

# Ostali primeri javnih blokčejn tehnologija



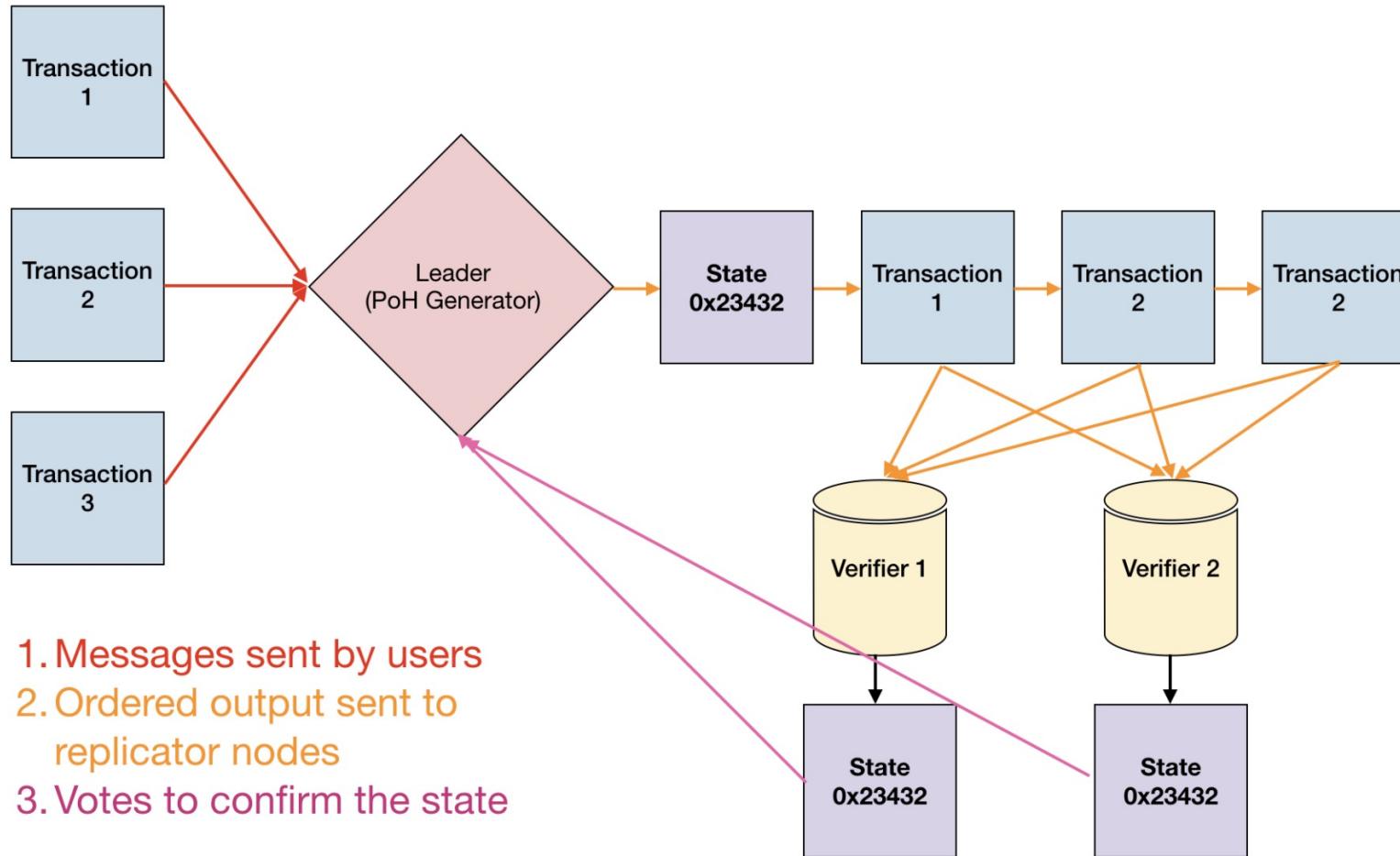
- Sajt: <https://solana.com/>
- Open source projekat, Solana Foundation registrovana u Švajcarskoj
- **Anatoly Yakovenko**, novembar 2017, Solana Whitepaper (<https://solana.com/solana-whitepaper.pdf>)
- "Solana is a decentralized blockchain built to enable scalable, user-friendly apps for the world."
- Incijalno napisana u **C**-u, pa reimplementirana u **Rust**-u
- **Solana je javni blokčejn sa fokusom na visokim performansama** (blok na 400 ms), skalabilnosti i niskoj ceni transakcija (<0.01 USD)
- Github: <https://github.com/solana-labs/>
- Dokumentacija: <https://docs.solana.com/introduction>



- Nativna kriptovaluta – token SOL, 1 lamport je  $10^{-9}$  SOL
- **Proof of History** konsenzus algoritam – tehnika za beleženje protoka vremena među računarima koji ne veruju jedni drugima
  - **Proof of History (PoH)** i ubrzani **Proof of Replication (PoR)** – originalno predložen za Filecoin
- Koncept **Solana klastera** (skup validatora sa liderom), spolja vidljiv kao jedinstven sistem
  - lider klastera je izabrani generator Proof of History
  - verifikatori repliciraju stanje blokčejna i omogućavaju njegovu visoku dostupnost
- Teorijski limit za 1 Gbps mrežu:  $1 \text{ Gbps} / 176 \text{ B} = 710\text{k tps}$
- Ekosistem sa više stotina aplikacija (NFT, DeFi, Web3, ...);  
<https://solana.com/ecosystem>

Izvor: <https://medium.com/solana-labs/solanas-network-architecture-8e913e1d5a40>

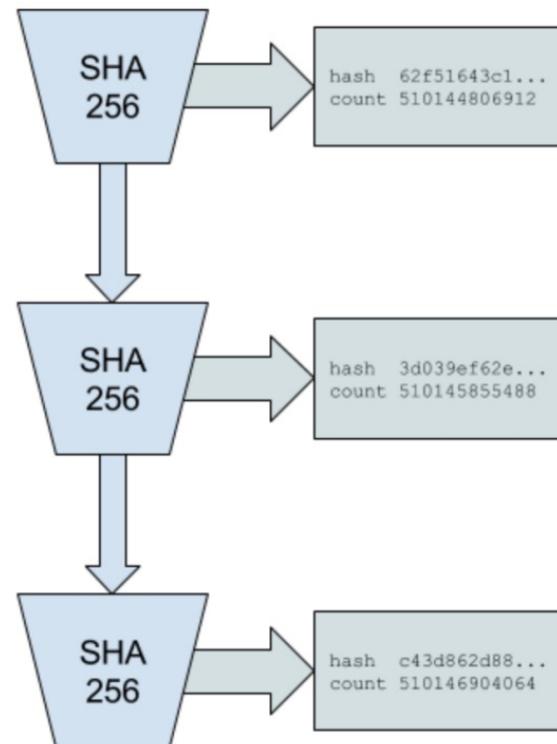
# SOLANA



Izvor: <https://solana.com/solana-whitepaper.pdf>

# SOLANA

PoH Sequence		
Index	Operation	Output Hash
1	sha256("any random starting value")	hash1
200	sha256(hash199)	hash200
300	sha256(hash299)	hash300



Izvor: <https://solana.com/solana-whitepaper.pdf>



- Sajt: <https://www.cardano.org>
- Cardano je open-source decentralizovani javni blokčejn i kriptovaluta, razvija se pod okriljem Cardano Foundation registrovane u Švajcarskoj
- Pokrenut od strane Čarlsa Hoskinsona (jedan od suosnivača Ethereum-a) 2015, finansiran kroz ICO
- Prva blokčejn platforma nastala na osnovu “scientific philosophy and a research-first driven approach”, napisan u Haskellu, jezici Plutus i Marlowe
- Kriptovaluta – token Ada (ADA), 1 ADA =  $10^6$  lovelace
- Vizija Cardana: “Its new style of regulated computing will bring greater financial inclusion by providing open access for all to fair financial services.”
- Cardano koristi poseban Proof of Stake konsenzus algoritam – “Ouroboros: A Provably Secure Proof-of-Stake Blockchain Protocol” (<https://eprint.iacr.org/2016/889.pdf>)



- Biblioteka radova: <https://iohk.io/research/library/>

The screenshot shows the IOHK Library homepage with a dark background. At the top, there's a navigation bar with links for TECHNOLOGY, RESEARCH, ABOUT, BLOG, CONTACT, CAREERS, and a language dropdown set to English. Below the navigation is a large red graphic of interconnected dots forming a network. The main title "IOHK | LIBRARY" is centered in large white letters. Below the title is a search bar with the placeholder "Search" and a count of "125 papers". Three research papers are listed in cards:

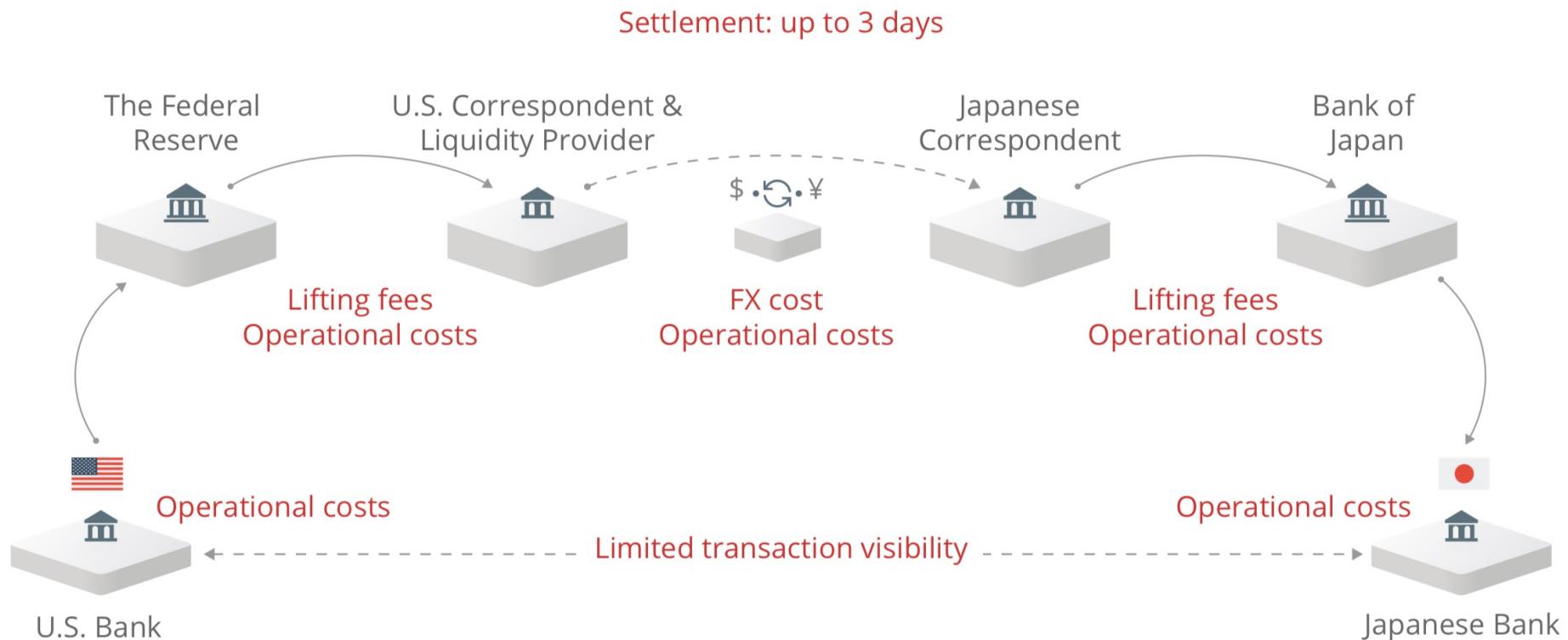
- Turn-Based Communication Channels**  
Carlo Brunetta, Mario Larangeira, Bei Liang, Aikaterini Mitrokotsa, Keisuke Tanaka  
November 2021, ProvSec '21
- Probability Models of Distributed Proof Generation for zk-SNARK-Based Blockchains**  
Yuri Bespalov, Alberto Garoffolo, Lyudmila Kovalchuk, Hanna Nelasa, Roman Oliynykov  
November 2021
- Policy-Compliant Signatures**  
Christian Badertscher, Christian Matt, Hendrik Waldner  
November 2021, TCC '21



- Sajt: <https://ripple.com>, predstavljen 2012. (od 2004. Ripplepay, pa potom kao OpenCoin) – Arthur Britto, David Schwartz, Ryan Fugger, Jed McCaleb
- **Ripple je sistem za poravnavanje (engl. settlement) transakcija u realnom vremenu i razmenu valuta** koji pruža **mrežu za novčane pošiljke** (engl. remittance)
- Kriptovaluta – ripple (XRP)
- Transakcije se kompletiraju za 2 do 3 sekunde
- Cena transakcije je 0.00001 XRP (10 drops)
- **Dva proizvoda u produkciji** koriste XRP:
  - **xRapid** je komercijalni proizvod koji omogućava bankama da koriste XRP kako bi globalno prenose novac
  - **xCurrent** omogućava bankama da globalno prenose novac tako da mogu da prate kako i gde se prenosi



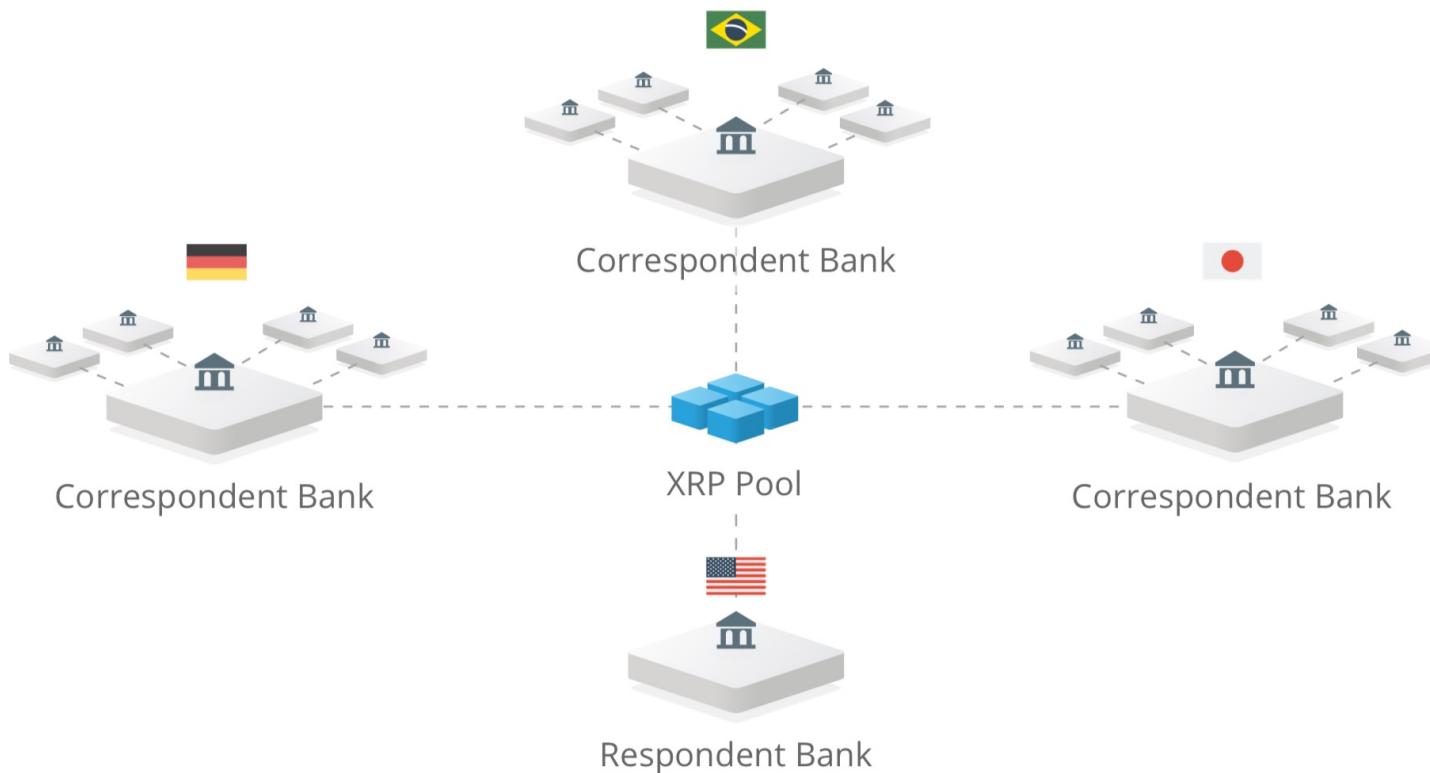
- Tradicionalne međunarodne bankarske transakcije:



Izvor: [https://ripple.com/files/xrp\\_cost\\_model\\_paper.pdf](https://ripple.com/files/xrp_cost_model_paper.pdf)



- Ripple sistem za međunarodne bankarske transakcije:



Izvor: [https://ripple.com/files/xrp\\_cost\\_model\\_paper.pdf](https://ripple.com/files/xrp_cost_model_paper.pdf)



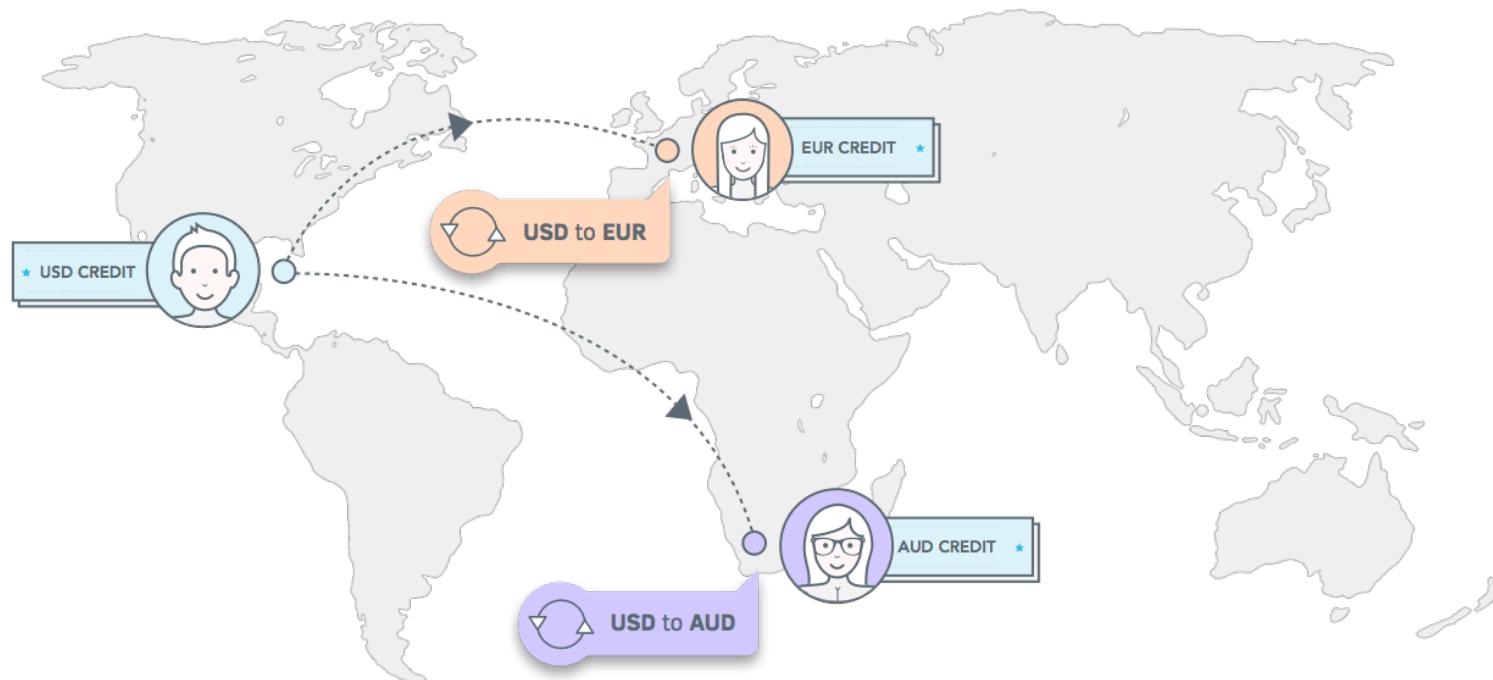
# STELLAR

- Sajt: <https://www.stellar.org>
- Stellar je **open-source, decentralizovani protokol za transfer digitalnih u fiat valute** koji omogućava međunarodna plaćanja između bilo koje dve valute
- Pokrenut 2014. – Jed McCaleb, suosnivač i CTO, prethodno eDonkey, Mt.Gox BTC berza, Ripple (2011), David Mazieres (Stanford) – Chief Scientist
- Kriptovaluta – lumen (XLM)
- FBA konsenzus algoritam (<https://www.stellar.org/papers/stellar-consensus-protocol.pdf>)
- Slučajevi korišćenja vrlo slični kao kod Ripple:
  - **novčane pošiljke** (engl. remittances) – brzo i jeftino međunarodno slanje novca u različitim valutama
  - **mikroplaćanja** (engl. micropayments) – povećanje efikasnosti i smanjivanje cene malih transfera
  - **servisi za osobe ranije bez bankovnih računa** (engl. services for the unbanked) – snižavanje cene usluga kako bi se došlo do novih klijenata – računi sa niskom cenom održavanja, pozajmice i mikroštendnja



# STELLAR

- Brze međunarodne transakcije sa različitim valutama sa vrlo malim provizijama:



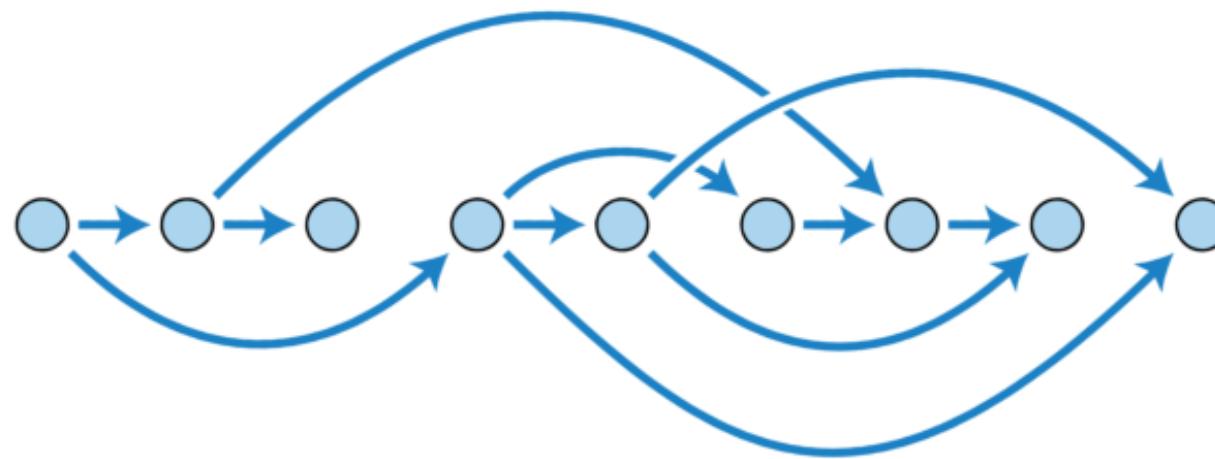
Izvor: <https://www.stellar.org>



Constellation

# Constellation

- Sajt: <https://constellationnetwork.io/>
- Constellation je sistem baziran na Hypergraph HGTP sa acikličnim usmerenim grafom (engl. *directed acyclic graph – DAG*), napisan u Skali
- Arhitektura DAG, svaki poteg je transakcija:



Izvor: [https://www.reddit.com/r/CryptoCurrency/comments/pbw024/blockchain\\_vs\\_dag\\_an\\_overview/](https://www.reddit.com/r/CryptoCurrency/comments/pbw024/blockchain_vs_dag_an_overview/)



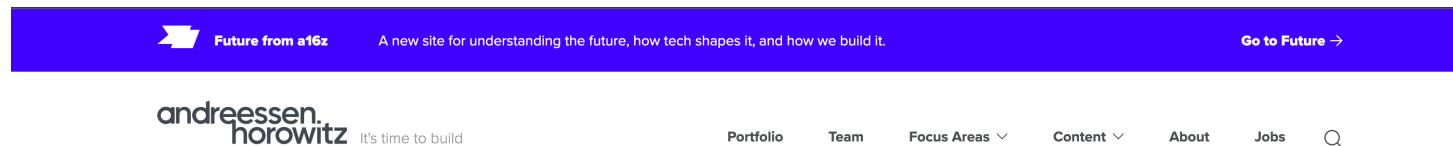
Constellation

# Constellation

- Ekosistem mikroservisa (koncept kanala stanja – engl. *state channel*) za rad sa velikim skupovima podataka
- Nativna kriptovaluta – token DAG
- Konsenzus algoritam PRO (engl. *Proof of Reputable Observation*)
- "A Technology Ecosystem that Bridges Real-World Businesses with Crypto Economies"
- DeFi platforma Lattice Exchange sa tokenom LTX:  
<https://constellationnetwork.io/solutions/lattice/>
- White Paper: <https://constellationnetwork.io/discover/whitepapers/>

# Online resursi

- Andreessen Horowitz (a16z) – Crypto Cannon:  
<https://a16z.com/2018/02/10/crypto-readings-resources/>



## Crypto Canon

by Sonal Chokshi, Chris Dixon, Denis Nazarov, Jesse Walden, and Ali Yahya

cryptocurrencies & blockchains •  
online communities • open source •  
coding literacy & access •  
glossaries & terms to know • listicles •  
nature of the firm & evolving institutions •  
NFTs • trends 2018 • what we're reading



Here's a list of crypto readings and resources (2018-2019). It's organized from building blocks and basics; foundations (& history); and key concepts — followed by specific topics such as governance; privacy and security; scaling; consensus and governance; cryptoeconomics, cryptassets, and investing; fundraising and token distribution; decentralized exchanges; stablecoins; and cryptoeconomic primitives and crypto goods (non-fungible tokens, cryptocollectibles, token-curated registries, curation markets). We also included a section with developer tutorials, practical guides, and maker stories — as well as other resources, such as newsletters/updates and courses, at the end. [You can find a16z's writings, posts, and videos on the topic at [a16z.com/crypto](https://a16z.com/crypto).]

For a list of resources dedicated to NFTs, applications, community/social tokens and creator DAOs, please see  
[a16z.com/nftcanon](https://a16z.com/nftcanon).

\* \* \*

### Building Blocks and Basics

**WTF is the blockchain?** — understanding the problem it solves before defining it  
by Mohit Mamoria  
<https://hackernoon.com/wtf-is-the-blockchain-1da89ba19348>

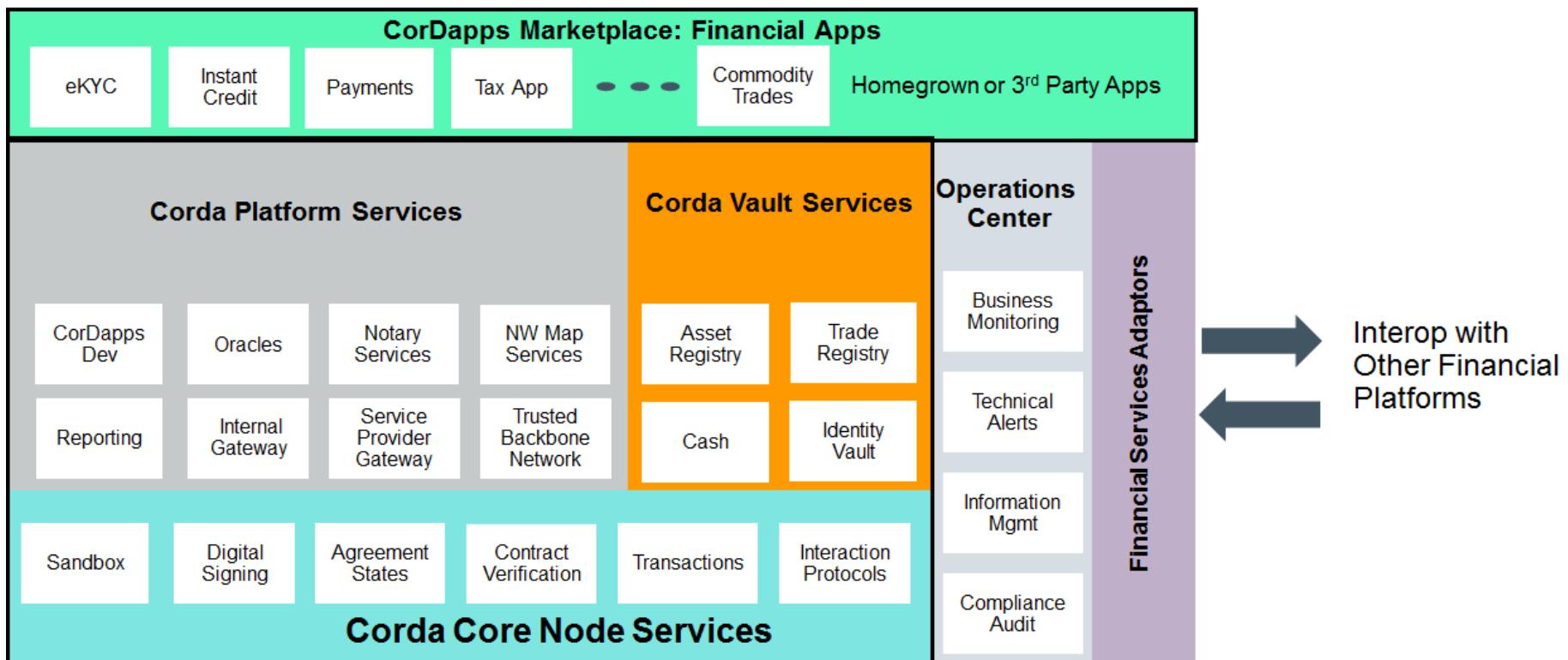
# Primeri privatnih DLT



- **R3** nastao kao konzorcijum devet banaka (Bank of America, HSBC, UBS, Credit Suisse, ING, ...)
- Primene u **poslovnom domenu** (bankarstvo, osiguranje, tržišta kapitala, međunarodna trgovina),
- **Privatna mreža sa kontrolom pristupa**
- Koristi **JVM**, pametni ugovori u **Javi** ili **Kotlinu**
- **DLT** koji **nije blokčejn**, transakcije se ne organizuju u blokove, već se obrađuju na pojedinačnom nivou u realnom vremenu
- Onlajn resursi: <https://github.com/chainstack/awesome-corda>
- Osobine:
  - **privatnost**
  - **performanse**
  - **skalabilnost**
  - **open source**



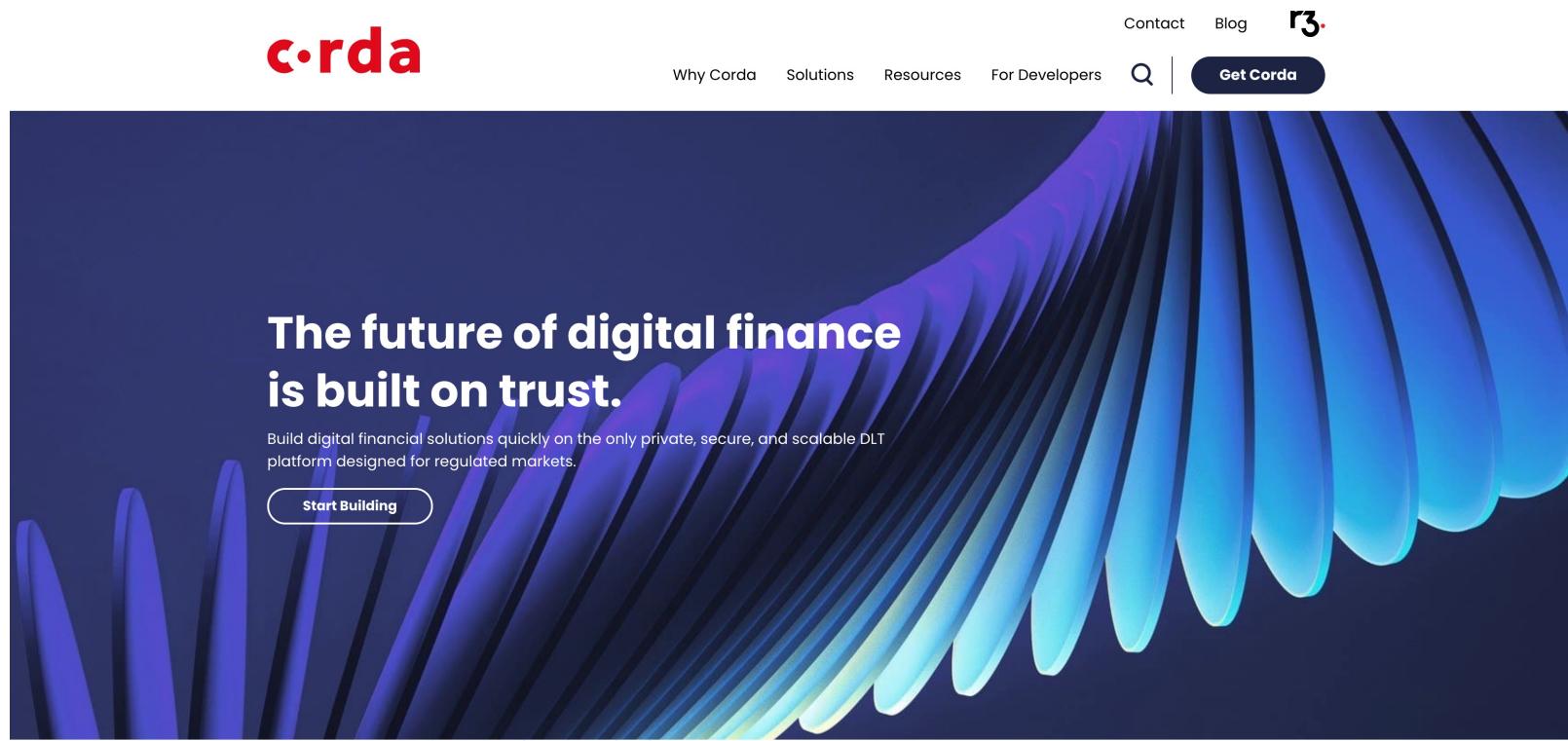
## Corda Application Architecture



Izvor: <http://arunkottolli.blogspot.com/2017/10/r3-corda-application-architecture.html>



- **Corda i Corda Enterprise**
- R3 Corda platforma (<https://www.r3.com/corda-platform/>)
- R3 Conclave (<https://www.conclave.net/>) – confidential computing



Izvor: <https://www.r3.com/corda-platform/>



- **Kaleido Corda** (<https://www.kaleido.io/product/features#protocol-corda>)

The screenshot shows the Kaleido website's navigation bar at the top, featuring the Kaleido logo, a search bar, and links for Product, Pricing, Solutions, Open Source, Resources, and Company. Below this, a horizontal bar highlights 'Corda'. The main content area is divided into two sections: 'Corda Enterprise' on the left and 'Corda OS' on the right. On the far left, a sidebar lists 'Featured Services' including Kaleido Core, Infrastructure, FireFly, Tools, Protocol, Ethereum, Corda (which is highlighted with a red vertical bar), and Fabric. Below this is a section titled 'Kaleido Services'.

**Corda**

**Featured Services**

- Kaleido Core
- Infrastructure
- FireFly
- Tools
- Protocol
- Ethereum
- Corda**
- Fabric

**Kaleido Services**

**r3.**

**Corda Enterprise**

Corda Enterprise builds on top of the open source version and adds critical capabilities for enterprise production deployment.

*Coming Soon*

**corda**

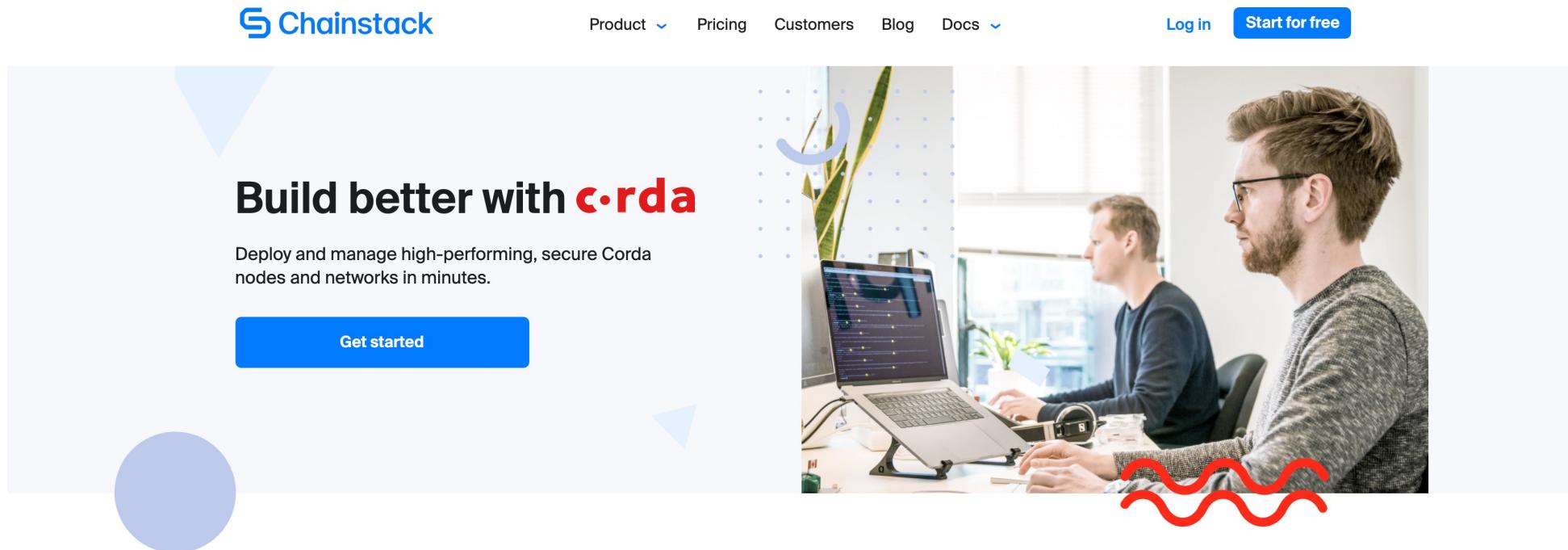
**Corda OS**

Corda is an open source blockchain protocol, designed for business from the start.

Izvor: <https://www.kaleido.io/product/features#protocol-corda>

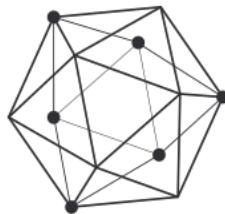


- **Chainstack Corda** (<https://chainstack.com/protocols/corda/>)



The screenshot shows the homepage of the Chainstack Corda website. At the top, there is a navigation bar with the Chainstack logo, a search icon, and links for Product, Pricing, Customers, Blog, Docs, Log in, and Start for free. Below the navigation, a large blue banner features the text "Build better with corda" and a subtext: "Deploy and manage high-performing, secure Corda nodes and networks in minutes." A prominent blue "Get started" button is located at the bottom of the banner. To the right of the banner, there is a photograph of two men working at desks in an office environment, with laptops displaying data. The background of the page includes abstract shapes like triangles and circles in blue and red.

Izvor: <https://chainstack.com/protocols/corda/>



# HYPERLEDGER

- Hyperledger je **open-source kolaborativna inicijativa** stvorena kako bi se **unapredile blokčejn tehnologije** i njihova **primena u različitim sektorima poslovanja** (engl. **enterprise**)
- Nosilac je inicijalno bila Linux fondacija, a potom Hyperledger fondacija
- Pokrenuta krajem 2015. na inicijativu većeg broja kompanija (IBM, Intel, SAP, ...)
- Februara 2016. početak aktivnog razvoja
- Obuhvata veći broj radnih okruženja i alata (ukupno 16 projekata na kraju 2020.)



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

# Hyperledger članovi



J.P.Morgan

 AIRBUS

The Airbus logo features a stylized circular emblem with three concentric arcs of dots, followed by the word "AIRBUS" in a bold, blue, sans-serif font.

DAIMLER

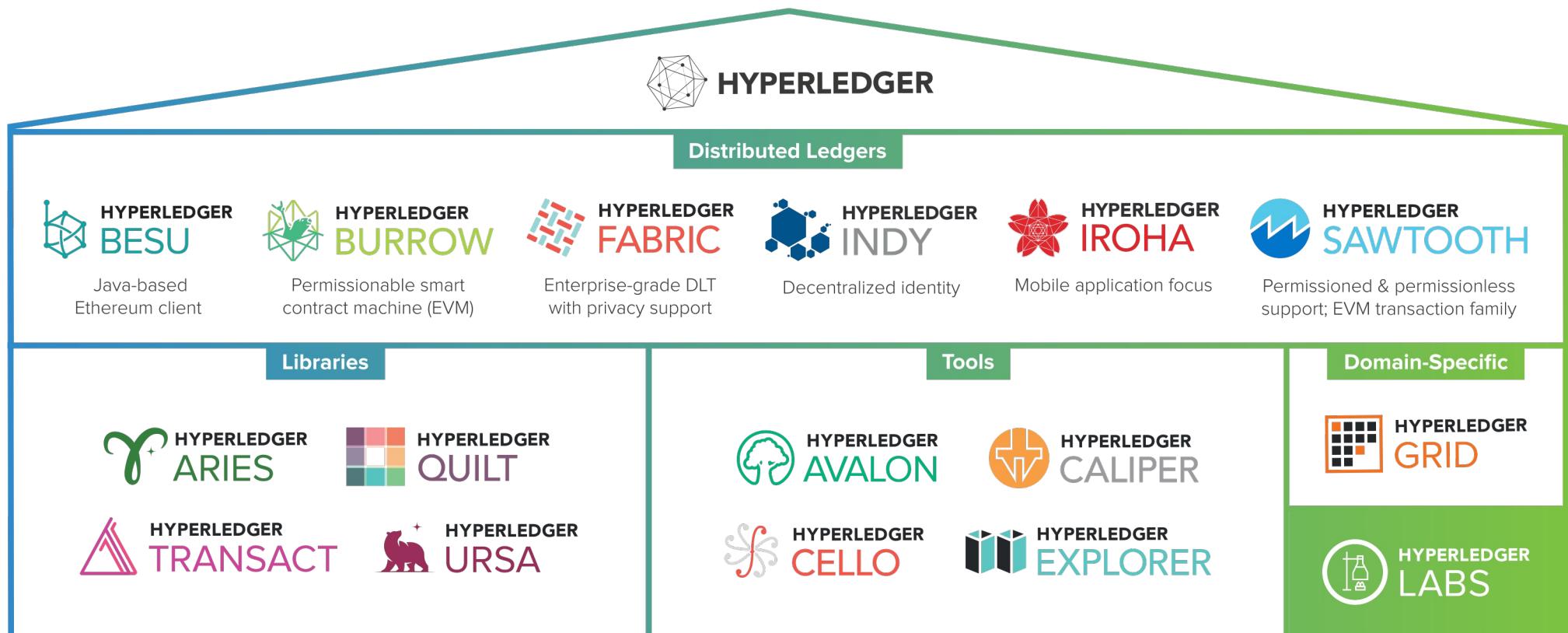


# Hyperledger projekti

- **Distribuirane knjige** (engl. *distributed ledgers*):
  - Fabric
  - Sawtooth
  - Iroha
  - Indy
  - Burrow
  - Besu
- **Alati** (engl. *tools*):
  - Avalon
  - Cello
  - Explorer
  - Caliper
- **Namenski** (engl. *domain-specific*):
  - Grid
- **Biblioteke** (engl. *libraries*):
  - Quilt
  - Ursa
  - Aries
  - Transact



# Hyperledger projekti



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

# Hyperledger projekti

## Infrastructure

Technical, Legal, Marketing,  
Organizational

Ecosystems that accelerate  
open development and  
commercial adoption



Cloud Foundry

Node.js

Hyperledger

Open Container  
Initiative

## Frameworks

Meaningfully differentiated approaches  
to business blockchain frameworks  
developed by a growing community of  
communities

Hyperledger  
Indy

Hyperledger  
Fabric

Hyperledger  
Iroha

Hyperledger  
Sawtooth

Hyperledger  
Burrow

## Tools

Typically built for one framework, and through  
common license and community of communities  
approach, ported to other frameworks

Hyperledger  
Composer

Hyperledger  
Explorer

Hyperledger  
Cello

Izvor: [https://www.hyperledger.org/wp-content/uploads/2017/08/HyperLedger\\_Arch\\_WG\\_Paper\\_I\\_Consensus.pdf](https://www.hyperledger.org/wp-content/uploads/2017/08/HyperLedger_Arch_WG_Paper_I_Consensus.pdf)

# Hyperledger slučajevi korišćenja

## 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.



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

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

Izvor: <https://www.hyperledger.org/wp-content/uploads/2018/03/The-Hyperledger-Vision-II-I.pdf>

# Hyperledger slučajevi korišćenja

## Seafood Supply Chain Traceability

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.



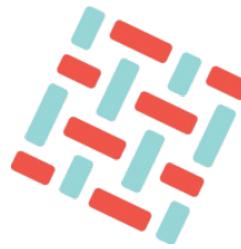
Izvor: <https://www.hyperledger.org/wp-content/uploads/2018/03/The-Hyperledger-Vision-II-1.pdf>



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.](#)



# HYPERLEDGER FABRIC

- **Hyperledger Fabric je platforma za rešenja sa distribuiranom glavnom knjigom i mrežom sa kontrolisanim pristupom** (engl. *permissioned network*), koja se zasniva na **modularnoj arhitekturi** i omogućava **visok stepen poverljivosti, otpornosti, fleksibilnosti i skalabilnosti**
- IBM donirao značajan deo koda
- Github: <https://github.com/hyperledger/fabric>
- Osobine:
  - **Modularnost**
  - **Poverljivost**
  - **Otpornost (resiliency)**
  - **Fleksibilnost**
  - **Skalabilnost i visoke performanse**



Izvor: <https://developer.ibm.com/tv/the-creation-of-hyperledger-fabric-v1-for-stable-blockchain-networks/>

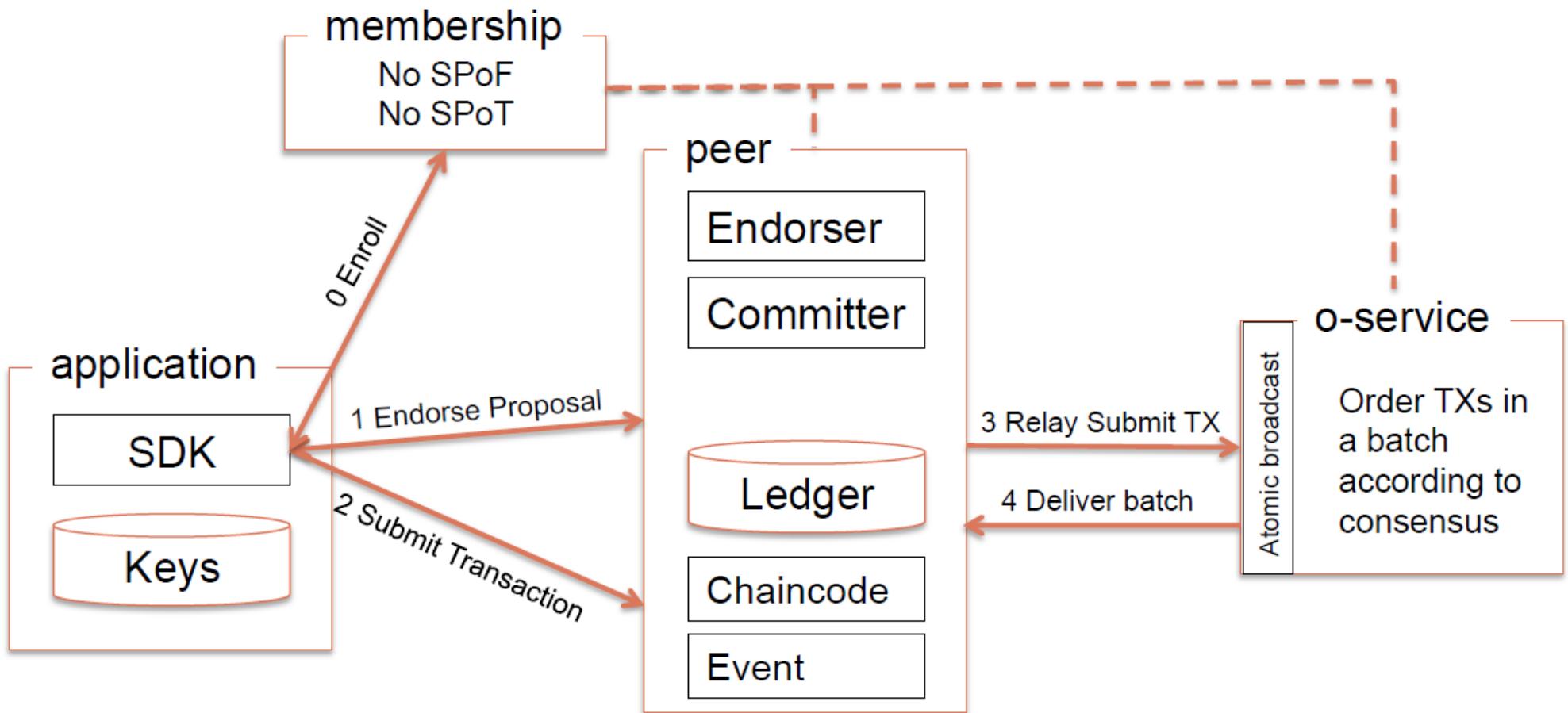
# Bitcoin vs Ethereum vs Hyperledger Fabric

	<b>Bitcoin</b>	<b>Ethereum</b>	<b>Hyperledger Fabric</b>
<b>Kriptovaluta</b>	bitcoin	etar	/
<b>Mreža</b>	javna	javna ili privatna sa kontrolom pristupa	privatna sa kontrolom pristupa
<b>Transakcije</b>	anonimne	anonimne ili privatne	javne ili poverljive
<b>Konsenzus</b>	Proof of Work	Proof of Stake	RAFT, PBFT u najavi
<b>Pametni ugovori</b>	/	da (Solidity, LLL, ...)	da (chaincode – Go, JavaScript, Java)
<b>Jezici</b>	C++	C++, Python, Go	Go, JavaScript, Java

# Fabric – osnovni koncepti

- Dve mreže: **uređivačka** (engl. *ordering*) i **peer**
- Tipovi čvorova (engl. *nodes*): **klijent**, **peer** i **uredživač** (engl. *orderer*)
- Peer: može igrati dve uloge – **endorser**, **commiter**
- Transakcije: **deploy**, **invoke** i **query**
- **Pružalac servisa članstva** (engl. *Membership Services Provider* – MSP) – Fabric CA
- **Servis za uređivanje** (engl. *Ordering Service*) – orderer: ranije SOLO i Apache Kafka, RAFT, PBFT u najavi
- Koncept **kanala** (engl. *channels*) – podmreže sa posebnom glavnom knjigom, omogućavaju **poverljive transakcije**

# Fabric arhitektura



Izvor: <https://jira.hyperledger.org/secure/attachment/10056/FabricNext-Community.pdf>

# Fabric pružalac usluga članstva

- **Pružalac usluga članstva** (engl. *Membership Services Provider – MSP*) realizuje komponenta **Fabric CA** (Certificate Authority)
- Može se koristiti i OpenSSL za sertifikate – važno je da se generišu ECDSA sertifikati
- Kod Fabrica v0.6 je MSP bio jedinstvena tačka otkaza (engl. *Single Point of Failure – SPoF*)!
- Od Fabrica v1.0 i nadalje dosupni višestruki MSP
- **Root sertifikat** za svakog člana (member) i **enrollment sertifikat** za svakog autorizovanog korisnika
- Ključevi zasnovi na kriptografiji sa eliptičnim krivama (**ECC**) i Rivest-Shamir-Adelman (**RSA**) kriptosistemu, ECC ključevi jači

# Chaincode

- **Programski kod koji u Hyperledger Fabricu implementira pametne ugovore**
- **Čitanje iz i upis u glavnu knjigu moguć je samo preko chaincode-a**
- Mogu se izvršavati paralelno nad disjunktnim skupovima endorser-a
- Programske jezice opšte namene za pisanje chaincode: **Go, Node.js (JavaScript), Java (od v1.3)**
- Funkcije:
  - Init (inicijalizacija chaincode-a, kreiranje dobara, upis stanja)
  - Invoke (get, set, delete), Query
  - main(): err := shim.Start(new(SimpleChaincode))

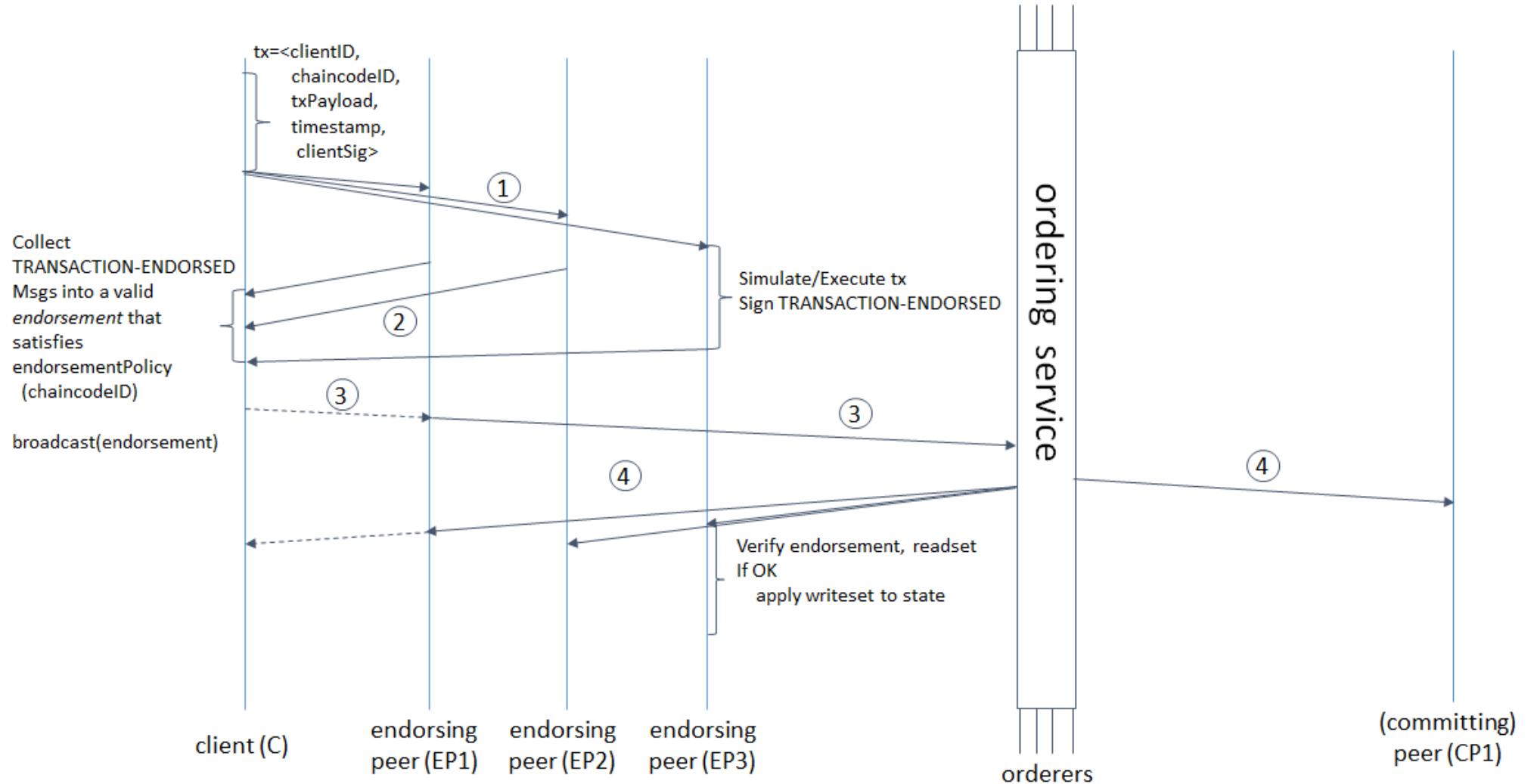
# Fabric servis za uređivanje

- Poseban **skup čvorova uređivača** (engl. **orderers – consenters**) koji uređuju transakcije u blokove čini **servis za uređivanje** (engl. **ordering service**)
- Radi **nezavisno od peer mreže** i uređuje transakcije po FCFS (engl. *First-Come-First-Served*) principu za sve kanale na mreži
- Izvršavanje chaincode-a, koje je potencijalno skupo, je uklonjeno sa kritične putanje servisa za uređivanje – **veći propusni opseg i bolja skalabilnost** (<https://arxiv.org/abs/1801.10228>)
- Lako zamenjiva implementacija: **RAFT**, u planu PBFT implementacija
- **Zajednička tačka za celu mrežu** – čuva i **sistemski lanac** koji sadrži blokove sa podacima o konfiguraciji (MSP, pravila, podaci o identitetu članova...)

# Fabric konsenzus algoritam

- **Konsenzus algoritam** kod **Hyperledger Fabrica** izvršava se u tri faze:
  1. **saglasnost** (engl. **endorsement**) – vodi se odgovarajućim pravilima (npr. najmanje  $m$  od  $n$  potpisa) po kojima učesnici podržavaju određenu transakciju
  2. **uređivanje** (engl. **ordering**) – prihvataju se podržane transakcije i postiže se konsenzus o njihovom redosledu u bloku koji će biti upisan u ledger
  3. **validacija** (engl. **validation**) – uzima se blok uređenih transakcija i potvrđuje se tačnost rezultata, uključujući proveru politike saglasnosti (engl. endorsement policy) i dvostrukе potrošnje (engl. double-spending)

# Fabric tok transakcije



Izvor: [https://www.hyperledger.org/wp-content/uploads/2017/08/HyperLedger\\_Arch\\_WG\\_Paper\\_I\\_Consensus.pdf](https://www.hyperledger.org/wp-content/uploads/2017/08/HyperLedger_Arch_WG_Paper_I_Consensus.pdf)

# Fabric glavna knjiga

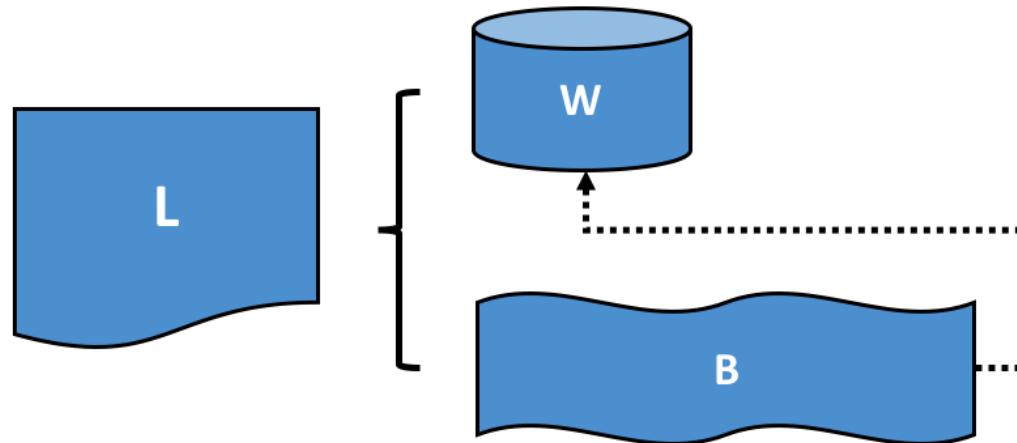
- U glavnoj knjizi se **beleže sve promene stanja** (transakcije) **nastale kao rezultat poziva chaincode-a**. **Svaka transakcija rezultuje skupom ključ-vrednost parova** (engl. key-value pairs) koji se upisuju u glavnu knjigu

glavna knjiga = log transakcija + stanje sveta

- **Log transakcija** (engl. *transaction log*) je lanac, tj. blokčejn
- **Stanje sveta** (engl. *world state*) čuva se u izabranom sistemu za rad sa parovima ključ-vrednost (engl. *key-value store – KVS*) (LevelDB – default, CouchDB, ...)
- Za svaki kanal postoji po jedna glavna knjiga
- Svaki peer čuva kopiju glavne knjige za svaki od kanala čiji je član
- Veličina i frekvencija izdavanja blokova su programabilni

# Fabric glavna knjiga

- **Glavna knjiga** (Ledger – L) sastoji se od **blokčejna** (Blockchain – B) i **stanja sveta** (World state – W), pri čemu blokčejn B određuje stanje sveta W, tj. stanje sveta W je izvedeno iz B

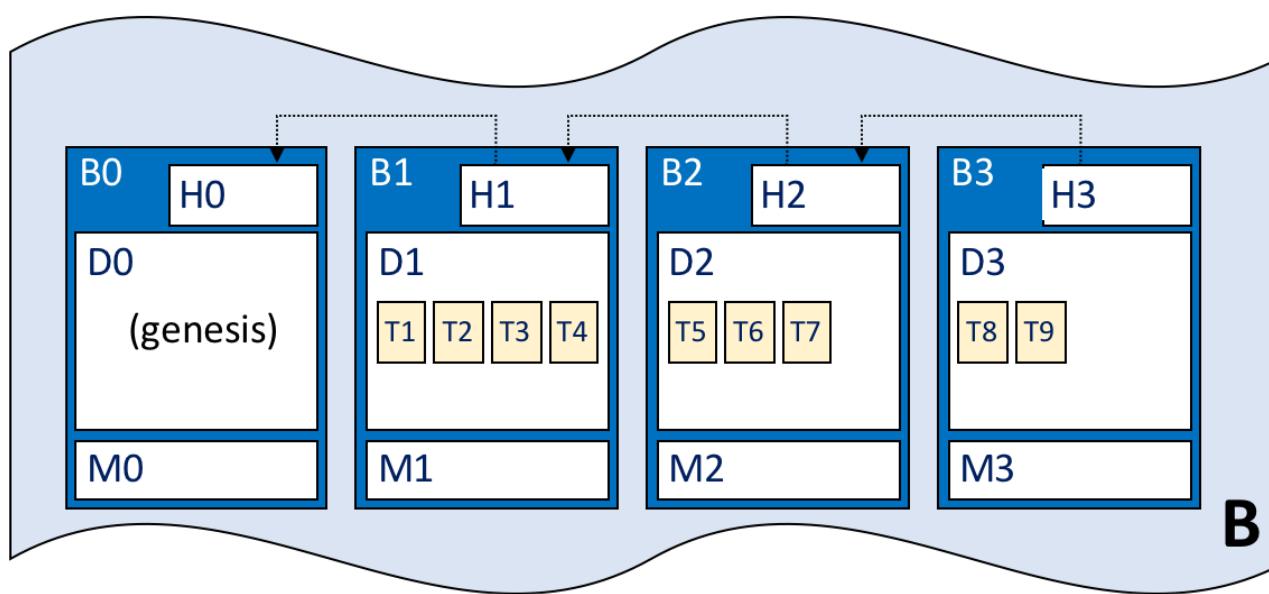


L	Ledger
W	World State
B	Blockchain
L W	L comprises B and W
B W	B determines W

Izvor: <https://hyperledger-fabric.readthedocs.io/en/latest/ledger/ledger.html>

# Fabric blokčejn

- Primer Fabric blokčejna sastavljenog od 4 bloka (B0, B1, B2, B3)
- B0 je **blok postanka** (engl. *genesis block*) – sadrži konfiguracionu transakciju koja sadrži inicijalno stanje kanala mreže

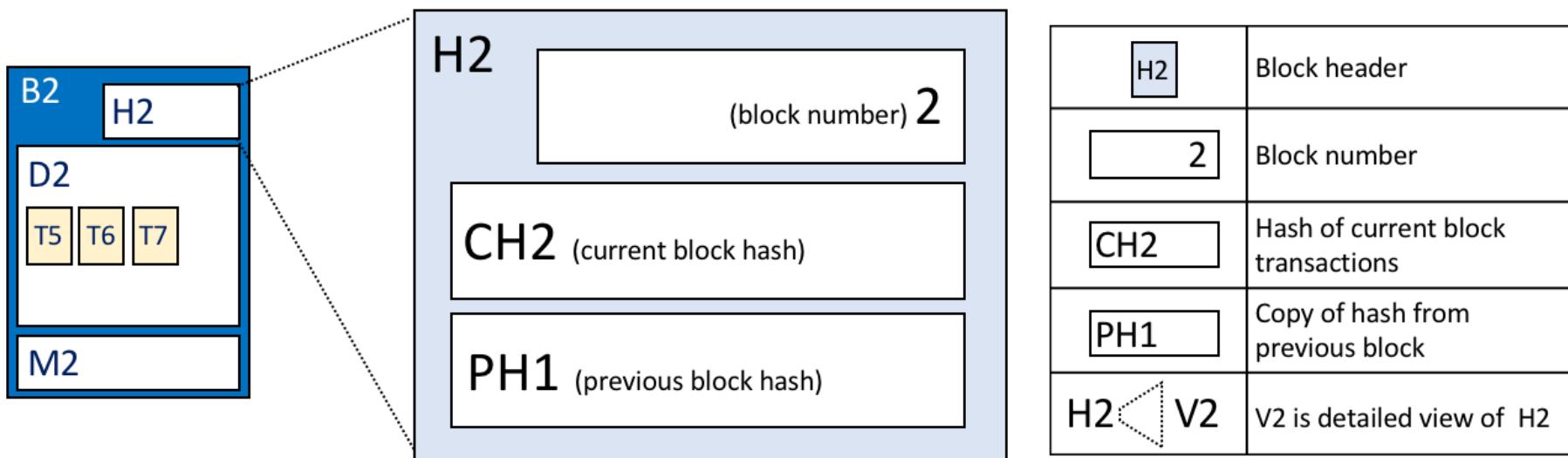


B	Blockchain
B1	Block
H3	Block header
D1	Block data
T5	Transaction
M3	Block metadata
↓	
H1	H2 is chained to H1
H2	

Izvor: <https://hyperledger-fabric.readthedocs.io/en/latest/ledger/ledger.html>

# Fabric blok

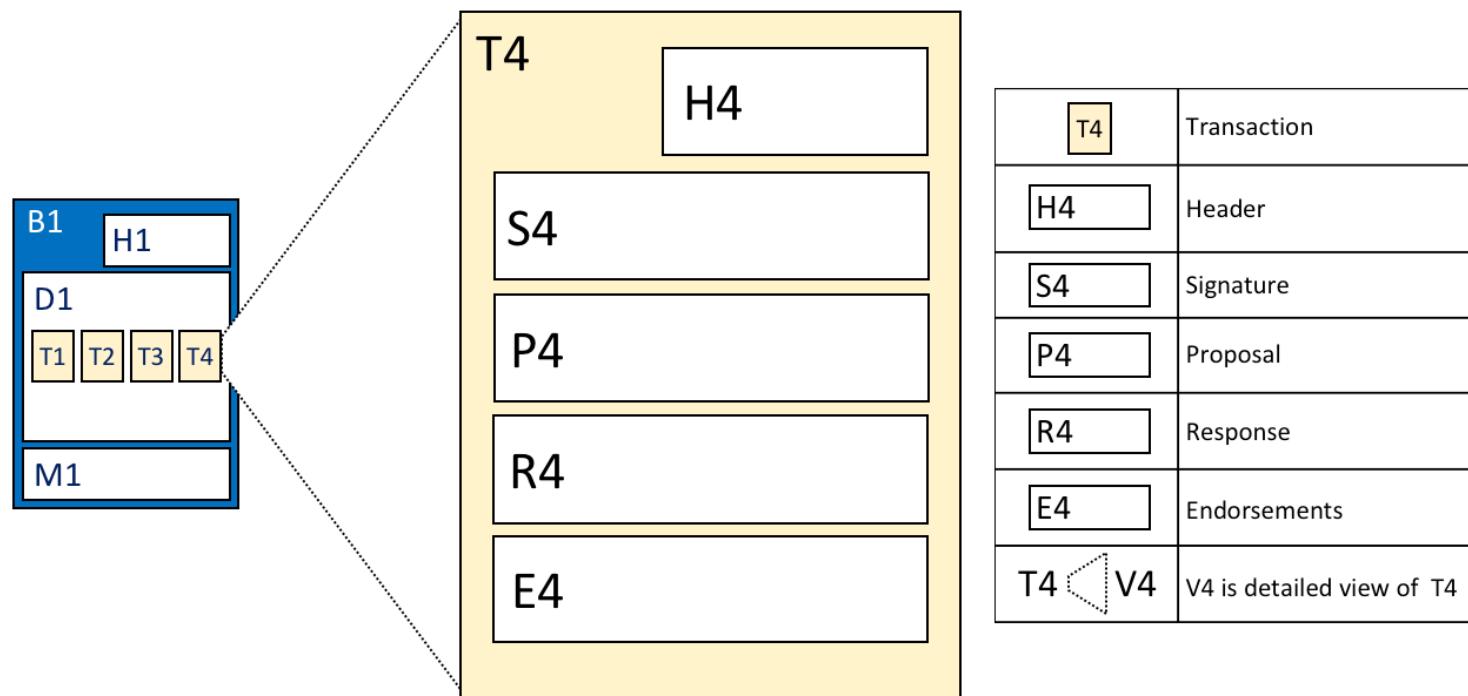
- Zaglavlje Fabric bloka ima tri polja: **broj bloka, heš trenutnog bloka i heš iz zaglavlja prethodnog bloka**
- **Blok** sadrži i **podatke bloka** (engl. *blockdata*) i metapodatke



Izvor: <https://hyperledger-fabric.readthedocs.io/en/latest/ledger/ledger.html>

# Fabric transakcija

- **Transakcija u podacima bloka** (engl. *blockdata*) sastoji se od **zaglavlja** (engl. *transaction header*), **potpisa** (engl. *transaction signature*) klijentske aplikacije, **predloga** (engl. *transaction proposal*) – ulaznih parametara za chaincode, **odgovora na transakciju** (engl. *transaction response*) – izlaz chaincode-a, i **liste podrške** (engl. *list of endorsements*)



Izvor: <https://hyperledger-fabric.readthedocs.io/en/latest/ledger/ledger.html>

# Online resursi – Hyperledger

- Hyperledger White Papers:  
<https://www.hyperledger.org/learn/white-papers>
- Hyperledger Architecture, Volume I:  
[https://www.hyperledger.org/wp-content/uploads/2017/08/HyperLedger\\_Arch\\_WG\\_Paper\\_I\\_Consensus.pdf](https://www.hyperledger.org/wp-content/uploads/2017/08/HyperLedger_Arch_WG_Paper_I_Consensus.pdf)
- Official documentation:  
<https://hyperledger-fabric.readthedocs.io/en/latest/>
- Rocket Chat:  
<https://chat.hyperledger.org/>
- StackOverflow:  
<https://stackoverflow.com/questions/tagged/hyperledger-fabric>



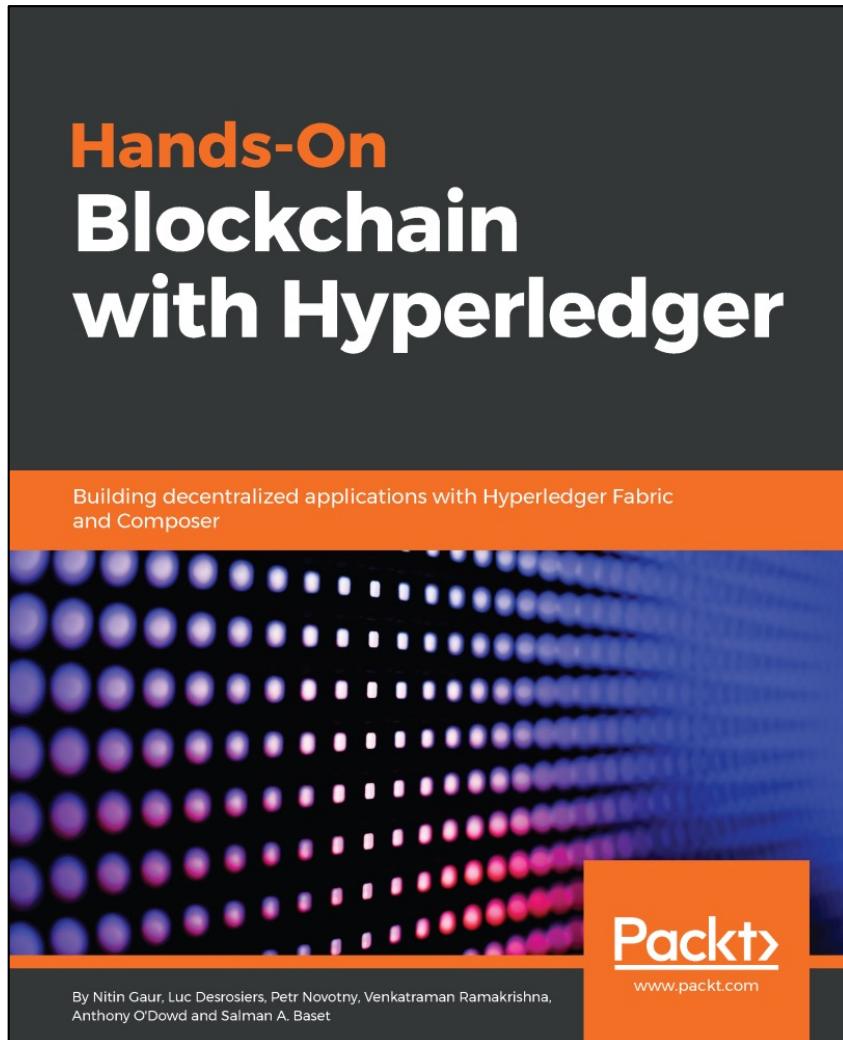
# Hyperledger online resursi i reference

- Hyperledger Github (<https://github.com/hyperledger>):

The screenshot shows the GitHub organization page for 'Hyperledger Project'. The top navigation bar includes links for Features, Business, Explore, Marketplace, Pricing, This organization, Search, Sign in or Sign up, and a logo icon. Below the header, there's a large image of a geometric network graph and the text 'Hyperledger Project' with a link to 'https://www.hyperledger.org'. A 'Pinned repositories' section displays six repository cards:

- fabric**: Read-only mirror of https://gerrit.hyperledger.org/r/#/admin/projects/fabric. Languages: Go, Stars: 4.5k, Forks: 2.7k.
- composer**: Composer is a framework for building Blockchain business networks. Languages: JavaScript, Stars: 920, Forks: 434.
- sawtooth-core**: Core repository for Sawtooth Distributed Ledger. Languages: Python, Stars: 759, Forks: 369.
- iroha**: Iroha - A simple, decentralized ledger. Languages: C++, Stars: 698, Forks: 218.
- burrow**: Hyperledger Burrow. Languages: Go, Stars: 334, Forks: 126.
- indy-node**: Indy Node. Languages: Python, Stars: 127, Forks: 153.

# Literatura – Hyperledger Fabric



**Hyperledger Fabric: A Distributed Operating System for Permissioned Blockchains**

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Artem Barger  
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ACM Reference Format:  
Elli Androulaki, Artem Barger, Vita Bortnikov, Christian Cachin, Konstantinos Christidis, Angelo De Caro, David Enyeart, Christopher Ferris, Gennady Laventman, Yakov Manevich, Srinivasan Muralidharan, Chet Murthy, Binh Nguyen, Manish Sethi, Gari Singh, Keith Smith, Alessandro Sorniotti, Chrysoula Stathakopoulou, Marko Vukolić, Sharon Weed Cocco, and Jason Yellick. 2018. Hyperledger Fabric: A Distributed Operating System for Permissioned Blockchains. In *EuroSys '18: Thirteenth EuroSys Conference 2018, April 23–26, 2018, Porto, Portugal*. ACM, New York, NY, USA, 15 pages. <https://doi.org/10.1145/3190508.3190538>

**ABSTRACT**  
Fabric is a modular and extensible open-source system for deploying and operating permissioned blockchains and one of the Hyperledger projects hosted by the Linux Foundation ([www.hyperledger.org](http://www.hyperledger.org)).  
Fabric is the first truly extensible blockchain system for running distributed applications. It supports modular consensus protocols, which allows the system to be tailored to particular use cases and trust models. Fabric is also the first blockchain system that runs distributed applications written in standard, general-purpose programming languages, without systemic dependency on a native cryptocurrency. This stands in sharp contrast to existing blockchain platforms that require "smart-contracts" to be written in domain-specific languages or rely on a cryptocurrency. Fabric realizes the permissioned model using a standard notion of membership, which may be integrated with industry-standard identity management. To support such flexibility, Fabric introduces an entirely novel blockchain design and revamps the way blockchains cope with non-deterministic resource exhaustion, and performance attacks.  
This paper describes Fabric's architecture, the rationale behind various design decisions, its most prominent implementation aspects, as well as its distributed application programming model. We further evaluate Fabric by implementing and benchmarking a Bitcoin-inspired digital currency. We show that Fabric achieves end-to-end throughput of more than 3500 transactions per second in certain popular deployment configurations, with sub-second latency, scaling well over 100 peers.

\*Work done at IBM.

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**1 INTRODUCTION**  
A blockchain can be defined as an immutable *ledger* for recording transactions, maintained within a distributed network of mutually untrusting *peers*. Every peer maintains a copy of the ledger. The peers execute a *consensus protocol* to validate transactions, group them into blocks, and build a hash chain over the blocks. This process forms the ledger by ordering the transactions, as is necessary for consistency. Blockchains have emerged with Bitcoin [3] and are widely regarded as a promising technology to run trusted exchanges in the digital world.  
In a *public* or *permissionless* blockchain anyone can participate without a specific identity. Public blockchains typically involve a native cryptocurrency and often use consensus based on "proof of work" (PoW) and economic incentives. *Permissioned* blockchains, on the other hand, run a blockchain among a set of known, identified participants. A permissioned blockchain provides a way to secure the interactions among a group of entities that have a common goal but which do not fully trust each other, such as businesses that exchange funds, goods, or information. By relying on the identities of the peers, a permissioned blockchain can use traditional Byzantine-fault tolerant (BFT) consensus.  
Blockchains may execute arbitrary, programmable transaction logic in the form of *smart contracts*, as exemplified by Ethereum [5]. The scripts in Bitcoin were a predecessor of the concept. A smart contract functions as a *trusted distributed application* and gains its security from the blockchain and the underlying consensus.

<https://arxiv.org/abs/1801.10228>