Blockchain in Telecom
Interoperability

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Agenda

• Blockchain Fundamentals and Benefits
• Evolution Roadmap
• Blockchain Reference Models
• Main Challenges
• Key Takeaways

Note: **Distributed Ledger Technologies (DLT)** is the technical term that defines this technology, where blockchain is the main type of DLT.
Blockchain Telecom Roadmap
Future Outlook 2030

Phase 1
- Development Phase
- Islanded/Isolated Blockchains
- Focus on Public-Permissionless
- Cloud Vendor Lock-in, Managed Cloud

Initial Coin Offering (ICO) Hype

Phase 2
- Mainstream Adoption
- Focus on Private-Permissioned/Hybrid
- Standards, Scalability
- Interconnected/Interchains Protocols
- Interoperability
- "Carrier/Telco-Grade" Design
- Multi-Cloud, Multi-Ledger

Blockchain Telecom

Enterprise processes
network, services

5G, IoT, Cloud

2008
2013
2017
2018
2019
2022
2030

Bitcoin
Ethereum
Programmable Blockchain

Satoshi’s Bitcoin paper

IEEE Blockchain Initiative

IEEE Globecom 2019 Workshop on Blockchain in Telecommunications: Emerging Technologies for the Next Decade and Beyond

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Towards a Secure, High Performance DLT Blockchain Web 3.0

2008
- Cryptocurrency
2013-present
- Cryptocurrency/programmable smart contract
2019
- 2P2S Inter-chain Enterprise-Grade DLT

**2P2S Enterprise-Grade Inter-Chain Sidechain**

- Focus on:
  - Standards
  - Interoperability
  - Security

**Programmable Blockchain**

- Fragmented technologies
- No-standards
- Crypto-frenzy

**Highly secure** (client, p2p, encrypted protocols, trusted environment)

**Scalable** (inc. machine micro-transactions)

**High performance** (use of SLA)

**High levels of privacy** (assets and transactions), level 1 GDPR compliance

Source: BEC, 2018
Blockchain Fundamentals and Benefits

Benefits

- Trustable
- Transparent
- Traceable
- Immutable
- Decentralized (ownership)
- Auditable
Principles

Key Principles

- Open Standards
- Secure
- Technology Agnostic
- Future Proof
- Interoperable
- Scalable
- Modular
- Manageable
- Reliable
- Inclusive

"Open" and Interoperable DLT/Blockchain Standards-Based
Decentralized Applications - DApp

TELCOS

Centralized Cloud-Centric

ISP ISP ISP

Mobile, Wireline

(centralized) Apps Today

BLOCKCHAIN P2P NETWORK

company

nodes

Decentralized Applications (DApps) 2019 →
Blockchain DLT (BDLT) System-of-Interest (per IEEE42010)

- Blockchain-IoT Reference Architecture, based on IEEE 42010 framework (undergoing)
- All alternatives included - considers more than Blockchain as technology enabler
- Addresses key domain/layer levels
- Includes (most) Blockchain/DLT technologies elements
Defining the Key BDLT Blockchain-DLT Layers

The building layers of Blockchain DLT systems need to be defined to categorize its key elements, independent of the DLT technology adopted.

- **NETWORK** (connectivity, runtime, cloud infrastructure and/or P2P)
  - Things

- **DATA MODELS**
  - Things

- **SERVICES**
  - Things

- **APPLICATIONS**
  - Things

- **TRANSACTIVE**
  - Things

- **physical and cybersecurity layer**
  - market, monetization layer
  - decentralized apps (Dapps)
  - transactions/contract, tokens
  - consensus algorithms
  - block, chain structure, cryptography, hashing
  - node, OS, VM/kubernetes, P2P messaging/discovery
  - IoT, OS, UID
Blockchain “Tower of Babel”

The need for Blockchain DLT interoperability!

- Corda
- Hyperledger consortium A
- Hyperledger consortium B
- Multichain
- Quorum
- EEA permissioned
- Ethereum main net permissionless
- NEO
- EOS
- Bitcoin permissionless

Permissioned blockchain
Permissioned Blockchain "Silos"

Single company, inter and intra-companies
Blockchain consortia silos

- Single company blockchain A
- Single company blockchain B
- Single company blockchain C
- intra-company consortium blockchain A
- inter-company consortium blockchain B
- inter-company consortium blockchain (vertical market A)
- inter-company consortium blockchain (vertical market B)
Blockchain DLT Interoperability is the ability of distributed ledger computing systems to interconnect multiple intra and inter-DLT blockchain sub-systems and systems to create, destroy, modify, change, transfer, register and validate digital assets and transactions and its states, across multi-ledgers in a secure, scalable, trusted and consensus-based approach.

3 important design criteria

- open-protocols
- multi-chain, multi-ledger frameworks
- 2P2S (privacy, performance, scalability & security)
Blockchain in Telecom requires “carrier-grade” design principle

- National Wide Backbone
- Regional Backbone
- Metro Networks
- Access Networks (micro, pico, nano, femto)
- Home-Local Networks
Blockchain DLT Interoperability Layers

There are different levels of Blockchain DLT interoperability

- Semantic Interoperability
- dApps, Smart Contract Interoperability
- Multi-Ledger Interoperability
- Middleware Layer Interoperability
- Multi-Cloud/P2P Network Interoperability
Blockchain DLT Interoperability Techniques and Use Cases

- Notary schemes
- Relays and sidechains
- Hash-locking

use cases

- Asset portability
- Atomic swap
- Cross-chain oracle
- Cross-chain contracts
The first design criteria for permissioned DLT systems is to identify which DLT category applies for a particular application. There isn’t a “one-size fits all” solution in Blockchain design.
Multi-Cloud, Multi-Ledger Interoperability

**OPTION A**
- multi-cloud, single-vendor single-ledger

- DLT Ledger
  - AWS cloud
  - AWS cloud
  - AWS cloud

**OPTION B**
- multi-cloud, multi-vendor single-ledger

- DLT Ledger
  - AWS cloud
  - Google cloud
  - Azure cloud

**OPTION C**
- multi-cloud, multi-vendor multi-ledger

- DLT Ledger 1
  - AWS cloud
  - Google cloud
  - Azure cloud

- DLT Ledger 2
  - AWS cloud
  - Google cloud
  - Azure cloud
Next Step: Blockchain Interoperability
Connecting the Dispersed Blockchains!

early days of Internet

with Blockchain Interoperability

2018 Blockchain Fragmented Ecosystem

DLP Interoperability Labs (DLP-i-Labs)
Blockchain DLT Interoperability Framework

DLT Gateway

- Interconnects multi-cloud, multi-ledger
- Interconnects blockchains with legacy systems (e.g. ERPs and other database)
- Interconnects blockchains to augmented and edge intelligence (AI/ML, IoT)

- Supports single and multi-ledger API
- Supports multi-client interfaces and Dapps

Distributed Applications (Dapp) | Web/Mobile UI | Others OS
---|---|---
API Layer

DLT Ledger 1 | DLT Ledger 2

Distributed Applications (Dapp)
- AWS cloud
- Google cloud
- Azure cloud

Web/Mobile UI
- Distributed Applications (Dapp)
- Web/Mobile UI

Others OS
- Distributed Applications (Dapp)
- Others OS
Key Takeaways

- Blockchain DLT silos and multi-ledger permissioned and permissionless technologies create a “Tower of Babel”, similarly to the early days of the Internet networks and protocols.

- There are 3 main categories when designing DLTs: operational, enterprise IT and customer-facing, each one with a distinct set of functional requirements.

- Multi-cloud, multi-ledger interoperability is the first infrastructure layer to be considered.

- DLT gateways can interconnect multi-blockchain ledgers, and legacy IT, including new AI/ML and IoT solutions.

- “Carrier/telecom-grade” design – needs redundant, scalable, secure and high performance blockchain networks.

- **Blockchain DLT interoperability** is very important for global adoption of blockchain, and the IEEE standards will address this topic.
IEEE Blockchain in Telecom Workshop, Globecom 2019
(December 13th)

TOPICS TO BE COVERED
This workshop will be aligned with IEEE Blockchain Initiative strategic directions and promoted as a joint initiative with Globecom.

The IEEE Globecom Telecommunications Blockchain Workshop invites prospective authors to submit their original technical work on any aspect of engineering, science, and technology of current interest to the workshop. Topic areas include, but are not limited to, the following:

- Blockchain in 5G Technologies
- Blockchain in IoT
- Blockchain in Networking and Cloud Technologies
- Blockchain in Telecommunications Process, Operation and Customer Management
- Blockchain Telecom Enterprise Applications
- Blockchain Telecom in Home Automation and Communications
- Blockchain Telecom Cybersecurity
- Blockchain Telecom Scalability, Performance and Privacy
- Blockchain Telecom Interoperability
- Blockchain Telecom Pilots and Applications
- Blockchain Telecom Regulatory Challenges and Requirements
- Blockchain Telecom Emerging Technologies

THANK YOU!

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About the BEC

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