



# HYPERLEDGER

## An Introduction to Blockchain Technology for Business

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**Intelligent Blockchain Engineering Lab**

Department of Computer Science Engineering

**Korea University**



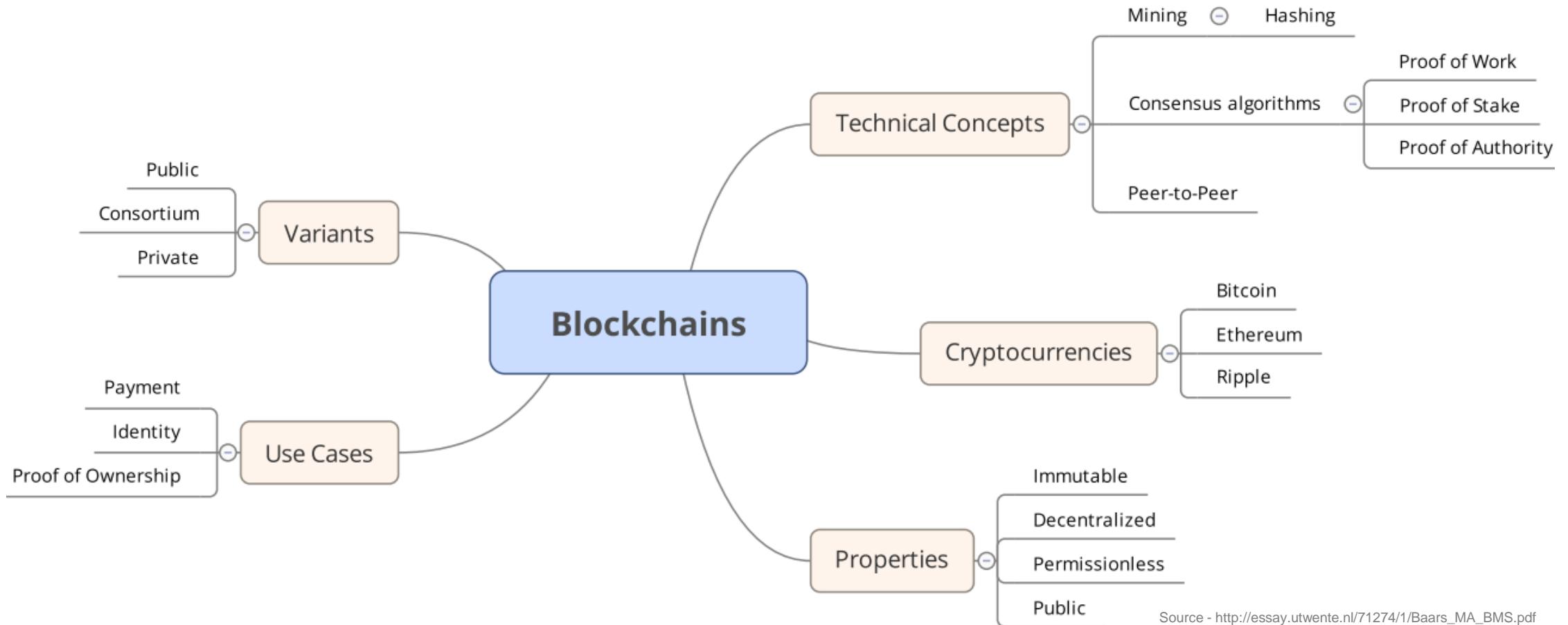
# Agenda

- ① DLT / Blockchain Concepts
- ② Blockchain for Business Requirements
- ③ Hyperledger Project Overview
- ④ Hyperledger Ref. Architecture
- ⑤ Early Adopted Industries

# Introduction

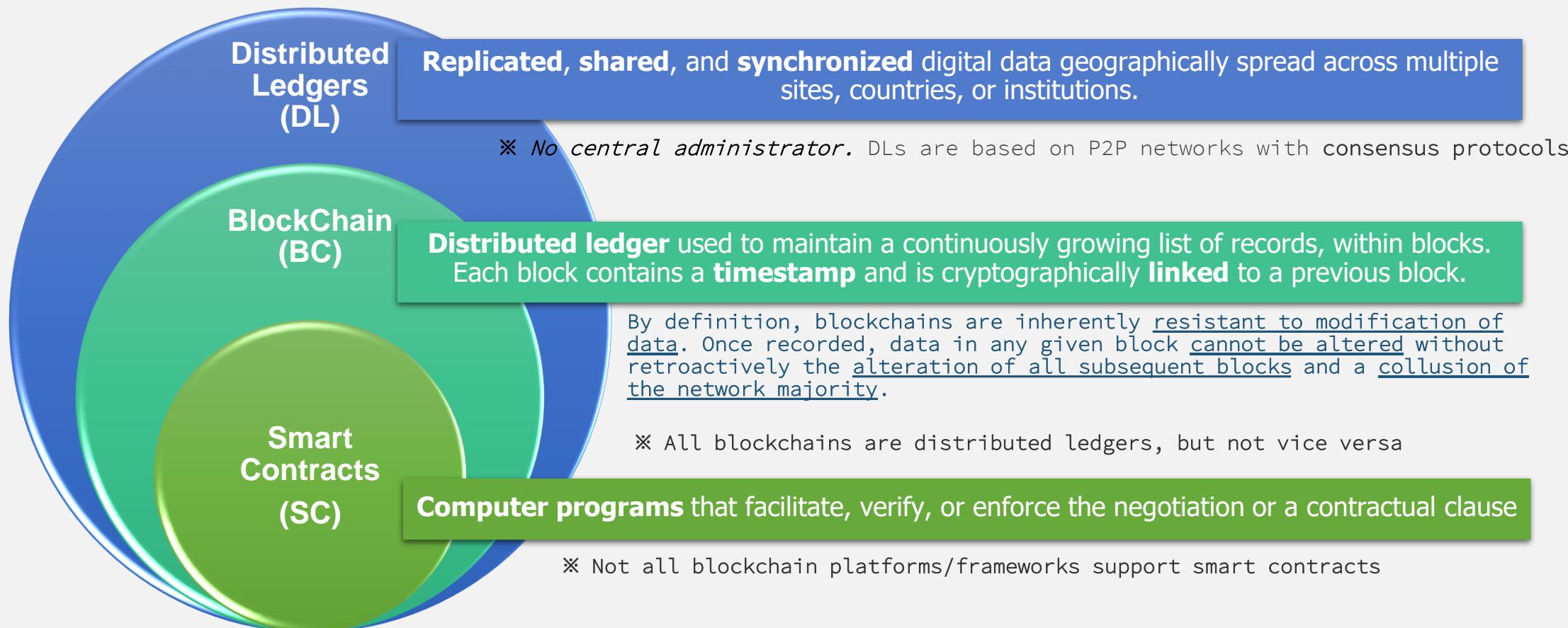
**Blockchain** - "A peer-to-peer distributed ledger forged by consensus, combined with a system for smart contracts and other assistive technologies."

[hyperledger.org](http://hyperledger.org)



# Concepts Definition

Distributed Ledgers, Blockchain, and Smart Contracts are interrelated, but different



# Centralized vs Decentralized Systems

## Centralized System

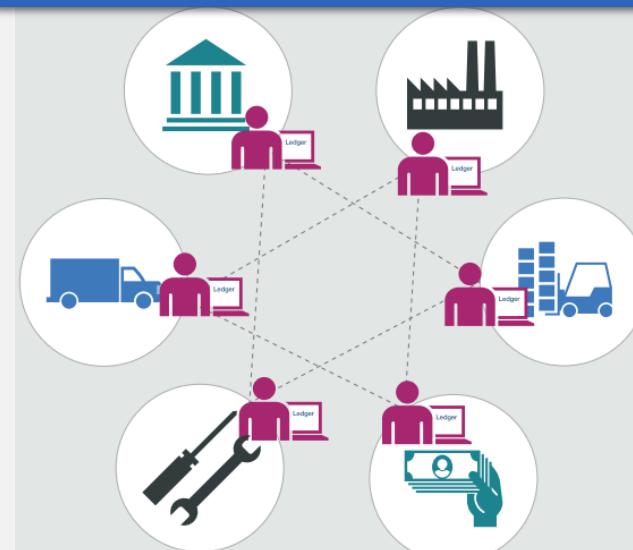


**Transactions are complex.**

- A** Each participant has his own, separate ledger — increasing the possibility of human error or fraud
- B** Reliance on intermediaries for validation creates inefficiencies
- C** Can be a paper-laden process, resulting in frequent delays and potential losses for all stakeholders

VS

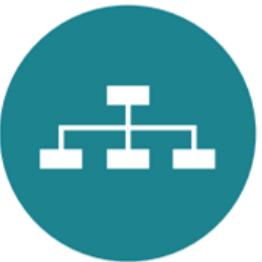
## Blockchain-based Decentralization



**Blockchain makes it better.**

- A** Single shared ledger that is tamper-evident. Once recorded, transactions cannot be altered
- B** All parties must give consensus before a new transaction is added to the network
- C** Eliminates or reduces paper processes, speeding up transaction times and increasing efficiencies

# The benefits of blockchain are critical to enterprises.



## Distributed

It works as a system of record that is shared among participants of the business network, eliminating the need to reconcile disparate ledgers.



## Permissioned

Each member of the network has access rights so that confidential information is shared on a need-to-know basis.



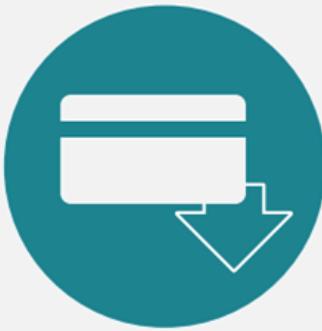
## Secured

Consensus is required from all network members and all validated transactions are permanently recorded. No one, not even a system administrator, can delete.

# Blockchain can enable enterprises across many industries to:



Free up capital flows



Lower transaction cost

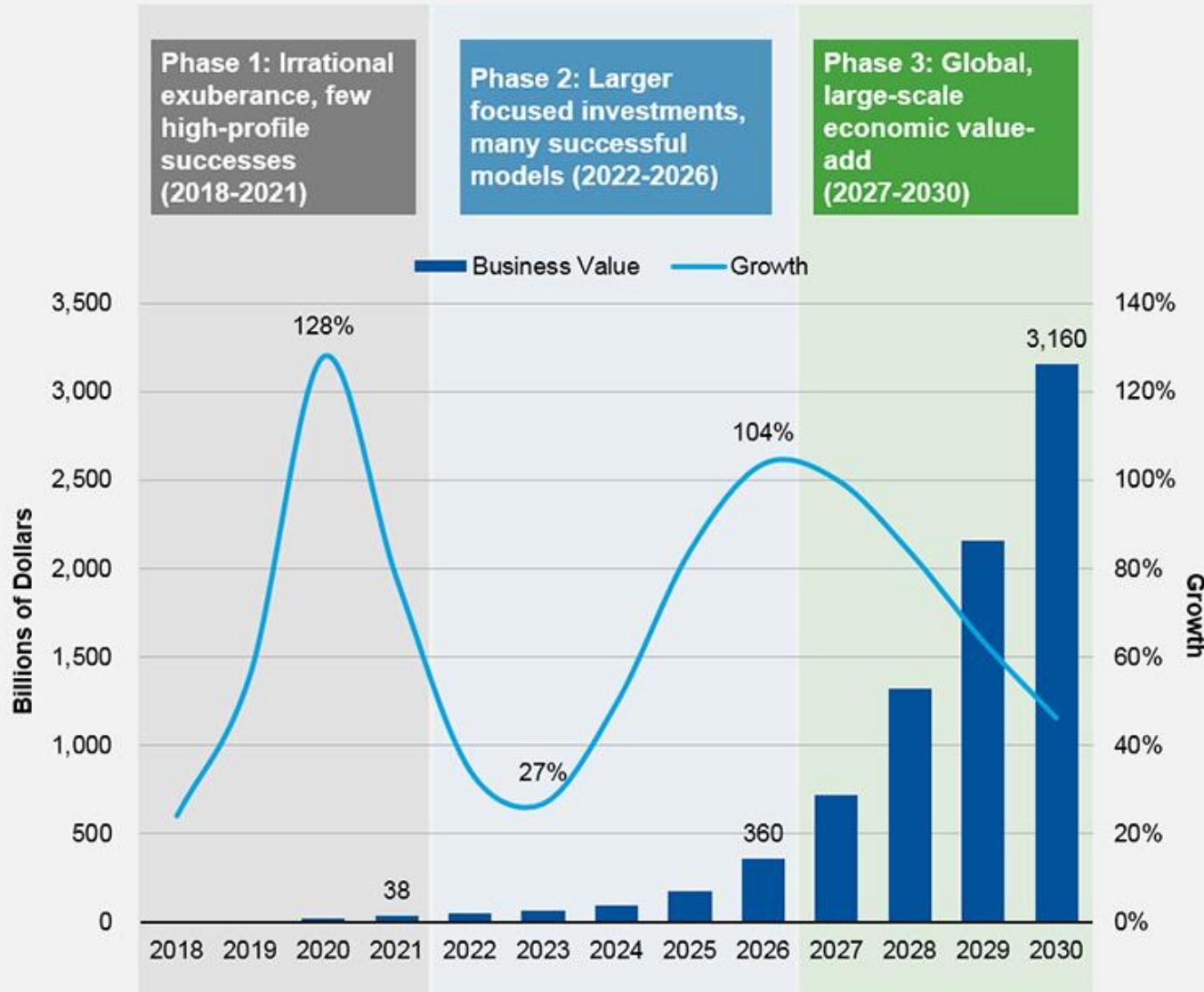


Speed processes



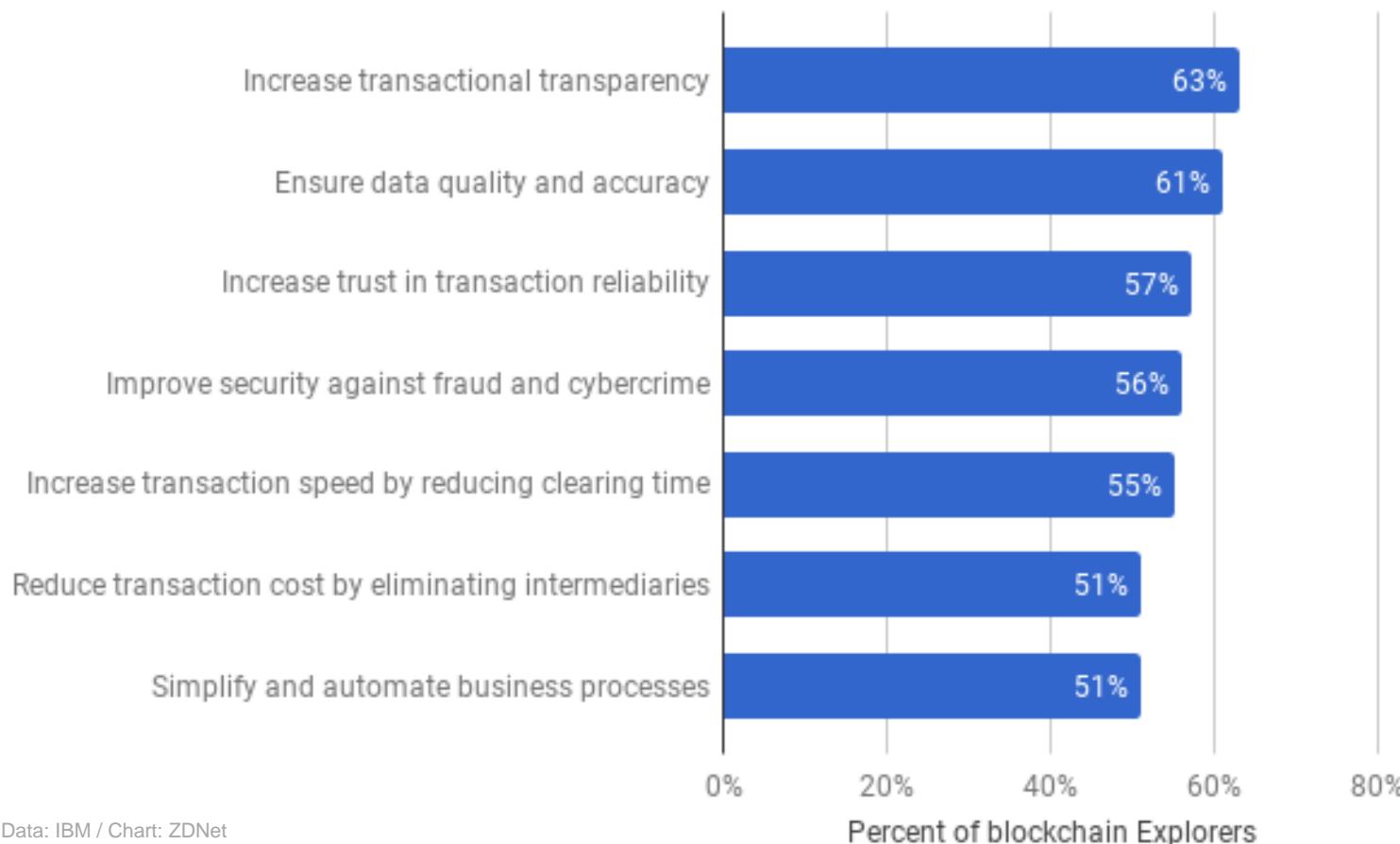
Provide security and trust

## Blockchain Business Value Forecast, 2018-2030

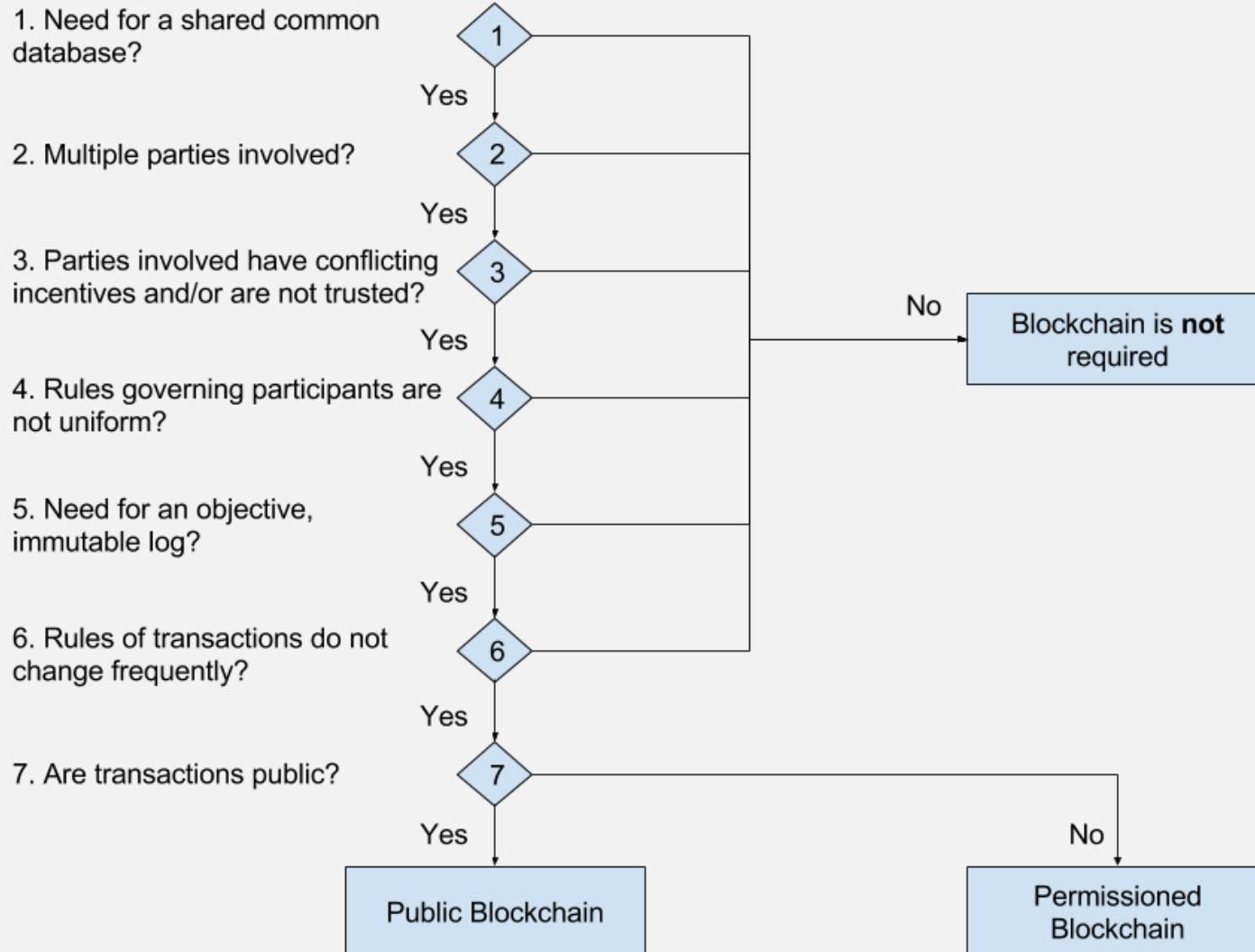


# Systems of Trust : Blockchain Support for Enterprise Strategy

Systems of trust: Blockchain support for enterprise strategy



# Blockchain Applicability Decision Framework



# Blockchain for Business Requirements

- Blockchain for enterprises or business requirements :

①

Privacy and confidentiality

②

Permissioned participants' identity

③

Accountability & Auditability

④

Performance, scalability & level(s) of trust

⑤

QoS and Reliability

⑥

Security and Resiliency

- **Hyperledger** is a distributed ledger technology that provides an **efficient** and **secure infrastructure** for the issuance and exchange of digital assets.

# Hyperledger Project Overview

Hyperledger is an **open source** and **collaborative** effort created in 2015 to advance cross-industry blockchain technologies



**HYPERLEDGER PROJECT**

- A global collaboration that includes (global) leaders in various areas :



# Hyperledger Project Overview



260 member companies



827 contributors



12 project codebases



126,149 commits made



Highly modular  
technologies



160+ Meetup groups  
in 66 countries



7.4M lines of code



Open, transparent  
governance

# Hyperledger Project Members



<https://www.hyperledger.org/members>

## Associates Members



## Associates Academia



# Hyperledger Project Members

## General Members



# Hyperledger Goals

**Where open source teams build diverse approaches  
for business blockchain technology systems**



**Create enterprise grade, open source, distributed ledger frameworks & code bases**  
to support business transactions



**Provide neutral, open, & community-driven infrastructures**  
supported by technical and business governance



**Build technical communities**  
to develop blockchain and shared ledger POCs, use cases, field trials and deployments



**Educate the public**  
about the market opportunity for blockchain technology



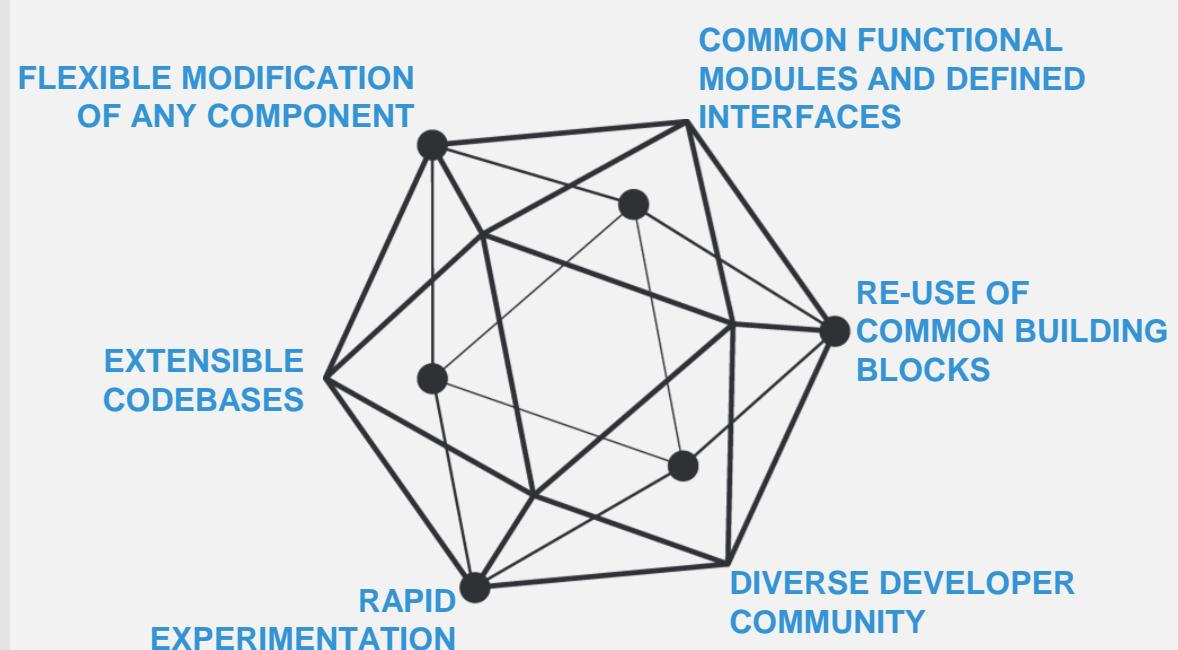
**Promote our community of communities**  
taking a toolkit approach with many platforms and frameworks

# Hyperledger Modular Approach Benefits

Similar to The Linux Foundation, **Hyperledger** also has a **modular umbrella approach**.

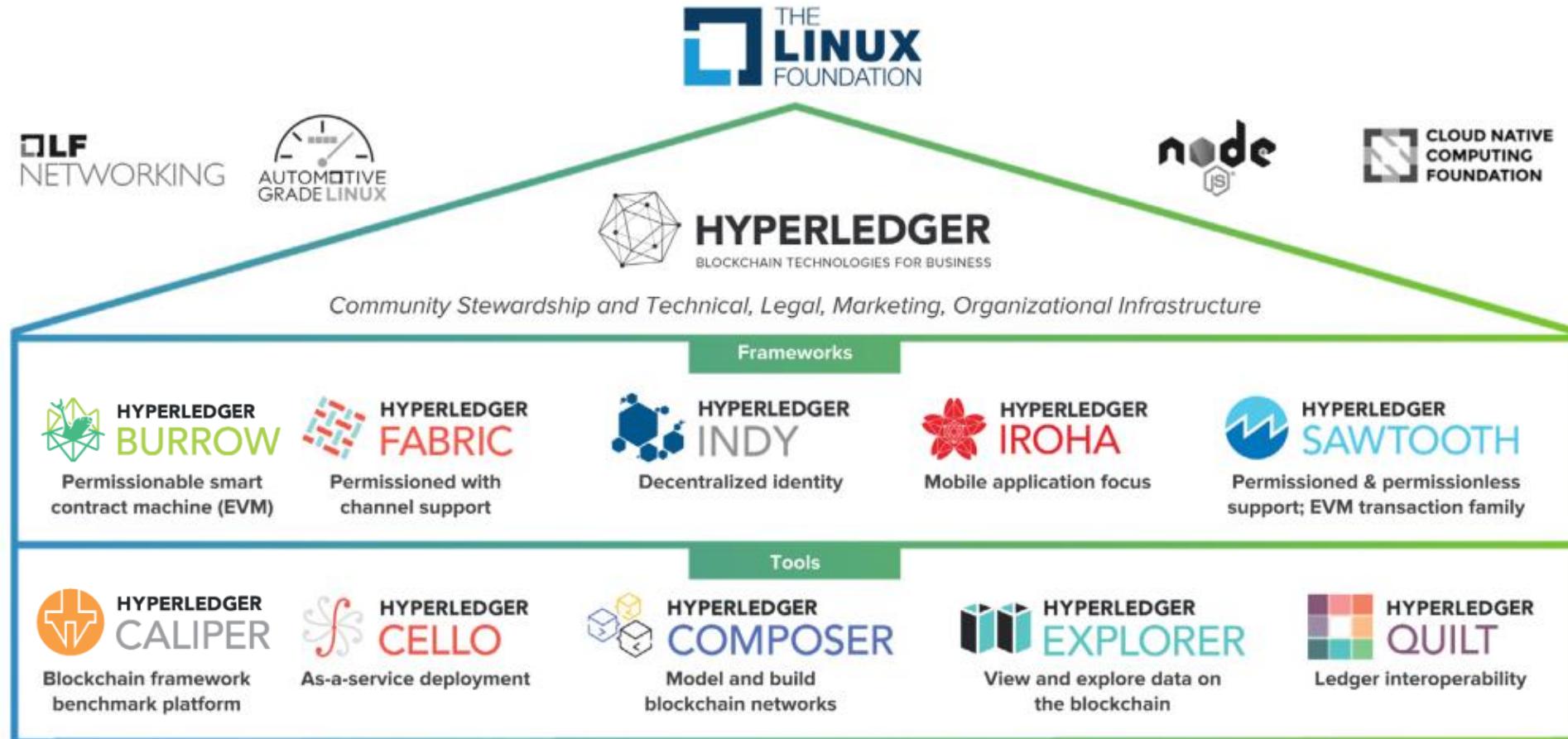
- At the top level, The Linux Foundation and Hyperledger provides the **infrastructure for open development to occur**. This includes technical, legal, marketing, and organizational aspects.
- Under Hyperledger's umbrella are **frameworks** and **tools** that take different approaches to creating blockchains for business across industries.

**There are many benefits to this modular approach.**



# Hyperledger Project Overview

Similar to The Linux Foundation, Hyperledger also has a **modular umbrella approach**.



# Hyperledger Project

## New Framework and tool added to Hyperledger Project

### Hyperledger Frameworks



Hyperledger Grid is a WebAssembly-based project for building supply chain solutions. It includes a set of libraries, data models, and SDK to accelerate development for supply chain smart contracts and client interfaces.

### Hyperledger Tools



Hyperledger Ursa is a shared cryptographic library that would enable people (and projects) to avoid duplicating other cryptographic work and hopefully increase security in the process.

# Hyperledger Project Overview – August 2019

## The Hyperledger Greenhouse

Business Blockchain Frameworks & Tools Hosted by Hyperledger



**HYPERLEDGER**

### Distributed Ledgers



**HYPERLEDGER  
BURROW**

Permissionable smart  
contract machine (EVM)



**HYPERLEDGER  
FABRIC**

Enterprise-grade DLT  
with privacy support



**HYPERLEDGER  
INDY**

Decentralized identity



**HYPERLEDGER  
IROHA**

Mobile application focus



**HYPERLEDGER  
SAWTOOTH**

Permissioned & permissionless  
support; EVM transaction family

### Libraries



**HYPERLEDGER  
ARIES**



**HYPERLEDGER  
QUILT**



**HYPERLEDGER  
TRANSACT**



**HYPERLEDGER  
URSA**

### Tools



**HYPERLEDGER  
CALIPER**



**HYPERLEDGER  
CELLO**



**HYPERLEDGER  
COMPOSER**



**HYPERLEDGER  
EXPLORER**

### Domain-Specific



**HYPERLEDGER  
GRID**



**HYPERLEDGER  
LABS**

# Hyperledger Project Overview – Sep 2019

## The Hyperledger Greenhouse

Business Blockchain Frameworks & Tools Hosted by Hyperledger



**HYPERLEDGER**

### Distributed Ledgers



**HYPERLEDGER  
BESU**

Java-based  
Ethereum client



**HYPERLEDGER  
BURROW**

Permissionable smart  
contract machine (EVM)



**HYPERLEDGER  
FABRIC**

Enterprise-grade DLT  
with privacy support



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Decentralized identity



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### Libraries



**HYPERLEDGER  
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**HYPERLEDGER  
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### Tools



**HYPERLEDGER  
CALIPER**



**HYPERLEDGER  
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### Domain-Specific



**HYPERLEDGER  
GRID**

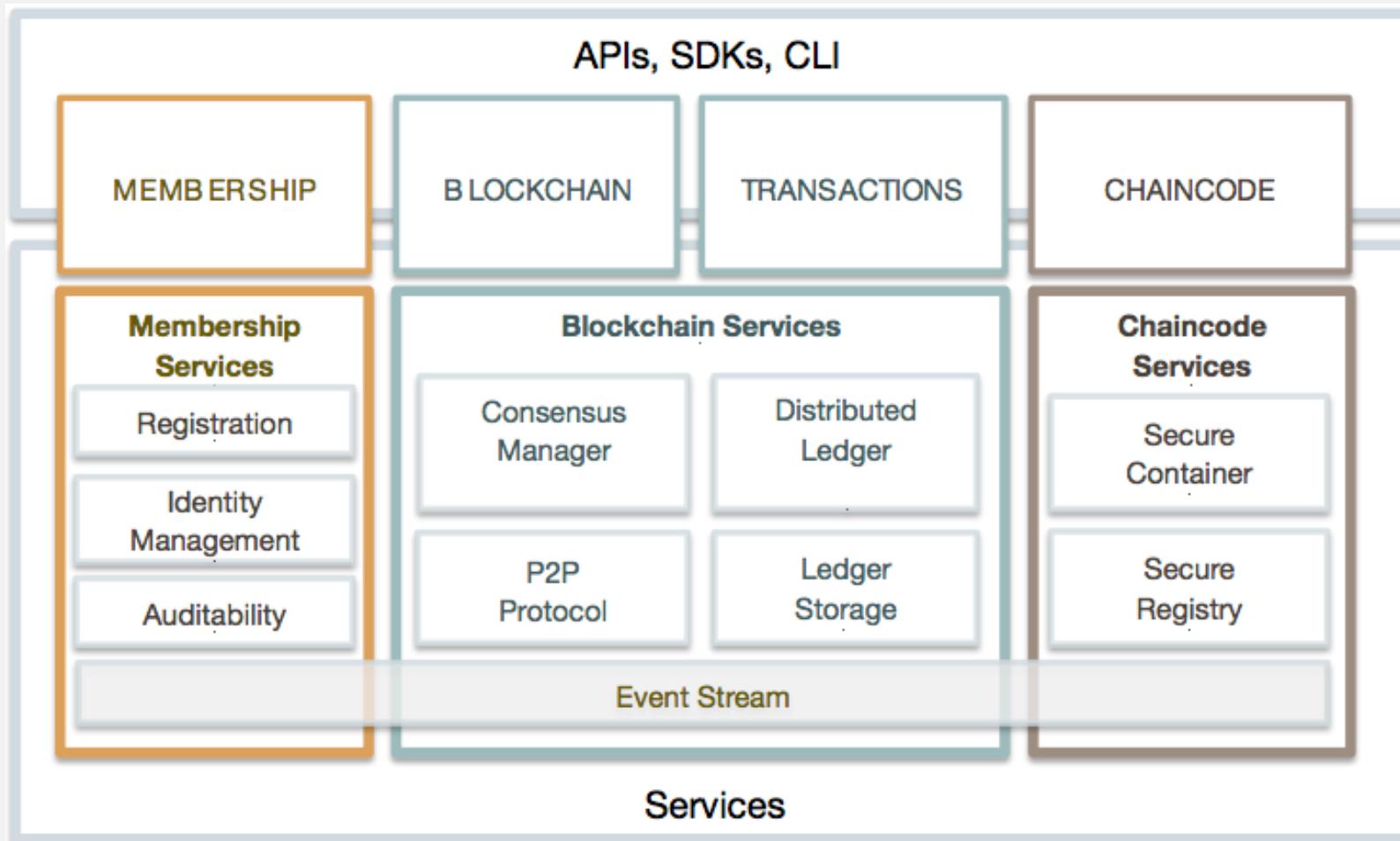


**HYPERLEDGER  
LABS**

# Hyperledger Blockchain Framework

Framework	Description
<b>Hyperledger Fabric</b>	Intended as a foundation for developing applications or solutions with a modular architecture, Hyperledger Fabric allows components, such as consensus and membership services, to be plug-and-play.
<b>Hyperledger Iroha</b>	A business blockchain framework designed to be simple and easy to incorporate into infrastructural projects requiring distributed ledger technology.
<b>Hyperledger Sawtooth</b>	A modular platform for building, deploying, and running distributed ledgers. Hyperledger Sawtooth includes a novel consensus algorithm, Proof of Elapsed Time (PoET), which targets large distributed validator populations with minimal resource consumption.
<b>Hyperledger Burrow</b>	A permissionable smart contract machine. The first of its kind when released in December, 2014, Burrow provides a modular blockchain client with a permissioned smart contract interpreter built in part to the specification of the Ethereum Virtual Machine (EVM).
<b>Hyperledger Indy</b>	Tools, libraries, and reusable components for providing digital identities rooted on blockchains or other distributed ledgers so that they are interoperable across administrative domains, applications, and any other silo.

# Hyperledger Reference Architecture



Hyperledger Reference Architecture by the Hyperledger Architecture Working Group

# Hyperledger Reference Architecture Components

Modules	Description
<b>Membership Services</b>	Membership provides services for managing identity, privacy, confidentiality and auditability on the network.
<b>Blockchain Services</b>	Blockchain services manage the distributed ledger through a peer-to-peer protocol, built on HTTP/2.
<b>Chaincode Services</b>	Chaincode services provides a secured and lightweight way to sandbox the chaincode execution on the validating nodes.
<b>Events</b>	Validating peers and ChainCodes can emit events on the network that applications may listen for and take actions on.
<b>Application Programming Interface (API)</b>	The API allows applications to register users, query the blockchain, and to issue transactions. There is a set of APIs specifically for chaincode to interact with the stack to execute transactions and query transaction results.
<b>Command Line Interface (CLI)</b>	CLI includes a subset of the REST API to enable developers to quickly test ChainCodes or query for status of transactions. CLI is implemented in Golang and operable on multiple OS platforms.

# Hyperledger Project Governance

## Available Tools

- **Common software license:** Apache v2
- **Common IP framework:** the Developer Certificate of Origin
- **Collaboration tools** (Gerrit, Jira, Rocket.Chat, Slack, email)
- **Promotion and branding**
- **Security processes and practices for bugs**

## A Team of Developer Volunteers

- Build code in the open
- Manage individual roadmaps and release schedules
- Responsible for following Hyperledger policies and requirements
- Align modular code with other projects

## Infrastructure from The Linux Foundation

- Executive Director
- Business Operations
- Technical Staff for Security, Ecosystem and Community Development
- Communications Staff for Marketing, PR and Events
- Legal Counsel
- Membership Sales

# Key Characteristics of Prominent DLT Platforms

## Distributed Ledger Frameworks



Public      Private

### Scalability

Uses efficient consensus algorithms to allow for the scaling up of transactions

### Privacy

Allows for the use of confidential channels for sending and storing sensitive data on a need-to-know basis

### Adoption

Currently the most used platform for developing enterprise Blockchain technologies



Public      Private

### Scalability

Very efficient consensus algorithms to ensure transaction remain cheap as the network scales up

### Privacy

Transactions are stored and broadcasted across the entirety of the created network

### Adoption

Released in January 2018 and has been seen as a versatile alternative to Fabric for enterprise applications



Public      Private

### Scalability

Participants are not required to store the entire ledger

### Privacy

Data is not broadcasted globally and only ever stored on a need-to-know basis

### Adoption

Developed for financial institutions and is seeing some use cases for other industries

## Distributed Computing Platform



Public      Private

### Scalability

What limits the use of Ethereum is the cost of transactions that increases as they become more complex

### Privacy

Transactions are broadcast across the entire public Ethereum network

### Adoption

Ethereum is an active currency on the market and there are multiple applications developed on the platform

**Source:** Capgemini Applied Innovation Exchange.

# Hyperledger Early Adopted Industries

<https://www.hyperledger.org/resources/industries>



## Education & Research

[Read More](#)



## Energy & Resources

[Read More](#)



## Financial Services

[Read More](#)



## Government & Legal

[Read More](#)



## Healthcare

[Read More](#)



## Identity

[Read More](#)



## Media & Entertainment

[Read More](#)



## Mobility & Transport

[Read More](#)



## Non-profit & Social Impact

[Read More](#)



## Real Estate

[Read More](#)



## Retail

[Read More](#)



## Supply Chain

[Read More](#)

# Hyperledger Use Case



Mineral Traceability from Mine to Manufacturer

## HOW HYPERLEDGER FABRIC SUPPORTS SUPPLY CHAIN

<https://www.hyperledger.org/resources/publications/tantalum-case-study>



**Identity**  
Facial Recognition



**Origin**  
GPS & QR/NFC Tags



**Refining**  
Mass Balance



**Shipping**  
Container Tracking



**Manufacturing**  
Mass Balance



**Logistics**  
GPS & RFID



**Final Assembly**  
Product ID



**URU ID  
Check**



**Circulor  
Protocol™**



**Circulor  
Protocol™**



**Certified  
3PL**



**Certified Origin  
Components**



**Certified  
3PL**

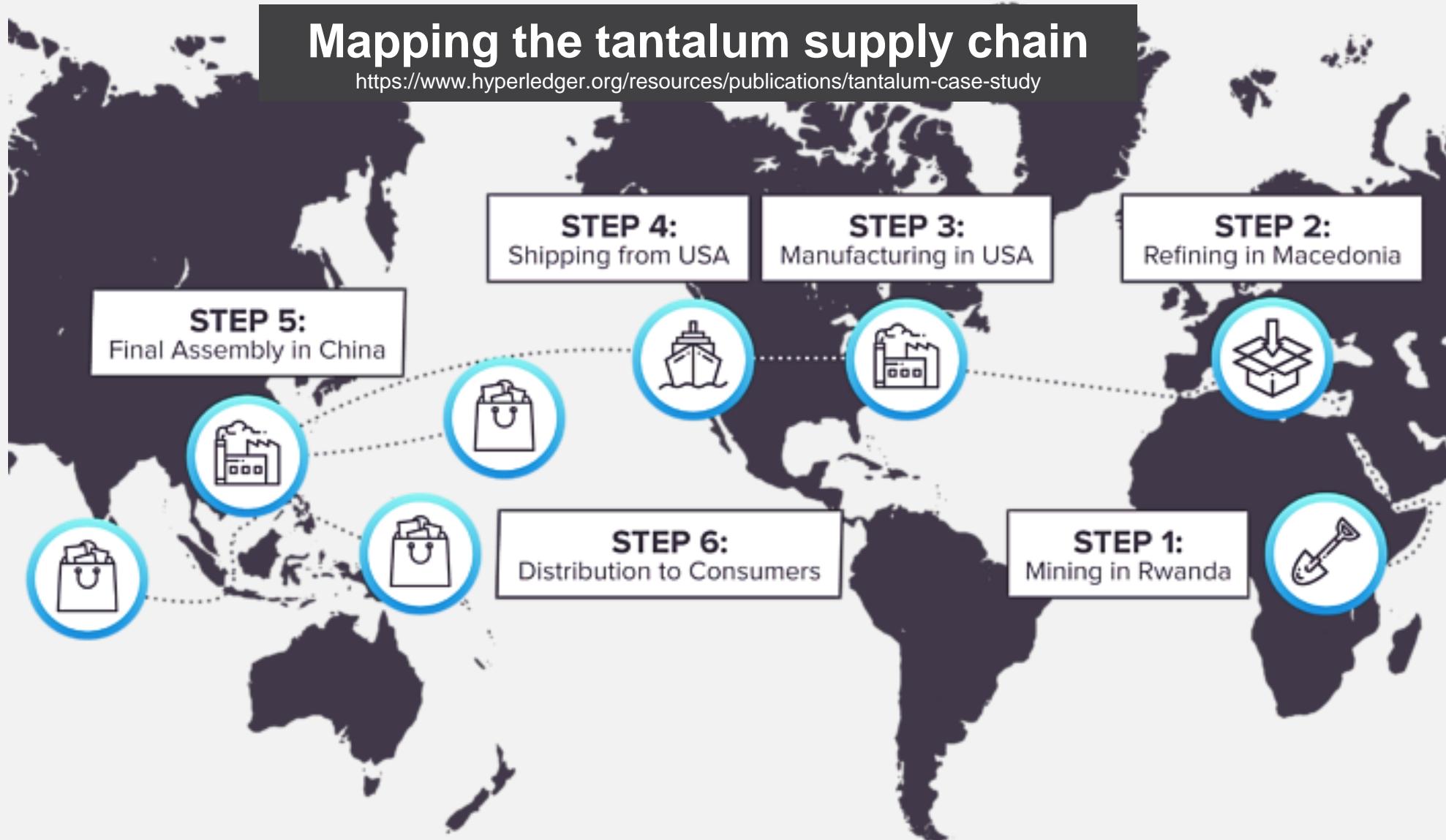


**Certified Ethical  
Sourcing**

# Hyperledger Use Case

## Mapping the tantalum supply chain

<https://www.hyperledger.org/resources/publications/tantalum-case-study>



# Hyperledger Frameworks



Hyperledger Burrow is a permissionable smart contract machine. The first of its kind when released in December, 2014, Burrow provides a modular blockchain client with a permissioned smart contract interpreter built in part to the specification of the Ethereum Virtual Machine (EVM).



An enterprise-grade permissioned distributed ledger framework that offers modularity, versatility, and privacy options to satisfy a broad set of industry use cases ranging from finance, to healthcare, to supply-chain and more.



Hyperledger Grid is a WebAssembly-based project for building supply chain solutions. It includes a set of libraries, data models, and SDK to accelerate development for supply chain smart contracts and client interfaces.

<https://www.hyperledger.org/project>



Hyperledger Indy is a distributed ledger, purpose-built for decentralized identity. It provides tools, libraries, and reusable components for creating and using independent digital identities rooted on blockchains or other distributed ledgers for interoperability.



Hyperledger Iroha is an easy to use, modular distributed blockchain platform with its own unique consensus and ordering service algorithms, rich role-based permission model and multi-signature support.



Hyperledger Sawtooth is a modular platform for building, deploying, and running distributed ledgers. Hyperledger Sawtooth includes a novel consensus algorithm, Proof of Elapsed Time (PoET), which targets large distributed validator populations with minimal resource consumption.

# Hyperledger Tools



Hyperledger Aries is infrastructure for blockchain-rooted, peer-to-peer interactions. It provides a shared, reusable, interoperable tool kit designed for initiatives and solutions focused on creating, transmitting and storing verifiable digital credentials.



Hyperledger Explorer can view, invoke, deploy or query blocks, transactions and associated data, network information, chain codes and transaction families, as well as any other relevant information stored in the ledger.



Hyperledger Caliper is a blockchain benchmark tool, which allows users to measure the performance of a specific blockchain implementation with a set of predefined use cases.

[» LEARN MORE](#)



Hyperledger Quilt offers interoperability between ledger systems by implementing ILP, which is primarily a payments protocol and is designed to transfer value across distributed ledgers and non-distributed ledgers.



Hyperledger Cello aims to bring the on-demand "as-a-service" deployment model to the blockchain ecosystem to reduce the effort required for creating, managing and terminating blockchains.

[» LEARN MORE](#)



Hyperledger Transact provides a platform-agnostic library that handles the execution of smart contracts, including all aspects of scheduling, transaction dispatch, and management.

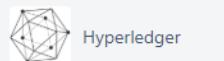


Hyperledger Composer is a collaboration tool for building blockchain business networks, accelerating the development of smart contracts and their deployment across a distributed ledger.



Hyperledger Ursa is a shared cryptographic library that would enable people (and projects) to avoid duplicating other cryptographic work and hopefully increase security in the process.

# Hyperledger Projects Progress Status



Hyperledger

## PAGE TREE

- Hyperledger Code of Conduct
- Calendar of Public Meetings
- FAQ
- Projects
- Security
- Special Interest Groups
- Working Groups
- Page Archive
- About

## Projects

Title	Project	Status	CI Badge	Description
Hyperledger Burrow	HYPERLEDGER BURROW	INCUBATION	cii best practices in progress 82%	Permissioned Ethereum smart-contract blockchain
Hyperledger Caliper	HYPERLEDGER CALIPER	INCUBATION	cii best practices in progress 97%	Blockchain benchmark framework which allows users to measure the performance of a specific blockchain implementation with a set of predefined use cases.
Hyperledger Cello	HYPERLEDGER CELLO	INCUBATION	cii best practices not started	Blockchain management/operation
Hyperledger Composer	HYPERLEDGER COMPOSER	INCUBATION	cii best practices passing	Development framework/tools for building Blockchain business networks
Hyperledger Explorer	HYPERLEDGER EXPLORER	INCUBATION	cii best practices not started	Blockchain Web UI
Hyperledger Fabric	HYPERLEDGER FABRIC	ACTIVE	cii best practices passing	Distributed ledger in GoLang
Hyperledger Grid		INCUBATION	cii best practices not started	WebAssembly-based project for building supply chain solutions
Hyperledger Indy	HYPERLEDGER INDY	INCUBATION	cii best practices in progress 95%	Distributed ledger purpose-built for decentralized identity
Hyperledger Iroha	HYPERLEDGER IROHA	ACTIVE	cii best practices passing	Distributed ledger in C++
Hyperledger Quilt	HYPERLEDGER QUILT	INCUBATION	cii best practices not started	An interoperability solution for blockchains, DLTs and other types of ledgers
Hyperledger Sawtooth	HYPERLEDGER SAWTOOTH	ACTIVE	cii best practices passing	Distributed ledger with Multi-Language Support
Hyperledger Ursula		INCUBATION	cii best practices not started	A shared cryptographic library that would enable people (and projects) to avoid duplicating other cryptographic work and hopefully increase security in the process.

# Hyperledger Communities

Learn how to get involved with Hyperledger



<https://www.hyperledger.org/community>



# Resource Center

Custom content developed to get started with Hyperledger Technologies



## Webinars

Register for upcoming Hyperledger webinars or watch them on-demand.



## Videos

Explore how-to videos and community spotlights on Hyperledger topics.



## Training

Discover and enroll for training courses on Hyperledger technologies.



## Tutorials

Find resources for self-taught learning about the Hyperledger projects.



## Publications

Read popular white papers, position papers and case studies.



## Vendor Directory

Search for business blockchain products and services built by our members with Hyperledger code.



## Blockchain Showcase

Check out the cross-industry PoCs, pilots and production deployments in use today, built with Hyperledger frameworks and tools.



## Universities

Learn about resources for universities to help make an impact on Hyperledger.



## Jobs

Search for Hyperledger and business blockchain job listings.



## Industries

See how different industries are adopting Hyperledger projects.

# Hyperledger Training Sale

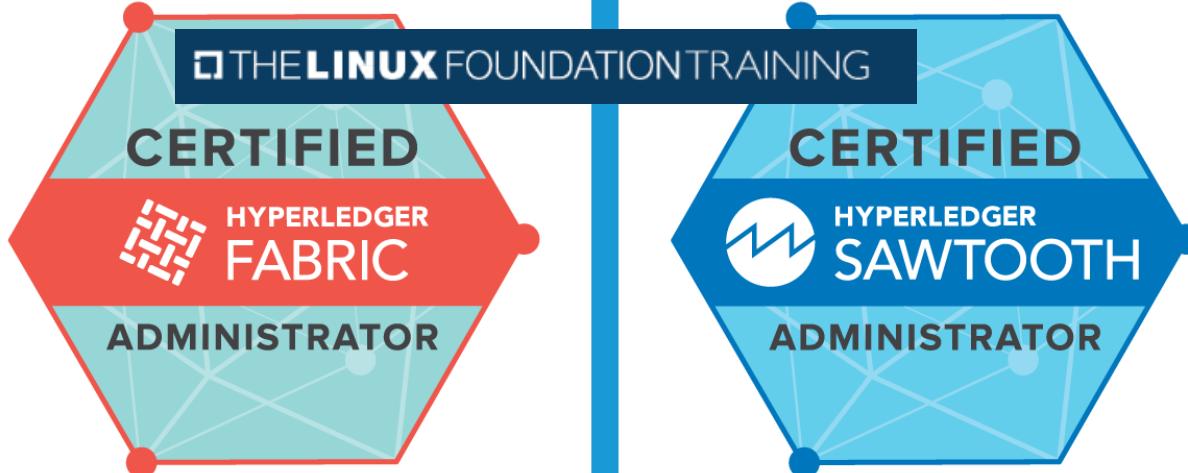
Looking to learn Hyperledger?

<https://training.linuxfoundation.org/hyperledger-training-sale/>

We just released a new certification for Hyperledger Fabric, and to celebrate, we're offering 30% off all our Hyperledger courses and certifications! No matter where you're at in your blockchain journey, we have something for you!

Certified Hyperledger Fabric Administrator (CHFA)

Certified Hyperledger Sawtooth Administrator (CHSA)



The purpose of the Certified Hyperledger Fabric Administrator (CHFA) certification is to provide assurance that CHFAs can effectively build a secure Hyperledger Fabric network for commercial deployment.

\$300 \$210

BUY NOW

The purpose of the Certified Hyperledger Sawtooth Administrator (CHSA) certification is to provide assurance that CHSAs can effectively build a secure Hyperledger Sawtooth network for commercial deployment.

\$300 \$210

BUY NOW

# References

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- [6] Hyperledger Architecture, Volume 2: Smart Contracts - [https://www.hyperledger.org/wp-content/uploads/2018/04/Hyperledger\\_Arch\\_WG\\_Paper\\_2\\_SmartContracts.pdf](https://www.hyperledger.org/wp-content/uploads/2018/04/Hyperledger_Arch_WG_Paper_2_SmartContracts.pdf)
- [7] <https://www.hyperledger.org/resources/publications#presentations>
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- [9] [https://developer.ibm.com/code/wp-content/uploads/sites/118/2017/09/Marbles\\_BlockChain\\_Tech\\_Talk1.pdf](https://developer.ibm.com/code/wp-content/uploads/sites/118/2017/09/Marbles_BlockChain_Tech_Talk1.pdf)
- [10] <https://www.altoros.com/blog/hyperledger-fabric-v1-0-to-bring-improved-transactions-and-a-pluggable-data-store/>
- [11] [https://github.com/yeasy/hyperledger\\_code\\_fabric/blob/master/README.md](https://github.com/yeasy/hyperledger_code_fabric/blob/master/README.md)
- [12] <https://fabric-sdk-node.github.io/>
- [13] <https://developer.ibm.com/blockchain/> | <https://www.ibm.com/developerworks/cloud/library/cl-blockchain-basics-intro-bluemix-trs/>

# Thank you!

## Q & A



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