect homeowners.



The winning team at the Consensus 2017: Building Blocks Hackathon, built an online property banking and acquisition game utilizing Hyperledger Fabric with IBM Bluemix.

HyperProperty shows that Hyperledger Fabric can be used to guarantee who owns what properties. Lessons from *HyperProperty* can be applied to any tokenized economy where assets are represented by tokens on a blockchain. When assets need to be traded, trade participants can exchange value for the token and make transactions without a middleman. This has the potential to facilitate more efficient and less costly real estate transactions.

[Play HyperProperty.](#)

Healthcare Records

Blockchain may offer a way to get the healthcare industry to commit to an information sharing platform in which pointers to personal health data could be stored on a secure, permissioned chain and shared back and forth quickly like email.

Hyperledger Composer offers a set of APIs, a modeling language and a programming model to quickly define and deploy business networks and applications that allow participants to send transactions that exchange assets.

Say, for example, a patient's x-ray sits on a cloud site and insurers can request the password to access it. Password requests get stored on a chain, and a set of smart contracts allow the doctor to share the pointers to the x-ray with the insurance company. The patient has a wallet noting which chains their records are stored on. When those pointers are shared, they're recorded as auditable events in the healthcare system, allowing patients to have complete visibility into their data and ultimately the ability to mediate and approve who their records are shared with.



Join the Hyperledger Healthcare Working Group (HLHC) to help bring commercial blockchain adoption to the healthcare industry.

CHANGE
HEALTHCARE



HASHED
HEALTH
HEALTHCARE BLOCKCHAIN INNOVATION

 **KAISER PERMANENTE**

 **patientory**

Together we can create a blockchain system that disenfranchises the most vulnerable 40

[Learn more here.](#)



Interstate Medical Licensing

Associate Hyperledger Member State of Illinois has implemented a pilot program in collaboration with General member Hashed Health using Hyperledger Fabric to reduce complexity of interstate medical licensing, as well as to improve the veracity of provider directories and claims adjudication processes.

The Hyperledger Fabric pilot program will identify opportunities to improve the efficiency and accuracy of the medical credentialing process in the state of Illinois. The concept will utilize a blockchain-based registry to streamline the sharing of smart contracts and medical credential data to automate workflow associated with interstate and multistate licensure.

In the short-term they anticipate this pilot will show how distributed ledger technology can help reduce the complexity of interstate licensing processes in Illinois. In the long-term, they see this as a secure, privacy-enhancing way in which state licensure boards can efficiently manage credentialing at national scale, while also presenting health payers and provider networks a 'single source-of-truth' to improve the veracity of provider directories and claims adjudication processes.



HEALTHCARE BLOCKCHAIN INNOVATION



**The Illinois
BLOCKCHAIN
Initiative**

Read the full [announcement](#).

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Music and Media Rights

Dot Blockchain Media (dotBC) is building a music content rights registry that will help musicians express their rights and wishes for commercializing their art in an interoperable file format. Data is maintained across a distributed network that utilizes Hyperledger Sawtooth.

dotBC's blockchain implementation is a foundation for music and media rights expression into the works themselves. It creates a fair and transparent method for music composers, artists, publishers and rights holders to express their rights and wishes for commercializing their art into a modern and interoperable file format. dotBC maintains partnerships and connections in the music and wider media industries to enable seamless data exchanges between more than 63 million globally recorded works from independent and major label artists and the dotBC ecosystem.

“Hyperledger Sawtooth will enable us to scale rapidly and customize transaction processors specifically for ingesting rights data. We look forward to delivering a strong and lasting solution, anchored on a sophisticated and secure blockchain foundation, for the music and media industries with Intel.”

– Benji Rogers, dotBC CEO



Although not a member of Hyperledger, dotBC is able to leverage the open source Hyperledger Sawtooth platform for recording its content rights registry for the media industries.

Read the full story in [Crypto Ninjas](#). 42

Trade&Supply-chains

- International Trading
 - Different Currency
 - Lack of Trust
 - Time Cost
- Supply Chain
 - Many Participants
 - Complicated Process
 - Lots of Documentation/Pro



Diamond Supply Chain

In 2003, the Kimberley Process Certification Scheme (KPCS) was established to prevent conflict diamonds. Purchased diamonds now come with a certificate to prove the distributor did not obtain the diamond from rebels, that the mine has been audited, etc. The idea is that paperwork can confirm provenance; however, the process is lengthy and there is a history of fraud from missing paperwork.

To keep blood diamonds from entering the supply chain Hyperledger Premier member SAP Ariba is collaborating with Everledger to pilot a distributed ledger diamond track and trace system using Hyperledger Fabric v1.0 that everyone in the industry can write to from miners, to distributors, to retailers.

Holding a diamond to light creates a unique pattern that may be used to create an ID. When a bag of diamonds changes hands in the supply chain, it forms two entries in the chain: the diamond IDs present upon sending and receipt. Once a diamond ID number is inside the system it provides integrity as any stakeholder can then query and instantaneously verify a diamond's provenance.



This system is empowering whistleblowers, governments, mining companies, retailers, journalists, and human rights organizations to get specific on tracking where conflict diamonds are entering the supply chain and preventing them from entering the market.

[Read about the Hyperledger Fabric pilot in International Business Times.](#)

Green Assets Management

General Hyperledger member Energy Blockchain Labs partnered with Premier member IBM on the world's first blockchain-based green assets management platform based on Hyperledger Fabric. In production use by the carbon asset market in China, it allows enterprises to generate carbon assets more efficiently, helping to build a green, low-carbon and environmentally-friendly future in China.

Blockchain technology is expected to become an important means for effective control of carbon emissions, which is of great significance to China, the world's largest source of carbon emissions. Carbon asset development, also known as CER (Carbon Emission Reduction) quota issuing, is one of the most popular ways of encouraging enterprises to decrease emissions and use low carbon emission technology.

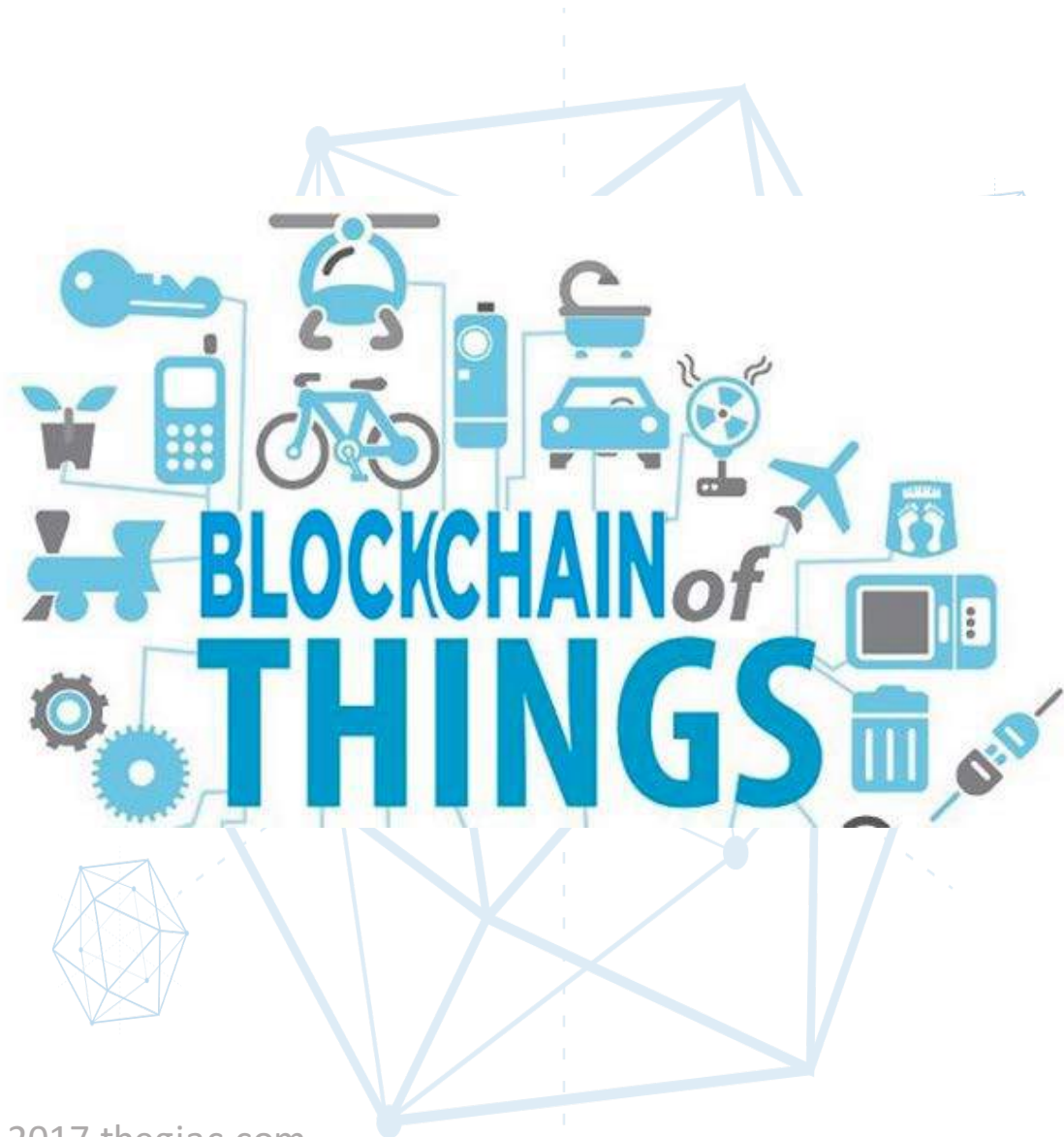
The platform is estimated to significantly shorten the carbon assets development cycle and reduce the cost of carbon assets development by 20-30 percent just in the pilot stage of the platform, enabling cost-effective development of a large number of carbon assets.



Learn more about Energy Blockchain Labs in their [Hyperledger Community Spotlight video](#).

Internet of Things, AI?

- Imagine, billions of smart devices connect to each other automatically.



Ethical Seafood Movement

Blockchain technologies are being used in the fishing industry to drive fish catch towards more ethical practices, obstructing pirate fisherman and fish that are caught outside of legal fishing areas from being sold.

Hyperledger Premier member Intel is collaborating with the Hyperledger community to implement a modern approach to seafood traceability. Leveraging the Hyperledger Sawtooth framework, the seafood journey can now be recorded from ocean to table.

IoT sensors can be attached to any object (like fish) that is entrusted to someone else for transport, with trackable ownership, possession, and telemetry parameters such as location, temperature, humidity, motion, shock and title. The final buyer can access a complete record of information and trust that the information is accurate and complete.

Revolutionizing the seafood supply chain is just one example of the many ways Hyperledger Sawtooth can have real world benefits.



Intel has revealed a public demo that finds it showcasing how a seafood supply chain can be built using Hyperledger Sawtooth.

[Watch the explainer video and read the full case study on the Hyperledger Sawtooth project page.](#)

[Read about the demo in CoinDesk.](#)

全球首本超级账本技术图书!



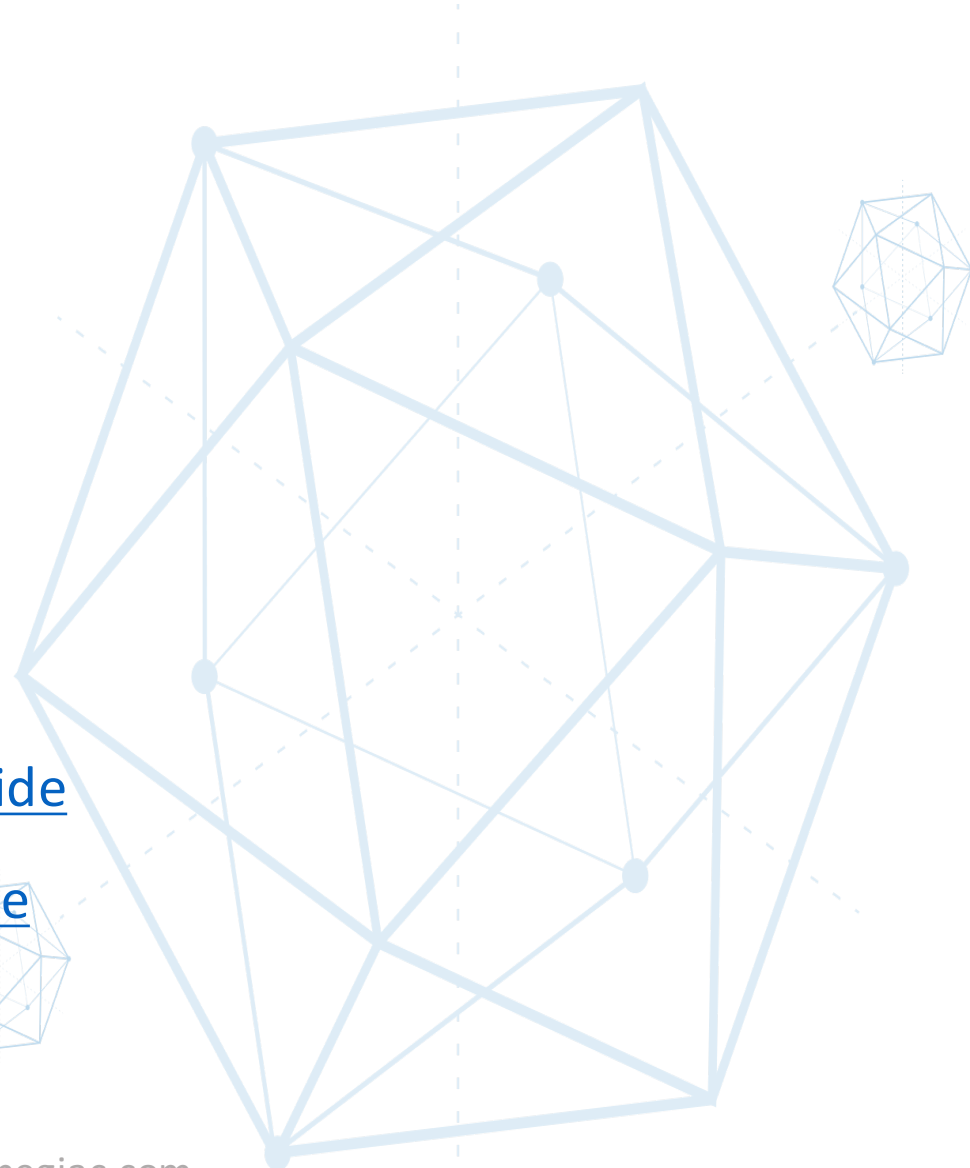
- 超级账本全球技术委员会委员、核心设计和开发者编撰，得到企业界、学术界、科技界、开源社区国内外专家联袂推荐。
- 本书由浅入深，详细讲解超级账本等项目架构设计精华与应用开发案例，是区块链与分布式账本开发落地专业指南。

Questions?

Slides available at github.com/yeasy/seminar-talk#hyperledger

Reference

- [Hyperledger Project](#)
- [Hyperledger Wiki](#)
- 《[区块链原理设计与应用](#)》
- 《[Docker 技术入门与实战](#)》
- github.com/yeasy/blockchain_guide
- github.com/yeasy/docker_practice



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