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By transporting valuable digital assets over mobile networks in a secure and transparent framework, blockchains can speed the growth of the digital economy, deliver new services, and enhance user experiences. >>

Blockchains in Mobile Networks

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Blockchains are a Distributed Ledger Technology (DLT) with the potential to disrupt many industries by enabling open and trusted exchanges over the Internet without using central servers or an independent trusted authority. Blockchains facilitate transparent, verifiable, and secure digital asset transactions with proof of rights and ownership.

Based on cryptography-driven consensus building, blockchains use a decentralized database and peer-to-peer computing nodes to offer equal incentives for conducting transactions over a secure, trusted layer. In 2008, a blockchain was first used to introduce Bitcoin, an electronic payment network, and is now emerging as the underlying technology to power a new 'Internet-of-value' paradigm.

Each digital ledger block contains a timestamp and a link to a previous block. Units of value go from owner A to owner B via network nodes that track account balances. Ownership is verified through links to all previous transactions. Each node records all transactions. Authentication is achieved by consensus, and trust is generated by the transparent and auditable flow of information.

By storing information in multiple cryptographically validated ledger copies across a network, blockchains eliminate single points of failure, hacking attacks, or control by any single entity. Compromising an entire global network is difficult because the historical transaction data is embedded within multiple nodes.

Opportunities for Mobile Carriers

Blockchain technology offers mobile carriers superb opportunities to support the transformation of business models through new network layers, which can revolutionize how data integrity is verified and value and rights are transmitted and/or tracked over the infrastructure to subscribers.

Tier 1 mobile carriers are likely to create new blockchain partnerships with universal digital ledgers to improve industry-wide interoperability. This will control costs, provide wide coverage, and effectively redefine the intermediary role of many industries.

A number of blockchain projects are based on concepts well aligned with the goals of specific 5G architectures, ranging from distributed systems and databases to low-latency/high-performance distributed computing nodes. Adding blockchains to old and new

distributed systems can make operations more secure, autonomous, flexible, and profitable. Network protocols and infrastructures will need to address the network timing requirements of blockchain-based applications, scale to support millions of nodes, and ensure that transactions are reaching all participating peers. Each transaction over the mobile network must be digitally signed to ensure authenticity. By enabling mobile network elements to be exchanged dynamically, blockchains can encourage mobile network growth by enabling a market for access rights to other network resources.

Mobile carriers are well positioned to offer a 'blockchain-as-a-service' ecosystem for content providers, who could store their offerings throughout the mobile network and use the blockchain infrastructure for access control and monetization. Smart contracts will protect copyrights, automate the sale of content online, and eliminate the risk of copying and content redistribution by hackers. In addition, blockchains provide for variable, demand-based pricing of content through automated discovery

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Keys to Adoption

Mobile networks can be critical in blockchain success. The carriers that step up will generate momentum for blockchain integration by tackling new use cases to enhance the digital experience of their subscribers.

With significant technical barriers to entry, moving blockchains beyond the proof-of-concept stage will require major industry players able to support many types of use cases over the public network to work in collaboration with private entities and government regulators that represent the legal systems of different states, provinces, and countries.

Service providers can offer low-cost, low-risk, blockchain-service platforms to various developers. The core strategy must be the installation of new infrastructure components to support the deployment of blockchain frameworks that are then backed by network and distributed cloud computing platforms. Mobile carriers will own and support the backend blockchain that application developers can utilize to create new trust and transaction applications.

Many large industry players are competing for control in the IoT space, investing in blockchain technologies with a focus on security, encryption, and smart contract innovations. To compete, mobile carriers need to offer blockchain frameworks that leverage the IoT, Big Data, content delivery, and digital identity.

Mobile carriers must look beyond simply extending the connectivity of existing telecom infrastructure. They need to create value, authenticate digital information, and execute smart contracts that are supported by market analytics, predictive maintenance, and the mass-scale automation of management applications and services. Smart IoT contracts will allow the automation of remote IoT-based systems and facilitate the autonomous exchange of data and value among devices and virtual or physical objects over the network.

For the next wave of technology, industry players need to design a global network of computing nodes for validating and relaying blockchain transactions. This network must:

- Allow secured nodes to join the network voluntarily to manage the database and provide incentives to participate in the computation.
- Feature speed, volume, and low latency.
- Duplicate ledgers across thousands of servers and perform regular updates and reconciliation.

Blockchains will be integrated with Artificial Intelligence (AI) and behavioral analytics, enabling infrastructure providers to obtain insight from the transactions.

Blockchain Uses in Mobile Networks

- IoT

Today, IoT connections must scale up to secure billions of interactions among machines and sensors. This results in network slowdowns and higher costs. Without managing microtransactions and settling payments, billions of daily transactions will engulf traditional financial services.

The integrity of the data exchanged among billions of IoT devices is ensured using blockchain's decentralized approach. Trusted communications between peer-to-peer devices (distributed file sharing and autonomous device coordination) will increase system throughput and cut costs.

Smart contracts will automate IoT devices and objects, and guarantee secured access to trusted IoT

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data. Each blockchain can be addressed directly to allow for registration and control.

- Smart City

Blockchains enable transparent, safe, and reliable transaction infrastructures that speed up digital services by connecting trusted peers with municipal stakeholders.

Smart contracts will make value-added services more secure, private, autonomous, and anonymous; they will increase efficiency and resource sharing. Open data and verifiable integrity allow multiple parties levels of transparency that simplify joint operations and maintenance with increased and unifying trust. Further, the marketplace can now decide new city services monetization.

For enhanced protection against cyber attacks and fraud, blockchains help authenticate device identity, protect sensory data used in transportation, and manage access to city facilities.

Smart City-driven shared economies will include collaborative ownership and maximize urban asset uses. For instance, blockchains can record solar energy production for purchasing excess renewable energy credits. Electricity can be generated locally and transferred to neighbors or by selling back to the grid.

Linking smart contracts with IoT applications will further increase new service launches. Smart devices and real-time data will help users make choices that facilitate:

- Autonomous negotiations between car sensors and traffic data for charging fees instantly to driver accounts.
- Reduced carbon footprints by taxing cars for pollution and other metrics.
- Monitoring environmental conditions and generating data for sale.
- Reduced insurance rates based on authenticated maintenance and safety records.
- Discovery and data mining across devices for cryptographically protected automated neighborhood surveys.

5G architecture and IoT connectivity are primary Smart City initiatives, allowing mobile carriers to supply blockchain solutions based on wireless infrastructure. Other critical innovations may include: cryptocurrency, zero-factor authentication, application fault tolerance, consensus network protocols, Peer-to-Peer (P2P) autonomous protocols, and private and public smart contract frameworks.

- 5G Service Enablement

In place of the current and aging cellular system, a blockchain framework will assist a new generation of distributed wireless networks by allowing seamless provisioning between heterogeneous access nodes and devices. With blockchains, provisions and agreements between access nodes, networks, and subscribers are negotiated on-the-fly as digital smart contracts. Any device can negotiate the best service, and the carrier can dynamically adjust the code in the smart contract in any network node. This permits seamless services and new charging and business models among networks, providers, and 5G access nodes. Blockchain-enabled mobile services can be adapted to location and subscriber needs, and adjusted to supply and demand.

Blockchains can assist in 5G wireless access technology deployments by providing seamless access across a diverse number of networks to devices and IoT endpoints. Improved internal processes, such as Operational Support Systems (OSS) and Business Support Systems (BSS), will reduce costs and increase competitiveness.

Networks will be flattened and latency reduced by delegating OSS and BSS functions to the edge using distributed P2P negotiation.

- Content Distribution

For large content delivery providers such as Netflix, placing secured content closer to users via a platform running on blockchain technology will let creators upload content and transfer it ‘similarly to Bitcoin.’ This would create an open marketplace for content trading and consumption by all with access. Privacy tools will enable users to manage and resell data to which they have acquired rights.

Content providers can decide on the specifics of applying digital rights management to their assets. Also, decentralized storage protects against hacking or lost data, accelerates data transfer, and minimizes streaming time.

- Integrity Protection

Two shortcomings of traditional public key cryptogra-

phy are the possible compromise of private keys and the expense of signature verification. Blockchain-based Keyless Signature Infrastructures (KSIs) deliver scalable, signature-based authentication of digital data. KSIs are fast, efficient, and scalable.

- Cloud Computing

A decentralized mobile cloud solution can permit users to allocate portions of their processing assets. This allows cloud applications to be protected and encrypted.

- Dynamic Sharing

Blockchain's dynamic sharing functions offer:

- Simplified authentication: Open standard authorization protocols can be applied to any or all parts of the mobile network.
- Billing, invoicing, and other transactions: Blockchain cryptography protects information and creates a fully recorded transaction audit trail.
- Roaming connection management: This method manages roaming connections globally.
- Shared network infrastructure and spectrum: Network carriers can dynamically transfer infrastructure elements among themselves or other parties on demand via secure, auditable transactions.
- Mobile money: This currency relies on blockchain.
- Recordkeeping: This step can protect public records from fraud.

Blockchains and Beyond

Blockchains can transform the digital economy and enable organizations to meet their goals for open and trusted exchanges over mobile networks. Mobile operators can leverage the development of 5G and blockchain technologies to deliver a broad range of new services. Verizon is the first U.S. operator to provide access rights to digital content based on subscription type. Rights are transferred by keys that migrate content to new users — who can define new keys to protect the information.

Recently submitted patents reveal that Verizon has experimented with blockchain technology as a digital rights management platform for sensitive data storage.

A second wave of blockchain advances is from the open source community. These innovations are leading to new ventures, such as Swarm and Enigma, and other decentralized platforms and applications. Furthermore, newcomers with cutting-edge blockchain technologies are addressing verticals like transportation (LaZooz), social networking (Synereo), and cloud storage (Storj.io).

Corporate Interest

Blockchain's potential is being explored by new startups in partnership with large institutions to offer a range of applications — including digital rights, trading platforms, and alternative digital currencies. Anticipating a growing demand for such products and services, U.S. venture capital funding has increased from USD 1 million in 2012 to over USD 300 million in 2016.

Major IT players, such as Microsoft and IBM, are enabling enterprises to set up blockchain infrastructures on cloud platforms. However, a number of blockchain adoption barriers must be overcome, and proven solutions will take time. This leaves room for vendors such as Huawei to provide solutions based on 5G infrastructures. ▲

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Link: Blockchains, Smart Contracts, and the Shared Economy

Anything of value moved over the network can be recorded and validated by a blockchain ledger, including digital content and the electronic tracking of physical goods and services. From a user perspective, blockchains can have the appearance of an advanced distributed operating system.

Smart contract software that runs on the blockchain layer is executed by the entire network. At its core is a common ruleset that is evaluated autonomously to agree upon common standards. Many people expect 2017 to be a breakout year for increased use of smart contracts. These contracts can change how digital transactions are handled by creating a more collaborative economy, improving the efficiency of how value is exchanged across physical and cultural boundaries, and executing complex multi-party agreements. Existing enterprises that embrace blockchain technology will be well positioned to provide customized and transparent transaction-validation services.

Blockchain may have a big impact on the 'shared economy' concept as users will be able to reach and record transaction agreements without a controlling authority. Service suppliers could collaborate and deliver more value directly to customers by bypassing service aggregators and intermediaries.