Distributed Ledger Technologies (DLTs) in the Telecom space

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Current Landscape

In 2022, blockchain technology has reached everyone's ears, ranging from crypto-currencies to NFTs and the aspirations of the "metaverse". From crypto-currencies alone, the market grew from about $700B to around $2T, having even reached $3T. About a three-fold increase in market capitalization in 2021 alone (CoinMarketCap, n.d.)! Big names in the corporate world also see opportunity in this technology, from sectors like Bank, Finance, Insurance, Energy, Government, Real Estate and the list goes on.

This post serves as an introduction as to how companies in the Telecommunications sector can leverage this novelty and how some have already done so, while also taking into consideration the possible repercussions in such adoption.

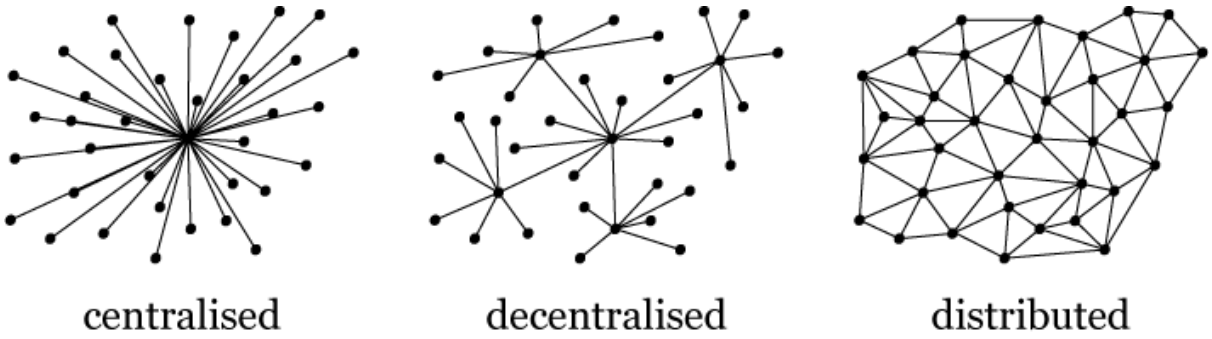
What are blockchain technologies?

Before delving right into the use cases, it is useful to provide a short description for the ones that aren't acquainted with the technology. Blockchain technologies are a subcategory of Distributed Ledger Technologies (DLTs).

Consider a generic corporation. An accountant used to have to report every single financial transaction on a book of records, or ledger, and keep these documents as company property, registering employers' pay, equipment, and service providers, among other things. Assume that the corporation hasn't been disclosing the complete truth about where the money is going and is thereby committing fiscal fraud. A set of fiscal examiners is then tasked with checking every transaction that has been recorded, fact-checking them, and so on. Up to this point, there have been two points of concern, whether or not the company has been fraudulent. The first is that the financial entities had to trust that the accountants haven't tampered with the ledger and the second is the need of these financial entities themselves.

DLTs have provided away, for the first time, to have a ledger that is in everyone's possession rather than trusting an entity to keep the records for themselves. This means that there is the option of a trustless ledger where no third parties are required to fact-check them. The mechanism for how this is achieved depends on the DLT itself, but for the time being what is important is that this is nonetheless achievable.

Now, **what makes blockchain so special in respect to other DLTs?** The most important aspect is that despite the ledger being distributed in a blockchain, it can also be decentralised. The distinction between being distributed and decentralised is quite intricate and there is an excellent post from the creator of the Ethereum blockchain, Vitalik Buterin, that scrutinises the topic in case you are interested in the details (Buterin, 2017). For the sake of brevity, think of it as in the following diagram.



It can be seen that a decentralised system is very much a distributed system. The distinction is that in a purely distributed network, if a node fails, the whole network fails, while in a decentralised network, this is not the case.

How is then a distributed and decentralised network, such as a blockchain, orchestrated? This has been a several-decade effort that culminates in Satoshi Nakamoto's Bitcoin whitepaper (Nakamoto, 2008). In essence, it is a network where each transaction is time-stamped via hashing algorithms into an ongoing chain of hash-based blocks of these transactions compliant with the consensus protocols. The longest chain not only proves the sequence of events but also proves that the consensus was achieved by the majority of the nodes that process the transactions. As long as nodes that aren't colluding to attack the network hold the bulk of the computational power, they'll produce the longest chain and outrun attackers. These are the characteristics that enable the blockchain to be tamper-proof, distributed, decentralised (in case this is intended), and pseudo-anonymous, while also being a trustless network.

'Consensus protocols,' a keyword in the previous paragraph, is the basis for this trustless approach. There would be no guarantee that the system would act as it was intended if consensus protocols were not in place. Simply described, they are incentive-based protocols that provide nodes a reason to behave correctly. The most known of these is Proof of Work (PoW), employed in Bitcoin, which uses CPU-intensive problem-solving to create blocks of transactions that obey the rules of the blockchain. The reward for the work is some Bitcoins. Of course, there are disadvantages, the most significant of which is energy usage, but one thing we must acknowledge is that the Bitcoin blockchain is yet to be breached in its 14-year existence. Another prominent consensus protocol is Proof of Stake, which randomly selects a pool of token "donors" to create a block based on the number of tokens it has on stake (in the case the pool acts maliciously, a percentage of the tokens staked are taken away). This protocol is used in blockchains such as Cardano, Solana, Binance Smart Chain, and, in the future, Ethereum. Other consensus protocols are Proof of Elapsed Time (used in some Hyperledger blockchains), Proof of Burn, Proof of Capacity, Proof of Weight, just to name a few.

It is important to mention that the case for a public and decentralised blockchain might not be exactly what is desired, especially for performance and privacy reasons. For this reason, there exist private, or permissioned, blockchains. The most notorious of these promising blockchains are the ones provided by the Hyperledger Foundation and Ripple. Opposed to the public, or permissionless, blockchains, the access for new participants is given by the consortium, the regulated authority, or other members already in the network.

Blockchain implementation in the Telecommunications Sector

Having established foundational knowledge on blockchain technology, it is clear that the shared, immutable record of transactions and option for transparency within a network can be leveraged in various sectors. According to Accenture, Communication Service Providers (CSPs) are fully aware of the potential in the blockchain. This awareness goes far as major companies such as AT&T, Colt, Deutsche Telekom, Globe Telecom, and Vodafone are all experimenting with blockchains. Some even state that this technology might even have the greatest impact on their organisation over the following years (Ridgewell & Newman, 2019).

Blockchain could be applied in many areas of improvement, such as settlement, roaming, payments, identity management, and authentication, to name a few, while also cooperating and even enabling or empowering other emerging technologies.

Blockchain applications to solve current problems

When it comes to settlement, most problems revolve around call detail records (CDRs). CDRs seem inefficient and prone to fraud, in the sense that CSPs must rely on partners' networks and data to collect, process, and transmit call and data records to them. Telefónica, in collaboration with IBM, has developed a unique CDR, called '1CDR', that contains information from all the participants on a call in a single record (Wong, 2018). Their aim is that thanks to the blockchain if consensus rules could be applied between all the actors of the same call and the data of the call record agreed upon, many disputes and billing problems would be avoided. Globe Telecom, Singtel, and Openet are also addressing this issue with the objective of "elimination of CDRs for billing settlement and fraud detection" (Mehta, n.d.).

Identity management is also being tackled with blockchain. Globe Telecom, KDDI, Ultrafast, Telefónica and Infosys are focused on this task. Most notably AT&T is developing a secure multi-factor authentication platform, recording the data on blockchain solutions provided by IBM and Microsoft. The storage of this data is also allowing AT&T to collaborate with numerous partners by providing access to it on online transactions without the fear of leaks and mutability. Now AT&T even took the next step in providing blockchain solutions (AT&T, n.d.). Another honourable mention goes to Telefónica with the development of 'TrustID', a solution that has been moved to the Hyperledger Foundation (Nieto, 2020).

Blockchain is also being used to automate customer onboarding processes and other error-prone manual approaches. Colt Technology Services is focused on using blockchain to automate their inter-carrier settlement of wholesale international services, as well as, in partnership with Zeetta Networks, in buying and selling network services in a secure, distributed, and trustless marketplace (MEF Forum, 2018). On the topic of automation, SoftBank, through its involvement in the Carrier Blockchain Study Group, seeks to create a payment platform system that aims to eliminate late transactions or transaction failures between CSPs (BusinessWire, 2019). SoftBank is an active investor in blockchain technologies, continuously showing its interest in the technology (Cyrus, 2021) (Malak, 2021).

This autonomy not only translates to a lesser need for intermediaries, a big cut on expenses but also on the importance of every single device in the network. In other words, blockchain allows the network to not depend on single nodes, shifting to a decentralised architectural approach. This is especially important for the prevention of digital denial-of-service (DDoS) attacks that seem so regular in the present.

Vodafone is also a big advocate for blockchain technology. They intend to apply this technology across multiple sectors such as identity, supply-chain management, roaming, and the internet of things (IoT). For IoT, the intention is to supplement their already existent service platform with a Digital Asset Broker to enable peer-to-peer transactions. For roaming, the leveraging of blockchain enables more efficient, instantaneous, and seamless inter-operator processes (Ridgewell, 2019).

Deutsche Telekom is also keen on integrating blockchain for roaming. In their case, they use smart contracts to adjust roaming costs to customers' needs. Deutsche Telekom constructed a dedicated group, within its Telekom Innovation Laboratories (T-Labs), for blockchain applications, such as a procedure for blocking stolen phones and a decentralised blocking list to enable the anonymization and distribution of blocked international mobile equipment identity (IMEI) numbers (Ridgewell & Newman, 2019). On the other hand, the company is actively involved in blockchain solution providers, joining the Hyperledger community (Ridgewell & Newman, 2019) and, more recently, acquiring the public blockchain network ‘Celo’ (Weidmann, 2021).

Blockchain applications with other technologies of the future

It is also important to relate how blockchain can work side-by-side or even propose the use of other new emerging technologies.

Take Artificial Intelligence (AI) as an example. Each AI system, and each algorithm within it, necessitates extensive training and, as a result, vast volumes of dependable data to make accurate predictions. Data on a blockchain is secure, trusted, and shareable, exactly what is desired. We stress security because it is simple to determine whether or not data on the

blockchain has been tampered with, opposed to the significant difficulties that exist now. With the combination of blockchain and machine learning algorithms, hacking and stealing sensitive data may become increasingly more difficult.

There is also the case for edge computing. With edge computing and blockchain technology, the benefits could be for both. On the side of blockchain, edge computing would allow for greater computing and communication capabilities. For the side of edge computing, when blockchain is applied, it ensures the data is tamper-proof and traceable.

The sharing of faster and regulated connectivity for reliable service, instant monetisation through smart contracts, local connection prices based entirely on local supply and demand, and the emergence of new business models to repurpose idle capacity are all examples of how blockchain allows for a smoother and richer experience with 5G. In auditing agreements, blockchain will also play a reinforcing role. Different carriers, for example, will be able to dynamically share infrastructure thanks to safe, auditable transactions on a blockchain. Another wonderful example is the establishment of a safe, trustless, and autonomous network slicing broker, which enables more efficiency, lower costs, and increased security all at the same time. Still, within 5G, blockchain can provide microtransactions and smart contracts to Mobile Virtual Network Operators (MVNOs) and Mobile Network Operators (MNOs) so that they do not have to spend millions or even billions on 5G construction. This can serve as a rental for the high-frequency spectrum from larger corporations, or even the government, in real-time or on a pay-as-you-go basis.

Ubiwhere, along with its consortium members Altice Labs, Atos, Bartr, Comunicare Digitale, Fondazione Bruno Kessler, i2CAT, IBM Israel, Intracom Telecom, Malta Communication Authority, Networks, Telefónica, and Universidad de Murcia, is excited about the **5GZORRO's blockchain capabilities for 5G**.

Blockchain will be used to automate the secure, flexible, and multi-stakeholder combination and composition of resources and services in this project.

Smart contracts will also be used, not only to standardise and map third-party technical data into these contracts, but also for ubiquitous computing/connectivity, dynamic spectrum allocation, pervasive virtual content delivery network (CDN) services over third-party resources, and even service level agreement (SLA) management.

Another application will be the **formation of a shared spectrum market**, which will allow real-time trading of spectrum allocations between parties with no pre-established trust relationship. For more information feel free to check (*5GZORRO*, n.d.).

Closing remarks

As seen, blockchain technology is no longer an aspiring and unproven technology yet to be adopted. Many big and small players of several sectors have provided proofs of concept or fully adopted this technology and the Telecommunication sector is no different. Blockchain is still an emerging technology and for that reason, CSPs should be at least informed of its real value.

As with any emerging technology, blockchain provides new ways of solving old problems yet is still able to work hand in hand with other technologies of the future. It provides new revenue opportunities and even cuts on costs otherwise impossible. But despite its many capabilities, it is not meant to be applied in every single area of the business.

At the time of writing, there are many blockchain service providers, ranging from old acquaintances such as Microsoft with the Azure Blockchain Service (Microsoft, n.d.) (now retired) and IBM in collaboration with the Linux Foundation on the Hyperledger project (The Linux Foundation, n.d.) to new rising consortiums and companies such as the Ethereum Foundation (Ethereum Foundation, n.d.), ConsenSys' Quorum (ConsenSys, n.d.) and countless others. The choice of blockchain solution depends, ultimately, on the problems the company intends to solve, but the biggest choice seems to be whether or not one chooses a permissioned or a permissionless blockchain.

This article demonstrates that the fuss around blockchain technologies is legitimate, in part, however, we are still in the early stages. Blockchain has now begun to stand on its own two feet, and it is up to the community to nourish and evolve it so that it can run towards the limitless potential it has demonstrated.

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