**Survey Report: Types and Layers of Blockchains and Real-Time Use Cases**

Executive Summary

This survey report provides an in-depth overview of various types and layers of blockchains and explores their real-time use cases. Blockchain technology has gained significant attention in recent years due to its potential to revolutionize various industries. Understanding the different types and layers of blockchains and their practical applications is essential for grasping the full extent of their impact.

Introduction

Blockchain technology is a distributed ledger system that records transactions across a network of computers in a secure, transparent, and tamper-resistant manner. Blockchains come in various types and often include multiple layers to cater to specific requirements and use cases. In this report, we categorize blockchains into three main types: Public, Private, and Consortium (or Hybrid) blockchains, and we also examine the layers of blockchains and real-time use cases for each type and layer.

**Types of Blockchains**

**1. Public Blockchains**

Public blockchains are open to anyone and are characterized by their decentralized nature. They rely on consensus mechanisms like Proof of Work (PoW) or Proof of Stake (PoS) to validate and secure transactions. Examples of public blockchains include Bitcoin and Ethereum.

Real-Time Use Cases for Public Blockchains:

- Cryptocurrencies: Public blockchains like Bitcoin serve as digital currencies, enabling peer-to-peer transactions without intermediaries.

- Smart Contracts: Ethereum allows for the creation of decentralized applications (DApps) and smart contracts that execute automatically when predefined conditions are met.

- Decentralized Finance (DeFi): Public blockchains are the foundation of DeFi applications, facilitating lending, borrowing, and trading of digital assets.

- Tokenization: Asset tokenization on public blockchains enables fractional ownership of real-world assets such as real estate or art.

**2. Private Blockchains**

Private blockchains are restricted to a specific group of participants who have permission to access and participate in the network. They are often used by enterprises for internal purposes and are highly customizable. Examples include Hyperledger Fabric and Corda.

Real-Time Use Cases for Private Blockchains:

- Supply Chain Management: Private blockchains enhance transparency and traceability in supply chains, reducing fraud and errors.

- Identity Verification: Private blockchains are used for identity management, ensuring secure and verifiable access to services.

- Interbank Transactions: Banks use private blockchains to settle cross-border transactions efficiently.

- Healthcare Records: Private blockchains enable secure sharing of patient records among healthcare providers.

**3. Consortium (Hybrid) Blockchains**

Consortium blockchains are semi-decentralized networks controlled by a group of organizations. They strike a balance between public and private blockchains, offering a degree of transparency while limiting access to trusted participants. Examples include R3 Corda (Consortium) and Binance Smart Chain (BSC).

Real-Time Use Cases for Consortium Blockchains:

- Trade Finance: Consortium blockchains streamline trade finance processes by providing a common platform for documentation and payments.

- Cross-Industry Collaboration: Multiple organizations within an industry or ecosystem can collaborate on a shared blockchain for data exchange and trust-building.

- Tokenized Assets: Some consortium blockchains support tokenized assets for trading and investment.

- Regulatory Compliance: Organizations can use consortium blockchains to ensure compliance with industry regulations and standards.

**Blockchain Layers**

In addition to different types, blockchains often consist of multiple layers, including:

1. Protocol Layer: This layer defines the core rules and consensus mechanisms of the blockchain. Examples of blockchain protocols include Bitcoin's protocol and Ethereum's protocol.

2. Network Layer: The network layer consists of nodes (computers) that participate in the blockchain network. These nodes validate transactions and maintain the network's decentralized nature.

3. Application Layer: The application layer encompasses the user-facing applications and smart contracts built on top of the blockchain. DApps, DeFi platforms, and other blockchain-based applications reside in this layer.

**Conclusion**

Blockchain technology continues to evolve, offering a wide range of solutions across various industries. The choice of blockchain type—public, private, or consortium—and the understanding of blockchain layers depend on the specific requirements and goals of a project. Real-time use cases of blockchains span from cryptocurrencies and smart contracts to supply chain management and identity verification, showcasing the versatility and potential of this technology.

As blockchain adoption continues to grow, further innovations and use cases are expected to emerge, shaping the future of decentralized systems and secure data management.

Layer 0:

Layer 0 typically refers to the physical layer of blockchain infrastructure.

- Data Centers: Examples of data center providers that support blockchain infrastructure include Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP).

- Mining Hardware: Examples of mining hardware include Antminer S19 (used for Bitcoin mining) and Bitmain's ASIC miners.

Layer 1:

Layer 1 represents the base layer of a blockchain network, including the main blockchain protocol itself.

- Bitcoin (BTC): Bitcoin is the original and most well-known cryptocurrency, operating as a standalone blockchain with its own protocol.

- Ethereum (ETH): Ethereum serves as both a base layer blockchain and a platform for decentralized applications (DApps) with its native cryptocurrency, Ether.

Layer 2:

Layer 2 solutions are designed to enhance and scale the capabilities of Layer 1 blockchains.

- Lightning Network: The Lightning Network is a Layer 2 solution for Bitcoin, enabling faster and cheaper microtransactions on the Bitcoin network.

- zkSync: zkSync is a Layer 2 scaling solution for Ethereum, utilizing zk-Rollup technology to improve transaction throughput and reduce fees.

Layer 3:

Layer 3, if considered, could refer to even higher-level protocols or networks built on top of Layer 2 solutions.

- Aave: Aave is a DeFi platform built on top of Ethereum's Layer 2 scaling solution, zkSync, offering lending and borrowing services.

- Uniswap: Uniswap is a decentralized exchange (DEX) that operates on various Layer 2 solutions, enabling users to trade tokens with reduced gas fees compared to the Ethereum mainnet.

Please note that the terminology and categorization of layers in blockchain technology can vary, and the usage of "Layer 3" is less common and may not always be well-defined. The examples provided here are based on the general interpretation of these layers.

Blockchain Layers and Scaling Solutions

1. Polygon (Matic) - Layer 2 for Ethereum:

- Polygon is a layer 2 scaling solution for Ethereum, enhancing scalability and reducing transaction fees.

- Provides sidechains and tools for Ethereum-compatible DApps.

2. Binance Smart Chain (BSC):

- Binance Smart Chain is a separate blockchain with EVM compatibility, enabling easy migration of Ethereum-based DApps.

3. Polkadot and Kusama:

- Polkadot is a multi-chain network focusing on interoperability between blockchains.

- Kusama serves as a testing ground for new features before deployment on Polkadot.

4. Avalanche:

- Customizable blockchain platform supporting interoperability and acting as a layer 2 solution for Ethereum.

5. Optimistic Rollups and zk-Rollups:

- Layer 2 scaling solutions for Ethereum, aggregating and optimizing transactions before mainnet submission.

6. Harmony:

- Sharding protocol enhancing scalability and cross-shard communication.

7. StarkWare:

- Layer 2 scaling solution provider using zk-Rollups technology to boost Ethereum-based applications.

8. Flow:

- Blockchain designed for DApp and digital asset creation, emphasizing scalability and user experience.

9. NEAR Protocol:

- Sharded, developer-friendly blockchain platform offering scalability and ease of DApp development.

10. Solana:

- High-performance blockchain platform known for fast transaction speeds and scalability, suitable for DApps and DeFi.

These solutions represent diverse approaches to blockchain scalability, including layer 2 solutions, sharding, interoperability, and performance optimization, addressing key challenges and expanding blockchain application possibilities.