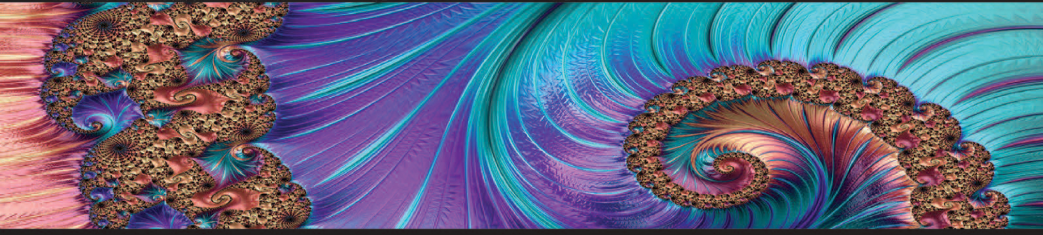


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6G AND NEXT- GENERATION INTERNET

Under Blockchain Web3 Economy

Abdeljalil Beniiche

6G and Next-Generation Internet

The sixth generation (6G) of wireless cellular networks is expected to incorporate the latest developments in network infrastructure and emerging advances in technology. It will not only explore more spectrum at high-frequency bands but also converge driving technological trends, including connected robotics, artificial intelligence (AI), and blockchain technologies. There is also a strong notion that the nature of mobile terminals will change, whereby intelligent mobile robots are anticipated to play a more important role. Importantly, 6G will become more human-centered than 5G, which primarily focused on industry verticals.

This book explores the human-centeredness of blockchain and Web3 economy for the 6G era. Aimed at graduate students, network and blockchain researchers, professionals, engineers, and practitioners, this book discusses the symbiosis of blockchain with other key technologies such as AI and robots, while putting the focus on the Tactile Internet for advanced human-to-machine interaction. By focusing on the research field of robonomics in the 6G Era, which studies the social integration of robots into the economy and human society, the book puts the various developed ideas and concepts into the perspective of the future Super Smart Society 5.0.

Abdeljalil Benüiche received his PhD in telecommunications from the Institut National de la Recherche Scientifique (INRS), Montréal, Canada. His research focuses on 6G networks, Tactile Internet, blockchain, information security, behavioral economics, and Society 5.0. His research findings have been published in many prestigious journals, such as *IEEE Network*, *IEEE Wireless Communications*, *IEEE Communications Magazine*, and *IEEE/OSA Journal of Optical Communications and Networking*. He has served and continues to serve on the technical program committees and a reviewer of numerous major international conferences, journals, and magazines. Currently, he is a Security Architect in the financial industry.



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List of Acronyms

1G	First Generation
2G	Second Generation
3G	Third Generation
4G	Fourth Generation
5G	Fifth Generation
6G	Sixth Generation
6Genesis	6G Enabled Smart Society and Ecosystem
6GFP	6Genesis Flagship Program
ABI	Application Binary Interface
ACC	Access Control Contract
ACK	Acknowledgment
AGI	Artificial General Intelligence
AI	Artificial Intelligence
AMM	Automated Market Making
ANN	Artificial Neural Network
API	Application Programming Interface
APT	Advanced Persistent Threat
AR	Augmented Reality
AWS	Amazon Web Services
B5G	Beyond 5G
BIoT	Blockchain-based IoT
BS	Base Station
CCSC	Crypto Currency Smart Card (CCSC)
CI	Collective Intelligence
CoC	Computation Oriented Communication
CoMP	Coordinated MultiPoint
CoZ	Crowd-of-Oz
CPS	Cyber-Physical Systems
CPSS	Cyber-Physical-Social Systems
CPU	Central Processing Unit
CTS	Clear To Send
CV	Computer Vision
DApps	Decentralized Applications
DAO	Decentralized Autonomous Organization

DCF	Distributed Coordination Function
DEX	Decentralized Exchanges
DIFS	DCF Interframe Space
DLT	Distributed Ledger Technology
DNS	Domain Name System
DSOC	Decentralized Self-Organizing Cooperative
DVB	Digital Video Broadcasting
ECDSA	Elliptic Curve Digital Signature Algorithm
e-Deliveries	Registered Electronic Delivery Services
eMBB	enhanced Mobile Broadband
EOA	Externally Owned Account
EPON	Ethernet Passive Optical Network
ERC	Ethereum Request for Comments
ESF	Edge Sample Forecast
ESPN	ExtraSensory Perception Network
ETSI	European Telecommunications Standards Institute
EVM	Ethereum Virtual Machine
FiWi	Fiber-Wireless
GSM	Global System for Mobile Communications
GWAP	Games With A Purpose
H2H	Human-to-Human
H2M	Human-to-Machine
H2R	Human-to-Robot
HABA/MABA	Humans-Are-Better-At/Machines-Are-Better-At
HART	Human-Agent-Robot Teamwork
HCI	Human-Computer Interfaces
HetNets	Heterogenous Networks
HIT	Human Intelligence Task
HITL	Human-In-The-Loop
HO	Human Operator
HRI	Human-Robot Interaction
HSI	Human System Interface
HTML	HyperText Markup Language
IA	Intelligence Amplification
ICO	Initial Coin Offering
ICT	Information and Communications Technology
IFrame	Inline Frame
IoE	Internet of Everything
IoT	Internet of Things
IP	Internet Protocol
IPFS	Inter-Planetary File System
ITU	International Telecommunication Union

JC	Judge Contract
KPI	Key Performance Indicators
LED	Light-Emitting Diode
LLL	Lisp Like Language
LoRa	Long Range
LPWA	Low-Power Wide-Area
LTE-A	LTE-Advanced
M2M	Machine-to-Machine
MAP	Mesh Access Point
MEC	Multi-access Edge Computing
MIMO	Multiple-Input Multiple-Output
mMTC	massive Machine Type Communications
mmWave	millimeter-Wave
MP	Mesh Point
MPP	Mesh Portal Point
MR	Mobile Robot
MTurk	Amazon Mechanical Turk
MU	Mobile User
NAT	Network Address Translation
NFT	Non-Fungible Token
NOMA	Non-Orthogonal Multiple Access
OFDM	Orthogonal Frequency Division Multiplexing
OLT	Optical Line Terminal
ONU	Optical Network Unit
P2P	Peer-to-Peer
PHY	Physical Layer
PON	Passive Optical Networks
PoS	Proof-of-State
PoW	Proof-of-Work
QR	Quick Response
RACS	Remote APDU Call Secure
RAN	Radio Access Network
RF	Radio Frequency
RFID	Radio Frequency Identification
RPC	Remote Procedure Call
RSS	Really Simple Syndication
RTS	Request To Send
SHA	Secure Hash Algorithm
sHRI	social Human-Robot Interaction
SIFS	Short Interframe Space
SLA	Service Level Agreement
SMS	Short Message Service

SSI	Self-Sovereign Identity
TDM	Time Division Multiplexing
TLD	Top-Level Domain
TOR	Teleoperator Robot
URL	Uniform Resource Locator
URLLC	Ultra-Reliable Low-Latency Communications
VPN	Virtual Private Network
WDM	Wavelength Division Multiplexing
WLAN	Wireless Local Area Network
WOBANs	Wireless-Optical Broadband Access Networks
WOR	WiFi Offloading Ratio
WoZ	Wizard-of-Oz
XR	Extended Reality

6G-Blockchain

Vision and Research Directions



BACKGROUND AND MOTIVATION

Evolution of Mobile Networks and Internet

The general evolution of global mobile network standards was first to maximize coverage in the first and second generations and then to maximize capacity in the third and fourth generations. In addition to higher capacity, research on fifth generation (5G) mobile networks has focused on lower end-to-end latency, higher spectral efficiency and energy efficiency, and more connection nodes [1]. More specifically, the first generation (1G) mobile network was designed for voice services with a data rate of up to 2.4 kbit/s. It used analog signals to transmit information, and there was no universal wireless standard. Conversely, second generation (2G) was based on digital modulation technologies and offered data rates of up to 384 kbit/s, supporting not only voice services but also data services such as short message service (SMS). The dominant 2G standard was the global system for mobile (GSM) communication. The third generation (3G) mobile network provided a data rate of at least 2 Mbit/s and enabled advanced services, including web browsing, TV streaming, and video services. For achieving global roaming, 3GPP was established to define technical specifications and mobile standards. Fourth generation (4G) mobile networks were introduced in the late 2000s. 4G is an all-Internet Protocol (IP) based network, which is capable of providing high-speed data rates of up to 1 Gbit/s in the downlink and 500 Mbit/s in the uplink in support of advanced applications like digital video broadcasting (DVB), high-definition TV content, and video chat. LTE-Advanced (LTE-A) has been the dominant 4G standard, which integrates techniques such as

coordinated multipoint (CoMP) transmission and reception, multiple-input multiple-output (MIMO), and orthogonal frequency division multiplexing (OFDM) [2]. The main goal of 5G has been to use not only the microwave band but also the millimeter-wave (mm-wave) band for the first time in order to significantly increase data rates up to 10 Gbit/s [3]. Another feature of 5G is a more efficient use of the spectrum, as measured by increasing the number of bits per Hertz [4]. ITU's International Mobile Telecommunications 2020 (IMT 2020) standard proposed the following three major 5G usage scenarios:

1. Enhanced mobile broadband (Embb)
2. Ultra-reliable and low latency communications (URLLC)
3. Massive machine-type communications (mMTC) [5]

One of the most interesting 5G low-latency applications is the emerging Tactile Internet that envisages realizing *haptic communications* and thereby enabling users to not only see and hear but also touch and manipulate remote physical and/or virtual objects through the Internet [6, 7]. The Tactile Internet, which is driven by recent advancements in computerization, automation, and robotization, is expected to significantly augment human-machine interaction, thereby converting today's content delivery networks into skillset/labor delivery networks [8–10]. The Tactile Internet holds promise to create new entrepreneurial opportunities and jobs, which are expected to have a profound socioeconomic impact on almost every segment of our everyday life with use cases ranging from augmented/virtual reality (AR/VR) and autonomous driving to healthcare and smart grid. Many of these industry verticals (e.g., AR/VR, teliagnosis, telesurgery, and telepresence) require very low latency and ultra-high reliability for realizing ultra-responsive interactive applications such as bilateral teleoperation/telepresence. Note, however, that some use cases which do not necessarily require mobility all the time can be realized over fixed broadband networks. This suggests that future cellular networks need to be fully converged networks, allowing for a flexible selection of different fixed and mobile access technologies while sharing core network functionalities [11].

Interactive systems, including in particular AR/VR and teleoperation, demand an ultra-low round-trip latency of 1–10 ms together with high reliability. The high availability and security, ultra-fast and highly reliable response times and carrier-grade reliability of the Tactile Internet will add a new dimension to the interaction of humans with machines/robots. To gain a more profound understanding of the Tactile Internet, it may be helpful to compare it to the emerging Internet of Things (IoT) and 5G mobile networks. While the concept of IoT is far from novel and goes back to 1995, it is only recently that we are experiencing a rapidly increasing growth of interest in IoT from

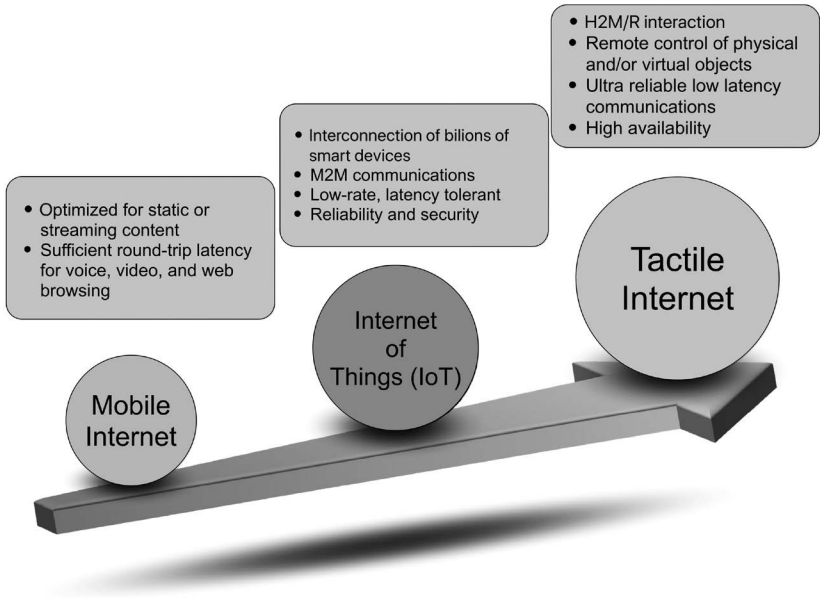


FIGURE 1.1 Revolutionary leap of the Tactile Internet in compliance with ITU-T Technology Watch Report.

both industry and academia. [Figure 1.1](#) depicts the revolutionary leap of the Tactile Internet in compliance with the ITU-T¹ Technology Watch Report on the Tactile Internet [12]. While the ultra-fast response time and carrier-grade reliability of the Tactile Internet will add a new dimension to human-machine interaction, emerging 5G networks have to handle an unprecedented growth of mobile data traffic as well as an enormous volume of data from smart sensors and actuators, the empowering elements of the IoT.

The difference between the Tactile Internet and IoT may be best expressed in terms of underlying communications paradigms and enabling end devices. The Tactile Internet involves the inherent human-in-the-loop (HITL) nature of human-to-machine interaction, whereas the IoT is centered around autonomous machine-to-machine (M2M) communications without any interaction with humans. The Tactile Internet relies on human-to-machine/robot (H2M/R) interaction and thus allows for a human-centric design approach towards creating novel immersive experiences, expanding humans' capabilities through the Internet. Furthermore, the Tactile Internet may be viewed as an extension of immersive VR from a virtual to a physical environment. It allows for the tactile steering and control of not only virtual but also real objects, e.g., teleoperated robots. The boundary between virtual (i.e., online)

and physical (i.e., offline) worlds is to become increasingly imperceptible, while both digital and physical capabilities of humans are to be extended via edge computing variants, ideally with embedded artificial intelligence (AI) capabilities.

Recently, Maier et al. [13] introduced the *Internet of No Things* as an important stepping stone toward ushering in the sixth generation (6G) post-smartphone era, in which smartphones may not be needed anymore. We argued that while 5G was supposed to be about the Internet of Everything, to be transformative 6G might be just about the opposite of Everything, that is, Nothing or, more technically, No Things. The Internet of No Things offers all kinds of human-intended services without owning or carrying any type of computing or storage devices. It envisions Internet services appearing from the surrounding environment when needed and disappearing when not needed. The transition from the current gadgets-based Internet to the Internet of No Things is divided into three phases: (i) bearables (e.g., smartphone), (ii) wearables (e.g., Google and Levi's smart jacket), and then finally (iii) nearables. Nearables denote nearby computing/storage technologies and service provisioning mechanisms that are intelligent enough to learn and react according to user context and history in order to provide user-intended services.

Joseph A. Paradiso [14] outlined his pioneering work on extrasensory perception (ESP) in an IoT context at MIT Media Lab. The authors showed that in a sensor-driven world, network-connected sensors embedded in anything function as extensions of the human nervous system and enable us to enter the long-predicted era of ubiquitous computing as envisioned by Mark Weiser more than a quarter of a century ago. In "The Computer for the 21st Century," Mark Weiser argued that the most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it [15]. This is now widely referred to as ubiquitous computing, though Mark Weiser called it *embodied virtuality* originally.

Figure 1.2 depicts the architecture of our proposed extrasensory perception network (ESPN), which integrates the following three evolutionary stages of mobile computing: (i) ubiquitous, (ii) pervasive, and (iii) persuasive computing. Ubiquitous computing is embedded in the things surrounding us (i.e., nearables), while pervasive computing involves our bearables and wearables. Persuasive computing aims at changing the behavior of users through social influence. An interesting phenomenon for changing behavior in an online virtual environment is known as the "Proteus effect," where the behavior of individuals is shaped by the characteristics and traits of their virtual avatars, especially through interaction during inter-avatar events. The underlying physical network infrastructure, which is illustrated in Fig. 1.2, consists

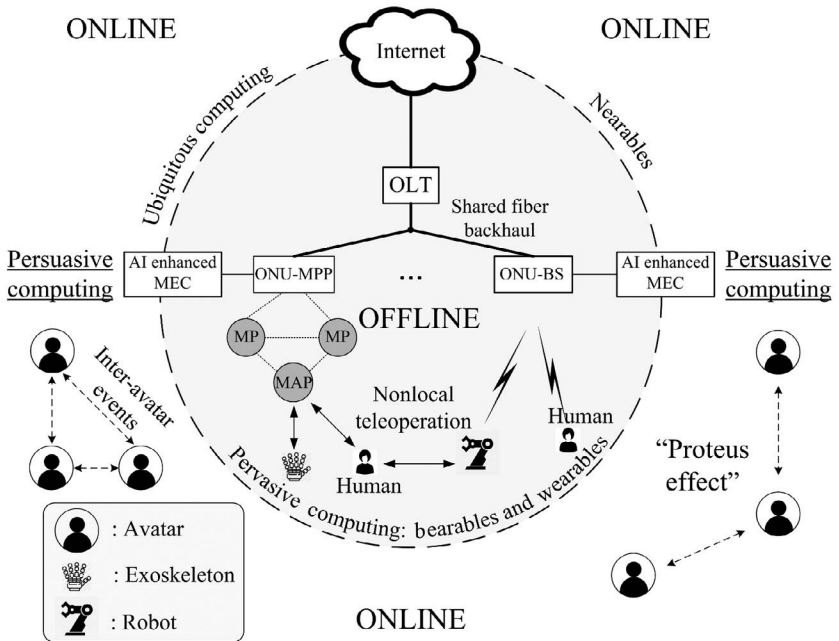


FIGURE 1.2 Extrasensory perception network (ESPN) architecture integrating the three evolutionary stages of mobile computing: (i) ubiquitous, (ii) pervasive, and (iii) persuasive computing.

of a fiber backhaul shared by WLAN mesh portal points (MPPs) and cellular base stations (BSs) that are collocated with optical network units (ONUs), which in turn are connected to the central optical line terminal (OLT) of the fiber backhaul. Based on real-world haptic traces, we studied the use case of nonlocal teleoperation between a human operator (HO) and teleoperator robot (TOR), which are both physical (i.e., offline) entities (Fig. 1.2). Further, Maier and Ebrahimzadeh [16] showed that AI-enhanced MEC helps decouple haptic feedback from the impact of extensive propagation delays by forecasting delayed or lost haptic feedback samples. This enables humans to perceive remote task environments in real-time at a 1 ms granularity.

6G Vision

As 5G is entering the commercial deployment phase, research has started to focus on 6G mobile networks, which are anticipated to be deployed by 2030 [17–19]. Typically, next-generation systems do not emerge from the vacuum,

but follow the industrial and technological trends from previous generations. Potential research directions of 6G consistent with these trends were provided in [20], including among others:

- *6G will continue to move to higher frequencies with wider system bandwidth:* Given that the spectrum at lower frequencies has almost been depleted, the current trend is to obtain wider bandwidth at higher frequencies in order to increase the data rate more than 10 times.
- *Massive MIMO will remain a key technology for 6G:* Massive MIMO has been the defining technology for 5G that has enabled the antenna number to increase from 2 to 64. Given that the performance gains have saturated in the areas of channel coder and modulator, the hope of increasing spectral efficiency for 6G will remain in the multiple antenna area.
- *6G will take the cloud service to the next level:* With the ever-higher data rates, short delays, and low transmission costs, many of the computational and storage functions have been moved from the smartphone to the cloud. As a result, most of the computational power of the smartphone can focus on presentation rendering, making VR, AR, or extended reality (XR) more impressive and affordable. Many AI services that are intrinsically cloud-based may prevail more easily and broadly. In addition to smartphones, less expensive functional terminals may once again flourish, providing growth opportunities in more application areas.
- *Grant-free transmissions could be more prominent in 6G:* In past cellular network generations, transmissions were primarily based on a grant-oriented design with strong centralized system control. More advanced grant-free protocols and approaches will be needed for 6G. It is possible that the non-orthogonal multiple access (NOMA) technology may have another opportunity to prevail due to its short delay performance even though it failed to take off during the 5G time period.
- *mMTC is more likely to take shape in the older generation before it can succeed in the next generation:* mMTC has been one of the major directions for the next-generation system design since the market growth of communications between people has saturated. High expectations have been put on 5G mMTC to deliver significant growth for the cellular industry. Until now, however, this expectation has been mismatched with the reality on the ground. Therefore, the current trend appears to indicate that mMTC would

be more likely to prevail by utilizing older technology that operates in a lower band.

- *6G will transform a transmission network into a computing network:* One of the possible trademarks of 6G could be the harmonious operations of transmission, computing, AI, machine learning, and big data analytics such that 6G is expected to detect the users' transmission intent autonomously and automatically provide personalized services based on a user's intent and desire.

In September 2019, the world's first 6G white paper was published as an outcome of the first 6G wireless summit, which was held in Levi, Finland, earlier in March 2019 with almost 300 participants from 29 countries, including major infrastructure manufacturers, operators, regulators as well as academia [21]. Each year, the white paper will be updated following the annual 6G wireless summit. While 5G was primarily developed to address the anticipated capacity growth demand from consumers and to enable the increasing importance of the IoT, 6G will require a substantially more holistic approach, embracing a much wider community. Further, 6G will become more human-centered than 5G, which primarily focused on industry verticals. Putting people at the center of a future super-smart society lies also at the heart of the recently emerging concept of Society 5.0 [22].

Many of the key performance indicators (KPIs) used for 5G are valid also for 6G. However, beyond 5G (B5G) and 6G, KPIs in most of the technology domains once again point to an increase by a factor of 10–100, though a 1000 times price reduction from the customer's viewpoint may be also key to the success of 6G [23]. Note that cost reduction is particularly important for providing connectivity to rural and underprivileged areas, where the cost of backhaul deployment is the major limitation. According to Yaacoub and Alouini [24], providing rural connectivity represents a key 6G challenge and opportunity given that around half of the world's population lives in rural or underprivileged areas. Among other important KPIs, 6G is expected to be the first wireless standard to exceed a peak throughput of 1 Tbit/s per user.

Arguably more interestingly, 6G envisions that totally new services such as telepresence, as a surrogate for actual travel, will be made possible by combinations of graphical representations (e.g., avatars), wearable displays, mobile robots and drones, specialized processors, and next-generation wireless networks. Similarly, smartphones are likely to be replaced by pervasive XR experiences through lightweight glasses, whereby feedback will be provided to other senses via earphones and haptic interfaces. Furthermore, 6G needs a network with embedded trust given that the digital and physical worlds will be deeply entangled by 2030. Toward this end, blockchain also

known as distributed ledger technology (DLT) may play a major role in 6G networks due to its capability to establish and maintain trust in a distributed fashion without requiring any central authority.

Blockchain and Distributed Ledger Technologies

The radical potential of blockchain technology has long spread outside the world of crypto into the hand of the general public. We've all heard through one way or another that it is most likely the most revolutionary technology that is presently available in any known market and that includes the real world as well as the digital space. Blockchain technology is principally behind the emergence of Bitcoin [25] and many other cryptocurrencies that are too numerous to mention [26]. A blockchain is essentially a distributed database of records (or public ledger) of all transactions or digital events that have been executed and shared among participating parties [27]. Each transaction in the public ledger is verified by consensus between the majority of the participants in the system. Once entered, information can never be erased. The blockchain contains a certain and verifiable record of every single transaction ever made. At the point when the block reaches a certain size, it is timestamped and linked to the previous block through a cryptographic hash, thereby forming a chain of timestamped blocks (hence the name blockchain), as depicted in Fig. 1.3.

Blockchain technology is being successfully applied in both financial and non-financial applications. It has the potential to reduce the role of one of the most important economic and regulatory actors in our society, the middleman [28, 29]. Blockchain technology was initially linked to the decentralized cryptocurrency Bitcoin, as it is the main and first application of the network (known as Blockchain 1.0 [30]). However, there exist many other use cases and several hundred different applications besides Bitcoin that use blockchain technology as a platform such as Ethereum.

Ethereum is a type of open software platform that runs on blockchain technology. At its heart lies the so-called Ethereum Virtual Machine (EVM), which is capable of executing code of arbitrary algorithmic complexity [31]. The Ethereum platform can be used not only as a cryptocurrency but also to allow developers to write smart contracts, and program codes stored on a blockchain that are executed when predetermined conditions are met. Ethereum smart contracts allow end-users to interact with next-generation decentralized applications (DApps). As opposed to traditional centralized applications, where the backend code is running on

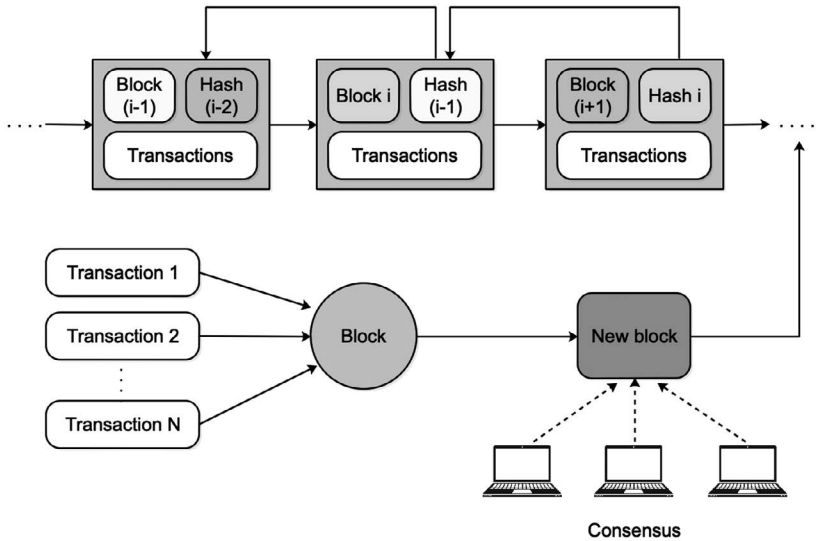


FIGURE 1.3 A graphical representation of blockchain transaction workflow.

centralized servers, DApps are apps whose server-client models are decentralized. DApps run on blockchain networks without a central authority and use decentralized storage protocols. DApps may be used in many other fields by making the process of creating applications much easier and more efficient. For instance, they can be used for realizing non-financial blockchain DApps (e.g., IoT device registration DApp, blockchain-based digital identity application). The rise of Ethereum and smart contracts heralded Blockchain 2.0 [30].

As the hype of blockchain technology advanced, Blockchain 3.0 aims to popularize blockchain-based solutions expanding the traditional sectors (finance, goods transactions, and so on) to government, IoT, decentralized AI, supply chain management, smart energy, health, data management, and education [32, 33]. Therefore, the applications of blockchain have evolved to much wider scopes. However, these new applications introduce new features to the next-generation platforms including key aspects such as platforms interconnection or more advanced smart contracts that provide higher levels of transparency while reducing bureaucracy with self-enforcing code. These new technologies, therefore, promise more decentralized and spontaneous coordination over the Internet between users who do not know or trust each other, often referred to as decentralized autonomous organizations (DAO). DAO exists as open-source, distributed software for executing smart contracts

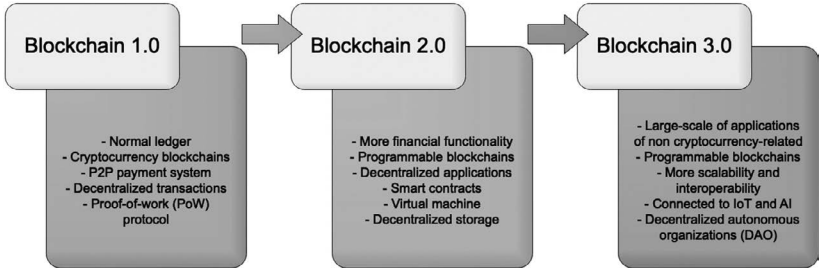


FIGURE 1.4 Evolution of blockchain technology.

built within the Ethereum project. DAO is like a decentralized organization, except that autonomous software agents (i.e., smart contracts) make the decisions, not humans. In a more decentralized setup, the governance rules automatically steer behavior with tokenized incentives and disincentives [34]. In such cases, programmable assets called tokens managed by a special smart contract act as governance rules to incentivize and steer a network of actors without centralized intermediaries [34]. Further, the tokens issued by the DAO enable their respective holders to vote on matters about the development of the organization and make decisions. As a result, the decision-taking process is automated and a consensus is reached among the participants. For illustration, Fig. 1.4 depicts the evolution of blockchain technology from Blockchain 1.0 to 3.0.

The introduction of smart contracts to the blockchain has added programmability to this disruptive technology and has changed the software ecosystem by removing third parties for the administration of (non) business purposes. Although promising, smart contracts and blockchain do not have access to the information outside of their networks (i.e., off-chain data). The blockchain in fact is an enclosed system where interactions are limited to the data available on it. Hence, it is still an open practical problem referred to as the “oracle problem” that is defined as how real-world data can be transferred into/from the blockchain [35]. Toward this end, oracles (also known as data feeds) act as trusted third-party services that send and verify external information and submit it to smart contracts to trigger state changes in the blockchain [36]. Oracles may not only relay information to the smart contracts but also send it to external resources. They are simply contracts on the blockchain for serving data requests by other contracts. Without oracles, smart contracts would have limited connectivity; hence, they are vital for the blockchain ecosystem due to broadening the scope of smart contracts operation.

ADVANCED BLOCKCHAIN TECHNOLOGIES: PRIOR ART AND RECENT PROGRESS

In this section, we review prior research work related to advanced blockchain technologies and, after classifying them into three separate yet interdependent categories, we discuss each one in greater detail. The main branches of our classification are DAO, blockchain oracles, and token engineering.

DAO

The last few years have seen the emergence of DAO in the field of blockchain as a new form for running organizations on the Internet. DAO is novel socio-technical systems that enable a new way of online coordination and decision-making. DAO as a new form of online governance are collections of smart contracts deployed on a blockchain platform that intercede groups of members (humans or machines). In short, DAO may be defined as a group of members with common goals that join under a blockchain infrastructure that enforces a set of shared rules. Typically, the members of a DAO are registered, each with a unique address. They also have a number of governance tokens linked to that address, which are usually required for participation and may play a role in the DAO decision-making process. It is also common that DAO manage resources, e.g., cryptocurrencies, whereby DAO members may decide how to allocate them through a decision system.

The first remarkable DAO was *The DAO*, launched in April 2016 by a group of programmers. The DAO was a sort of hedge fund, in which contributors could directly vote for proposed projects. Investors would exchange Ether for tokens during an Initial Coin Offering (ICO). Then investors would vote for new projects with their votes or tokens. In June 2016, due to an error in The DAO code, an attacker robbed a large part of its funds [37]. Another example of DAO on decentralized finance (DeFi) is MakerDAO², which began in 2015. MakerDAO aims to bring financial stability and transparency to the world economy. This community governs the Maker Protocol, which defines the use of the Dai token, a stable cryptocurrency that avoids financial risk when Ethereum's cryptocurrency value fluctuates. A variety of DAO platforms have recently emerged to facilitate the deployment of DAO in the blockchain by significantly reducing the technological knowledge required

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