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Supplementary Materials

Blockchain Platforms Commonly Used for eKYC, SSI, DID:

TABLE: Blockchain Platforms Commonly Used for eKYC, SSI, DID

Blockchain Platform (Year Introduced)	Key Features	Potential Use Cases for eKYC, SSI, DID
Ethereum (2015)	Proof of Stake (PoS), Smart contracts, Decen- tralized applications (DApps), ERC-20 tokens, ERC-721 tokens (NFTs), Large developer com- munity.	Widely utilized for secure and efficient identity ver- ification, SSI, and eKYC applications due to its versatility and support for smart contracts.
Ethereum Virtual Machine (EVM) Supported: Binance Smart Chain (2020), Avalanche (2020), Polygon (2017)	Binance Smart Chain: High throughput, Low transaction fees, Proof of Staked Authority (PoSA). Avalanche: High scalability, Quick finality, In- teroperability. Polygon: Layer 2 scaling, High compatibility with Ethereum, Low transaction fees.	Binance Smart Chain: Ideal for scalable and cost- effective eKYC, SSI, and DID implementations. Avalanche: Suitable for applications needing fast and secure identity verification. Polygon: Used for large-scale eKYC deployments due to enhanced performance and reduced costs.
Hyperledger Fabric (2015)	Modular consensus (PBFT, Raft, etc.), Permis- sioned blockchain, Modular architecture, High flexibility, Privacy, and confidentiality.	Enterprise-grade eKYC solutions, SSI, and DID with enhanced privacy and security for sensitive data.
Hyperledger Besu (2019)	Ethereum client for enterprise use, supports pub- lic and private networks, and compatibility with Ethereum mainnet.	Facilitates cross-platform KYC verifications, suitable for both public and private sectors, enabling secure identity verification.
Hyperledger Indy (2017)	Built for decentralized identity solutions, sup- ports SSI, and verifiable credentials.	Enables individuals to control their identity data, reducing data exposure and improving privacy for eKYC and DID.
Alastria Network (2017)	Permissioned blockchain network based on Ethereum.	Durable option for secure identity verification pro- cesses, supporting eKYC and DID.
Fisco BCOS (2016)	Interoperability scalability supports various blockchain frameworks.	Implemented for secure identity verification, SSI, and eKYC, showcasing interest in platform interop- erability.
CITA (2018)	High performance, modular design, supports permissioned blockchain.	Utilized in research to demonstrate secure and effi- cient eKYC, SSI, and DID processes.
Xuperchain (2019)	High throughput, low latency, flexible architec- ture.	Used in studies to enhance secure identity verifica- tion, SSI, and eKYC through improved scalability and efficiency.
Quorum (2016)	Permissioned version of Ethereum, enhanced privacy, and performance.	Ideal for enterprise use, supporting confidential transactions and permissioned networks for eKYC, SSI, and DID.
Corda (2016)	Notary services, Permissioned blockchain, De- signed for business transactions, Focus on pri- vacy and scalability.	Used for secure and efficient eKYC, SSI, and DID in financial and business sectors.

Stellar (2014)	Stellar Consensus Protocol (SCP), Cross-border payments, Low transaction fees, and focus on financial inclusion.	Supports cross-border identity verification, SSI, and eKYC with quick and cost-effective transactions.
Tezos (2018)	Liquid Proof of Stake (LPoS), On-chain gover- nance, Self-amending protocol, Smart contracts.	Provides a flexible and upgradeable platform for eKYC, SSI, and DID solutions with formal verifi- cation for security.
EOS (2018)	Delegated Proof of Stake (DPoS), high transac- tion throughput, free transactions for users, and developer-friendly.	Suitable for high-performance eKYC, SSI, and DID applications needing fast and cost-effective process- ing.
Cardano (2017)	Ouroboros Proof of Stake (PoS), Strong focus on security and sustainability, Layered architecture, Peer-reviewed research.	Provides robust security and sustainability for eKYC, SSI, and DID solutions, supported by extensive aca- demic research.
Polkadot (2020)	Nominated Proof of Stake (NPoS), Interoper- ability, Scalability, Heterogeneous multi-chain framework.	Supports scalable and interoperable eKYC, SSI, and DID solutions across multiple blockchain networks.
Ripple (XRP Ledger) (2012)	Ripple Protocol Consensus Algorithm (RPCA), Fast and low-cost international payments, Enterprise-focused, Centralized control.	Suitable for fast and secure identity verification, SSI, and eKYC in financial services, especially for cross- border transactions.
Binance Smart Chain (BSC) (2020)	Proof of Staked Authority (PoSA), Compatibil- ity with Ethereum Virtual Machine (EVM), High throughput, and Low transaction fees.	Ideal for scalable and cost-effective eKYC, SSI, and DID implementations with high compatibility with Ethereum-based applications.
Ripple (2012)	Real-time gross settlement system, currency ex- change, and remittance network.	Supports identity verification, SSI, and eKYC in financial services with fast and secure transactions.

Table: Blockchain Platforms for eKYC, SSI, DID with Scalability with TPS and Latency (ms)

Category	Platform	Scalability	Transaction Per Second (TPS)	Latency (ms)	Key Features
Ethereum Ecosystem	**Ethereum (PoW/PoS)**	Moderate	~30 TPS (PoW), ~100+ TPS (PoS)	~200–500	Smart contracts, large ecosystem, scalable with Ethereum 2.0 and Layer 2.
	Polygon	High	~7,000 TPS	<100	Layer 2 scaling solution for Ethereum with low fees and high throughput.
	Binance Smart Chain	High	~160 TPS	~200	High throughput and low fees using Proof of Staked Authority.
	Avalanche	Very High	~4,500 TPS	<50	High throughput, sub-second finality, and scalability for time-sensitive apps.
Hyperledger Family	**Hyperledger Fabric**	High	~3,000 TPS	~100	Modular, permissioned blockchain for enterprise applications.
	Hyperledger Indy	Moderate	~500 TPS	~150	Decentralized identity (SSI) and verifiable credentials.
	Hyperledger Besu	Moderate to High	~1,000 TPS	~150	Enterprise Ethereum client supporting private and public networks.

Permissioned Blockchains	**Quorum**	High	~1,500 TPS	~100	Optimized for permissioned networks with high privacy and throughput.
	Corda	High	~600 TPS	~200	Enterprise-grade blockchain focusing on privacy and scalability.
Interoperable Platforms	**Polkadot**	Very High	~1,000 TPS per parachain	<100	Multi-chain architecture enabling parallel transaction processing.
	Fisco BCOS	High	~2,000 TPS	~50	Designed for secure and scalable enterprise blockchain applications.
Financial Platforms	**Ripple (XRP Ledger)**	Very High	~1,500 TPS	~50	Optimized for fast, low-cost cross-border payments.
	Stellar	High	~1,000 TPS	~100	Cost-effective and scalable financial transactions for global inclusion.
High-Performance Platforms	**Tezos**	Moderate	~50 TPS	~300	Focused on security, governance, and sustainability.
	EOS	Very High	~4,000 TPS	<50	High performance with Delegated Proof of Stake (DPoS).
	Xuperchain	Very High	~10,000 TPS	~20	Enterprise-grade platform for high-throughput applications.
Innovative Platforms	**Cardano**	High	~250 TPS	~150	Peer-reviewed PoS blockchain focusing on security and scalability.

Classification Scalability based on Transaction Per Second (TPS):

Scalability	**TPS Range**	**Platforms (TPS, Latency (ms))**
Very High	4,000 + TPS	Xuperchain (~10,000 TPS, ~20 ms), Polygon (~7,000 TPS, <100 ms), Avalanche (~4,500 TPS, <50 ms), EOS (~4,000 TPS, <50 ms)
High	1,000 – 3,999 TPS	Hyperledger Fabric (~3,000 TPS, ~100 ms), Ripple (~1,500 TPS, ~50 ms), Stellar (~1,000 TPS, ~100 ms), Quorum (~1,500 TPS, ~100 ms)
Moderate to High	500 – 999 TPS	Hyperledger Besu (~1,000 TPS, ~150 ms), Polkadot (~1,000 TPS per parachain, <100), Fisco BCOS (~2,000 TPS, ~50 ms)
Moderate	< 500 TPS	Ethereum (PoW: ~30 TPS, PoS: ~100+ TPS, ~200 – 500 ms), Hyperledger Indy (~500 TPS, ~150 ms), Tezos (~50 TPS, ~300 ms), Corda (~600 TPS, ~200 ms), Cardano (~250 TPS, ~150 ms)

Factors for Scalability:

Beyond **Transactions Per Second (TPS)**, scalability encompasses several critical aspects that determine a blockchain's ability to handle growth and diverse applications. **Architecture** plays a pivotal role, as blockchains employing multi-chain structures or Layer 2 solutions, such as Polygon and Polkadot, enhance scalability through parallel processing and interoperability. The **consensus mechanism** also significantly impacts scalability; for instance, Delegated Proof of Stake (DPoS) and Proof of Staked Authority (PoSA) achieve higher TPS than traditional Proof of Work (PoW) systems by optimizing resource usage and reducing overhead. Furthermore, **real-world performance** is a key metric, with platforms like Hyperledger Fabric and Ripple demonstrating exceptional scalability in practical deployments. Lastly, use cases influence scalability ratings, as blockchains tailored for specific domains, such as Hyperledger Indy for Self-Sovereign Identity (SSI), may be highly efficient within their niche but are considered less scalable in a broader context.

What Scalability Means?

Scalability in blockchain refers to the system's ability to handle increasing transactions, users, or data without a drop in performance. It includes:

Transaction Throughput: Measured in **TPS**, indicating how many transactions the blockchain can process in a second. Higher TPS means better throughput, which is crucial for high-demand applications like eKYC and financial transactions.

Network Latency: The time it takes for a transaction to be confirmed on the network. A scalable system keeps latency low even under heavy transaction loads.

Storage Requirements: Scalability also considers the ability to manage growing amounts of data efficiently without requiring prohibitively high storage resources.

Consensus Efficiency: The ability of the blockchain's consensus mechanism (e.g., PoW, PoS, DPoS) to handle scaling demands while maintaining security and decentralization.

Interoperability: Scalability also includes how well the blockchain interacts with other networks to distribute workloads or increase capacity (e.g., Polkadot's parachains).

Platforms Specially Made for eKYC, SSI, and DID:

TABLE I Platforms Specially Made for eKYC, SSI, DID

Platforms	Key Features and Use Cases for SSI, DID, eKYC
Sovrin	The Sovrin DID platform leveraging SSI. Features Decentralized Identifiers (DIDs), verifiable credentials, and robust privacy and security measures. Supports interoperability with other identity systems. Sovrin Ledger (public, permissioned blockchain), DID Documents, and wallets manage identities. Supports digital identity verification, access control, and data sharing.
uPort	uPort uses the Ethereum blockchain for decentralized identity management, enabling users to manage digital identities with SSI. It offers identity management, verifiable credentials, privacy, and security through a mobile app, Ethereum smart contracts, and uPort connect library.
Civic	Civic enables users to manage personal information with SSI, featuring secure identity verification, Civic Wallet for personal info and cryptocurrencies, and reusable KYC. Civic uses Civic Tokens (CVC) and offers a Civic App, Civic Secure Identity Platform, and Civic Connect APIs.
Jolocom	Jolocom allows users to own digital identities independently of central authorities, offering secure and verifiable credentials with SSI. Features include the Jolocom SmartWallet, Jolocom Library, and Jolocom Registry, supporting standards like W3C Verifiable Credentials and DIDs.
Veres One	A decentralized identity network with DIDs, offering secure and verifiable identity data management. Supports crypto- graphically secure credentials.
Ontology	A high-performance public blockchain for decentralized trust ecosystems, featuring a dual-token model with ONT and ONG tokens. Use cases include digital identity, data marketplaces, finance, insurance, and supply chain management.
SelfKey	A blockchain-based identity management platform offering an identity wallet for secure storage, management, and sharing of digital identities. SelfKey's marketplace streamlines identity verification processes, reducing redundancy and providing access to KYC services.
SecureKey	Known for privacy-enhancing solutions, its Verified.Me service enables Canadians to verify identities through trusted sources like banks and government institutions. Leverages blockchain for enhanced security and collaborates with major institutions.
ShoCard	A blockchain-based identity platform emphasizing SSI principles. It allows users to control their personal information, supporting financial services, KYC compliance, authentication, and access control.
ID2020	A global public-private partnership providing secure, verifiable, portable digital identities. Promotes interoperability across platforms and offers certification marks for digital identity solutions. Focuses on ethical standards and human rights.

KILT Protocol	A blockchain-based identity protocol on Polkadot, focusing on SSI principles. It offers digital identity verification, access control, and data sharing. Features include Spirits (digital identities), CTYPES (claim formats), and KILT Coins.

Table: Scalability and Performance Analysis of Platforms Specially Made for eKYC, SSI, DID

Platform	**TPS (Transactions Per Second)**	**Latency (ms)**	**Scalability Mechanism**
Sovrin	~1,000+	<200	Decentralized ledger, Layer 2
uPort	~100+ (Ethereum PoS dependent)	Variable	Ethereum Layer 2 solutions
Civic	~1,000	<150	Private infrastructure, reusable KYC
Jolocom	~500	~200	Off-chain data management
Veres One	~1,000	~100	Purpose-built DID registry
Ontology	~4,000	<50	High throughput dual-token model
SelfKey	~1,000	~100	Decentralized KYC marketplace
SecureKey	~1,500	~50	Verified.Me partner network
ShoCard	~500	~200	Off-chain storage for SSI
ID2020	~1,000	~150	Multi-platform interoperability
KILT Protocol	~3,000	~100	Polkadot-based parachains