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A New Era for Digital Payment Industry Focusing on Cryptocurrencies and Central Bank Digital Currencies

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CANDIDATO

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A mamma e papà,

La mia forza, il mio tutto.

Grazie.

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1. Introduction

1.1 The Origins of the Digital Payments

Digital payments are born as an alternative of cash or check payments. We can define digital payments as a set of many instruments in order to pay for goods or services in an electronical way. The electronic payment ecosystem or e-payment started with era of internet; it wouldn't be this kind of system without internet. The internet history began in 1969 with ARPANET, the military network that was meant to be communication network during the Vietnam War period. However, the main turning point occurred in 1989 when Tim Berners-Lee discovered the so-called "pages" or "sites" that made it easier to access and publish information on the internet.

The concept of digital payment and in particular of credit card is born with Edward Bellamy in his masterpiece Looking Backward.[1] The book introduces the credit cards, even if they seem and work as a debit card. Without considering the utopistic novel the first charge card appeared in 1921 when a charge card was issued to Western Union customers. Soon after, department stores, service stations and hotels also began offering charge cards to customers so they didn't have to travel to their hometown bank.

Along with the development of the internet, online payments began to operate in the 1990s. Established in 1994, Stanford Federal Credit Union was the first institution to offer online banking services to all its customers. Initially, online payment systems were not user-friendly and needed specialized knowledge of data transfer protocol.

[1] Bellamy, E., *Looking Backwards from 2000 to 1887*. Strelbytskyy Multimedia Publishing, 2020.
Looking Backward from 2000 to 1887 is a utopian novel by Edward Bellamy, a journalist and writer from Chicopee Falls, Massachusetts; it was first published in 1888. Although Bellamy's novel did not discuss technology or the economy in detail, commentators frequently compare Looking Backward with actual economic and technological developments.

In the beginning, the major players in the digital payment market were Millicent and Ecash[2], founded in 1995 and 1996 respectively.

Most first generation systems were token-based; token-based systems rely on tokens, sometimes known as e-coins, to give purchasing power. Customers purchase tokens from a broker to pay merchants in general. Following that, merchants submit the tokens they have received to the broker, who then pays the merchants. Instead customers and merchants in account-based systems, the other less common system, both have accounts with a broker or bank, and customers authorize the broker to move funds to merchant accounts.

The motivation behind token-based systems was the overwhelming popularity of cash in the retail commerce. These systems wanted to introduce E-Cash with as many attributes of cash as possible: widespread acceptability, guaranteed payment, no transaction fees and anonymity (O'Mahony 1997)[3]. Examples of such systems are Millicent (developed by Digital Equipment Corporation, nowadays HP in 1995), ECash (developed by DigiCash in 1996), MicroMint and PayWord (developed by R. Rivest and A. Shamir in 1995–96), SubScrip (developed by Newcastle University, Australia in 1996), NetCash (developed at the University of Southern California in 1996) and iKP (developed by IBM in 1997). We also found a few account-based systems: Mondex (developed by MasterCard in 1995), CyberCoin (developed by Cyber- Cash Inc. in 1996) and Mini-Pay (developed by A. Herzberg and IBM in 1997).

After the introduction of the Diners Club card in 1950, the credit card industry began to resemble what we're familiar with today.

In 1951, the Franklin National Bank (presently European American Bank) issued the first modern credit card, which was accepted by local merchants. Within a short period of time over 100 additional banks started issuing cards. Cardholders paid their bills upon receipt, and no fee or interest was charged. Merchants were charged a fee by the issuing bank for any

[2] Chaum D. (1983) Blind Signatures for Untraceable Payments. In: Chaum D., Rivest R.L., Sherman A.T. (eds) Advances in Cryptology. Springer, Boston, MA. https://doi.org/10.1007/978-1-4757-0602-4_18.
eCash software on the user's local computer stored money in a digital format, cryptographically signed by a bank. The user could spend the digital money at any shop accepting eCash, without having to open an account with the vendor first, or transmitting credit card numbers.

[3] Parhonyi R., Nieuwenhuis LJM., Pras A. *The fall and rise of micropayment systems*. In Lammer T, editor, Handbuch E-Money, E-Payment & M-Payment. Heidelberg, Germany: Springer. 2006. p. 343-361 https://doi.org/10.1007/3-7908-1652-3_25.

transaction made on the card. Because these cards could only be used within a limited geographical region, customer volume was low and the banks' profits minimal.

The BankAmericard, founded in 1958, was the first modern-day credit card issued by a third-party bank. The Bank of America, based in California, introduced BankAmericard in 1958, and soon developed an extensive network of licensee banks throughout the United States by licensing a single bank as its local affiliate in each major metropolitan area. Each of the licensee banks assumed the responsibility for enrolling cardmembers in their particular geographical area, as well as for reaching agreements with merchants to accept the card as payment for merchandise or services. The card became Visa in 1977.

Since then, technology has given us the videotex systems of the late-1970s/mid-1980s; online banking and bill pay in 1994; the mobile web payment (WAP) in 1997; and the current wave of mobile payments apps.

Looking at the timeline, without repeating the events already mentioned, in 1997 there were the first mobile payments and first contactless payments[4] and in 1998 PayPal is founded;[5] in 1999 thanks to Ericsson and Telnor Mobil, mobile phones could be used to purchase movie tickets; in 2003 Alibaba launches Alipay in China;[6] in 2007 both the iPhone and the Droid operating system are released and M-PESA creates the first payments system for mobile phones.[7] in 2008 Bitcoin is invented and in 2011 Google Wallet is released. In 2013 WeChat Pay is rolled into the popular messaging platform[8]; in

2014 Apple Pay is launched, followed a year later by Android and Samsung Pay.

To resume in 2020, 90 percent of smartphone users will have made a mobile payment. It’s estimated that by 2017, there will be $60 billion in mobile payment sales.

With the advent of the COVID-19 it will be even easier to see developments about digital and digital payments.

[4] Coca-Cola installs two vending machines in Helsinki that accept payment by text message.

[5] PayPal’s user base grew nearly 10% daily. Tesla CEO Elon Musk and venture capitalist Peter Thiel were among its co-founders.

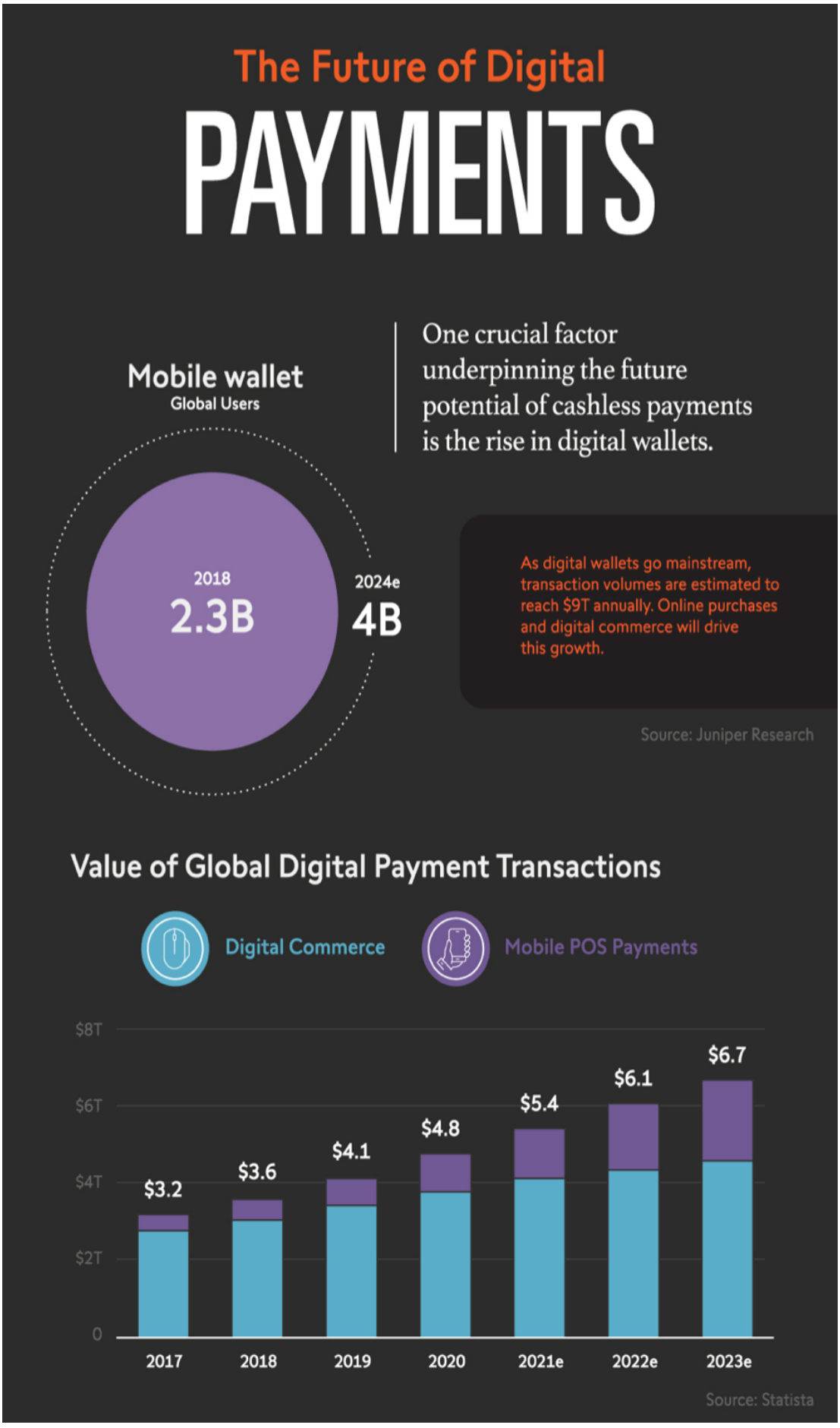
[6] Today, the mobile payment platform has witnessed stunning growth — leveraging digital wallets accepted by merchants in over 50 countries and regions.

[7] Kenya-based M-PESA launched its mobile banking and microfinancing service. Today, it has over 37 million active users on its platform across Africa.

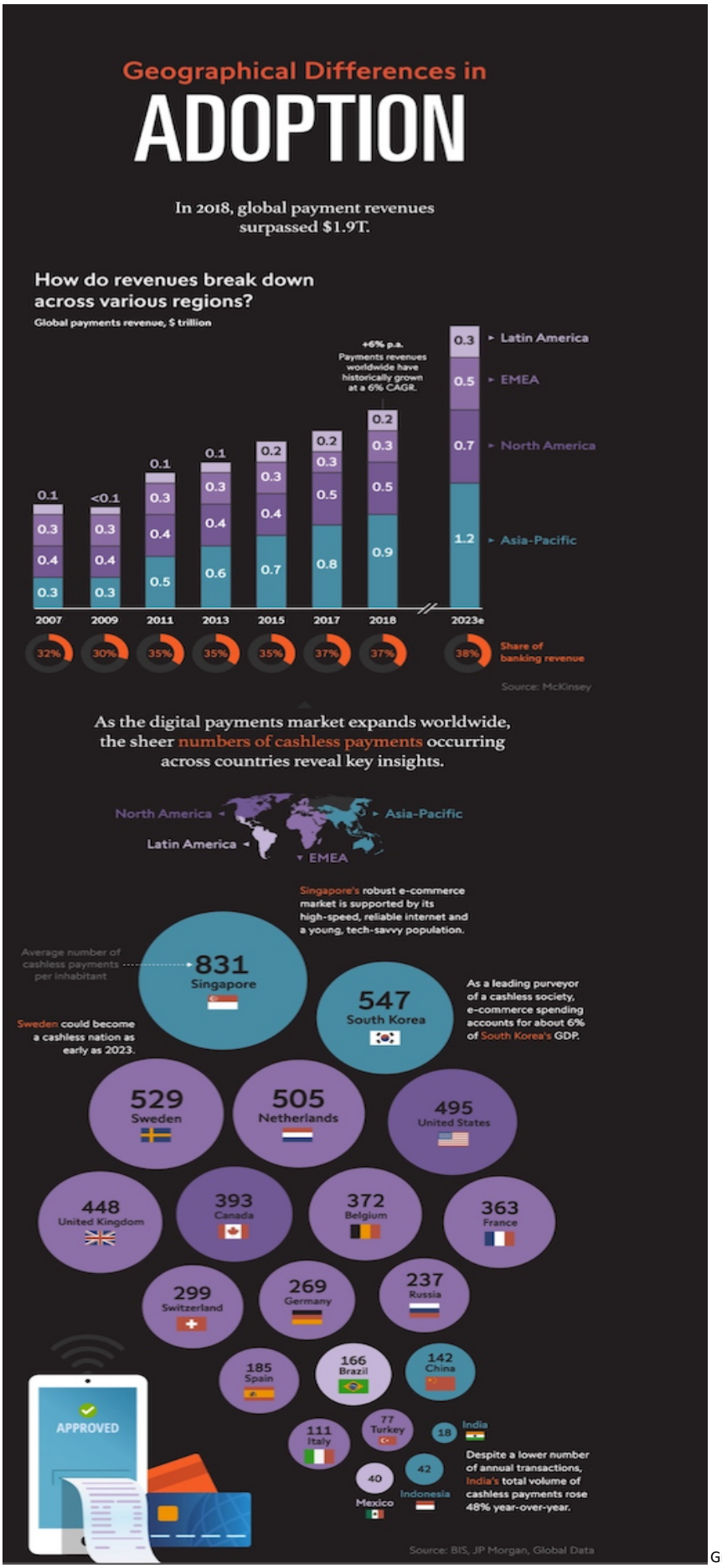
[8] By 2018, it surpasses 800 million monthly active users.

As transactions rise, a number of other technological innovations could be instrumental to shaping the evolution of the digital payments industry. These could be some technological innovations that the industry could offer; messaging-app payments, Facebook Messenger, WhatsApp, and WeChat can leverage the reach of billions of users; Voice-activated commands, paying for gas, groceries, or retail via voice could soar; peer-to-peer (P2P) payments, Bank of America and Visa are investing heavily into P2P partnerships; cryptocurrencies, over one million transactions take place daily on average; biometric payments, smartphone biometric security features could spur traction across digital payments; facial recognition, may soon replace QR codes across retail, transit, and airports in China; crypto wallet adoption, blockchain wallet users are predicted to soar to 200 million by 2030; hardware & in-store interfaces, Square, Stripe, and Clover are driving new mobile processing integrations.

The $4.1T digital payments ecosystem is facing a notable transition, catalyzed by a wave of global advancements and disruption. As the industry continues to widen its reach, consumers and investors alike can benefit from the shift towards a cashless economy.


The Future of Digital
PAYMENTS
Mobile wallet
Global Users
2018
2.3B
2024e
4B
One crucial factor underpinning the future potential of cashless payments is the rise in digital wallets.
As digital wallets go mainstream, transaction volumes are estimated to reach $9T annually. Online purchases and digital commerce will drive this growth.
Source: Juniper Research
Value of Global Digital Payment Transactions
Digital Commerce
Mobile POS Payments
$8T
$6T
$4T
$2T
0
$3.2
$3.6
$4.1
$4.8
$5.4
$6.1
$6.7
2017
2018
2019
2020
2021e
2022e
2023e
Source: Statista

Graphic 1.1


Geographical Differences in
ADOPTION
In 2018, global payment revenues surpassed $1.9T.
How do revenues break down across various regions?
Global payments revenue, $ trillion
+6% p.a. Payments revenues worldwide have historically grown at a 6% CAGR.
Latin America
EMEA
North America
Asia-Pacific
2007
2009
2011
2013
2015
2017
2018
2023e
Share of banking revenue
Source: McKinsey
As the digital payments market expands worldwide, the sheer numbers of cashless payments occurring across countries reveal key insights.
North America
Asia-Pacific
Latin America
EMEA
Singapore's robust e-commerce market is supported by its high-speed, reliable internet and a young, tech-savvy population.
Average number of cashless payments per inhabitant
831 Singapore
547 South Korea
As a leading purveyor of a cashless society, e-commerce spending accounts for about 6% of South Korea's GDP.
Sweden could become a cashless nation as early as 2023.
529 Sweden
505 Netherlands
495 United States
448 United Kingdom
393 Canada
372 Belgium
363 France
299 Switzerland
269 Germany
237 Russia
185 Spain
166 Brazil
142 China
111 Italy
77 Turkey
18 India
40 Mexico
42 Indonesia
Despite a lower number of annual transactions, India's total volume of cashless payments rose 48% year-over-year.
APPROVED
Source: BIS, JP Morgan, Global Data
Graphic 1.2

1.2 Mastercard History

Mastercard had its origins in the late 1940s when several U.S. banks gave their customers specially-issued paper that could be used like cash in local stores.[9] Over the next decade, several franchises evolved in which a single bank in a major city would accept cards as payment with certain merchants they had chosen to work with. In 1966, one of these groups formed the Interbank Card Association (ICA), which later became MasterCard International.

ICA was not dominated by a single bank; member committees were created to run the association. They established rules for authorization, clearing, and settlement. They also handled marketing, security, and legal aspects of running the organization.

At approximately the same time of the introduction of the BankAmericard, a different group of American bankers decided to organize their own network and accept one another's credit cards. On August 16, 1966, these bankers formed the Interbank Card Association (ICA) to organize, manage and oversee the functions associated with credit card payments, including authorization, clearing and settlement. ICA was the umbrella organization for Master Charge, whose name was later changed to MasterCard. In order to identify both merchants and Interbank Card Association members, the symbol "i" was created and placed on cards and at purchasing locations. CA was unlike BankAmericard in that the association was not dominated by one bank but rather governed by consensus among its member banks. Committees supported by an extensive staff were set up to operate and supervise the activities of the association. Besides establishing guidelines for card authorization, clearing and settlement, the Interbank Card Association assumed responsibility for marketing the card, in addition to providing security and legal representation to protect the association's trademark. ICA wasted no time in entering the international market by forming close ties to Banco Nacional de Mexico (Banamex) in Mexico in 1968, and with Eurocard International in continental Europe. During the same year, ICA added the first Japanese members to the association.

ICA created INAS in 1973, a centralized computer network that connects the acquiring member or merchant to the issuing member or financial institution electronically. This

[9] The paragraph 1.2 concerns the history of Mastercard starting from the detailed information on the web site of the company, https://brand.mastercard.com/brandcenter-ca/more-about-our-brands/brand-history.html, and on fundinguniverse.com, http://www.fundinguniverse.com/company-histories/mastercard-international-inc-history/.

computer network allowed the issuer and merchant to interact rapidly and directly, eliminating the need for time-consuming phone exchanges for authorizations. In order to speed up authorization and decrease fraud, ICA made the magnetic strip an international standard on all of its cards in 1974. In 1975, the INET system was established to allow members to trade transactions electronically, eliminating the need to physically transmit charge slips by automating the entire transaction process. In 1979, the International Chamber of Commerce changed the name and trademark of Master Charge to MasterCard to reflect the expansion of the association's services beyond the charge card. Access Ltd. from the United Kingdom, Standard Chartered Bank of South Africa, and the first Australian member joined the association in the mid to late 1970s.

Despite its apparent success, MasterCard's billings and cardholders began to drop in comparison to Visa, another charge card system. Dissatisfied with MasterCard's performance, the ICA board of directors put pressure on the president, John J. Reynolds, to make some long-overdue adjustments. Reynolds' response, however, was deemed unsatisfactory by many board members, and he was requested to quit.

Russell E. Hogg, a senior executive at Macmillan Inc. with substantial experience at American Express Company's Card Division, was named president of the ICA in February 1980 by the board of directors. Hogg immediately implemented sweeping changes within Interbank, taking his cue from the board of directors: he redrew the company's organization chart and created horizontal reporting lines, thereby encouraging employee communication and eliminating the long-standing classic hierarchical structure to which Reynolds had adhered. Several of the company's support divisions were relocated to St. Louis and placed under new supervision; he completely eliminated all jobs dealing with increasing U.S. members because Hogg believed the domestic credit card market was saturated; and he fired eight of the company's highest-ranking officers. Despite these reforms, Hogg's efforts to develop MasterCard into a frontrunner capable of competing with Visa faced an uphill battle.

Despite the fact that the vast majority of credit card issuers in the United States already offered both Visa and MasterCard, Visa had clearly established a worldwide character. BankAmericard was issued under about 20 different names around the world before changing its name to Visa in 1977. Nonetheless, by 1980, the Visa brand had solidified its image and identity. MasterCard, on the other hand, not only struggled to persuade its American

customers that the name change from Master Charge was a good idea, but it also had an identity that was divided by affiliates and a slew of joint ventures in Europe and Asia.

Hogg's plan was to focus on growing and expanding MasterCard's product and service offerings. In 1981, the business launched MasterCard Travelers Cheques and, the following year, the Gold MasterCard card, which was the corporation's first attempt at market segmentation. In order to fight user fraud, MasterCard launched its Emergency Card Replacement program in 1983, which incorporated a laser hologram on all of its cards. It wasn't easy keeping up with Visa, especially with its massive, state-of-the-art, extremely complex electronic communications network. Hogg oversaw the launch of MasterCard's global packet-switching network, Banknet, in 1984, which allows its international card acceptance centers to authorize transactions. At the same time, Hogg decided to merge INET into Banknet and adjust INAS on the system so that authorizations could be transmitted more effectively from one member to the next. MasterCard, like Visa, has introduced an automated point-of-sale initiative to strengthen its global authorization system.

Because affinity cards were such a hit in Japan, the Card Program Development Group was founded in 1985, and the MasterCard BusinessCard was quickly introduced for the worldwide market. There were more than 120 million MasterCard cardholders around the world at the time. In 1986, the first MasterCard office in the Pacific Rim opened in Hong Kong, and one year later, MasterCard arranged to be the first credit card issued in the People's Republic of China. During this time, the company opened a regional office in Miami for Latin America, and cardholders and members were given access to the full range of Banknet services at locations all over the world.

Hogg paid $34 million for Cirrus, the world's largest automated teller machine (ATM) network, in 1988. In addition, MasterCard purchased a 15% stake in Eurocard International. However, just as the 20 millionth MasterCard card was being issued in the Pacific Rim region, and the first MasterCard card was being issued in the Soviet Union, Interbank's board of directors began to express their discontent with Hogg's aggressive management style. The ICA board of 25 directors, which represents over 28,000 member banks, chastised Hogg for wasting money on failed programs like travel vouchers and "smart cards," and accused his management team of supplying inaccurate data on MasterCard's market share of charge-card billings. Hogg abruptly resigned in July 1988 due to disagreements and competing interests among the board of directors.

Alex W. Hart has been named as the new chief executive officer and president by the board of directors. Hart initiated a scheme to alleviate some of MasterCard's management challenges by forming regional boards of directors in Europe, Asia, and South America. He was a former executive vice president of First Interstate Bancorp. with substantial experience in credit card administration. Hart oversaw the debut of the MasterCard ATM Network in 1989. MasterCard also processed a local settlement in Venezuela, marking the first time the corporation has done so outside of the US mainland. Around the same time, the company launched the MasterCard Card Processing Service, which allowed members outside of the United States to utilize a microcomputer to issue cards and buy programs swiftly and cheaply. The MasterCard ATM Network and CIRRUS ATM Network were joined in 1990 to form the MasterCard/CIRRUS ATM Network. MasterCard customers had access to cash at over 50,000 places across the world through this network. Furthermore, Hart negotiated with the organizers of the 1990 World Soccer Cup to become the official card for the tournament; his efforts were well rewarded, as MasterCard was enormously successful in boosting brand recognition by capitalizing on the sporting event with the largest global audience in 1990. At the same time, MasterCom, a two-year-old system for electronically sending photographs of sales slips from one bank to another, was launched as a global service. Banknet began processing cash transactions in India in the same year.

MasterCard launched Maestro, a global debit system for cardholders of participating institutions such as Eurocard International, Eurocheque International, and other ATM networks in the United States, in 1991. Both systems are highly advanced on-line, point-of-sale debit systems that perform authorization, data accumulation, and debiting on an individual's bank account, and were created to compete with Visa's Interlink system. A bank's proprietary debit card is used in both Visa and MasterCard's debit schemes. The card, which has the mark of one or both associations, can be used in place of cash and cheques at locations where their mark is displayed. The primary market for debit transactions is ordinary retail transactions, such as daily purchases at supermarkets, petrol stations, and convenience stores.

In August 1992, MasterCard handled the first Maestro debit transaction. Interlink, on the other hand, had reached 120 million debit card transactions by the same period. Visa's Interlink debit program was far ahead of MasterCard's program by the beginning of 1993, with more than 16 million debit cardholders compared to only 800,000. Because both Visa and

MasterCard know that banks will only need one debit brand and will not agree to use both, competition between the two corporations is heating up.

MasterCard began an intensive advertising campaign in 1991 with the goal of raising its profile and, as a result, gaining a larger percentage of global credit card billings. MasterCard's sponsorship of the World Cup in 1994 included sponsoring 269 matches between 1991 and 1994, which will undoubtedly help to raise awareness of MasterCard's name and services. Its entry into the credit card market for taxi cab rates has also helped it gain a competitive edge over Visa and American Express. MasterCard is, in fact, slowly but steadily gaining market share from Visa.

To better compete with the other major credit cards such as Visa, American Express, Discover, Diners Club, and Carte Blanche, ICA's management structure has been revamped, and MasterCard's marketing strategy, advertising, program development, and electronic communications network have all been improved. However, the credit card industry in the United States is saturated, making it increasingly difficult to sign up new cards. Despite being well-prepared for the future, MasterCard will have to work hard to overtake Visa's advantage in credit card billings.

In 2001 Mastecard Advisors launches, the world's largest payments consulting firm.

In 2002 Mastercard merges with Europay International to create Mastercard International and converts to a private-share corporation.

In 2006 Mastercard transitions to a new corporate governance and ownership structure and begins Mastercard Worldwide trading on the NYSE as MA. Mastercrad Worldwide name and logo are introduced.

Since that, a series of partnership has been established to develop the business, focusing on cryptos and CBDCs. This theme will be analyzed during the next chapters of the thesis.

1.3 Visa History

Visa Inc. is a worldwide financial services firm based in Foster City, California[10]. It permits electronic payments transfers all around the world, with Visa-branded credit cards, debit

[10] The paragraph 1.3 concerns the history of Visa starting from the detailed information on the web site of the company, https://www.visa.co.uk/about-visa/our_business/history-of-visa.html, and on fundinguniverse.com, http://www.fundinguniverse.com/company-histories/visa-international-history/.

cards, and prepaid cards being the most widespread. Visa is one of the most valuable companies in the world.

Visa does not issue cards, grant credit, or set rates and fees for consumers; instead, it sells Visa-branded payment products to financial institutions, which they then use to offer credit, debit, prepaid, and cash access services to its clients. Visa's global network (known as VisaNet) completed 100 billion transactions with a total amount of US$6.8 trillion in 2014, according to the Nilson Report, a journal that studies the credit card industry.

The BankAmericard credit card program was founded by Bank of America (BofA) in September 1958. In 1966, BofA began licensing the BankAmericard service to other banking institutions in response to competitor Master Charge. By 1970, BofA had relinquished direct control of the BankAmericard program, instead forming a consortium with the other BankAmericard issuer banks to oversee it. In 1976, it was renamed Visa.

Nearly all Visa transactions are processed through VisaNet, the company's own data center network, which is based in Ashburn, Virginia, Highlands Ranch, Colorado, London, England, and Singapore. These facilities are well-protected against natural disasters, crime, and terrorism; they can run independently of one another and external utilities if necessary; and they can process up to 30,000 simultaneous transactions and 100 billion computations per second.

Based on annual amount of card payments transacted and number of issued cards, Visa is the world's second-largest card payment company (debit and credit cards combined), having been eclipsed by China UnionPay in 2015.

However, because UnionPay's scale is mostly determined by the size of its native market in China, Visa remains the largest bankcard firm in the rest of the globe, where it controls 50% of total card payments.

Bank of America (BofA) established the BankAmericard credit card program in Fresno, California, on September 18, 1958. BofA had flooded Fresno mailboxes with a first bulk mailing (or "drop," as they were dubbed) of 65,000 unsolicited credit cards in the weeks running up to the debut of BankAmericard. BofA's in-house product development think tank, the Customer Services Research Group, and its chairman, Joseph P. Williams, came up with BankAmericard. In 1956, Williams persuaded senior BofA executives to allow him to conduct the world's first successful mass distribution of unsolicited credit cards (functioning cards, not just applications) to a broad population.

Williams' breakthrough achievement was in bringing the all-purpose credit card to fruition (in the sense that his project was not scrapped outright), not in coming up with the concept. By the mid-1950s, the average middle-class American had numerous revolving credit accounts with various businesses, which was clearly wasteful and cumbersome owing to the necessity to carry multiple cards and pay many bills each month. The financial services industry in the United States had long recognized the need for a unified financial instrument, but no one knew how to create one. There were existing charge cards like Diners Club (which required full payment at the end of each billing cycle) and "at least a dozen attempts to design an all-purpose credit card" by the mid-1950s. Prior attempts, on the other hand, had been made by small banks that lacked the wherewithal to make them work. Williams and his colleagues closely examined these failures in the hopes of avoiding making the same mistakes as those banks; they also looked at existing revolving credit programs at Sears and Mobil Oil to see why they were successful. Fresno was chosen because of its population of 250,000 people (large enough to support a credit card but small enough to keep initial beginning costs low), BofA's market share of that population (45%), and relative isolation, which would limit public relations harm if the experiment failed. Florsheim Shoes, according to Williams, was the first big retailer to take BankAmericard in its stores.

The 1958 test went well at first, but BofA became concerned when it learned that another bank was planning its own drop in San Francisco, BofA's home market. By March 1959, BankAmericard was being accepted by 20,000 merchants in San Francisco and Sacramento; by June, BofA was dropping cards in Los Angeles; and by October, the entire state of California had been inundated with over 2 million credit cards. However, the program had numerous flaws, and Williams (who had never worked in a bank's loan department) quit in December 1959 because he was too serious and trusting in his confidence in the underlying decency of the bank's clients. Twenty-two percent of accounts were late, far higher than the projected four percent, and police departments across the state were flooded with reports of credit card fraud. Politicians and journalists joined the chorus of outrage directed at Bank of America and its new credit card, particularly once it was revealed that the cardholder agreement held customers accountable for all charges, including those resulting from fraud. BofA officially lost over $8.8 million on the launch of BankAmericard, but when the full cost of advertising and overhead was included, the bank's actual loss was probably around $20 million.

After Williams and a few of his closest allies left, however, BofA management concluded BankAmericard could be saved. They made a "huge effort" to clean up after Williams, enforced adequate financial controls, sent an open letter to 3 million homes across the state apologizing for the credit card fraud and other concerns their card had raised, and were eventually able to get the new financial instrument to work. The BankAmericard program became profitable for the first time in May 1961. BofA kept this information hidden at the time, allowing widespread bad impressions to remain in order to stave off competition. This method succeeded until 1966, when BankAmericard's profits were just too large to conceal.

In response to a new competitor, Master Charge, which had been founded by an alliance of several regional bankcard organizations to compete against BankAmericard, BofA began signing licensing deals with a group of banks outside of California in 1966. Due to federal prohibitions that were not removed until 1994, BofA (like all other U.S. banks at the time) was unable to grow directly into other states. Various banks licensed the card system from Bank of America over the next 11 years, resulting in a nationwide network of banks supporting the BankAmericard system. Thanks to BofA and its licensees and competitors, the "drops" of unsolicited credit cards proceeded unabated until 1970, but not before over 100 million credit cards had been delivered to the American public.

BofA licensed the BankAmericard scheme to banks in numerous other nations in the late 1960s, and they began issuing cards with localized brand names. Consider the following scenario:

From 1968 to 1977, a group of Canadian institutions (including Toronto-Dominion Bank, Canadian Imperial Bank of Commerce, Royal Bank of Canada, Banque Canadienne Nationale, and Bank of Nova Scotia) issued Chargex credit cards.

It was known as Carte Bleue in France (Blue Card). The logo can still be found on many Visa cards issued in France today.

Sumitomo Bank issued BankAmericards in Japan through the Sumitomo Credit Service.

For some years, Barclaycard was the only BankAmericard issuer in the United Kingdom. The logo is still used today, however it is not only on Barclays' Visa cards, but also on its MasterCard and American Express cards.

Banco de Bilbao was Spain's sole issuer until 1979.

Dee Hock, a manager of the National Bank of Commerce (later Rainier Bancorp), was chosen to oversee the Pacific Northwest launch of the bank's own licensed version of BankAmericard

in 1968. Despite the fact that Bank of America had nurtured the public perception that BankAmericard's difficult starting issues were now safely behind it, Hock discovered that the BankAmericard licensee program was in horrible disarray due to its haphazard development and growth. For example, when Bank of America was the exclusive issuer of BankAmericards, "interchange" transaction concerns between banks were becoming a severe problem that had never been seen before. Hock offered that other licensees form a group to explore and analyze the different difficulties with the licensee program, and he was quickly appointed chair of that committee.

After months of discussions, the group led by Hock was able to persuade Bank of America that BankAmericard had a promising future outside of the bank. Bank of America relinquished management of the BankAmericard initiative in June 1970. The program was taken over by the various BankAmericard issuer banks, who formed National BankAmericard Inc. (NBI), an independent Delaware corporation tasked with managing, promoting, and developing the BankAmericard system in the United States. In other words, like its competitor Master Charge, BankAmericard was changed from a franchising system to a jointly operated consortium or alliance. Hock was the first president and CEO of NBI.

Bank of America, on the other hand, retains the power to grant and support BankAmericard licenses directly to banks outside the United States. Licenses have been awarded in 15 countries by 1972. When the international licensees ran into problems with their licensing programs, they contacted Hock as a consultant to help them reorganize their relationship with BofA, much as he had done for the domestic licensees. In order to run the international BankAmericard program, the International Bankcard Company (IBANCO), a multinational member business, was created in 1974.

In 1976, the directors of IBANCO decided that merging the various international networks into a single network with a single name would be in the best interests of the company; however, many countries were still hesitant to issue a card associated with Bank of America, despite the fact that the affiliation was purely nominal. As a result, BankAmericard, Barclaycard, Carte Bleue, Chargex, Sumitomo Card, and all other licensees merged in 1976 under the new name "Visa," which kept the unique blue, white, and gold flag. IBANCO became Visa International, and NBI became Visa USA.

Dee Hock, the company's founder, coined the term Visa. He thought the phrase was instantly identifiable in a wide range of languages and regions, and that it also meant universal

acceptance. Bank of America stated in October 2007 that the BankAmericard brand would be revived as the "BankAmericard Rewards Visa."
In 2008 The “V” ticker symbol appears on the N.Y. Stock Exchange as Visa becomes the largest initial public offering in U.S. history.
In 2016 Visa Inc. and Visa Europe reunite as one global company.
As Mastercad, Visa has started several partnerships in recent years focusing on cryptos and CBDCs.

1.4 The Four Party Scheme: How does Visa and Mastercard work

A bank or any other eligible financial institution can join a card scheme, which is a payment network linked to payment cards such as debit or credit cards. When a person joins a card scheme, they gain the ability to issue cards and acquire merchants who are part of that scheme's network. Visa and MasterCard are two of the most well-known card systems, or card brands, in the world. Every year, their cards process billions of transactions.
The next paragraphs introduce that paradigm and explains also which sort of hardware security module (HSM) is required for each of its cryptographic components.
The Four Corners are:
The Cardholder (also named sometimes the consumer),
a consumer who has been granted a card by a financial institution is referred to as a Cardholder (typically, a bank). That cardholder is merely permitted to use the card and does not actually own it. The financial institution that issued the card (sometimes known as the "issuer bank") retains ownership of the card. In most cases, the cardholder is a customer of the issuing financial institution and has a payment card account directly linked to it. However, this is not a rule; in rare cases, this may not be the case (e.g., corporate credit cards or petroleum cards given to employees, for example).

The Merchant,
sometimes known as "The Acceptor," is the consumer's vendor. The merchant sells the cardholder goods or services and accepts card payments. Restaurants, motels, and shops with POS payment terminals are typical examples (Ingenico, Verifone, Telpo, or Vax machines, for

instance). It's worth noting that the Merchant could be an ATM or another totally automated machine. The merchant's principal responsibility is to "accept" payment cards.

The Issuer (usually a bank),

things become more obfuscated at this point, and the average user's experience is generally limited. The financial institution that issues the payment cards to the cardholder is known as the Issuer. It'll probably be a bank most of the time. The Issuer can issue three different types of payment cards, debit card, credit card or prepaid card.

It's worth noting that these payment cards are issued on behalf of a certain card payment network by the issuing bank. Visa, Mastercard, Europay, JCB, American Express, and Discover are examples of card payment networks. They can also be closed-loop private payment networks, such as a domestic scheme.

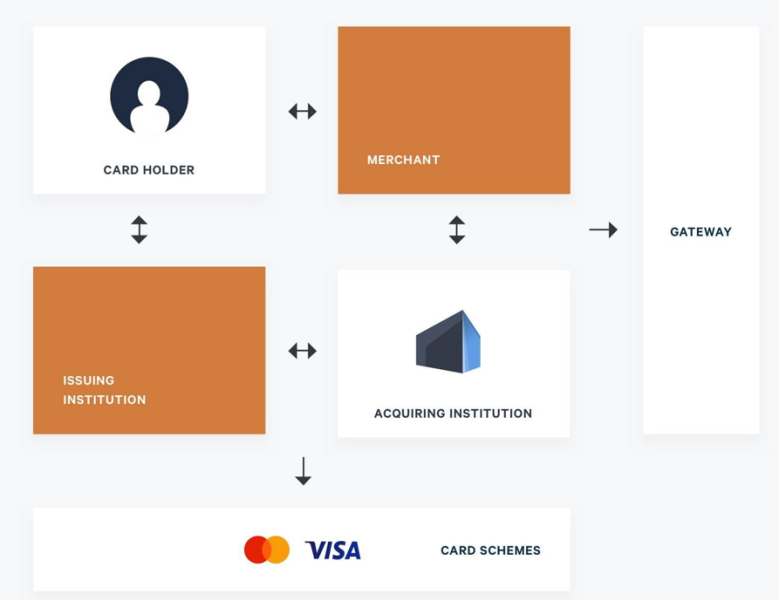
The issuer bank is in charge of both the manufacturing and management of the payment card's cryptography. This is usually done through card integrator businesses.

The Acquirer (usually also a bank),

Is the financial system that gives the Merchant the tools he or she needs to take credit and debit cards. The acquirer can be a third-party system other than the bank with which the merchant has a relationship. In general, the Acquirer will offer the Merchant with hardware and software, as well as the ability to execute transactions.

The Acquirer is responsible for managing the transaction's final return codes (whether they are return authorization codes or not).

Authorizing the Merchant to deliver an item or service will be the responsibility of the Acquirer.



The Merchant links to their Acquirer in the Four Corner Model. The Acquirer communicates with the Cardholder's card issuer via a scheme. It's worth noting that there's usually another third-party functioning as a switch or gateway between the Merchant and the Acquirer.

The Model, while appearing to be simple, involves several flows between the four components.

In most cases, the Issuer will not be the same as the Acquirer. Interbank processes are required in such circumstances. Money transfers and compensation between banks are part of interbank processes. This is a complicated technique that involves clearing and settlement procedures.

The Cardholder's action of purchasing something from the Merchant with their payment card is, of course, the starting point. This initiates an authentication flow from the Merchant to their Acquirer bank, and then from the Acquirer bank to the Issuer bank, via the applicable card scheme network's large network of switches, gateways, and servers.

The authorization flow will eventually produce a favorable or negative outcome (this may be a bit more complicated in reality). The Merchant will usually supply the goods or services after receiving a favorable permission. When you use your card in a local store, you'll notice something similar. The cashier will then supply the products, the ATM will provide the currency, and a receipt will normally be printed, among other things.

It's worth noting that this Four Corner Model frequently devolves into a Three-Corner Model (e.g., a triangle), in which the Acquirer bank is bypassed and the authorization flow is routed directly to the Issuer via switches and gateways.

This reduces the amount of friction on the payment network and speeds up transactions.

Cryptography is, of course, requested between all parties in this model. As a result, many cryptographic keys and activities must be handled in secure settings, such as those provided by a hardware security module (HSM).

The possessor of the card has an HSM, the payment card acts like a micro-portative HSM if it has a chip (which is required in EMV transactions).

For the Merchant the HSM is determined by the Merchant's size as well as the nature of the Merchant. A small Merchant will have POS terminals that are typically outfitted with secure memory and cryptographic-specific hardware. These computers can function as "little HSMs" and are well-suited to the needs of small businesses. This is also true for ATMs that are isolated.

Large stores, such as malls, on the other hand, frequently run "hubs" where payment terminals are controlled and transactions are pooled. Still, under the management of the Merchant, these hubs may be massive, collecting thousands of transactions before sending them to a gateway. To safeguard the transactions they collect, these hubs require network-attached HSMs.

The Issuer needs HSMs when it issues cards, holds keys, and manages the cryptography involved with the cards. It also needs HSMs to authorize the cryptographic flow.

In the model, the Acquirer must manage all the Merchants' financial terminals' keys and process the cryptographic flow towards the Issuer. Acquirers usually need performant and robust HSMs in large quantities.

End-to-end secure transactions are ciphered and secured at every turn in the Four Corner Model. As a result, HSMs and automated key management are critical in such a scenario.

With the ever-increasing volume of transactions and criminal hackers' talents, superfast and super-secure HSMs are currently in demand.

The framework for maintaining multiple keys throughout their life cycles is provided by a contemporary key management system (coupled with HSMs). There are many different types of key management systems and ways to deploy them, but the following are the most significant features for a payments security team to look for:

- Support for a wide range of important types and formats
- For strong key generation, use a certified hardware random number generator (within an HSM)
- A verified, tamper-resistant hardware device is used to protect stored keys.
- Common/difficult tasks can be automated.
- Strong user authentication and logical access controls
- Audit log that can't be tampered with (for compliance audits)

As introduced before is not rare a three-party scheme; a three-party arrangement consists of three principal parties.

The issuer (who has a relationship with the cardholder) and the acquirer (who has a relationship with the merchant) are the same entity under this paradigm. There are no charges between the issuer and the acquirer as a result of this. Because this is a franchise, each market has just one franchisee, which is the model's incentive. Within the brand, there is no competition; instead, you compete with other brands.

Diners Club, Discover Card, and American Express are examples of this system, though in recent years these schemes have joined with other issuers and acquirers to increase their circulation and acceptance, and Diners Club is now a four-party scheme in many locations.

2. Cryptocurrencies and Blockchain

2.1 The Cryptocurrencies Timeline

David Chaum, as stated before, invented ecash, an anonymous cryptographic electronic money, in 1983. Later, in 1995, he put it into practice with Digicash, an early type of cryptographic electronic payments that needed user software to withdraw notes from a bank and select certain encrypted keys before sending them to a destination. This made it impossible for the issuing bank, the government, or any other third party to track the digital currency.

The National Security Agency published a paper, How to Make a Mint: the Cryptography of Anonymous Electronic Cash[11], in 1996, detailing a Cryptocurrency system, first on an MIT email list and then in The American Law Review in 1997. (Vol. 46, Issue 4).

In 1998, Wei Dai published a description of "b-money"[12], characterized as an anonymous, distributed electronic cash system. Shortly thereafter, Nick Szabo described bit gold. Like Bitcoin and other cryptocurrencies that would follow it, bit gold (not to be confused with the later gold-based exchange, BitGold) was described as an electronic currency system which required users to complete a proof of work function with solutions being cryptographically put together and published.

The decision by Facebook to rebrand itself as Meta in last few weeks is actually rather retro. People constructing digital replicas of themselves to interact with other avatars in a virtual environment may appear to be a cutting-edge concept, but the metaverse is a nearly 20-year-old concept that has only been significantly updated.

[11] Law L., Sabett S., Solinas J., How to Make a Mint: The Cryptography of Anonymous Electronic Cash, National Security Agency Office of Information Security Research and Technology Cryptology Division, 18 June 1996.

[12] Dai W., B-Money, (1998), http://www.weidai.com/bmoney.txt.

The origins of digital assets like Bitcoin and Ether, as well as non-fungible tokens, smart contracts, and the thousands of "shitcoins" out there, can be traced back to video games where avatars played and occasionally worked, acting out fantasy lives created by their human creators.

It may seem strange today, when cryptocurrency markets are worth more than $2 trillion, that their ancestors are the once-popular virtual-reality games World of Warcraft and Second Life. Former child actor Brock Pierce, a 2020 presidential contender in the United States, noticed in the early 2000s that gamers preferred to buy tokens rather than do chores to acquire them. "Just because something is not tangible, doesn't mean it's worthless," Pierce explains, recalling how he hired hundreds of individuals in China and South Korea to play video games and collect in-game tokens, which he then sold to lazy customers in the west.

They built a market place for in-game tokens worth $200 billion with William Quigley, the current CEO of the Worldwide Asset eXchange, the largest non-fungible token (NFT) platform. They established the groundwork for the Bitcoin sector in the process.

"After World of Warcraft gold, the intellectual leap required to recognize the value of Bitcoin was very small," Pierce adds.

After an unknown person using the pseudonym Satoshi Nakamoto published a paper in October 2008 outlining suggestions for a new technology called blockchain, which would rely on user consent to operate rather than a centralized body, Pierce became an early adopter of Bitcoin[13]. It would serve as the foundation for Bitcoin, a digital currency that can be "mined" by using computers to solve puzzles. The total number of Bitcoins available is limited to 21 million.

In January 2009, Nakamoto mined the first Bitcoin, thus launching the blockchain network and digital currency. In May 2010, a guy in Florida spent 10,000 Bitcoins (equivalent to more than

[13] Bitcoin is a decentralized digital money that was first introduced in January of 2009. It is based on ideas presented in a white paper by Satoshi Nakamoto, a mysterious and pseudonymous figure. The identity of the individual or people behind the technology is still unknown. Bitcoin promises reduced transaction fees than existing online payment methods, and it is run by a decentralized authority, unlike government-issued currencies. Bitcoin is classified as a cryptocurrency since it is protected by encryption. There are no real bitcoins; instead, balances are recorded on a public ledger that anyone can see (although each record is encrypted). A large amount of computational power is used to verify all Bitcoin transactions, a process known as "mining." Bitcoin is not issued or backed by any banks or governments, and a single bitcoin has no monetary value. Despite the fact that Bitcoin is not legal cash in most parts of the world, it is extremely popular and has sparked the creation of hundreds of rival cryptocurrencies known as altcoins. When Bitcoin is exchanged, it is typically abbreviated as BTC.

$600 million at today's prices) for two pizzas, marking the first time the digital money were used to make a purchase.

It would be an exaggeration to suggest that this made a splash. In the aftermath of the global financial crisis, interest rates had dropped, and central banks had begun enormous bond-buying programs to shore up their economies. However, despite the weak financial backdrop, Bitcoin was beginning to gather traction.

Libertarians and computer geeks were first, followed by currency dealers and other members of the financial trading industry, some of whom were interested by the fact that the technology made it hard to undo or erase previous transactions. Others, such as billionaire investor Michael Novogratz, were drawn to Bitcoin by its scarcity, as evidenced by the 21 million unit limit.

By 2011, Bitcoin had grown in popularity to the point where trading platforms were gaining traction. These early exchanges, such as Mt.Gox, were headquartered in Asia, catering to Asian retail investors who had developed a taste for the asset as a result of their gaming experience. They gave early users the ability to mine and exchange their own currency.

The introduction of trading platforms sparked the first Bitcoin price bubble, with the exchange rate reaching $32 before plummeting to roughly $2 in 2011. According to Max Boonen, the creator of B2C2, one of the largest crypto trading companies today, the price surge put Bitcoin on the map. He points out that the coin has gone through several bubbles, each one higher than the one before it.

"The 'whales' [owners of significant holdings] we know now got into Bitcoin just before the 2013 bubble," explains Boonen. He points out that Greece's debt crisis and subsequent bailout prompted many rich investors to purchase digital coins as a last-resort hedge at the time. "It was the first time that macroeconomic events had an impact on Bitcoin, so it was noteworthy."

However, the rest of the world was mainly uninterested in the debut of Tether[14], the first stablecoin, which was meant to connect the worlds of digital currencies and fiat money. It was also the occasion of Mastercoin's first ever initial coin offering.

[14] Tether (often called by its symbol USDT) is a cryptocurrency that is hosted on the Ethereum blockchain with tokens issued by Tether Limited, which in turn is controlled by the owners of Bitfinex. Tether is called a stablecoin because it was originally designed to always be worth US$1.00, maintaining $1.00 in reserves for each tether issued.

In 2013, the Winklevoss brothers filed the first application for a Bitcoin exchange traded fund, which went practically undetected. Similarly, despite its crucial position in crypto markets today, the Ethereum[15] blockchain and Ether, its native currency, the second cryptocurrency to be developed, failed to make waves in mainstream finance when it was introduced in 2015. The capacity of Ethereum to carry data in its code was a significant breakthrough, and it now serves as the foundation for decentralized finance markets, where algorithms handle transactions, settlement, and other services. This $236 billion market is seen as the cutting edge of finance by many.

Bitcoin's prominence then rose in 2017, when small-time investors all around the world became interested as the price climbed past $20,000 for the first time. Initial coin offerings have also grown in popularity. The following year saw the worst drop yet, ushering in the so-called crypto winter, in which many dismissed Bitcoin as a fad with no future.

The crypto mood improved in March of last year, when the pandemic struck, causing an infusion of hedge funds and family offices into Bitcoin, attracted by its restricted supply. As a result, the narrative about Bitcoin has transformed from a failed currency to a digital version of gold for some. The increase in Bitcoin's price was subsequently bolstered by billionaire hedge fund managers, attracting other institutional investors, banks, and Tesla electric-car mogul Elon Musk.

Cryptocurrency markets have expanded in popularity in the last 18 months, and new assets like NFTs are thriving. Thousands of rival coins, such as dogecoin, have sprung up as a result of the buzz, some of which have dubious value propositions. Blockchains such as Cardano[16],

[15] Ethereum is a blockchain platform that has its own money, Ether (ETH), as well as its own programming language, Solidity.
Ethereum is a decentralized public ledger for validating and recording transactions as a blockchain network. Users of the network can create, publish, monetize, and use applications on the platform, and they can pay with Ether, the network's cryptocurrency. Insiders refer to the network's decentralized applications as "dApps."
As of May 2021, Ethereum is only second in market value to Bitcoin as a cryptocurrency.

[16] Cardano is a third-generation decentralized proof-of-stake (PoS) blockchain platform that aims to outperform proof-of-work (PoW) networks. The infrastructure load of rising expenses, energy utilization, and lengthy transaction times limits scalability, interoperability, and sustainability for PoW networks like Ethereum.
The Ouroboros consensus protocol is used by the Cardano platform. Cardano's Ouroboros protocol was the first PoS system that was not only proven to be secure but was also the first to be informed by sophisticated academic study.

Solana[17], and Polkadot[18], on the other hand, have arisen with the goal of making the technology more efficient.

Bitcoin has had a rocky road and continues to be quite unpredictable. However, the general trend has been upward: from roughly $0.08 in 2010, Bitcoin reached a peak of slightly under $67,000 in October of this year. For a 13-year-old, this is quite impressive.

El Salvador became the first country to recognize Bitcoin as legal cash in June 2021, when the Legislative Assembly voted 62–22 in favor of a bill introduced by President Nayib Bukele to define the cryptocurrency as such.

In August 2021, Cuba passed Resolution 215, allowing it to accept Bitcoin as legal money, circumventing US sanctions.

The government of China, the world's largest cryptocurrency market, made all cryptocurrency transactions illegal in September 2021, capping a crackdown on cryptocurrency that had previously prohibited the operation of middlemen and miners within the country.

2.2 Stablecoins, Introducing Cryptocurrencies

Cryptocurrencies such as stablecoins are a type of cryptocurrency. Stablecoins, unlike bitcoin and other speculative coins, are nominally tied to underlying assets to prevent price volatility. Because of their stability, they have become the preferred currency for purchasing other cryptocurrencies.[19]

Stablecoins originally appeared in 2014, but their popularity has exploded since the beginning of this year. In January 2021, roughly $30 billion in coins were in circulation. This had climbed to more than $130 billion by October 2021.

[17] Solana is a blockchain platform for decentralized and scalable applications. Solana is an open-source project now managed by the Solana Foundation in Geneva, with the blockchain developed by Solana Labs in San Francisco. In comparison to other blockchains like Ethereum, Solana is substantially faster in terms of transaction processing and has significantly cheaper transaction costs.

[18] Polkadot is a one-of-a-kind proof-of-stake coin that aims to provide interoperability between different blockchains. Its protocol connects permissioned and permissionless blockchains, as well as oracles, allowing systems to collaborate under one roof. Polkadot's essential component is its relay chain, which enables network interoperability. For specific use scenarios, it also allows for "parachains," or alternative blockchains with their own native currency.

[19] According to the article of the Financial Times written in October 2021.
Venkataramakrishnan S., “What are stablecoins for — and how stable are they?”, (October 21, 2021). Available at https://www.ft.com/content/16a5f891-0a59-47a1-8e62-b9039d91b8c3.

There are dozens of different types of coins, but only a few account for the majority of the total value: by November 2021, market leader Tether had issued more than $70 billion in tether; another $34 billion was in USD coin, which is jointly run by payment services company Circle[20] and cryptocurrency exchange Coinbase[21].

Customers acquire stablecoins on exchanges, with some of their funds going toward purchasing reserves to provide asset backing for the coins. After that, stablecoins can be used to purchase other cryptocurrencies. Stablecoins can settle transactions far faster than wire transfers of cash. As a result, they are appropriate for both acquiring volatile cryptocurrencies and exiting them if the price falls.

Stablecoins have also found use in decentralized finance, where they can generate revenue for clients in a variety of ways, such as by lending them to other users or providing liquidity for trade. Stablecoins are being used for cross-border transactions in regions where access to dollars is limited, according to reports on the ground.

The vast majority of stablecoins are backed by fiat money. Tether, USD coin, and Binance USD, the third largest cryptocurrency, all claim to be tied to US dollars. Others are linked to the euro and the yen, however they only make up a small portion of the category. Several stablecoins are linked to gold reserves, including Paxos' pax dollar, which is being tested by Meta's Novi digital wallet.

Algorithmic stablecoins make up a lesser but still significant component of these currencies. They are linked to other cryptocurrencies, including stablecoins in some situations. In order to avoid breaking the peg, their algorithms produce and destroy coins. The most valuable of these is dai, which has nearly $6 billion in coins in circulation.

While issuers claim that fiat stablecoins are tied to the dollar, their reserves can be more exotic as a result of less stringent regulation than commercial banks or money-market funds. Different stablecoin operators have provided differing levels of disclosure due to the lack of a necessity to provide clarity about what assets they hold.

[20] Circle is a peer-to-peer payments technology company. It was founded by Jeremy Allaire and Sean Neville in October 2013. Circle's mobile payment platform, Circle Pay, allows users to hold, send, and receive traditional fiat currencies.

[21] Coinbase is a secure online platform for buying, selling, transferring, and storing digital currency.

In the instance of Tether, commercial paper, a type of short-term debt, accounts for over half of its more than $70 billion in assets. Although the portfolio is considered to include at least some international paper, the issuer and even the country of origin of this paper remain unknown. Regulators and others are concerned that the company's claimed reserves are too large, fearing that it would jeopardize financial stability. The rating agency Fitch has cautioned that if stablecoins' commercial paper assets had to be sold off quickly, it might create credit market contagion.

By the end of September 2021, Circle and Coinbase promised that the USD currency would be completely backed by cash and treasuries (government bonds), as evidenced by their monthly attestations. Until March 2020, the USD currency was fully backed by dollars, despite Coinbase's claims to the contrary until August 2021.

Tether has been on authorities' radar for a long time. It settled with New York Attorney General Letitia Jones in February 2021, after she accused the business and its sibling exchange Bitfinex of concealing "massive" losses. Despite its assertions that it kept one dollar for each tether, the examination found that the firm had no access to bank accounts anywhere in the world for periods of time. Neither firm confessed to any wrongdoing.

Because of concerns to consumer protection, monetary policy efficacy, and financial system stability, regulators are increasingly convinced that the entire sector needs to be reined in.

In November 2021, the President's Working Group on Financial Markets, led by the Treasury Department, issued a report urging Congress to pass legislation regulating stablecoins as banks.[22]

The Bank of England has cautioned that stablecoins will face "tough problems" in the United Kingdom. In 2020, the Financial Action Task Force warned that the mechanisms for asset stabilization could open the door to market manipulation.

The Committee on Payments and Market Infrastructures, which is part of the Bank for International Settlements, and the International Organization of Securities Commissions released a report in October 2021 proposing that stablecoins be brought in line with existing payment system and clearing house standards.[23]

[22] The press release available at https://home.treasury.gov/news/press-releases/jy0454.

[23] The press release available at https://www.bis.org/press/p211006.htm.

2.3 Cryptocurrencies, What Are

Cryptocurrencies are digital assets established by a private entity to serve as a store of value that can be used to buy and sell goods and services. A pure cryptocurrency, unlike today's money, is not issued by a central issuing authority and its value is transferred and recorded on an open public ledger called a blockchain. Cryptography also secures and verifies the currency's provenance and transfer of ownership.

There are dozens of cryptocurrencies, with Bitcoin, Ethereum, Binance Coin[24], and Cardano being the most well-known. There is, however, a distinction to be made between a cryptocurrency, sometimes known as a coin, and a token.

A cryptocurrency has its own blockchain; it is the native currency of the blockchain on which it is created and traded. A token, on the other hand, is a monetary unit that symbolizes projects developed on top of an existing blockchain. Ether, for example, is the Ethereum blockchain's native currency. However, Ethereum is used to create a token like Dai. Dai is a stablecoin, which acts as a link between traditional financial markets and the digital world.

Observers are increasingly using the term "crypto assets" to refer to all of the projects now underway in the field. Asset tokens, a crypto-based replica of an existing security and usually a regulated activity, are another enterprise.

The Bank of England estimates that the value of crypto assets will have increased by nearly 200 percent by 2021, from just under $800 billion to $2.3 trillion. Nonetheless, the central bank points out that this is a small part of the $250 trillion global financial system.

In order to better understand how cryptos work a detailed analysis is due.

Starting from the ledger, it is a record of inflows (credits) and outflows (debits) from a single account and across several accounts in any financial accounting system.

[24] Binance Coin is the cryptocurrency issued by the Binance exchange and trades with the BNB symbol. BNB was initially based on the Ethereum network but is now the native currency of Binance's own blockchain, the Binance chain. Every quarter, Binance uses one-fifth of its profits to repurchase and permanently destroy, or "burn," Binance coins held in its treasury. Binance was created as a utility token for discounted trading fees in 2017, but its uses have expanded to numerous applications, including payments for transaction fees (on the Binance Chain), travel bookings, entertainment, online services, and financial services.

Financial ledgers have traditionally been consolidated and regulated by a single dependable source. To record transactions against the bank's accounts, retail banks generally employ a centralized ledger. Bank A cannot see the ledger of Bank B, and vice versa. The clearing and settlement activities of Mastercard for example rely on a transaction ledger.

Underlying protocols that control who can post transactions to the ledger, what kind of transactions can be posted, and so on support the operation of a ledger. These protocols ensure that the transaction history is known, the transaction order is known, and the ledger's transactions are all correct. There must also be an element of trust. Financial activity is less likely to occur for obvious reasons, when possible, transaction parties do not trust the ledger's accuracy or the ledger holder's ability to settle transactions. In a private or centralized ledger, trust is conferred through licenses, reputation and other guarantees.

Each node, or participant, in a system of exchange could have copies of a shared ledger as an alternative to a central trusted authority. Transactions are broadcast to all nodes in this distributed ledger approach, and each node is responsible for logging all transactions.

Cryptography is used in distributed ledgers based on a blockchain to supposedly achieve improved operating efficiencies (lower costs), increased transparency, and immutability.

While this eliminates the requirement for a centralized, trusted authority, ledgers still face several obstacles. For example, each participant couldn’t believe that they are receiving the same transactions—in the same order—as everyone else if transactions are broadcast to several participants. This is performed efficiently using a mathematical variant of "follow the leader," in which nodes fight for the right to submit the next entry or block of entries to the distributed ledger. Computational work or computational effort are terms used to describe this competition.

The cryptographic function—a special type of mathematical formula capable of converting an indeterminate (any length) data message into a string of bits with a fixed length—is a key component in cryptocurrency. A hash is the name given to this output.

Five characteristics of cryptographic functions are useful; every time the same input is used, the same output is produced. You may do this by typing "Signals" into any online SHA 256[25]

[25] SHA-256 stands for Secure Hash Algorithm 256-bit and it’s used for cryptographic security. Cryptographic hash algorithms produce irreversible and unique hashes. The larger the number of possible hashes, the smaller

hash calculator (without quotes or spaces). For a computer to accomplish the hash calculation, it must be rapid and easy; it's impossible to predict the hash; it is impossible to generate two messages with the same hash value; small alterations to the original message will cause the hashing to behave in unexpected ways.

If we attach a number (nonce) to any message, such as Signals0 or Signals76872, our cryptographic function will generate an unpredictable, unique hash for each new nonce.

We can find a nonce that results in a hash that starts with "0" with enough guesses. It's also true that given enough guesses, we may come up with a different nonce that, when attached to the original message, produces a hash beginning with 30 "0"s (followed by 34 additional hexadecimal characters).

This is incredibly beneficial for two reasons. To begin, the only way to find this nonce is to make educated guesses at all possible numbers. Signals 1, 2, 3... until we strike it rich. The chances are one in a billion.

Second, after the nonce has been found, anyone may use our cryptographic function to instantly construct a hash and visually validate it fits the required feature of (in our example) 30 zeroes.

This initial string of 30 zeroes is our Proof of Work, or a characteristic of a hash resulting from a specific message nonce pair that can be easily verified. This is called proof of work.

A blockchain is used to organize most, but not all, cryptocurrencies.

A blockchain is made up of discrete blocks that represent the chain's links. Once joined to the chain, each block represents a verified entry on the distributed ledger.

Each block contains the "winning" nonce in addition to the transactions that make up the message (i.e., that generates a hash achieving the requisite Proof of Work). Other facts gathered in the header must also be included in a block. The hash of the previous block in the chain is contained in the header, which is important.

Because changing any component of any previous message will change the hash and break the chain, the inclusion of the previous hash is what keeps the chain together.

The genesis block is the first block in a blockchain.

The process of creating new blocks and adding them to the blockchain is known as mining.

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the chance that two values will create the same hash. SHA was developed by the U.S. National Security Agency and has thus far not been cracked.

In a distributed ledger, transactions are broadcast to all nodes on the blockchain. As a result, a basket of proposed transactions is ready to be added to a block at any given time.

Miners put together blocks from the available transactions in a basket. They must then compete with all other miners to find the nonce that satisfies the Proof of Work criteria. When a block is discovered, it is immediately shared with the other nodes, who can use the Proof of Work to swiftly validate the solution. The new block is added to the existing blockchain after a predefined number of nodes have validated the solution.

A block reward is earned in various cryptocurrencies when a miner successfully adds a block to the network. This incentive is usually in the form of a predetermined quantity of cryptocurrency.

Mining requires a lot of computational power because each block is essentially a competition to guess the nonce that supplies the Proof of Work. China is home to the world's largest mining facilities which account for up to 70% of all mining. Significant mining operations can also be found in countries like Canada, Sweden, and Iceland, thanks to low-cost alternative energy sources (e.g., geothermal, hydro) and a cold climate that lowers the costs of maintaining server temperatures.

Cryptocurrencies may limit the number of transactions or the quantity of data that a miner can put into a block in specific instances. Each block in Bitcoin, for example, cannot be larger than 1MB. Due to the scarcity, transaction costs are highly reflective in aggregate of consumer demand for transaction processing, which provides an interesting scenario.

We know that transactions are broadcast to the nodes and stored in a pool of future transactions from the beginning. We also know that miners oversee deciding which transactions will be combined into blocks. So, how can a person be certain that his or her transactions are being recorded on the blockchain is the real question. Economic incentives or transaction fees are the answer. Potential transactions broadcast to the nodes may be accompanied by transaction fees, at the discretion of the originator, to encourage miners to include them in their blocks. The transaction originator oversees deciding whether to include transaction fees. The miner receives the transaction fee after a transaction is added to a block and the block is added to the chain.

There are currently over 2,000 cryptocurrencies in use, but the market is primarily concentrated among the top five: Bitcoin, Ethereum, XRP[26], Litecoin[27], and Bitcoin Cash[28]. In fact, these publicly traded assets make up more than 80% of the overall cryptocurrency market.

Bitcoin, the first and best-known decentralized cryptocurrency, is worth mentioning not just because of its market dominance of 64 percent, but also because of its 15K acceptance venues, which include corporations like Overstock, Newegg, and even KFC Canada.

In general, cryptocurrencies are volatile instruments, with price fluctuations that can be large over short periods of time. The fact that bitcoin has no inherent value, has been exposed to massive security breaches, and has little to no regulatory control are all aspects that contribute to its volatility.

Stablecoins are a type of cryptocurrency asset that has evolved in response to this volatility. Stablecoins are coins that are pegged or linked to underlying assets such as fiat currency, gold, and other cryptocurrencies. As a result, the stablecoin's risk profile is more like that of the backing collateral. Stablecoins, despite their advantages, account for less than 2% of the cryptocurrency market.

Cryptocurrency, like other types of digital payment, is usually kept in a digital wallet. These wallets not only provide a secure environment in which to store numerous cryptocurrencies, but they also make transaction creation and receipt easier.

[26] Ripple (XRP) ranks among the most valuable blockchain-based tokens by market capitalization. Ripple is a technology that acts as both a cryptocurrency and a digital payment network for financial transactions. It was first released in 2012 and was co-founded by Chris Larsen and Jed McCaleb. Ripple is a blockchain-based digital payment network and protocol with its own cryptocurrency, XRP. Rather than use blockchain mining, Ripple uses a consensus mechanism, via a group of bank-owned servers, to confirm transactions.

[27] Litecoin (LTC) is a cryptocurrency that was founded in 2011, two years after Bitcoin, by a former Google engineer named Charlie Lee. Litecoin can be used as an avenue for paying people anywhere in the world without an intermediary having to process the transaction.
Measured by market capitalization, Litecoin is the 14th-largest cryptocurrency.

[28] Bitcoin Cash is the result of a Bitcoin hard fork that occurred in August 2017.
Bitcoin Cash was created to accommodate a larger block size compared to Bitcoin, allowing more transactions into a single block. Despite their philosophical differences, Bitcoin Cash and Bitcoin share several technical similarities. They use the same consensus mechanism and have capped their supply at 21 million.
Bitcoin Cash itself underwent a fork in November 2018 and split into Bitcoin Cash ABC and Bitcoin Cash SV (Satoshi Vision). Bitcoin Cash ABC is referred to as Bitcoin Cash now.

Cryptocurrency wallets, on the other hand, have several distinguishing characteristics that set them apart from typical digital wallets. Cryptocurrency wallets, for example, may have a limit on the currencies they will accept.

Another distinction is that cryptocurrency, like a credit card account number, can be stored in either hot or cold storage. The wallet is connected to the internet in hot storage. This means the wallet might be stored in a linked device's browser or app. Because they can be easily transacted with, hot wallets give Bitcoin a certain amount of liquidity. They're also thought to be less secure because they're networked, making them vulnerable to digital theft.

Wallets are not connected in cold storage. This refers to both hardware and "paper wallets." Hardware-based cold storage wallets work like a supercharged thumb drive and may incorporate mechanical buttons for transaction entry. Paper wallets are precisely what they sound like: printed or handwritten records of the private keys and public addresses linked with the cryptocurrency in question.

Consumers can use cryptocurrency exchanges to buy, sell, and trade crypto assets. The number of bitcoin exchanges more than tripled between 2015 and 2018, reaching more than 200.

Consumers can deposit funds using a variety of methods, depending on the exchange and region, such as cards, bank transfers, wire transfers, and so on. Consumers can then use these monies to buy cryptocurrencies on the exchange, much like they could trade in foreign fiat currency.

Because not all cryptocurrencies are available on all exchanges, cryptocurrency traders are likely to have many accounts.

Some exchanges may demand the usage of proprietary wallets and provide merchants with tools to accept bitcoin transactions.

Regulators all throughout the world are concerned about money laundering at the exchange level. Recent Financial Action Task Force FATF guidance affecting inter-exchange transfers of more than $1,000/€1,000 now requires the originating exchange to transmit identifying information about both the sender and the intended receiver with the beneficiary exchange "quickly and securely." This is done not simply to prevent money laundering, but also to make the enforcement of economic sanctions and the blacklisting of suspected terrorists and criminals easier.

2.4 Crypto-assets, Categories and Tokenised Real-World Assets

Because crypto-assets can be created in a variety of ways and involve the ownership of a variety of rights, ranging from a financial interest in a corporation to solely non-financial rights, academic analysis tends to divide crypto-assets into three groups.

- Utility tokens give users access to a company's ecosystem, goods, or services. Utility tokens may also grant holders governance rights in the issuing corporation, such as the ability to vote on functional structure upgrades and generally influence the future of the issuing entity. Pre-payment of license fees or crowdfunding sales on platforms like Kickstarter[29] are common examples of these types of tokens. A utility token that fits into one of these schemes isn't typically thought of as a traditional investment or financial instrument because its goal is to enable the practical use of a blockchain-based ecosystem rather than to generate future revenue flows.
- Security, financial investment tokens are linked to an underlying asset and represent a fractional share of the asset's overall worth, but not the asset itself (e.g. a firm, real estate or collectibles). They provide rights to future profits and are often classified as financial products, securities, financial instruments, derivatives, or collective investment schemes under financial regulatory regimes.
- In their purest form, currency, payment tokens meet the economic characteristics of money, which include serving as a medium of exchange, a store of value, and a unit of account. Currency tokens, which are most famously represented by Bitcoin, have recently grown more diversified, and now include stablecoins like Diem.

Tokenisation of real-world assets other than art is at an early stage, but it has happened in property.

In March 2019, Berlin-based company Brickblock tokenised a real estate vehicle containing a €2m property in Wiesbaden, Western Germany. This was believed to be the first such transaction in Europe in which property shares were registered as digital tokens on the blockchain.

[29] Kickstarter PBC is a platform for creative projects to raise funds. Films, games, and music, as well as art, design, and technology, are all covered. Kickstarter is brimming with bold, original, and imaginative ideas that are brought to life with the help of others.

According to a joint study published in September by Hamburg Commercial Bank and the Frankfurt School Blockchain Center think-tank, an estimated 41 companies in 17 countries, including the United States, Germany, and Switzerland, had been experimenting with property tokenization. According to the research, the market is "still in its infancy."

However, because to a lack of transparency in the market, the study cautioned that this was only a preliminary estimate, and suggested that tokenizing and fractionalizing huge structures into small tradable pieces might make them more accessible to investors.

It has been suggested that tokenization might allow regular investors to participate in an increase in house prices with as little as €1 or $1 without ever owning a home.

RealT, a startup based in the United States, allows investors to purchase fractional tokenised ownership in the country's property market via blockchain. Digital tokens on the Ethereum blockchain are used to track property ownership in places like Detroit.

Other genuine assets, such as high-end whisky collections and limited-edition gins, have also been used to issue tokens.

Another asset that has been tokenized is gold. Paxos, a US-regulated blockchain infrastructure business for digital assets, has launched PAX Gold, a digital asset in which each token equals one fine troy ounce of a London Good Delivery gold bar held in Paxos' safe London vaults.

Investors in PAX Gold, which is a token developed on the Ethereum blockchain, own the underlying gold without having to worry about storing it. Holders of PAX Gold tokens can view the serial number and purity of each gold bar to which their tokens are assigned on Paxos' website.

2.5 Blockchain, How does Cryptos Work

Blockchain is the technology that underpins Bitcoin and dozens of other cryptocurrencies, and it has a lot of promise outside of digital currencies.

Blockchain technology is one of the most talked-about inventions of the twenty-first century. Blockchains, which were originally created to support Bitcoin, now power dozens more cryptocurrencies, and developers are seeking to integrate the technology into industries such as medicine, art, and banking.

A blockchain is a digital log of transactions that is kept by a network of computers and is difficult to hack or alter. Individuals can transact securely with one another without the need for an intermediary like as a government, bank, or other third party.

Cryptography is used to link the expanding list of records, known as blocks. Each transaction is independently validated, time-stamped, and contributed to a growing chain of data using peer-to-peer computer networks. The info can't be changed once it's been recorded.

While Bitcoin, Ethereum, and other cryptocurrencies have gained popularity, blockchain technology has potential uses in legal contracts, property sales, medical records, and any other field that requires the authorization and recording of a series of activities or transactions.

Here's how blockchain, also known as distributed ledger technology, works using the Bitcoin system as an example:

- Bitcoin transactions are entered and broadcast by a network of powerful computers known as nodes.
- Using computer algorithms, this network of thousands of nodes throughout the world competes to confirm the transaction. Bitcoin mining is the term for this. The miner that completes a new block first is rewarded with Bitcoin for their efforts. These fees are made up of newly created Bitcoin and network fees, which are passed on to the buyer and seller. Depending on the volume of transactions, the costs may increase or decrease.
- The sale is added to a block on the distributed ledger after it is cryptographically confirmed. The transaction must next be confirmed by the majority of the network.
- The sale is performed when the block is irrevocably chained to all prior blocks of Bitcoin transactions using a cryptographic fingerprint known as a hash.

As anticipated Blockchain technology was first mentioned in academic papers in 1982, in a dissertation on "the architecture of a distributed computer system that may be built, maintained, and trusted by mutually suspicious organizations." But it was Satoshi Nakamoto's pseudonymous paper "Bitcoin: A Peer-to-Peer Electronic Cash System," published in 2008, that put an academic idea into practice.

2.6 Blockchain Pros and Cons

Here are some of the advantages and disadvantages of blockchain technology when used to cryptocurrencies, using Bitcoin as an example:

Pros

Decentralization

While the Federal Reserve issues and oversees the US currency, no government entity issues or regulates Bitcoin or other cryptocurrencies. This also means that no single government or agency will be able to decide the fate of a public blockchain. The lack of intermediaries lowers costs by eliminating the fees associated with third-party transactions. Another benefit of blockchain is its time efficiency: unlike banks and other intermediaries, the blockchain is open for business 24 hours a day, 365 days a year.

Transparency combined with anonymity

On the Bitcoin blockchain, all transactions are recorded on computers all around the world. Because the address and transaction history of Bitcoin wallets, which house the cryptocurrency, are publicly available, transactions are entirely transparent. However, the owners of each wallet connected to those public addresses remain anonymous and are not recorded.

Precision and safety

There is a lesser risk of error because the transaction involves little human involvement. Each transaction must be approved and logged by a majority of network nodes, making data manipulation and alteration extremely difficult. This also makes it impossible for someone to spend a Bitcoin more than once.

Blockchain applications, both public and private

Blockchain technology has the potential to provide efficiencies that go well beyond digital money. Bitcoin, for example, is based on a public blockchain network, which means that anybody may join. However, many corporate applications may be built on private blockchain networks, which allow enterprises to regulate who joins;

Blockchain supply chain: Companies like IBM Blockchain are already leveraging blockchain technology to provide private network solutions that track product supply chains more accurately. Companies can, for example, utilize the technology to swiftly determine where recalled food products were shipped and sold.

Health-care records: A statewide blockchain network for electronic medical data, according to Deloitte Consulting, "may increase efficiencies and support improved health outcomes for patients."

Smart contracts: Using blockchain technology, contract terms can be automatically altered or updated if a set of circumstances is met.

Some developers are working on blockchain technology that could be used in elections.

Property transactions: Blockchain proponents claim that the technology may be used to sell a wide range of assets, including real estate, automobiles, and investment portfolios.

Underbanked people have options.

In nations and places where financial institutions are weak or corrupt, cryptocurrencies based on the blockchain protocol enable the movement and storage of money without the involvement of unscrupulous third parties.

Cons

Crypto is popular with criminals.

Some of the initial users of new technologies, like many others, have been criminal businesses. They use cryptocurrencies like Bitcoin as payment as well as to target Bitcoin holders for scams because of the secrecy they provide. Customers of Silk Road, a black market online shopping network for illegal narcotics and other unlawful services that was shut down by the FBI in 2013, utilized Bitcoin, for example. Colonial Pipeline paid $4.4 million in cryptocurrencies to unlock its computer systems following a recent ransomware attack.

Meanwhile, Bitcoin investment fraud has increased in lockstep with the currency's recent record ascent. The Federal Trade Commission estimated that almost 7,000 consumers lost $80 million in quick-return scams between October 2020 and March 2021, a roughly 1,000 percent increase in reported losses year over year.

Cryptocurrency usage is still uncommon.

Many more exchanges, brokerages, and payment apps now sell Bitcoin, and many organizations accept Bitcoin as payment, including PayPal and Microsoft. Purchases made with blockchain currencies like Bitcoin, however, are still the exception rather than the rule. Furthermore, users must pay capital gains taxes on Bitcoin sold for purchases on cash apps like PayPal, in addition to any state and local taxes paid on the product or service.

Bitcoin mining consumes a lot of electricity.

Bitcoin mining is done via a network of high-speed computers that use a lot of energy. According to the University of Cambridge Electricity Consumption Index, if Bitcoin were a country, it would be the 34th largest electricity consumer, after the Netherlands and ahead of the Philippines. Elon Musk, the CEO of Tesla, stated in May 2021 that the company would stop accepting Bitcoin until it could find measures to lessen its carbon footprint. Other blockchain developers have come up with less energy-intensive alternatives.

The Bitcoin blockchain is quite sluggish.

The Bitcoin blockchain can handle approximately seven new transactions per second. Visa, the world's largest credit card operator, claims to be able to process 24,000 transactions per second. This creates a scalability issue for the Bitcoin system. This issue is being addressed by other types of blockchain-based cryptocurrencies. Ethereum 2.0, a widely awaited upgrade to the Ethereum system, is predicted to be capable of handling 10,000 transactions per second, up from the present rate of 30 transactions per second.

2.7 Regulation and Digital Strategies

Following Facebook's proposal for the creation of Libra[30], a combination of a private cryptocurrency fixed in value to major fiat currencies mated with its own and other global electronic payment and identification systems, global stablecoins (GSCs) have attracted significant global political, regulatory, and supervisory attention. Aside from the high-profile example of Libra and other possible GSCs, the subject of how crypto-assets should be regulated has been a major concern of regulators and market participants all around the world since the debut of Bitcoin in 2009, and especially during the crypto bubble of 2018.

[30] Libra is a Facebook-created cryptocurrency. The Libra cryptocurrency is designed to function as a low-cost global currency. It will effectively be digital money on your phone that you can use to pay for anything that accepts cryptocurrency. A basket of assets, including major currencies and government debt instruments, backs Libra.

Libra was renamed Diem in December 2020. Diem Association was renamed after Libra Association, which was in charge of monitoring the project, currency, and transactions. The libra token, first proposed in June 2019, was supposed to be a worldwide currency linked to a basket of sovereign currencies such as the US dollar and the euro.

However, the project's controlling body lost significant partners such as Visa and Mastercard after facing severe criticism from regulators throughout the world. Eventually, the group scaled back its ideas, settling for many "stablecoins" backed one-to-one by various government-supported currencies, as well as a single multi-currency token.

Policymaking on digital assets is disjointed around the world, in part because much of it has been a hurry to keep up with market changes and rising dangers. Another factor is the lack of a governing body to oversee a really global effort. While the Basel Committee on Banking Supervision brings together banking regulators to agree on global standards, there is no analogous body for digital assets.

Some argue that the Financial Stability Board, which includes finance ministers from some of the world's largest economies, is insufficiently broad because the issues surrounding digital assets extend beyond banking and into industries such as technology and wider society.

Gary Gensler, the newly appointed chair of the Securities and Exchange Commission (SEC) and former chair of the Commodity Futures Trading Commission (CFTC), is considered as a rallying force for needed worldwide coordination in the United States. He's gone out swinging, first encouraging crypto trading platforms to register with the SEC and then urging Congress to grant him authority to control what he refers to as the "wild west" of markets.

Smaller countries, as well as some US states, have been at the forefront. Some states, such as Wyoming in the United States, are rushing to build digital asset regimes in order to win business. Wyoming has approved more than 20 crypto-related regulations, including a new banking charter tailored for crypto firms. [31]

It is important to analyze the case of Wyoming also in relation with Decentralized Autonomous Organizations (DAOs), that are now on pace to revolutionize the way businesses operate in the future. In light of this, Wyoming recently approved a bill that explicitly recognizes DAOs and grants them the same legal authority as limited liability companies for the first time in US history.

A Decentralized Autonomous Organization (DAO) is a type of organization that is governed by a set of rules. Naturally, all organizations are controlled by a set of rules, but DAOs are unique in that these rules are embedded in the organization's computer software. These computer programs are also decentralized, which means they aren't controlled by a single entity (person, computer, etc).

[31] Aspan M., “How Caitlin Long turned Wyoming into crypto country”, (July 29, 2021) available at https://fortune.com/2021/07/29/caitlin-long-wyoming-crypto/.
About Wyoming Regulation on Cryptos see also
https://www.engage.hoganlovells.com/knowledgeservices/news/wyoming-passes-bill-exempting-some-tokens-from-securities-laws.

Because the system is decentralized, predefined rules cannot be disobeyed, and changes to organizational procedure and structure can only be implemented through a democratic process. DAO-based organizations are those that are striving toward a shared purpose or that wish to promote specific basic principles.

These operations and values are safeguarded, are not subject to human mistake, and are carried out automatically when utilizing DAO software. The DAO was founded in 2016 and was able to generate over $150 million in fundraising in what was at the time the greatest crowdfunding campaign, with the goal of bringing its potential to the rest of the world.

Years later, it appears that this vision is coming true, as Wyoming has become the first US state to recognize DAOs and offer them the same rights as limited liability companies, according to a law that took effect on July 1, 2021.[32] This is a ground-breaking regulation with far-reaching implications for the rest of the blockchain and crypto industries.[33]

Because these regulations are built into a computer system, they are automatically enforced, resulting in increased efficiency. For example, if the organization's rules indicate that a certain system upgrade must occur at a specific time or that certain payments must be made at specific periods, the computer system will automatically carry out these tasks.

However, some countries are cracking down hard, such as China, which labeled all cryptocurrency-related activity "illegal" in September. Meanwhile, El Salvador has made the cryptocurrency Bitcoin legal tender, which is an unusual move.

The regulation of digital assets in the United States is practically as disjointed as it is in the rest of the globe. Because cryptocurrencies are fundamentally securities, Gensler claims that regulation should fall to him. The Federal Reserve also plays a part, most notably by limiting the crypto and digital asset activities of the large banks it already controls.

Futures and other contracts based on digital assets are regulated by the CFTC. State authorities are primarily responsible for the licensing of money transfer enterprises, a category in which some cryptocurrency firms claim to fall.

Dollar-based stablecoins, a type of cryptocurrency whose value is linked to the greenback, are the best hope for national alignment. The US is so concerned about the consequences for

[32] Too analyze the law that took effect see https://www.wyoleg.gov/2021/Introduced/SF0038.pdf.

[33] Ladani N., “DAOs Are Taking Over, With New Wyoming Law”, (October 7, 2021); available at https://finance.yahoo.com/news/daos-taking-over-wyoming-law-194516224.html.

financial stability that the leaders of all of the country's top regulators said that stablecoin regulations are "urgently needed" and that the coin's operators should be regulated like banks.

The United Kingdom's approach is similar to the United States in that existing rules are being applied to items and situations for which they were never designed. Although the UK benefits from fewer local financial regulators, its regulatory history complicates several challenges.

In contrast to the single US definition, the UK has two regimes for "security tokens." A cryptocurrency can be classified as an equity or debt security, a collective investment scheme, or electronic money, depending on its characteristics. It could also be completely unregulated.

Instead Singapore has a long history of being a leader in the field of innovation. Ravi Menon, the president of the Monetary Authority of Singapore (MAS), underlined the city-goal state's to be a key crypto player. "We believe the greatest approach is not to restrict or prohibit these activities," he said.

The Payments Services Act, which was recently passed in Singapore, defines regulated non-security digital tokens, such as Bitcoin, as well as regulated e-money, or stablecoins, whose issuers must have a specific license.

The MAS is in charge of payments regulation, financial conduct and prudential regulation, as well as central banking, and it also has a dual duty to promote the development of the financial industry.

Legal uncertainty persists not only around the world, but also within the EU, leading in diverse approaches to crypto-assets, token offers, and stablecoins.

Rather than focusing just on issues and challenges related to digital assets, the European Commission took a broader approach to the future growth of digital finance and innovation in the EU, adopting a new Digital Finance Package on September 24, 2020[34]; on this date the European Commission released its new Digital Finance Strategy. The draft Regulation on Markets in Crypto-Assets (MiCA), which aims to provide a complete regulatory framework for digital assets in the EU, is one of the Strategy's focal points. The EU Commission has suggested MiCA as a customized regulation for utility tokens and stablecoins, such as payments tokens, asset-backed tokens, and "major" stablecoins (including "global stablecoins").

[34] Financial Stability, Financial Services and Capital Markets Union, European Commission, “Communication on Digital Finance Package” (24 September 2020)

The digital finance plan lays forth broad guidelines for how Europe might assist and regulate the digital transformation of finance in the next years. The strategy outlines four main objectives: reducing fragmentation in the Digital Single Market, adapting the EU regulatory framework to support digital innovation, promoting data-driven finance, and addressing the challenges and risks associated with digital transformation, including improving the financial system's digital operational resilience.

Embracing digital banking will unleash European innovation and open the door to better financial solutions for customers, especially those who are currently unable to obtain them. It opens up new avenues for capital to reach EU enterprises, particularly SMEs.

As a result, increasing digital finance would aid Europe's economic recovery strategy as well as the larger economic revolution. It would open up new financial channels in support of the Green Deal and Europe's New Industrial Strategy.

Because digital finance facilitates cross-border transactions, it has the potential to deepen Europe's economic and monetary union by enhancing financial market integration in the banking union and capital markets union.

A strong and thriving European digital finance sector would bolster Europe's ability to expand our open strategic autonomy in financial services, as well as our ability to regulate and supervise the financial system to defend Europe's financial stability and values.

The Commission recommends a crypto-assets framework to allow for innovation while maintaining financial stability and protecting investors. Crypto-assets are digital representations of values or rights that are electronically transmitted and stored. They can be used as a key to get access to a service, to make payments easier, or to act as financial instruments.

The Commission distinguishes between crypto-assets that are already covered by EU legislation and those that are not. The former will continue to be governed by current legislation, but the Commission recommends a pilot program for market infrastructures that want to attempt trading and settling financial instrument transactions in crypto-asset form. Market participants and regulators should be able to gain experience with DLT exchanges that trade or record shares or bonds on the digital ledger as a result of this.

For previously unregulated crypto-assets, including ‘stablecoins’, the Commission proposes a bespoke regime. The proposed regulation sets strict requirements for issuers of crypto-assets in Europe and crypto-asset service providers wishing to apply for an authorization to provide

their services in the single market. Safeguards include capital requirements, custody of assets, a mandatory complaint holder procedure available to investors, and rights of the investor against the issuer. Issuers of significant asset-backed crypto-assets would be subject to more stringent capital requirements, liquidity management and interoperability requirements.

3. Digital Payments and Cryptocurrencies

3.1 Mastercard, Visa and Cryptocurrencies

When it comes to cryptocurrency, credit card companies aren't waiting to be disrupted.
Visa and Mastercard have spent the last several years developing new products to better integrate cryptocurrency into their businesses.
While incumbents have been a recurring theme as new technologies have developed, the world's largest credit-card corporations, which operate payment networks that span the globe and connect millions of businesses and billions of people, appear to be battling hard to avoid this fate.
"They were growing very quickly. There were millions of customers signing up … and they had billions of dollars of assets on their (platforms).'" In a recent interview with the Financial Post, Cuy Sheffield, vice-president and head of crypto at Visa Inc., said.[35]
As he described it, the problem was that few, if any, shops accepted cryptocurrency directly, leaving much of the value outside of regular payment systems.
Visa, like its biggest competitor, Mastercard Inc., has spent the better part of the last three years rolling out new products to overcome that gap in order to more completely integrate cryptocurrencies into their business.
Mastercard's move in October to allow all banks and merchants on its network to provide crypto services, as well as Visa's establishment of a crypto-consulting service to help clients boost adoption, are both recent developments.
Currently, traditional financial institutions and the crypto realm operate on distinct payment rails, which are industry jargon for the platforms and networks that transmit money from sender to receiver. Transactions and net positions between financial institutions are cleared and settled for those who use credit and debit cards, such as Visa and Mastercard. By contrast, the blockchains on which crypotcurrencies trade are decentralized, relying on a network of thousands of different computers to clear and settle transactions in real time.

[35] Here the link to the article of the Financial Post, https://financialpost.com/fp-finance/cryptocurrency/credit-card-giants-arent-waiting-to-be-disrupted-when-it-comes-crypto.

According to Sheffield, the problem in properly bridging the gap between merchants and cryptocurrencies is not simply connecting them to one monolithic blockchain network, but to several networks.

Sheffield mentioned pre-paid debit cards as an example of how Visa's products might be used. Users can keep Bitcoin on the cards, and when they tap to spend it, the crypto wallet converts the cryptocurrency to cash. In other words, traditional currencies are used to make the transaction.

Visa is experimenting with stablecoins, which would allow consumers to settle transactions in real time, to get crypto onto its own payment rail, according to Shefield. Visa said that it was collaborating with Crypto.com on a pilot project using stablecoins backed by the US dollar.

Mastercard has also made a significant investment in cryptocurrency. This conclusion was solidified in a February blog post in which the firm detailed how they see itself playing a significant role in the future of payments.

“Whatever your opinions on cryptocurrencies — from a dyed-in-wool fanatic to utter skeptic — the fact remains that these digital assets are becoming a more important part of the payments world,” Mastercard's executive vice-president of digital assets, Raj Dhamodaran[36], wrote about it.

“Mastercard will start supporting select cryptocurrencies directly on our network,” he added.

At least five years ago, there was a discussion about studying and incorporating blockchain technology. By the time Bitcoin had a huge surge in 2021, the company had seen this trend play out on their own network as consumers used credit cards to buy crypto assets.

One of their main goods has been cryptocurrency-loaded cards.

The fundamental crypto card works by having a wallet with a variety of currencies and a card tied to that store of value, it's almost like a world-wide multi-currency card that the consumer can use with the help of the card issuer. In this instance, the wallet provider or the bank that issued the card can stamp whatever currency they choose at any given time, and it will be accepted anywhere Mastercard is accepted. Paraphrasing Dhamodharan’s words.

[36] Dhamodharan R., “Why Mastercard is bringing crypto onto its network”, (February 10, 2021); available at https://www.mastercard.com/news/perspectives/2021/why-mastercard-is-bringing-crypto-onto-our-network/.

Dhamodharan offered the purchase of a cup of coffee as an example of how to complete the transaction. The card issuer would convert the crypto into currency on the fly during the transaction. Mastercard would only be able to carry fiat onto the network this way.
“That’s one approach and some of our partners have chosen to ask the consumer to explicitly sell the currency and move into Fiat before they spend,” he said.

3.2 Mastercard Strategy

Mastercard’s strategy appears to be clear; is supporting cryptocurrency and blockchain and is providing new strategies to link his business to these new technologies, in particular with a series of partnerships.
In order to avoid doubts on these new trends Mastercard deals with the topic very clearly.
In these days there’s always a news story about Bitcoin, distributed ledger technology, or blockchain activities. This technology has undeniable potential, and Mastercard has been working on blockchain-related use cases for some years, in accordance with the tradition of leaning into emerging innovation to advance cash displacement and financial inclusion.
Following the departure from the Libra Association membership process in recent past, there has been a lot of interest in learning more about how the company evaluate innovations, programs, and partners with the potential to evolve the payments industry and improve the value.
Mastercard is convinced that for digital currencies to become trusted payment instruments for individuals and businesses, they must provide stability, regulatory compliance, and consumer protections.
Many of today's 2,600 digital currencies fail to meet this requirement.
Mastercard is dedicated to applying its experience in operating various secure, safe, and scalable payment networks around the world to emerging blockchain networks and digital currencies. The same criteria influence company’s participation in these efforts as they do in the networks. They must provide robust consumer protection, including privacy and security of the information and transactions of customers; deliver a level playing field for all stakeholders to contribute to and benefit from blockchain networks, including but not limited to financial institutions, merchants, and mobile network operators; and operate in strict accordance with all applicable laws and regulations, including anti-money laundering laws and

regulations, and in accordance with the economic systems of the countries in which the network works.

Remembering these principles, early patents on integrating cryptocurrencies into Mastercard's network can be seen in the company's recent decision to grant Wirex[37] a primary membership license, making it the first native cryptocurrency platform to issue payment cards directly. Consumers can use the cards to convert their cryptocurrencies into standard fiat currency, which they can then use to make purchases anywhere Mastercard is accepted.

Wirex in partnership with Mastercard, become the first cryptocurrency-native platform to secure Mastercard principal membership. Wirex will be able to issue payment cards directly as a result of its Mastercard's Principal Membership, providing even greater convenience, lower prices, and faster transactions on a platform that strives to make all currencies equal. Wirex will be able to continue to improve its cutting-edge services as a result of the agreement, which will allow consumers to instantaneously buy, hold, trade, and spend different traditional and cryptocurrencies at the best in-market rates on a single platform.

The last partnership is not linked to cryptocurrencies but to Non-Fungible Tokens (NFTs)[38] and Coinbase.

On mid-January, the largest cryptocurrency exchange in the United States announced a partnership with Mastercard aimed at simplifying the process of purchasing non-fungible tokens, which are digital ownership certificates for goods such as art pieces and have seen a surge in popularity in the past year. Since announcing the idea in October, Coinbase has amassed more than 2.5 million users on its NFT queue, making it a serious competitor to major platforms like OpenSea.

"Today, if you want to buy an NFT—such as a digital art piece—you first need to open a crypto wallet, buy crypto, then use it to purchase an NFT in an online marketplace," Mastercard's Raj

[37] Wirex is a digital payment platform with a mission - to make crypto and traditional currencies equal and accessible to everyone.

[38] NFTs, or non-fungible tokens, are cryptographic assets on the blockchain that include unique identification codes and metadata that identify them from one another. They cannot be traded or exchanged for equivalency, unlike cryptocurrencies. This contrasts with fungible tokens, such as cryptocurrencies, which are identical to one another and hence can be used as a means of exchange.

Dhamodharan, who leads the company's digital asset and blockchain partnerships, wrote in a blog post.[39] "We think it should be much easier. That will ensure NFTs can be for everyone."

Under the terms of the agreement, Mastercard would designate NFT as "digital goods," allowing cardholders to buy NFT with both credit and debit cards, a departure from the current situation in the United States, where many crypto purchases can only be made with debit cards. After the purchase, buyers will need a crypto wallet, either from Coinbase or elsewhere, to store the NFT.

Mastercard has been a proponent of cryptocurrency integration, announcing last year that cards would be able to deal in various cryptocurrencies on its network. It signed an agreement with Bakkt[40], a cryptocurrency company spun off from Intercontinental Exchange, in October to allow customers to spend cryptocurrency incentives on their credit and debit cards.

Bakkt adds to Mastercard's cryptocurrency ecosystem, enabling Crypto-as-a-Service, which gives users instant access to cryptocurrency capabilities. Mastercard partners will be able to offer bitcoin solutions thanks to the strength of the Mastercard network and Bakkt's trustworthy digital asset platform. Consumers will be able to buy, sell, and hold digital assets through Bakkt-powered custodial wallets, as well as get simplified issuance of branded crypto debit and credit cards.

Every day, Mastercard is committed to providing a diverse variety of payment options that provide more choice, value, and impact, for Sherri Haymond, executive vice president of Mastercard's Digital Partnerships.[41] The company will not only empower partners to offer a dynamic mix of digital asset possibilities, but also deliver differentiated and relevant customer experiences, thanks to the partnership with Bakkt and principled commitment to innovation.

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[39] Dhamodharan R., "Making it easier for everyone to buy NFTs", (January 18, 2022); available at https://www.mastercard.com/news/perspectives/2022/coinbase-nft-marketplace-making-it-easier-for-everyone-to-buy-nfts/

[40] Crypto trading exchange Bakkt, which counts NYSE-owner Intercontinental Exchange, Inc. (ICE) among its investors, is going public at the New York Stock Exchange (NYSE) via a merger with VPC Impact Acquisition Holdings Inc., a special purpose acquisition company (SPAC). SPAC companies raise money from public markets especially for the purpose of merging with startups in a particular sector and to take them public. The company will be renamed Bakkt Holdings, Inc. Bakkt is a trusted digital asset platform that enables consumers to buy, sell, store and spend digital assets. Bakkt's consumer platform, available through the recently released Bakkt app and to partners through the Bakkt platform, amplifies consumer spending and bolsters loyalty programs, adding value for all key stakeholders within the Bakkt payments and digital assets ecosystem.

[41] See https://www.cnbc.com/2021/10/25/mastercard-says-any-bank-or-merchant-on-its-vast-network-can-soon-offer-crypto-services.html.

Crypto assets are still being sought after by consumers as a means of making ordinary purchases. Nearly half (48%) of respondents in the Bakkt U.S. Consumer Crypto Survey of 2,000 U.S. consumers said they bought cryptocurrency in the first half of 2021, while 32% of those who didn't say they're very or somewhat interested in doing so before the end of the year. According to the Mastercard New Payments Index, 77 percent of millennials are interested in learning more about bitcoin, with 75 percent stating they would use it if they had a better understanding of it.

Nancy Gordon, Executive Vice President, Loyalty Rewards & Payments at Bakkt, considers that Bakkt is tremendously excited to join with Mastercard to deliver crypto loyalty services to millions of users. As brands and retailers want to appeal to younger consumers and their transaction preferences, these new products offer a unique chance to meet growing demand for crypto, payment, and rewards flexibility, is emerging from company considerations.

The commitment of both firms to the crypto industry is shown in this relationship. On October 18, 2021, Bakkt became public on the NYSE under the symbol BKKT, while Mastercard continues to invest in the digital asset area through several initiatives. This includes the purchase of CipherTrace[42], collaborations with leading crypto companies, the development of new platforms to test and support central bank digital currencies, and more.

As stated, the partnership with Coinbase focuses on the NFT market; NFT is one of the trendiest areas in crypto that has attracted growing interest from retailers and institutions outside of the cryptocurrency industry, with a market cap of $44 billion. Walmart Inc. recently filed trademark applications indicating that it plans to sell its own line of NFTs.

The Internal Revenue Service of the United States has also set its sights on the industry. While the laws for taxing tokens are unclear, officials who deal with tax evasion have stated that a crackdown is in the works.

[42] CipherTrace develops cryptocurrency Anti-Money Laundering, cryptocurrency forensics, and blockchain threat intelligence solutions. Leading exchanges, banks, investigators, regulators and digital asset businesses use CipherTrace to trace transaction flows and comply with regulatory anti-money laundering requirements, fostering trust in the cryptocurrency economy.
CipherTrace Cryptocurrency Anti-Money Laundering Report has become an authoritative industry data source. CipherTrace was founded in 2015 by experienced Silicon Valley entrepreneurs with deep expertise in cybersecurity, eCrime, payments, banking, encryption, and virtual currencies.

Even though many more individuals are aware of NFTs, the majority of people do not own them. NFTs, or non-fungible tokens, are digital assets that employ blockchain technology to track who owns them, such as art and baseball cards.

Coinbase, one of the world's largest cryptocurrency exchanges, aims to change that. In October, the business stated that it would launch a new marketplace where users could buy, sell, and collect NFTs.

There are already a few NFT exchanges, but Coinbase, like it did with cryptocurrencies, might make it possible for millions more people to hold NFTs. This shift may allow the NFT market to support more artists and musicians while also providing new methods for consumers to gather digital items and play online games.

Coinbase worked with Mastercard to expand this project, giving customers new payment options and making it easy for anyone to acquire NFTs with a Mastercard card. This partnership is part of Mastercard's larger effort to help the crypto ecosystem by providing additional crypto wallet options and cybersecurity precautions. The NFT marketplace from Coinbase is anticipated to open soon.

The goal at Coinbase is to increase global economic freedom. NFTs, for the company, play a significant role in this aim by enabling more people to participate in the creative economy and earn from their effort.

Creators, for example, can offer social tokens to a fan base. And these tokens serve as a sort of loyalty, allowing to create fan clubs, engage in interactions, and reward followers with virtual concerts, among other things. More importantly, unlike Web2 platforms, there’s the possibility to have a direct interaction with followers while keeping the majority of the economic value.

Coinbase want to make purchasing NFTs as simple as possible. For a large number of people, Coinbase was essentially a crypto onramp. Coinbase enabled millions of individuals to gain access to bitcoin for the first time. So, with Mastercard, the company want to achieve the same thing for NFTs by addressing the pain points to make buying an NFT as simple as possible while ensuring the best possible consumer experience.

Instead Mastercard side is focused on new strategies; Dhamodharan's strategy is clear and on 10th February 2022 stated why Mastercard is bringing crypto onto its network.[43] "We are here to enable customers, merchants and businesses to move digital value — traditional or crypto — however they want. It should be your choice, it's your money."

Whatever the general feelings on cryptocurrencies — whether a die-hard supporter or a skeptic — the fact is that they're becoming a bigger part of the payments industry.

This reality is being demonstrated on the Mastercard network, with users using cards to purchase crypto assets, particularly amid Bitcoin's recent price increase. Users are increasingly using crypto cards to gain access to these assets and then convert them to traditional currencies for expenditure. This data does not represent any specific persons; it is anonymized and aggregated, but the pattern is evident.

Mastercard is preparing for the future of crypto and payments right now, announcing that will begin directly supporting chosen cryptocurrencies on the network this year. This is a significant shift that will necessitate a significant amount of effort. Based on their digital currency principles, which emphasize consumer safeguards and compliance, they will be very selective about which assets they endorse.

The approach to cryptocurrency is simple: it's all about choice. Mastercard isn't advising to start utilizing cryptocurrency. But they're here to help customers, merchants, and enterprises move digital value in any way they desire, whether it's traditional or crypto. It should be their decision; after all, it is their money.

This effort will open a whole new world of possibilities for buyers and businesses, allowing them to deal in a whole different way. This adjustment could attract new clients who are already interested in digital assets, as well as help sellers retain existing customers who want this extra alternative. Customers will also have additional options to save, save, and send money.

The strategy is clear, the network will not support all of today's cryptocurrencies. While stablecoins are more regulated and reliable than in the past, many of the hundreds of digital assets in circulation still need to tighten their compliance mechanisms to satisfy companies' standards. We anticipate that customers and the ecosystem will rally towards crypto assets

[43] Dhamodharan R., "Why Mastercard is bringing crypto onto its network", (February 10, 2021); available at https://www.mastercard.com/news/perspectives/2021/why-mastercard-is-bringing-crypto-onto-our-network/.

that provide stability and security. The aim is to integrate the same stablecoins into the network.

Mastercard is looking for four key items.

First and foremost, company requires consumer protections, such as privacy and data security – the same kind of security that consumers have come to expect from their credit cards. Following that, stringent compliance standards will be required, including Know Your Customer, a requirement aimed at preventing criminal conduct and deceit in payment networks. Furthermore, these digital assets must adhere to local rules and regulations in the areas where they are employed. Finally, consumers will want to use these digital assets to make payments, which is another one of criteria. To join the network, crypto assets must provide the stability that customers want in a spending vehicle rather than an investing instrument.

Mastercard is already working hard to give consumers this cryptocurrency option. Last year, they collaborated with Wirex as stated before and BitPay[44] to develop crypto cards that allow individuals to transact with their Bitcoins. This year, they expanded their ties by partnering with LVL, a new cryptocurrency exchange. These partnerships expand on their many years of crypto collaborations, with many more in the works.

Cryptocurrencies do not pass across the network in any of these circumstances. Crypto partners convert digital assets to traditional currencies on their end before sending them to the Mastercard network. Because of the decision to support digital assets directly, many more shops will be able to accept crypto, which is presently limited by proprietary techniques specific to each digital asset. This adjustment will also eliminate inefficiencies by allowing customers and merchants to make purchases without having to convert back and forth between crypto and traditional currencies.

In addition, Mastercard is actively engaging with several major central banks across the world as they consider plans to introduce new digital currencies, known as CBDCs[45], to provide their

[44] The first and most experienced company in Bitcoin payments, BitPay builds powerful tools for spending, accepting, and building with Bitcoin.
The company has offices in North America, Europe, and South America and has raised over $70 million from top investors including Index Ventures, Aquiline Technology Growth, Menlo Ventures, Founders Fund, and Sir Richard Branson.

[45] CBDC stands for “central bank digital currency,” a new type of currency that governments around the world are experimenting with. What sets a CBDC apart from established currencies is that proponents hope it can use new payment technology, typically a blockchain, to potentially increase payment efficiency and lower costs.

citizens with a new means of payment. The company built a test platform for these institutions last year so they could utilize these currencies in a simulated environment. Mastercard look forward to maintaining his cooperation with governments and assisting them in determining the best approaches to establish these new currencies, based on company's extensive experience in payment systems.

With 89 blockchain patents awarded internationally and another 285 blockchain applications outstanding, Mastercard already has one of the largest blockchain patent portfolios in the payments industry to draw upon in order to make these projects successful.

So much of the work being done in the payments area — in banking, emerging fintechs, and crypto — inspires to advocate for change. And the company is doing everything it can to prepare these players for the next phase of their careers.

Another important partnership made by Mastercard is focused on the Asia Pacific Region.

Mastercard joins forces with Asia Pacific's leading digital currency companies to launch the region's first crypto-linked payment cards.

Consumers and businesses may now spend cryptocurrencies on physical or digital Mastercard payment cards thanks to a trio of collaborations with Amber[46], Bitkub[47], and CoinJar[48].

Three top cryptocurrency service providers in Asia Pacific will develop crypto-funded Mastercard payment cards in collaboration with Mastercard. Consumers and businesses in the Asia Pacific region will be able to apply for crypto-linked Mastercard credit, debit, or pre-paid cards for the first time, allowing them to convert their cryptocurrencies into traditional fiat currency that can be used everywhere Mastercard is accepted.

This new type of currency is still early in its development. Most countries are still only starting to explore the idea, such as the U.S. form of a digital dollar. A few ambitious countries, including China with its digital yuan and South Korea, have already finished a demo and are piloting the technology. But a CBDC has yet to be deployed on a large scale.
Each country exploring a CBDC has its own approach. Several CBDCs are based on the same general principles and blockchain technology underlying Bitcoin, the original cryptocurrency.

[46] Amber AI Group is an electronic technology and trading company that specializes in trading cryptocurrencies, including futures, spot, options, swaps and other derivatives. The company is headquartered in Hong Kong. The company also has its offices in Shenzhen, Seoul, New York and Vancouver. Amber Group creates systems, processes and tools for trading cryptocurrencies and ensuring their liquidity using sophisticated quantitative research and modern technologies. The company was founded in 2018.

[47] Bitkub, based in Bangkok, is a new generation digital asset and cryptocurrency exchange platform that offers advanced exchange services to individuals who intend to buy, sell, and store cryptocurrencies.

[48] Established in 2013, CoinJar based in Melbourne, is one of the longest-running cryptocurrency exchanges. Services allow users to buy, sell, store and spend digital assets.

Amber Group, Bitkub in Thailand, and CoinJar in Australia are the three digital asset service providers with which Mastercard has partnered. All three companies offer cryptocurrency purchase and exchange services in their respective home markets. These are the first cryptocurrency platforms in APAC to join Mastercard's global Crypto Card Program, which was created to make it easier and faster for crypto companies to bring secure, compliant payment cards to market as consumers increasingly seek to fund everyday transactions securely and efficiently with digital currencies.

While some merchants accept payments in digital currencies like Bitcoin or Eth, this is not a popular practice. Cardholders will be able to rapidly convert their cryptocurrencies into regular fiat currency, which can be spent anywhere Mastercard is accepted across the world, both online and offline, rather than sending them directly to a store. Mastercard's network will always accept traditional fiat currencies.

This announcement comes at a time when the Asia Pacific region's interest in cryptocurrencies is at an all-time high. According to the Mastercard New Payments Index, 45 percent of individuals surveyed in APAC say they are likely to explore using cryptocurrencies in the coming year, a significant increase from the 12% who did so in 2021 and higher than the global average of 40%.

To many people, cryptocurrency is an investment, a disruptive technology, or a one-of-a-kind financial tool. As interest and attention from all quarters grows, their real-world applications are increasingly emerging beyond the speculative, said Rama Sridhar, Executive Vice President, Mastercard Asia Pacific, Digital & Emerging Partnerships and New Payment Flows. Through collaboration with these partners that share Mastercard's basic principles of digital currency stability, regulatory compliance, and consumer protection, Mastercard is expanding what's possible with cryptocurrencies to provide customers even more choice and flexibility in how they pay.

The Crypto Card Program is part of Mastercard's digital assets strategy, which aims to give customers, merchants, and enterprises more options when it comes to moving digital value. Mastercard's Crypto Card Program helps participating fintech companies expand and execute by lowering obstacles to entry, expediting the onboarding process, and providing access to specialist fintech and digital asset experts and in-market teams.

Mastercard is committed to using its innovation, experience, and scale to help developing cryptocurrency and digital currency partners build global ecosystems that will modernize payments and change the way individuals and businesses transact.

Another important program developed by Mastercard and the most important competitor Visa is linked to central banks and digital currencies; the Central Bank Digital Currencies, known as CBDCs platform is attracting lots of interest around the payment industry.

Mastercard launched Central Bank Digital Currencies (CBDCs) Testing Platform, enabling central banks to assess and explore national digital currencies.

By replicating a CBDC ecosystem, central banks may examine use cases and test roll-out plans for CBDCs using an innovative virtual and unique testing platform.

Central banks, commercial banks, and technology and advisory businesses have been invited to work with Mastercard to assess the viability of CBDCs in their respective countries or regions.

As the world rushes to embrace digital payments, central banks are looking ahead to see how they might encourage innovation while maintaining monetary policy and financial stability as they issue and distribute money. According to a recent poll by the Bank for International Settlements, 80 percent of central banks surveyed are working on Central Bank Digital Currencies (CBDCs), and roughly 40 percent of central banks have gone from conceptual research to experimenting with concept and design.

For central banks to examine CBDC use cases, Mastercard introduced a special virtual testing environment. The platform allows banks, financial service providers, and consumers to simulate the issue, distribution, and exchange of CBDCs. Central banks, commercial banks, and technology and consultancy firms are asked to collaborate with Mastercard to analyze CBDC technology designs, validate use cases, and examine compatibility with current payment rails available to consumers and businesses.

Mastercard is a pioneer in managing numerous payment rails and bringing together partners to create a level playing field for everyone – from banks to businesses to mobile network operators – in order to bring as many people into the digital economy as possible. Mastercard aims to use its experience to make development of digital currencies more practical, safe, and secure.

Central banks have intensified their study of digital currencies with a variety of objectives, from boosting financial inclusion to upgrading the payments environment. In the investigation

of CBDCs, MasterCard is pushing innovation alongside the public sector, banks, fintechs, and advisory companies, working with partners who share with the company basic values and beliefs. This new platform will assist central banks in making judgments regarding the future of local and regional economies, both today and in the future.

Collaborations between the public and private sectors in the exploration of Central Bank Digital Currencies can help central banks better understand the range of technology possibilities and capabilities available with respect to CBDCs, Sheila Warren, Head of Blockchain, Digital Assets, and Data Policy at the World Economic Forum, said. Central banks can benefit from assistance in understanding the range of options accessible to them in relation to CBDCs, as well as receiving insight into potential prospects.

CBDCs are supposed to have the same value as a country's paper currency and to be backed by the same government. Central banks can issue CBDCs as a digital equivalent of a country's fiat currency in addition to printing money.

While there are several possible operational models, the most common one involves central banks producing and distributing currency, including digital currencies, through commercial banks and other licensed payment providers. Mastercard recognizes that each central bank's approach to CBDCs is unique, and the platform is equipped to determine whether CBDCs are appropriate for a certain region or country. The virtual platform can be tailored to the central bank's specific operating environment, allowing them to with banks and consumers, simulate a CBDC issuance, distribution, and exchange ecosystem, including how a CBDC can interact with existing payment networks and infrastructures – such as cards and real-time payments; demonstrate how a CBDC can be used by a customer to pay for products and services anyplace that Mastercard is accepted; examine different CBDC technology designs and use cases to identify market value and viability more quickly; examine CBDC development activities, such as the technological construction, security, and early design and operation testing.

Mastercard is committed to assisting central banks in their efforts to modernize payments by providing solutions that connect easily with existing payment methods. The company is dedicated to forming public-private partnerships in order to revolutionize the way people and businesses transact.

3.3 Visa Strategy

Almost all financial services firms are ready for a technological upheaval that threatens to disrupt business as usual. Banks are recognizing that going branchless and online-only is the way of the future, while brokerages are attempting to "democratize" investment with simple trading applications and algorithm-based robo-advisors.

This is something Visa is fully aware of. Despite having a market valuation of almost $500 billion, the payments behemoth is attempting to redefine itself. In a world where mobile wallets and real-time payments—from PayPal to the Federal Reserve's fast settlement network—threaten traditional cash and card transactions, the business has backed and partnered with would-be fintech competitors.

Visa president Ryan McInerney said Visa saw the beginnings of this fintech wave coming many years ago, and the company decided early on that they were absolutely going to lean into it.[49] Visa has its fingers all over the quickly digital world of moving money, whether it's deploying its payment system to enable mobile wallets like Apple Pay and Google Pay or collaborating with international remittance startups like Wise[50] and Remitly[51].

This strategy extends to cryptocurrency, which Visa has been pushing in recent years by forming partnerships with companies like Coinbase, Circle, and FTX[52], among others. The idea is to make it easier for users of those platforms to buy goods and services with their cryptocurrencies, while simultaneously providing Visa with new revenue streams from transactions involving a rapidly growing asset class. So far, it appears that the gamble has paid off.

[49] Mashayekhi R., “Visa’s embrace of crypto is starting to pay off”, (July 16, 2021). Available at https://fortune.com/2021/07/15/visa-crypto-payments-fintech-cryptocurrency/.

[50] Wise (formerly TransferWise) is a London-based financial technology company founded by Estonian businessmen Kristo Käärmann and Taavet Hinrikus in January 2011. The mission of the company is to facilitate international transfers of money.

[51] Remitly's vision is to transform the lives of immigrants and their families by providing the most trusted financial services on the planet. Remitly’s mission is to tirelessly deliver the promise to immigrants sending money across the world.

[52] FTX is a Bahamian-based cryptocurrency exchange. FTX is incorporated in Antigua and Barbuda and headquartered in The Bahamas. As of July 2021, the exchange is averaging $10 billions of daily trading volume and has over one million users. FTX operates FTX.US, a separate exchange available to US residents.

Visa announced that it has worked with 50 crypto platforms through card programs that make it easy to convert and spend digital currency at 70 million shops across the world. Furthermore, in the first half of 2021, the company stated that it has enabled over $1 billion in transactions via crypto-linked Visa cards. This follows Visa's announcement in March that it had settled a transaction for the first time using a virtual currency—in this case, the Circle-backed stablecoin known as USD Coin (USDC).

Oliver Jenkyn, Visa's Executive Vice President and Regional President for North America, stated at a fintech conference held by RBC Capital Markets that Visa want to be an on-ramp and an off-ramp between the ordinary world and the crypto world.[53] For example, if you have $1 million in Bitcoin in your account and want to go out and buy a burger, it's really difficult to make that transaction happen. However, if you place a Visa card in front of that crypto wallet or crypto exchange account, you may convert it to fiat currency and buy your burger and fries. This is the concept expressed by Jenkyn.

Visa's crypto platform is still a small part of a company that processed about $11.4 trillion in debit and credit card transactions worldwide in 2020. However, the value of its efforts extended far beyond the fees Visa presently receives from its crypto-linked cards; the business believes it will be in a strong position to benefit if crypto continues to increase in popularity in the future years.

It is an approach in line with Visa's overall fintech strategy—one where "rather than fintech being a disruptive influence, it actually creates more distribution points" for Visa's network, for Bank of America analyst Jason Kupferberg.

Not all elements of Visa's fintech strategy have succeeded. Its proposed $5.3 billion acquisition of financial data provider Plaid[54] fell apart publicly last year after a Justice Department antitrust lawsuit laid bare the company's insecurities about a burgeoning fintech "volcano," as one Visa executive phrased it, that threatened its business.

[53] See note 46.

[54] Plaid is a fintech company that facilitates communication between financial services apps and users' banks and credit card providers. During a transaction, Plaid communicates with your bank to keep your login information private. Plaid claims to use best-in-class encryption protocols to protect users' information.

Visa, on the other hand, has recovered from the snubbed transaction by announcing the acquisition of Swedish fintech firm Tink[55], which provides a Europe-focused open banking platform similar to Plaid's. The transaction is worth more than $2.1 billion.

Moving forward, cryptocurrency is as important a part of Visa's entire digital strategy as any other aspect of the broader fintech revolution—and it's only getting more so. Cuy Sheffield, Visa's head of crypto, announced weeks ago that the company's number of collaborations with crypto startups had surged by more than 40%.

One of the most interesting partnerships made by Visa is with Crypto.com.

Crypto.com is a cryptocurrency exchange app based in Singapore. It is a trademark of Foris DAX Asia Pte. Ltd, a Singapore-based company that is a subsidiary of Foris DAX MT (Malta) Limited. The app currently has 10 million users and 3,000 employees. The company was initially founded by Bobby Bao, Gary Or, Kris Marszalek, and Rafael Melo in 2016 as "Monaco". In 2018, the company was renamed as Crypto.com following a purchase of a domain owned by cryptography researcher and professor Matt Blaze.

Crypto.com became one of the primary catalysts in the widespread adoption of cryptocurrency this year.

They joined Visa's Global Alliance Partner program in March, obtaining primary membership in the process.

Following the announcement of a global cooperation with Visa in March 2021, Crypto.com became a Principal Member of Visa. Crypto.com can bring new crypto-friendly payment experiences to its consumers in main markets because it has a direct interaction with cardholders. This means Crypto.com is cementing the position as the world's largest and most popular crypto card program. The card program now spans 40 countries, including Australia and Brazil, where the company began direct issuance of Crypto.com Visa Card earlier this year.

In order to better understand the importance of this partnership, Visa, on March 2021 announced a key industry first in linking the worlds of digital and traditional fiat currencies: the use of USD Coin (USDC), a US dollar-backed stablecoin, to settle a transaction with Visa via Ethereum, one of the most widely used open-source blockchains. Visa is piloting the

[55] Tink is Europe's leading open banking platform, connecting to 3,400+ banks in 18 countries, with a comprehensive portfolio of API-based products. Products are delivered through an enterprise-grade PaaS where connections to all banks and products are accessible via a single API.

feature with Crypto.com with the intention of expanding the USDC settlement capabilities to more partners later this year.[56]

Support for digital currencies as a new sort of settlement currency is a significant step forward for Visa's network of networks strategy, which aims to improve all types of money transfer, whether on or off the Visa network. Visa is committed on contributing differentiated value to the ecosystem and making cryptocurrencies more secure, useful, and relevant for payments by leveraging its global footprint, collaboration approach, and trusted brand.

Visa has spent the last year creating a digital currency settlement pathway within its current treasury infrastructure, a network that moves billions of dollars every day across thousands of institutions in more than 200 markets and 160 currencies. Visa has established a pilot allowing Crypto.com to transmit USDC to Visa to satisfy a portion of its obligations for the Crypto.com Visa card program, in collaboration with Anchorage, the first federally chartered digital asset bank and an official Visa digital currency settlement partner.

Visa's normal settlement mechanism requires partners to pay in a traditional fiat currency, which can add cost and complexity to digital currency-based enterprises. The ability to settle in USDC will allow Crypto.com and other crypto native enterprises to examine fundamentally new business models without having to use traditional money in their treasury and settlement procedures. Visa's treasury enhancements and integration with Anchorage also improve Visa's capacity to support new central bank digital custodial accounts directly. Visa's treasury enhancements and integration with Anchorage[57] also improve Visa's potential to support new central bank digital currencies (CBDCs) as they develop in the future.

Crypto-native fintechs seek partners that understand their business and the complexity of digital currency form factors, said Visa Executive Vice President and Chief Product Officer Jack Forestell. The announcement marks a huge step forward in the capacity to meet the demands of fintechs operating in a stablecoin or cryptocurrency, and it's just an extension of what Visa does every day, which is safely processing payments in a variety of currencies all over the world.

[56] To see the press release about the topic, visit the link https://www.businesswire.com/news/home/20210329005171/en/.

[57] Anchorage is the premier digital asset platform for institutions. Founded in 2017 to meet the growing need for institutional custody that lets investors safely hold and use crypto, Anchorage has grown into a full-service financial platform and infrastructure provider for the digital asset space.

Kris Marszalek, Co-founder and CEO of Crypto.com said: “We’ve seen record-breaking growth in our business and the broader crypto ecosystem over the last year. To continue accelerating the world’s transition to cryptocurrency, we need partners who understand the opportunity and the tools that will help us get to market faster and more efficiently. Having been a Visa partner for several years, we’re excited to deepen that relationship through our global agreement and to pioneer an exciting world-first in stablecoin payments.”

“Anchorage’s platform has been purposefully built for institutions like Visa to build new products in crypto. We’ve been with Visa every step of the way since 2019 and are extremely pleased to see these first stablecoin payment rails come to life through Anchorage APIs,” said Diogo Mónica, Co-Founder and President of Anchorage.

David Puth, CEO of Centre[58], which oversees the licensing of USDC, said: "Visa is leading the market with its innovative approach to payments in many forms. We are very impressed with their efforts. Having USDC on the Visa network is an outstanding next step in our mission to connect the world using stablecoins built on Centre standards, starting with USDC." [59]

Furthermore, Visa has launched Crypto Advisory Services to assist partners in navigating a new money movement era.

The case for cryptocurrency is becoming more compelling for financial institutions; according to new worldwide data, nearly 40% of crypto owners would switch primary banks to one that offers crypto products.

On December 2021 Visa announced the launch of Visa's Global Crypto Advisory Practice, a new offering inside Visa Consulting & Analytics (VCA) aimed at assisting customers and partners in their cryptocurrency journeys. This comes at a time when digital currencies are gaining traction in the public eye, according to Visa study, awareness of crypto among financial decision makers worldwide is near universal, at 94 percent.

Understanding the crypto ecosystem is a critical first step for financial institutions wanting to attract or keep consumers with a crypto service, shops interested in NFTs, and central banks looking into digital currencies. Visa's global network of consultants and product experts have

[58] An open source technology project designed to create a more inclusive global economy, starting with USD Coin — the world’s second largest stablecoin brought by Circle and Coinbase.

[59] Press release with the words of Kris Marszalek, Diogo Mónica and David Puth available at https://www.visa.sx/about-visa/newsroom/press-releases/visa-network-to-settle-transactions-in-usd-coin-usdc.html.

deep expertise in helping financial institutions evaluate the crypto opportunity, develop concrete strategies, and pilot new user experiences and innovations like crypto rewards programs and CBDC-integrated consumer wallets, thanks to their work with more than 60 crypto platforms.

“We’ve seen a material shift in our clients’ mindset in the last year, from a desire to explore and experiment with crypto, to actually building a strategy and product roadmap,” said Carl Rutstein, Global Head, Visa Consulting & Analytics (VCA)[60].

Visa works with clients and partners in every location today, including the United States, where Visa's team is collaborating with UMB Financial Corporation[61]. “We came to Visa to learn more about digital currency and the use cases that are most relevant for various business lines as we serve our customers in the years ahead,” said Uma Wilson, Executive Vice President, Chief Information and Product Officer at UMB Bank.[62] VCA helped us begin to explore a roadmap of a strategy, from product and partner selection to cross-functional considerations such as Technology, Finance, Risk, and Compliance.”

Client interest in developing cryptocurrency solutions coincides with new Visa research indicating widespread awareness and adoption among consumers worldwide. Visa discovered that roughly one-third of respondents have personally dealt with crypto, either as an investment vehicle or as a medium of trade, in a new global survey titled "The Crypto Phenomenon: Consumer Attitudes & Usage." In addition, nearly 40% of cryptocurrency

[60] Visa Consulting & Analytics (VCA) is the company's payments consulting and advising division. This division consists of a client-facing worldwide workforce of over 700 payments consultants, data scientists, and economists located in over 75 cities. The extensive payments knowledge, breadth of data, and economic intelligence enable Visa to provide actionable insights, recommendations, and solutions that help clients make better business decisions and achieve measurable results.
VCA is in a unique position to assist clients in developing a digital currency strategy, capabilities assessment, business case, and go-to-market plan, which includes build-partner-buy considerations. Subject matter specialists can also help with product development, design and innovation, and marketing strategy and execution.

[61] UMB Financial Corporation is an American financial services holding company founded in 1913 as City Center Bank and based in Kansas City, Missouri. It offers a number of financial services from checking and savings accounts, credit services including home mortgages, auto loans, business loans and credit cards, to investing and wealth management, all are offered to individuals, companies and offers additional customization options for private wealth management.

[62] Press Release available at https://visa.gcs-web.com/news-releases/news-release-details/visa-introduces-crypto-advisory-services-help-partners-navigate.

owners surveyed say they are likely or very likely to transfer their primary bank to one that offers crypto-related goods in the coming year.

According to Terry Angelos, Senior Vice President and Global Head of Fintech at Visa, crypto represents a technological revolution for money movement and digital ownership. As consumers' attitudes on investing, banking, and the future of money evolve, every financial institution will need a crypto strategy.[63]

The Visa study polled nearly 6,000 financial decision makers in eight markets (Argentina, Australia, Brazil, Germany, Hong Kong, South Africa, the United Kingdom, and the United States).

The crypto news is having an effect. Crypto awareness is practically universal, with 94 percent of poll participants with discretion over their home money knowing about it.

A sizable portion of the population uses or invests in cryptocurrency: Nearly one-third of crypto-aware adults owns or uses bitcoin, and the majority (62 percent) think their usage has increased in the last year.

Emerging markets have a higher level of engagement. In emerging nations, 37% of crypto-aware consumers use or own cryptocurrency, compared to 29% in established markets.

Wealth-building and belief in cryptocurrency as the future of financial services are two major motivators. The two most important motivations for holding and using cryptocurrencies are to participate in the "financial method of the future" (42 percent) and to build wealth (41 percent).

Cards that are linked to cryptocurrency and prizes in cryptocurrency are appealing. Bitcoin-linked cards, which allow you to convert and spend crypto at merchants where you purchase in the same manner you may use a debit or credit card, have 81 percent interest among current crypto owners. 84 percent of people are interested in crypto incentives, which allow you to earn cryptocurrency as a reward for using your credit card.

In order to obtain crypto items, customers are willing to move banks. In the next 12 months, 18 percent of survey respondents said they will likely or very likely transfer their primary bank to one that offers crypto-related goods. This is especially true for emerging markets, where the percentage climbs to 24%. Nearly 40% of consumers who already hold cryptocurrencies are willing to make a purchase.

[63] See https://www.businesswire.com/news/home/20210203005124/en/Visa-Expands-Digital-Currency-Roadmap-with-First-Boulevard.

Starting the new year, Visa announced that it will take its crypto services to the next level by teaming with blockchain software company Consensys[64] to create a central bank digital currency onramp (CBDC).

The payments giant plans to launch a "CBDC sandbox" in the spring, where central banks can try out the technology after minting it on Consensys' Quorum network.

The collaboration is the latest step in the burgeoning cryptocurrency market, which has seen central banks compete to produce their own digital coins and big financial institutions dabble in cryptocurrency payments.

Central banks are shifting away from research and toward wanting to experiment with a tangible product, for Visa's Head of Crypto Chuy Sheffield.

CBDCs can be powered by distributed ledger or blockchain-based technologies. CBDC protocols are always "permissioned," meaning central banks maintain monetary and governance authority, unlike cryptocurrencies like bitcoin (BTC-USD) or ether (ETH-USD).

CBDCs are distributed using a "two-tier" arrangement by the partnership. Central banks would build their digital currency using Consensys' Quorum, which would allow them to determine the currency's monetary and governance principles. They then distribute the currency through financial intermediaries such as commercial banks, using Visa's infrastructure.

Some of the benefits of the Visa-Consensys concept were highlighted to Yahoo Finance[65] by Eswar Prasad, a senior professor of trade policy at Cornell University and author of "The Future of Money." It doesn't eliminate payment providers from the mix, and it might open competition for the most efficient, low-cost services.

According to Prasad, central banks will most likely opt to run their own payment infrastructure.

However, he added that Visa's strategy is notable because it might help retain the relevance of its payment network amidst fast-moving developments in the payment industry that could undercut its economic model. Stablecoins and various fintech payment systems are also among the developments.

[64] ConsenSys is a blockchain software technology company founded by Joseph Lubin with headquarters in Brooklyn, New York and additional United States offices in Washington, D.C. and San Francisco.

[65] Hollerith D., Visa, Consensys partner to build tech for central bank digital currencies, in *"Yahoo!Finance"*, January 13, 2022

Since 2019, Visa has been working on crypto-related goods, leveraging its current payment network to create "on-ramps" for buying crypto and "off-ramps" for converting it back to fiat currency.

It now settles transactions in a single stablecoin, and it recently launched a crypto consultancy service for banks considering their own cryptocurrency plans.

In the last year and a half, the number of countries investigating CBDCs has more than doubled. According to the Atlantic Council's CBDC tracker, at least 87 different countries — accounting for 90 percent of global GDP — are considering financial technology in some way. However, within that group, progress and goals have been inconsistent. A CBDC has been established by nine central banks, including Nigeria, the Bahamas, and seven additional Caribbean nations. Meanwhile, China is preparing to introduce its prototype digital yuan to international tourists for the 2022 Winter Olympics next month.

In the meanwhile, major central banks such as the Federal Reserve are unlikely to release a digital coin anytime soon. Fed Chair Jerome Powell indicated during his re-confirmation hearing that the Fed's long-awaited report on CBDCs will be released "in the coming weeks," but specified no specific timeframe.

It's more of an exercise in asking questions and getting feedback from the public than it is in taking views on subjects, Powell explained.

In October, a top executive at eCurrency[66], a firm that has advised the US Treasury and the Federal Reserve on CBDCs for more than a decade, said the Fed and US Treasury need congressional approval before they can issue a central bank-backed token.

CBDCs have a wide range of applications. Visa's global CBDC lead Catherine Gu told Yahoo Finance that two primary factors stand out based on interactions with central bankers.

To begin with, developing countries might leverage technology to provide financial access to previously unbanked populations. Second, CBDCs allow industrialized countries to more efficiently provide stimulus assistance in more focused ways to stimulate an economy, for as by giving the money an expiration date or limiting its usage to specific transactions.

[66] eCurrency pioneered Digital Symmetric Core Currency Cryptography (DSC) technology for central banks to issue and distribute Central Bank Digital Currency (CBDC) securely and efficiently.

However, there is a barrier to CBDC adoption and acceptance among users. It all depends on how much authority the technology gives central banks — and whether that threatens the hegemony of fiat currencies like the US dollar, the world's most widely used reserve currency. While CBDCs may bring new monetary policy tools, it is unclear how democratic countries will set limits.

“You also have this key issue for central banks to address; what will the coexistence of a CBDC look like and how would it integrate within the existing financial system,” Gu added.[67]

[67] See note 62.

4. Central Bank Digital Currencies (CBDCs)

4.1 Central Bank Digital Currencies Overview

Because of the possibilities presented by tokenization and programmability, a new technological era is emerging, allowing for the possibility of closing the gap between the real and digital worlds. As a result, the skin of money is already changing, as evidenced by the fact that physical banknotes can change and be redeemed in Central Bank Digital Currency.

Governments and corporate entities have shown a keen interest in the token economy, particularly that involving Stablecoins and Central Bank Digital Currencies, experimenting with various banking and financial use cases. This wave of digital money innovation is still gaining traction.

The question is: what role will central banks play in this new, innovative environment, and to what extent will its essential values be implemented?

Although the Central Bank Digital Currency is still a relatively new concept, it has already sparked interest from banks interested in learning how Blockchain technology may help them create a new form of money that can be used in both retail and wholesale situations.

Bitcoin, a highly original and unquestionably disruptive concept, was born just over 10 years ago. The latter tries to create a system in which value can be exchanged without the need for a central organization to oversee the system's operation. Bitcoin is a peer-to-peer digital currency system that functions without the use of a trusted middleman and relies on a protocol that is shared by all network users. Bitcoin was just the forerunner of the creation of an innovative ecosystem with new participants and economic logics, i.e. the Cryptocurrency world.

Blockchain, the "under-the-hood" technology of Bitcoin, has grown through time, significantly altering the connection between users who do not trust one another.

By transferring a portion of the physical economy to the Blockchain, these new characteristics have enabled tasks like as the tokenization of physical or monetary assets.

The concept of Stablecoins is at the heart of these new concepts. Stablecoins are privately produced cryptocurrencies that are usually backed up by fiat currency (EUR, USD), actual goods, or financial assets. The peg to the underlying collateralized assets keeps the value of

such cryptocurrencies "stable," as the term implies. Tech behemoths were among the first to express interest in Stablecoin's concept, particularly in the creation of a private money with a global purpose. The market for stablecoins has exploded in the last year. Tether, the most important Stablecoin backed by the dollar, today has a market capitalization of more than 13 billion dollars per dollar.

By depriving governments and central banks of their institutional role, the idea of creating many private currencies could jeopardize the world's monetary and financial dynamics. As a result, there is a critical need for Central Banks to investigate and find opportunities within the new forge offered by Blockchain technology.

After a nearly ten-year journey, the concept of Central Bank Digital Currency emerged, a new digital form of money produced by Central Banks that differs from balances in traditional reserve or settlement accounts. CBDCs are a response to decentralized phenomena like cryptocurrencies, private tokens, and the decline of cash use, addressing the requirement for regulatory control and financial stability while encouraging innovation.

Tokenization is the process of digitally recording an existing physical asset on a distributed ledger, according to the literature. Tokenization assets, such as financial instruments, a basket of collateral, or real assets, are defined by the Financial Stability Board as Distributed Ledger Technology (DLT) tokenization assets.

Asset tokenization is linking or integrating the economic value and rights obtained from pre-existing real assets into digital tokens generated on the Blockchain by convention. The word "Tokenomics" is frequently used to describe a situation in which businesses establish projects based on the exchange and enhancement of real or immaterial tokens.

The Digital Assets traded on the network can represent a variety of things, ranging from real objects to intangible assets like money, patents, and copyrights, among others.

Tokenization could leverage the transformation of all circulating money in CBDC, allowing for the creation of an infrastructure in which the digital token's ownership is guaranteed, the digital token cannot be faked, and it cannot be susceptible to double-spending. Account-based electronic money, on the other hand, uses a database-based reconciliation mechanism to amend ledger entries. From Bitcoin to ICOs to Cryptokitties, the road to Central Bank Digital Currency has been long and winding. Tokenization is here to stay, and thanks to the advent of CBDCs, it may confirm itself as a disruptive phenomenon that is here to stay for the upcoming years.

The design of a CBDC is heavily influenced by the actual needs and expectations of consumers, which is especially true in the retail industry. For a CBDC, four different dimensions can be defined that must be considered in order to meet market demands. This is especially true in the retail industry. As a result, four separate parameters for a CBDC can be defined, each of which must be weighed based on market needs.

Efficiency is intimately tied to the payment system's convenience and its resemblance to cash-like payments (peer-to-peer payments). As a result, the first priority is to define the architecture and duties of the Central Bank and other financial intermediaries (e.g. Commercial Banks, PSP, etc.). The most appropriate option is to define the operational roles of the Central Bank and Commercial Banks, as well as the importance of collaboration with the private sector, in order to provide consumers with a reliable payment service.

Accessibility, this is where the decision to build an account-based or token-based infrastructure comes from, two different approaches that will be discussed in detail in the following paragraphs. The design option should be centered primarily on the system's accessibility, so that it may be developed as inclusively as possible and, in whatever configuration, be able to preserve users' privacy, like how currency transactions are done now. The two possible accessibility models must be thoroughly investigated in order to determine which of the two best meets the CBDC's development needs.

Resilience, when establishing a CBDC, one of the most important factors to consider is the resilience and robustness of network operations. The CBDC must be built on either standard banking infrastructures or Distributed Ledger Technology. This decision has a significant impact on the infrastructure's structure and governance administration, which might be centralized or decentralized.

Interoperability, this dimension must be taken into account in order to ensure the potential of interaction between different CBDC systems; as a result, it has an impact on a higher-level layer of CBDC design decision.

CBDCs have the potential to enhance existing currency's functionality, making numerous payment use cases more efficient and serving as a digital substitute for cash money. CBDC's ability to provide these benefits will be mainly determined by its design.

CBDCs could improve trust, efficiency, and payment functionality for a variety of use cases and players, including these features.

Retail, CBDCs would provide a new option for digital transactions, instant peer-to-peer payments, and physical transactions, among a plethora of payment options already in use worldwide for the retail market (e.g. cash payment, credit, debit, etc.). They may also help to cut costs and broaden payment options.

Wholesale, today, bulk payments are made through national payment systems, and transactions are usually made through compensation interbank utilizing the Central Bank's currency and real-time gross settlement systems (RTGS). The CBDC concept could help institutions gain broader and more diverse access to high-value payments, as well as exploit the emergence of new wholesale financial infrastructure.

Cross-border, after the setup and access mode of a CBDC are established, the question of whether it can be utilized solely locally or internationally arises. CBDCs could establish more direct monetary ties at the international level, reducing risk and improving inefficiencies imposed by today's international banking model, all while increasing competition in foreign accounts and boosting financial market integration and inclusion.

CBDCs have the ability to restructure the Wholesale Payments System, which is still dependent on existing financial infrastructures, the Retail Payments System, which allows for new features and capabilities for end users, and the Cross-border System, which addresses the majority of present difficulties.

One option for CBDC design envisions the Bank as the entity responsible for all CBDC-related services. It should supply all of the essential technology for accounting and CBDC transactions. Additionally, the Bank shall provide all retail services, such as customer onboarding through KYC procedures, user interface, and funds custody, so that CBDC can be used to pay and transfer in stores and online.

However, such a model might possibly overburden the Central Bank's operational function, as it becomes accountable for all processes and risks, harming the CBDC's development in an atmosphere of competition and open innovation driven by private companies.

For these reasons, private sector participation in a CBDC system has various advantages; it allows a wider range of service providers. The participation of established financial service providers would lend legitimacy to CBDC and make it easier for their existing consumers to use it. Furthermore, allowing newer or smaller service providers to participate could encourage innovation and competition while also increasing consumer service and overall system resilience.

The presence of a larger number of service providers may improve the ecosystem's resilience and lessen the ecosystem's reliance on a single important source. Many private-sector companies already have extensive experience with consumer and commercial customer service, as well as the ability to communicate with them directly.

Stablecoins existed prior to the advent of the CBDC, generating a lot of curiosity from the public and a lot of skepticism from governments and central banks. For example, take the instance of Libra Coin, a Facebook developed private stablecoin that has dramatically modified its economic and architectural model in response to government criticism, particularly from the SEC (US Securities and Exchange Commission) in the United States.

In any case, the creation of a CBDC should consider if the potential benefits could be accomplished more effectively by allowing the private sector to develop new innovative arrangements including the world of Stablecoins.

This is a possibility, but there are a variety of potential drawbacks that must be considered.

The majority of Stablecoins are created and managed by private companies that back their value with Fiat Money or other assets held as collateral. Liquidity issues may develop if 100 percent support is not observed, as there may be no total assurance on the reserves held by the private organization.

Stablecoins would need to be regulated, which is difficult because it is unclear where such instruments may be placed. In fact, while CBDCs are issued by institutional participants and thus regulated ahead of time, Stablecoins are controlled by private businesses that may or may not always follow the present regulatory framework.

The cohabitation structure for Stablecoins and CBDCs, as well as the linkages and interconnections between these two forms of assets, are currently unknown.

The usage of Stablecoins instead of official currencies carries an inherent risk for governments and financial institutions.

CBDCs are a new type of money that allows individuals and businesses to make electronic payments with virtual currency issued by a central bank. This paradigm change could have an impact on the banking system's structure and how the Bank achieves its fundamental goals of maintaining monetary and financial stability.

CBDCs could help monetary policy be transmitted more effectively through particular channels, but the advantages must be balanced against the hazards, such as the potential consequences of banking disintermediation on credit supply. Families and businesses would

have to change some of their funds from bank deposits into Central Bank money in the form of CBDC if they only kept and utilized CBDCs for payments, therefore some disintermediation would be unavoidable. A significantly greater or faster shift from deposits to CBDC, on the other hand, might have substantial repercussions for the amount and cost of credit provided by the banking sector to the economy, as well as how the Bank achieves its objectives.

The implementation of CBDCs, for example, could push banks to respond by hiking interest rates on customer deposits, which are currently negative. In reality, while CBDCs' prospective configurations portray commercial banks as direct-to-user distribution channels, the possibility of implementing traditional banking models, such as fractional reserve banking, which have been the pillars of the banking system until now, may no longer be possible. The greatest concern, from this perspective, is that the shrinking of banks' balance sheets will influence lending availability, thereby jeopardizing financial stability.

For all of these reasons, it's critical to assess all of the opportunities and hazards, as well as to employ the macroeconomic tools at hand to mitigate any potential systemic threats.

There will be a few criteria that influence the level of these hazards, as follows, to offset and restrict as much as possible the potential risks outlined in the preceding paragraph.

Whether or not the CBDC pays interest; a non-interest bearing CBDC is less appealing for customer deposits, and so is less likely to become widely adopted. Uncompensated CBDCs will have a less impact on banking system disintermediation since families and companies will have less motivation to move their money from bank deposits to CBDCs.

Meanwhile, a remunerated CBDC might offer Central Banks with new tools to help them transmit monetary policy to deposit rates more quickly and completely. Remuneration, on the other hand, may boost the potential for greater disintermediation of the banking system by incentivizing households and businesses to put more of their money into CBDC.

The value of CBDC to insured depositors; FITD protects deposits of less than €100,000. (in Italy). Furthermore, consumer deposits are insured by specific insurance plans across Europe. However, some depositors who do not meet these insurance levels may be apprehensive about delays in accessing their funds in the case of a bank failure, or they may not be completely aware (or trusting) of the FCCS's protection. For such depositors, a remunerated CBDC could be an appealing alternative saving vehicle because it eliminates all credit risk.

The convenience of using CBDC for transactions: a major portion of the deposits maintained by commercial banks are what are known as 'transactions' balances, which are held to enable

households and businesses to conduct transactions. The simplicity of performing transactions may be more essential than the interest rate for these accounts, which will have a faster turnover of funds but lower average balances.

The choice of the operational function that must be assumed by the Central Bank and other financial intermediaries engaged has a big impact on the creation of the correct architecture at the CBDC's foundation. What distinguishes the various architectures is the structure of the Central Bank's claims and records, as well as the operational responsibilities of the network's players. Architecture is divided into three categories.

Both accessible, account-based, and token-based mechanisms can be simply implemented in each of the architectures. Although the functional and user utility characteristics of technical architecture are primarily influenced by the operational roles of the actors that allow network operations and provide infrastructure resilience, homes and enterprises who embrace CBDC are also highly influenced by these choices.

- The Direct Issuance concept is the simplest and most centralized, as it has the power to eliminate all other private organizations. In this arrangement, the Central Bank is in charge of keeping track of all financial records and retail transactions and issuing CBDCs to end users directly. Private institutions, on the other hand, are anticipated to participate in the other two architectural models, albeit their roles change primarily in that in the Indirect Issuance model, the claim is made against the intermediary rather than the Central Bank, as in the Hybrid model.

  The Direct Model may appear to be the most tempting at first glance since it is easier to adopt because it eliminates the need for intermediaries, but it has challenges that are difficult to resolve, which could jeopardize the payment system's reliability, speed, and efficiency. First, as evidenced by today's credit card networks, the private sector may have better ability to construct and operate technical infrastructure at this size. Furthermore, the Central Bank may find it difficult to implement retail KYC and customer due diligence because it would necessitate a large expansion of operations and the provision of such services.

  The Direct Issuance model design could be a compromise to the model stated, but with KYC and customer due diligence done by the commercial sector. As a result, the Central Bank may focus on performing basic transactions and, when necessary, controlling the creation of new currency, while private organizations take on the task of providing

complicated functionality. This model may be superior to the simple Direct Model, but it would still leave the Central Bank as the exclusive provider of payment services.

- The Two-tiered Issuance model best reflects the current state of the financial system, in which private intermediaries play a significant role. First, a major benefit of this arrangement is that the Central Bank is not responsible for any interface operations with retail consumers. The CBDC would no longer be a claim against the Central Bank, but rather against the Private Institution, which is a major flaw.

  This means that the approach would be unable to address present concerns of trust in private institutions while providing financial services to the general public. As a result, in the event of financial difficulty or insolvency in the private sector, the Central Bank would be unable to recognize consumer claims in the first instance because it does not own them. As a result, the Indirect Issuance model faces regulatory issues and should include deposit insurance coverage.
- The Hybrid model integrates the major elements of the previous types, as the name implies. In truth, in this approach, the claim is still against the central bank, but private institutions are involved to help with system functioning. The important feature is that the claims are stored separately by the Central Bank from the Payment Providers' retail register. If a private institution fails, the system will ensure the portability of digital assets, and the Central Bank will be able to handle the transfer of the customer's relationship to a healthy Provider, allowing him to resume operations. As a result, the Central Bank must be able to restore the retail balance while maintaining an up-to-date copy of all retail balances. In comparison to the Indirect approach, the Hybrid model may be able to provide higher resilience while benefiting from the participation of Private Institutions, which make network operations more efficient and relieve the Central Bank of its responsibility to interface with retail.

Although the CBDC concept can undoubtedly be implemented on traditional centralized technological infrastructures, DLT's individual component innovations may be beneficial, and an impressive technological infrastructure such as the one that underpins the CBDC should have distinct characteristics from traditional financial infrastructures. The basic distribution and decentralization pillars shared by all DLTs can considerably improve system resilience, accessibility, and service continuity, but they also pose significant scalability, privacy, and security concerns. In addition, the architectural models discussed in the preceding paragraph

must be considered when selecting infrastructure. Indeed, such a decision puts a different strain on the system that the Central Bank must construct and maintain.

The fundamental difference between a traditional technology-based strategy and a DLT-based approach is how data is stored, updated, and shared. Data storage and sharing are centralized and based on physical nodes owned solely by the network owner in the traditional approach, while data updating does not require distributed consensus, exposing the infrastructure to systemic risks such as those associated with the Single Point of Failure risk. DLTs, on the other hand, revolutionize the dynamics of data management and network operations, allowing for decentralized infrastructure control. In fact, DLTs are designed to be decentralized and distributed, with data stored on nodes that are conceptually and geographically dispersed and updating and data processing based on algorithms that allow all nodes in the network to reach consensus. This consensus approach makes the network far more resilient and robust, but it also affects the system's throughput and scalability, even if these issues have already been handled within permissioned contexts.

Another important feature of DLTs is the use of cryptography, which can potentially allow end users to use tamper-proof cryptographic systems, as well as assuming special accessibility and operating schemes that, when combined with a token-based approach, could provide significant privacy similar to that of banknotes.

The ability to use the features made possible by Smart Contracts that enable the concept of Programmable Money, that is, the ability to code true business logic into the DLT infrastructure itself, could also be a benefit of using DLTs. This feature allows the wholesale and retail worlds to utilize a wide range of use cases, considerably boosting the possibilities of establishing a huge number of services on the CBDC infrastructure.

Because there are trade-offs between different design principles, the correct balance must be struck in order to meet the Bank's policy objectives.

There are several features that must be considered while taking a dispersed approach to CBDC, including Control, can the Central Bank regulate who joins the network and maintain complete control over digital money minting? System Resilience, is there a single point of failure? Transparency, does everyone engaged have read-only access? Is the system completely open? Scalability, is the system scalable enough to support the development of a real-world CBDC infrastructure?

Such constraints must be considered while selecting the appropriate technological stack, particularly when deciding whether to utilize a permissioned or permissionless ledger.

Accessibility to a CBDC is one of the key characteristics of a virtual currency. The two main differences lie in the underlying data structure and in the authentication and funds transfer process.

There can be two different ways a consumer can access its Central Bank digital tokens.

Account-based model: in this approach, account ownership is tied to an identity, allowing anybody to authenticate the account's owner, and this form of accessibility is similar to the systems we use today to transfer digital payments. As with today's bank account, this approach implies that the asset claim is tightly linked to a certified identification. To complete a transaction, you must verify your identity using a personal password and an OTP number, as it is done today. When a transaction or a transfer of funds occurs, the account's position in the database is increased or decreased, and the record is updated.

Token-based model: ownership is connected to a proof in this technique. This is accomplished through the use of public key infrastructure (PKI) (Public Key Cryptography Infrastructure). End users can benefit from token-model accessibility since it provides greater privacy and closely resembles holding digital cash. An individual can prove ownership of their CBDC simply by using a digital signature. The token-based approach seeks to provide broader and less complex access than the account-based model, as well as enhanced privacy features for users and the elimination of concerns with fund restoration. On the other hand, this technique could lead to serious problems, particularly when it comes to user-managed cryptographic keys. Under fact, if the user loses his private keys in a non-custodial system (where the user is solely responsible for Key Management), he will lose access to his funds and will be unable to retrieve them without the assistance of a third party. Building Key protection measures can help to mitigate this issue. Another key issue is that, due to the uniqueness of this model, new AML compliance frameworks to the rules are required, necessitating the creation of new AML complying frameworks to the regulations and, as a result, finding the correct balance between privacy and regulation.

One of the possibilities provided by the CBDC concept's combination of DLT and Smart Contract is the creation of a "programmable money" paradigm. All of this is possible because to the usage of Smart Contracts, which can turn business logic into code that executes itself

based on external events. "Transfer €100 in programmable tokens from Y account to Z account on X date," for example, is a simple example.

A programmable CBDC allows for the creation and execution of a wide range of applications, particularly in the financial sector. For the sake of clarity, a critical financial use case that can be enabled owing to DLT and Smart Contracts will be briefly described: Delivery versus Payment (DvP) without the need for financial intermediaries.

In the area of finance, delivery versus payment is already in use through trusted middlemen. Banks, clearing houses, and central securities depositories are examples.

DvP is performed by the intermediary simultaneously updating numerous entries in their database and/or transferring instructions to other institutions, as the majority of today's deals are digital. Regardless, the money and the underlying security (or cash) will be held on a separate platform and by a different legal entity. This could result in severe delays and put your counterparties at risk. The usage of Blockchain technology and smart contracts in this context allows two parties to interact in a transaction without the danger of a counterparty. DvP enables two generic users to conduct an atomic transaction in which they swap two separate asset classes without the necessity for a third party to act as a guarantee (escrow).

The transaction's atomicity allows for actual delivery vs payment on a shared ledger without the requirement for a trusted middleman to oversee the operation. The digital DvP can only work because of a Smart Contract that runs in a decentralized context (DLT): the Smart Contract enforces the regulation between the two asset classes (shares vs CBDC) by wiring rules that cannot be changed or amended without the participants' knowledge.

4.2 Motivation for the creation of the CBDCs

Central banks' interest in CBDCs is motivated by a variety of factors. The following sections provide an overview of the often-mentioned factors before delving deeper into them. We concentrate on retail CBDCs because of their importance to deposit insurers.

The Bank for International Settlements (BIS) has been surveying central banks throughout the world for three years in a high-level stock-taking exercise to discover what pushes them to consider issuing CBDCs. Because financial inclusion is a key factor to consider when contemplating CBDCs in emerging markets and developing countries, central banks in these

regions have a higher desire to issue CBDCs than their counterparts in advanced nations. The vast majority of central banks cite domestic payment efficiency and security as reasons to consider CBDCs. Other important motivations include monetary sovereignty in light of the expected continued decline in cash use and the adoption of private digital currencies. Central bankers in advanced economies view the importance of financial stability and monetary policy as grounds for CBDCs as low and diminishing, in comparison to their peers in other areas of the world.

- Monetary Policy: retail CBDCs may be a future monetary policy instrument for central banks, as they provide an additional channel for monetary policy transmission. The setting of interest rates on CBDCs by central banks has the potential to have a direct impact on public money demand. Negative retail CBDC interest rates may also be an additional instrument of extremely flexible monetary policy in societies with little or no cash usage or where cash would be prohibited. Cash would be unavailable as a means of holding money at non-negative interest rates under such circumstances. This may make it easier for central banks to implement negative short-term lending rates (zero-level bound). Finally, CBDCs may make "helicopter money" more accessible to central banks.

  Acceptance of these arguments, however, is restricted. To avoid users fleeing into zero-rated cash, banknotes must be significantly phased out for CBDCs to have an influence as a monetary policy tool. Positive benefits of CBDC on monetary policy efficiency will be contingent on a large uptake of CBDC and/or a large volume of CBDC in circulation, which could jeopardize financial stability by promoting bank runs. Overall, at least in industrialized economies, there appears to be agreement that monetary policy will not be the major incentive for issuing CBDC.

  It's important to note that this discussion assumes that the general environment remains intact and that CBDC is the only new substance introduced. In such context, the increased benefit of CBDC for monetary policy efficacy appears to be negligible. The effectiveness of monetary policy in an environment where payment methods and currencies are changing rapidly is a topic that deserves its own discussion.
- Financial Inclusion: CBDCs may provide an alternate access to (central bank) money and associated payment services in jurisdictions where households have a low percentage of access to the commercial banking system or where banking systems are undeveloped, in a manner analogous to the provision of e-money. Financial inclusion appears to be less

important in more sophisticated economies when it comes to CBDCs. Following the continued reduction in the usage of cash, some central banks have suggested that CBDCs could provide an alternative for those consumers who are unable or unable (for example, for privacy reasons) to use fully digitalized private payment services.[68]

However, there are a variety of reasons for financial inclusion gaps, including consumer distrust of financial institutions, high travel or monetary costs associated with accessing financial services, financial literacy deficiencies, a lack of adequate identification documentation, or a potential lack of profitability for financial institutions in doing business with customers. CBDCs may not be able to handle all of these issues, and financial inclusion issues may be better addressed by including them into a larger agenda. Furthermore, CBDCs may be harmful to financial inclusion if they drown out private initiatives that serve the same aim better. CBDCs are "not likely to be the first or most easy choice" for increasing financial inclusion.

- Payment Services: payments are a key factor in central banks' decisions about whether or not to issue CBDCs.

  The use of cash is dwindling. Cash is now the sole type of central bank money available to the general people. At the same time, the overall use of cash is decreasing, though there are major regional variances. The COVID-19 pandemic has caused a further drop in currency usage, but it is unclear whether this will have long-term consequences. The higher the expenses of transportation and maintaining currency infrastructure become as the use of cash declines, the greater the burden on a shrinking number of remaining users. Private forms of money may therefore come under growing pressure to replace public money (cash). The public's trust in the currency would thus be completely reliant on the public's trust in issuers of private money, which could be troubling to central banks. These could be regulated and monitored banks, but they could also be non-bank cryptocurrency and stablecoin issuers. The latter are less controlled, at least for the time being, which may enhance the risk of mistrust. Subsidizing cash-handling costs or intervening with public policy (for example, requiring banks to maintain a specific number of ATMs) can help to

[68] Bank of England (2021), Group of central banks (2020), ECB (2020). Note however, that some user may avoid using CBDC for privacy reasons as well, as they may fear central bank knowledge of transactions [see: BIS(2021a)].

reduce the fall of cash and preserve its availability to some extent. However, such intervention is unlikely to have a significant impact on users' payment preferences.

A conversion of commercial bank money into risk-free central bank money (such as banknotes) would be impossible in times of stress if there was insufficient cash. Making CBDCs available to the general public as a digital cash-like form of central bank money could help to maintain currency confidence. CBDCs, on the other hand, have their limits: for financial reasons, the amount of CBDCs that an individual can possess is likely to be limited. It needs to be seen whether this limited ownership of CBDCs is adequate to establish faith in the sovereign currency.

Payment markets' resiliency; because remaining payment systems are private in nature, as opposed to public cash; are subject to network effects, thus concentration is likely to lead to a small number of operators achieving market dominance; and may be foreign-based, introducing political risks and risks to the ability to enforce local law and policy, payment markets' resilience may be harmed. Private payment providers may lack sufficient incentives to plan for unforeseen events, implying that significant governmental involvement may be required to address broader financial stability problems. Simultaneously, legislators and regulators may find it difficult to subject monopolistic, foreign-based providers to local legislation aimed at preparing for such eventualities.

At least for offline point-of-sale transactions, cash is currently a viable alternative to private electronic payment devices. Cash's potential as a contingency solution may be lost if its use continues to dwindle, with only electronic payments remaining as a payment option. This could have a negative influence on the payment sector's resilience. Retail CBDCs, as a public alternative, might provide the contingency option that cash has so far provided. CBDCs can also be used as a backup in e-commerce due to their digital nature (a role cash cannot play today). Due to the ability to operate CBDC in an offline mode, it might be used to some extent in the event of large-scale power and IT disruptions at point-of-sale.

CBDCs, on the other hand, may be vulnerable to cybersecurity and other digital concerns that also affect private payment systems due to their digital nature. These risks, if they materialize, could have a severe impact on the availability of and faith in public funds, which is one of the reasons for issuing a CBDC. It's unclear whether CBDCs can be developed with enough protections to mitigate these hazards. Private payment systems

may include payment systems through banking systems, non-banks, or stablecoins, despite the fact that they are prone to concentration tendencies. Depending on design choices, additional private schemes may remain available if one of these becomes unavailable. However, due to a potential lack of interoperability amongst those, service availability is likely to be limited.

In payment markets, efficiency and competitiveness are important. In private payment marketplaces, network effects are likely to result in severe consolidation, with a few number of providers dominating. In the medium-to-long run, such an atmosphere may create a variety of negative outcomes for the payments sector, including limits on future productivity growth and innovation, reduced customer choice, and potentially inflated transaction prices. There is a strong risk that these providers may achieve market domination that will be unchallengeable. Lock-in effects and high entry hurdles are among the causes, given that first-movers benefit from a huge user base and may restrict access to critical infrastructure. Data may also play a part in securing market domination, since data generated via the usage of such services can provide crucial insights into how to effectively optimize key workflows, bolstering the competitive advantage enjoyed by early and successful movers. Newcomers do not have access to this data or the user base. Data could also be used to shift market power from neighboring markets to payment markets, such as social networks or selling platforms. An oligopolistic organization of payment markets without cash as a disciplining force may result in poor welfare effects through high pricing and less innovation. Inappropriate use of users' data can also be a type of market abuse.

CBDCs may not be the only solution to oligopolistic tendencies in payment markets, however. Instead, how to respond to this dilemma is a difficult policy concern. Competition law, antitrust law, and regulation are the traditional responses to these issues in mature economies.

- Sovereignty over money and the economy: many countries risk becoming structurally dependent on foreign-based, dominant payment providers in the future, given the previously described oligopolistic trends in payment markets and the declining use of cash. As a result, sound regulatory enforcement, monitoring, and operational resilience measures may not always be effective. Jurisdictions may assist the formation of private payment products based inside their jurisdiction to discourage the public from using

alternative payment services, and/or consider issuing CBDCs as a public alternative to ensure robust and efficient payment marketplaces.

The potential of a sizable portion of the population using payment instruments that are not denominated in the sovereign currency or have only sporadic ties to it is the most compelling argument for the creation of a CBDC. Even if their currencies are stable, the risk of "digital dollarization" may be particularly high for small and open economies. This might apply to private payment products whose issuers compete with monetary sovereignty as issuers; managers of a globally accepted private currency (backed by one or a basket of sovereign currencies); and non-domestic public currencies (e.g. a CBDC issued by a third country).

It's worth noting that the latter may have shaped a jurisdiction's response to a private payment provider's dominant role.

For a variety of reasons, widespread public usage of other currencies and/or payment products endangers monetary sovereignty and central banks' ability to maintain financial and price stability.

The central bank has no or limited power to influence the value of digital private or non-domestic public currencies, which are used by a large portion of the population and influence purchasing power; Monetary policy tools (e.g. overnight interest rates) are only relevant for the sovereign currency, and thus may lose relevance for a significant portion of the economy; because the central bank is the sole issuer of the sovereign currency, its operations as lender of last resort (such as bail-ins) must be conducted in that currency. However, the currency's relevance to the actors involved in this action may have dwindled.

Finally, as a result of digitalization and the decrease of cash, there is a greater danger that a currency other than the one issued by the central bank may play a significant role in the economy of a jurisdiction. This might be a privately issued currency (e.g., a Stablecoin that benefits from massive network effects because it is widely trusted and used), but it could also be a retail CBDC issued by a foreign central bank. In these instances of "digital dollarization," a central bank loses demand for its own currency and risks losing its power to control pricing and financial stability. The central bank may be able to provide a public alternative in domestic currency that is easily useable by issuing a CBDC. Unfortunately, sufficient domestic demand for this CBDC is critical to its success; however, this is not guaranteed, as consumers may prefer to utilize private currencies.

4.3 Regulating CBDCs focusing on the European Central Bank

The European Central Bank (ECB) may take both legal (including regulatory and monitoring) and non-legal (or technical) steps to address the issues posed by cryptocurrencies. In terms of technological measures, the ECB may focus on increasing the efficiency of existing payment systems and eliminating existing frictions in market infrastructures to indirectly affect cryptocurrency markets, to the extent that this is within its competence. It might also go into the business of issuing Central Bank Digital Currency (CBDC). In terms of legislative measures, central banks may consider directly or indirectly regulating cryptocurrencies. However, given the limitations on the ECB's mandate and regulatory and supervisory tools, it is appropriate for the ECB to consider using indirect strategies and tools to influence cryptocurrency markets, as the most significant potential impact of cryptocurrencies on central banks is likely to be indirect through the impact of cryptocurrencies on banking and payment systems. The ECB's current supervisory and supervision capabilities over banking and payment systems can be used to adopt this indirect method.

The jury is still out on whether cryptocurrency experiments will succeed or fail, despite a decade-long fight to achieve acceptance. If the popularity of cryptocurrencies reaches a certain threshold, they may constitute a threat to the financial system, with direct implications for central banks' monetary policymaking as well as supervisory and oversight functions. Some of these problems would put activities, financial market infrastructures (FMIs), and organizations that fall within the ECB's core tasks and functions in jeopardy.

The European System of Central Banks' fundamental goal, according to article 127(1) of the TFEU and article 2 of the ESCB/ECB Statute, is to ensure price stability (ESCB)[69]. Basic tasks and other functions are among the ESCB's responsibilities (non-basic or ancillary tasks)[70]. The ESCB's primary responsibilities include developing and implementing the Union's monetary policy, conducting foreign exchange operations, keeping and administering the Member States' official foreign reserves, and ensuring the seamless operation of payment systems. The

[69] See: Stiglitz J.E., *The Euro: How a Common Currency Threatens the Future of Europe*, New York: W.W. Norton & Company, 2016.

[70] See: Article 127(2) TFEU and art. 3.1 ESCB Statute.

ESCB's non-basic or supplementary activities include banknote issuance, contribution to prudential supervision of credit institutions and financial system stability, advising services, statistical data collecting, and international cooperation and external operations.[71] Within this framework, cryptocurrencies may fall under the ESCB's tasks and jurisdiction if they constitute a danger to one of the bank's core or peripheral functions.

It appears that cryptocurrencies' potential effects on central banks can be separated into two categories: direct and indirect effects. Direct consequences include those that affect monetary policy, price stability, and central banks' monopoly over creating base money (e.g., banknotes) or the ECB's power to manage the money supply, which can be considered as a sine qua non for the price stability mandate and monetary policy conduct. The indirect consequences, on the other hand, are mostly caused by the interface between banking and payment systems and cryptocurrencies, both of which lie under the ECB's purview. Needless to say, the interface between banking and payment systems is where systemic risk and financial stability issues are most prevalent.

Addressing these direct and indirect repercussions, on the other hand, should remain within the ECB's mandated functions. In addition to the limitations placed on the ECB's areas of competence, EU primary and secondary legislation restricts the means available to it in order to achieve its goals. The ECB has been given the authority to adopt legislative actions that have direct impact on third parties other than the National Central Banks (NCBs) and the Eurosystem in order to carry out the ESCB's tasks. This includes formulating regulations and making decisions. It can also impose fines (through its decisions) and recurring penalty payments on companies that do not follow its rules and regulations.[72]

The ECB also has advisory powers, which allow it to accept non-binding recommendations and opinions within its scope of competence in addition to its regulatory authorities. These recommendations can be used to kick-start EU legislation or act as a catalyst for action. In terms of initiating legislation, the ECB and the European Commission share responsibility for

[71] See: Lastra R.M., "*The Law of the European Central Bank*," 266.

[72] Art. 132(3) of the TFEU. See also: Council Regulation (EC) No 2532/98 of 23 November 1998 concerning the powers of the European Central Bank to impose sanctions (OJ L 318, 27.11.1998, p. 4).;
Council Regulation (EU) 2015/159 of 27 January 2015 amending Regulation (EC) No 2532/98 concerning the powers of the European Central Bank to impose sanctions, OJ L 27, 3.2.2015, p. 1–6;
Article 18(1) of Council Regulation (EU) No 1024/2013 of 15 October 2013 conferring specific tasks on the European Central Bank concerning policies relating to the prudential supervision of credit institutions.

launching secondary legislation to supplement or change the ESCB/ECB Statute (i.e., complementary legislation). In addition, the ECB should be consulted on any proposed Union act in its fields of competence, and national authorities should consult the ECB on any draft legislative provision in its fields of competence. The ECB has been given more rule-making powers in the domain of financial services regulation with the development of the banking union and the Single Supervisory Mechanism (SSM). Adopting regulations, guidelines, and recommendations, as well as making judgments without prejudice to the competence and tasks of EBA, ESMA, EIOPA, and the ESRB, are among these authorities.

With these regulatory, supervisory, and oversight instruments at its disposal, it appears that the ECB may have direct or indirect influence over the cryptocurrency environment.[73] Direct regulation is defined as market discipline-inspired regulatory measures targeting the creditors and counterparties of those entities, whereas indirect regulation is defined as market discipline-inspired regulatory measures targeting the creditors and counterparties of such entities. Direct regulation, which uses command-and-control regulatory mechanisms, is primarily based on the threat of the law, whereas indirect regulation is mostly based on economic instruments.

Registration, transparency, capital requirements, and position limitations are common regulatory mechanisms used by direct regulation. Indirect regulation, on the other hand, employs a middleman to deliver the imperatives or directives to the final target, the regulated business or activity. In the availability of suitable surrogate regulators, indirect regulation is typically seen as a more efficient technique in financial regulation. Despite the potential direct impact of cryptocurrencies on central banking, a focus is primarily required on indirect intervention through the ECB's supervisory powers over banking entities, as well as its regulatory and oversight powers over payment systems, due to the limited scope for direct intervention by the ECB. Even with the indirect approach, the ECB, as a regulator, supervisor, or overseer, may not be able to address the difficulties of cryptocurrencies alone, given the hybrid character of cryptocurrencies and the limitations on the ECB's scope of competence

[73] Athanassiou P., *Hedge Fund Regulation in the European Union: Current Trends and Future Prospects,* Alphen aan den Rijn, The Netherlands: Kluwer Law International, 2009, 227.
For direct and indirect regulation in the regulation of the hedge fund industry, see: Nabilou H. and Pacces A.M., "*The Hedge Fund Regulation Dilemma: Direct Vs. Indirect Regulation," William & Mary Business Law Review* 6, no. I (2015).

and regulatory authorities. In some areas, the ECB can act as a catalyst for change (e.g., in its advisory capacity), collaborate with other regulators (e.g., the European Commission and the European Parliament, the EBA, and the National Competent Authorities (NCAs), including NCBs), or act in accordance with its contributory competence in protecting financial stability in collaboration with the NCAs. Furthermore, the ECB can contribute to policy formation at the international level through international financial fora, particularly the Financial Stability Board (FSB).

Although the initial knee-jerk reaction to the possible direct impact of cryptocurrencies on monetary policy and price stability would be to regulate them directly (e.g., by banning them), this study argues that this is neither practicable nor desirable. Instead, indirect regulation of cryptocurrencies through banking and payment systems could achieve regulatory goals without sacrificing fintech innovation's potential benefits. Many of the methods for ECB engagement in the cryptocurrency ecosystem appear to only allow for the ECB's indirect participation, based on the ECB's mandate and competences, as well as the regulatory and supervisory tools at its disposal. Central banks can play a significant role in this indirect regulation, particularly through their regulatory and monitoring authority over credit institutions and payment networks, as well as their position as a contributor to financial stability-enhancing measures.

Technical measures (i.e., non-regulatory measures) and regulatory measures are both examples of direct and indirect regulatory actions. One example of direct regulatory action by the ECB would be the rejection of cryptocurrencies and digital assets as collateral (i.e., eligible marketable assets) within the ECB's collateral eligibility framework. Furthermore, the regulator may consider regulating the code itself and placing design-based constraints on the code or protocol as a direct technical measure. However, it would be outside the scope of the ECB's mandate and competence in this case. Indirect regulatory measures would be largely achieved through regulatory and supervisory measures aimed at banks and payment institutions, such as imposing stricter criteria for access to the ECB's FMIs and technical platforms on banking and payment institutions that provide cryptocurrency payment services. Finally, indirect technological measures would either try to improve the efficiency and fix the flaws of existing payment and settlement systems, thereby indirectly impacting cryptocurrencies, or to venture into the uncharted realm of issuing CBDCs.

Central banks may be interested in actively regulating cryptocurrencies because to concerns regarding the unit of account, price stability, and the impact on the conduct of monetary policy. Cryptocurrencies can be regulated directly in a variety of ways. It could include setting rules and standards for governing white papers, or regulating the code or protocol (i.e., design-based regulation), developers, the design elements of a certain blockchain, node operators, wallet providers, miners, and users. On the other hand, indirect regulation would apply to exchanges where cryptocurrencies are swapped for fiat money, custodians (including custodian wallet providers), and other service providers, such as merchant acceptance facilities.

Imposing a blanket ban on cryptocurrencies and punishing individuals, exchanges, financial institutions, and payment processors who handle or deal in cryptocurrencies are examples of direct regulatory action. On the other hand, the ECB may be given the authority to retain cryptocurrencies as part of its responsibilities for conducting foreign-exchange operations and holding and managing the Member States' official foreign reserves. Given that the ECB and NCBs have the authority to acquire and sell spot and forward all types of foreign exchange assets and precious metals, and that foreign exchange assets include securities and all other assets in the currency of any country or units of account and in whatever form held, it would be difficult to argue that the ECB would not be able to acquire and hold cryptocurrencies if necessary.

Because some forms of direct regulation of cryptocurrencies rely on design-based regulation, this approach cannot be independent of the cryptocurrency's and its underlying blockchain's specific features. Cryptocurrencies developed on an open (unrestricted) blockchain, for example, should be viewed differently than those built on a closed (restricted) blockchain with identified and relatively centralized nodes. Similarly, largely centralized cryptocurrency schemes like Ripple should be considered differently than decentralized cryptocurrency schemes like bitcoin. The direct regulatory approach's reliance on the design elements of a specific cryptocurrency offers a severe barrier to direct regulation, given the recent development of cryptoassets with a variety of features, making direct regulation of cryptocurrencies a difficult undertaking.

Direct regulation of tokens generated on permissioned distributed ledgers would be simple, as it could target the ledger's owners or nodes with access to and ability to validate it. As a result, for centralized cryptocurrencies, the law can impose mandatory creation of a scheme

governance authority (body), information technology (IT) security requirements, and transaction verification process requirements (e.g., the number of nodes and miners needed for the finality of a transaction on the blockchain). These identifiable scheme authorities can be subjected to operational and business continuity requirements, publication of node operators' identities, and requirements such as investor or user vetting or customer due diligence before making the wallet or coin available to the user. Although most of the needs are much outside the ECB's current sphere of competence, the ECB can play a role in its advising capacity.

Even though many cryptocurrencies are meant to be decentralized and censorship-resistant, this does not mean that direct regulation of cryptocurrencies is doomed to fail. Governments can't completely eliminate decentralized cryptocurrencies, but they can stifle their growth. The success of any currency, like that of any other, is dependent on widespread acceptance, which implies network effects. A government prohibition on cryptocurrencies, on the other hand, might significantly stifle their network effects. Furthermore, an aggressive tax policy, such as defining bitcoin as property for tax reasons and applying property taxes each time a bitcoin or a fraction of a bitcoin changes hands, as some countries have done, would significantly hinder its use as a means of exchange.

Direct central bank regulation of cryptocurrencies may not be desired, or even viable, for a variety of reasons, and may ultimately fail to achieve the stated aims.

For starters, decentralized cryptocurrencies have no geographical boundaries, and direct regulation would encourage regulatory arbitrage. This is because of two major problems. To begin with, no government can successfully prohibit the use of a sufficiently decentralized cryptocurrency like Bitcoin. Because of Bitcoin's peer-to-peer structure, outlawing or heavily regulating it is likely to force it into the shadows of the internet.

Second, because regulatory arbitrage would render such a ban ineffectual if only a few states allowed Bitcoin, such a prohibition would be rendered ineffective. Border problems and a large opportunity for regulatory arbitrage across borders are created by the highly decentralized nature of cryptocurrencies, their digital nature, their worldwide reach, and the new and dynamic industries that are evolving within this ecosystem. When it comes to cryptocurrency, if a cryptocurrency is only legal in one country, it is likely to expand across borders in the virtual world. This has already happened in the regulator's cat-and-mouse game with unauthorized download websites and decentralized file-sharing protocols like BitTorrent.

In the case of cryptocurrencies, there have been instances of firms, particularly exchanges, changing their domicile at an unprecedented rate following the New York BitLicense. The global trading volume of cryptocurrency markets shifted from Chinese Yuan (CNY) to Japanese Yen (JPY) and US dollar in 2017, a year in which the Bank of China took steps to regulate and ban ICOs (USD).

Second, direct regulation's one-size-fits-all approach cannot appropriately manage the enormous range and heterogeneity of cryptocurrencies, as well as the tactics of the businesses that are developing around them. In the cryptocurrency world, there are a lot of different players with different responsibilities to play. Developers, issuers, miners, processing service providers, consumers, wallet providers, exchanges, and other trading platforms like as DEX, merchant acceptance facilities, and various other actors are among them. To say the least, a one-size-fits-all regulatory solution could, at best, be counterproductive due to the diverse design elements of new cryptocurrencies.

The fundamental issue with direct cryptocurrency regulation is that decentralized permissionless blockchain-based cryptocurrencies, which are supposed to be censorship resistant, are incompatible with the present financial regulatory structure. These cryptocurrencies can exist and operate independently of established institutions and market infrastructures, and they may or may not comply with existing legal frameworks. The problem is exacerbated by the fact that some issuing organizations lack managers, as well as a physical or legal entity and a place of business. As a result, direct regulation of cryptocurrencies, to the extent conceivable, would face the practical challenge of what or what to control, and it is difficult to offer a direct regulatory strategy to regulating cryptocurrencies in the absence of a centralized governance framework.

Regulating miners and possibly relatively centralized nodes on the Lightning Network, if that network establishes its long-term viability, is the closest that regulations can get to regulating such coins. Indeed, as second-layer solutions are produced, it is reasonable to predict that business communities will form around them, which regulators will be able to identify and target. However, if node operators are not part of financial institutions or payment systems, the ECB may lack the authority to regulate or influence them directly under the current regulatory framework. The ECB may only do so indirectly, with regulation focusing on the open-source cryptocurrency protocols' applications, use-cases, and enterprises.

Third, indirect regulation's relatively decentralized structure is an intriguing trait that makes it particularly well-suited to the regulation of cryptocurrencies. In this regard, finding the financial institutions with the most stable, continuous, and day-to-day ties with cryptocurrencies is necessary for developing acceptable indirect regulatory mechanisms for cryptocurrencies. Identifying these institutions entails identifying persons with significant expertise and awareness of the financial markets and their activities. These are the institutions that could be utilized as surrogate regulators, having regulatory powers delegated from government bodies. Because indirect regulation of cryptocurrencies would be implemented by multiple banks and payment institutions, it provides for the possibility of decentralized implementation and enforcement of rules that were initially applied to the banking and payment sectors, in addition to increasing the efficiency of regulation by providing incentives for surrogate regulators to compete with one another. This can help to alleviate the knowledge problem that most centralized regulatory agencies face, as well as making regulation less susceptible to regulatory capture.

4.4 Evaluating the International Scenario, the U.S. Digital Dollar and the e-CNY

Because a CBDC does not yet exist in the United States, the regulatory structure that would govern it has yet to be created. Chairman Powell stated in March 2021 that "enabling legislation" would be required before the Fed could move forward with the digital dollar; consequently, this currently undeveloped part of the law is likely to be rebuilt from the ground up in the following years. Due to the lack of CBDC regulation, and even though a CBDC would not be considered a cryptocurrency, a review of the current cryptocurrency regulations would offer context for the relationship between digital currencies and the law, which will be beneficial when evaluating a digital dollar.

The Securities and Exchange Commission ("SEC"), the Commodities and Futures Trading Commission ("CFTC"), the Federal Trade Commission ("FTC"), the Department of the Treasury through the Internal Revenue Service ("IRS"), the Office of the Comptroller of the Currency ("OCC"), and the Financial Crimes Enforcement Network ("FinCEN") have all been involved in cryptocurrency regulation, but little formal rulemaking has taken place. This is most likely attributable, at least in part, to agency concerns about overregulation and legislation that

would encourage foreign investment. That is, if the United States overregulates or passes legislation that makes cryptocurrency investment unfavorable in the United States, investors may opt to invest in cryptocurrency and other uses of blockchain finance technology elsewhere, which would be incompatible with the United States maintaining a leadership role in the development of this technology. This fear, however, should not prevent the development of sufficient, effective, and well-informed regulations. The necessity for these institutions to guarantee public protection in the face of the emergence of cryptocurrencies is only growing, as the Federal Trade Commission recently warned that cryptocurrency scammers are increasingly luring consumers into sending money to them. This reflects the underdeveloped nature of not only the regulatory framework that would one day regulate a CBDC, but also the regulatory framework that is currently in place to deal with digital currencies in general.

The federal government has adopted an unwelcoming attitude toward cryptocurrency regulation. Former Attorney General William Barr announced the development of the Bitcoin Enforcement Network in October 2020, in what was largely perceived as an attempt to undermine cryptocurrency users' ability to transact anonymously. The framework claims that the usage of private coins can be "indicative of possible criminal behaviour," and it notably targets decentralized exchanges, which allow users to swap bitcoin without the involvement of a third-party intermediary. The Department of Justice requires bitcoin exchanges to register with FinCEN and to "collect and keep customer and transactional data," or face civil and criminal fines.

In the United States v. Gratkowski, the Fifth Circuit ruled that law enforcement does not require a warrant to collect financial transaction data from cryptocurrency exchanges, and that the defendant had no reasonable expectation of privacy in his cryptocurrency transaction records. Finally, FinCEN and the US Treasury announced a bill in December 2020 that would force money service organizations, such as cryptocurrency exchanges, to collect identifying data on individuals who deal with their clients using self-hosted cryptocurrency wallets or overseas exchanges.

In addition to establishing a proper regulatory framework, the design of a digital dollar must be evaluated in terms of privacy. The digital dollar could be designed in one of two ways: as a token-based currency or as an account-based currency. If the digital dollar is token-based, a distributed or centralized ledger could be used. A blockchain is a method of implementing a

distributed ledger, however not all distributed ledgers use them. However, it is more likely that the government would prefer to utilize a centralized ledger, in which all transacting parties trust a designated central authority to determine and ensure transaction legality. Distributed ledgers, on the other hand, do not require a third-party since they are self-authenticating; they are maintained and validated by several nodes that store and retain the blockchain data. It's important to remember that distributed doesn't always imply decentralized. Distributed ledgers "may be decentralized, providing all participants equal rights inside the protocol, or centralized, designating specific users with specific powers."

If the digital dollar uses account-based technology (rather than token-based technology), "the central bank would hold accounts for CBDC users and would manage debits and credits between users directly." As a result, the central bank would have to administer and maintain far more accounts than it does now. A token-based system, on the other hand, "does not necessitate the reconciliation of two databases, but rather the near-immediate transfer of ownership, similar to passing over money from one person to another." As a result, the degrees of privacy given by the two solutions are clearly different.

Prioritizing the preservation of identifying information must be at the forefront of the creation of a digital dollar from an architectural aspect to secure the balance of governmental power with the protection of individual privacy concerns. Privacy must be "designed into the system from the beginning," as the Bank of Canada noted in a staff analytical note based on Dr. Anna Cavoukian's Privacy by Design concept, rather than "the alternative, of doing a functional design first and adding privacy...later, [which] carries risks of unnecessary trade-offs." This is because there is a significant difference between privacy and data protection.

Privacy is about preventing individuals from revealing information about their (legitimate) habits and behaviors in the first place, while data protection is about preventing unauthorised use of data after it has been collected." A future CBDC regulatory framework should recognize that the two are not interchangeable.

While technical privacy considerations are significant, the regulatory environment surrounding a CBDC is the main focus of investigation. In this sense, the first issue for the US government in constructing the legal infrastructure that must exist prior to the establishment of a CBDC must be privacy.

Speaking about China, The People's Bank of China (PBOC) was one of the first central banks to recognize the potential of digital currencies as a threat and an opportunity. China sees

privately produced digital currencies as a danger, and the country's efforts to ban Bitcoin and other cryptocurrencies go back almost as far as the technology itself; the first regulatory crackdown took place in December 2013[74]. Before the ink on the first prohibitive regulation had dried, the PBOC formed a professional working group to investigate digital currency. In 2016, this research group revealed their intention to issue a CBDC, which was later followed by a large-scale pilot in many major cities in 2019. President Xi spoke out in favor of blockchain development in late 2019, naming it a core technology as a show of support from the top. The PBOC said in April 2020 that it was expanding trial initiatives in anticipation of the implementation of a digital currency at the 2022 Olympics. Despite the profusion of study groups, pilot programs, and official announcements, information concerning China's CBDC's real design was patchy and at times inconsistent. Indeed, as recently as Spring 2021, senior PBOC officials themselves indicated in statements that there was still significant disagreement as to whether it would be central bank liability or a liability on commercial bank balance sheets.

In July 2021, the PBOC produced a White Paper that addressed the piecemeal problem but did not necessarily provide much more clarity. The architecture, infrastructure, and access parameters of China's CBDC (hereafter referred to as the e-CNY) as specified in the PBOC White Paper, as well as significant features linked to the design of e-CNY wallets, will be examined in the following Sections.

The e-CNY is China's digital fiat currency, designed to work in the same way as physical RMB. It will represent a claim on the central bank, backed by sovereign credit. It is primarily designed to meet the needs of domestic retail customers. Although it uses a two-tier architecture, its infrastructure and access systems are unclear.

The e-architecture CNY's is "two-tier," or indirect. Rather than giving customers with bank accounts, the PBOC will issue the e-CNY to "approved operators," such as commercial banks and other financial intermediaries, who will then redistribute it to consumers while also providing "exchange and circulation services" to the general public. Although the e-CNY

[74] See Guanyu Fangfan Bitebi Fengxian de Tongzhi, *Notice on Preventing Bitcoin Risks,* PBOC, MIIT, CBRC, CSRC, CIRC, Dec. 3, 2012, http://www.csrc.gov.cn/pub/newsite/flb/flfg/bmgf/zh/gfxwjfxq/201401/t20140122_242972.html (*prohibiting financial institutions and payment platforms from offering Bitcoin-related services in a rule that was poorly enforced and drafted with several loopholes—including focusing on Bitcoin to the exclusion of other cryptocurrencies*). See also Part III.A *infra*.

appears to favor China's central bank over commercial banks, the chosen architecture does not totally exclude commercial banks and private payment services such as WeChat Pay and Alipay. The PBOC recognizes these authorized operators' relative strengths and entrusts them with KYC onboarding, as well as the creation and management of wallets.

Whether the e-CNY infrastructure will be centralized or distributed is unknown. PBOC officials have openly denied the use of blockchain technology at times and underlined the areas in which blockchain would be employed at other times, yet the White Paper appears to indicate that it will include parts of both centralized and distributed technology; the e-CNY system is built on a distributed and platform-based architecture, it combines centralized and distributed architectures to form a hybrid technical framework that allows for the coexistence of dual states, such as steady and agile states, as well as the integration of centralized and distributed architectures.

Based on this description, there appear to be various design options. The PBOC might maintain a traditional centrally controlled database at the top layer, between the PBOC and the approved operators, similar to the current system for wholesale payments. It might also use a permissioned distributed ledger system, with the operators acting as permissioned nodes. The enormous number of individual transactions at the second layer, between authorized operators and individuals, may render the usage of distributed ledger technology prohibitively slow, hence the ledger is likely to be centralized.

Despite the fact that the specific form of the e-CNY is still being worked out, the White Paper stresses four key features. The first is a set of strategies aimed at mitigating the risk of financial disintermediation. The e-CNY, for example, will neither pay nor bear interest. This will eliminate some of the competitiveness between commercial banks. The e-CNY will also be part of a "framework of big data analysis, risk monitoring, and early warning for e-CNY to improve the foresight, accuracy, and effectiveness of e-CNY management," according to the report. This architecture may imply a safety valve that prevents withdrawals from commercial bank deposits into e-CNY during times of financial hardship, however this is not specifically stated.

A tiered system of wallets is the second feature, which is similarly meant to reduce the risk of a bank run. Under PBOC guidance, authorized financial intermediaries will design and administer these. Users will be unable to withdraw the entirety of their commercial bank deposits into their e-CNY wallets since different levels of wallets will have differing per-

transaction and balance limits. Tiers will be linked to KYC standards, with the notion of "anonymity for low value and traceability for large value" in mind. The "least-privileged" wallets—those with the strictest balance and transaction limits—can be opened without revealing any personal information, allowing for some anonymity. Individuals and organizations can open more privileged wallets, which will demand more identifying information. PBOC emphasizes the system's potential to protect against illegal activity, as well as its relative anonymity when compared to payment systems now managed by commercial firms. Although PBOC officials describe this system as having "controllable anonymity," this is likely only true for the individual parties to a transaction; PBOC will still have full visibility into these transactions.

Next, smart contracts will be used to make the e-CNY "programmable." This function will be guided by "security and compliance" issues, according to the PBOC, and will allow "self-executing payments according to specified criteria or terms agreed upon between two parties." Though not explicitly stated, this approach might be used to restrict consumers from transacting with unwanted companies, such as those linked to criminal operations. This feature has been implemented in pilot programs as an expiration date, limiting the currency's use to a specific time frame. In the future, government-issued stimulus payments might be accompanied by a smart contract that only allows the e-CNY to be spent in specific industries, allowing for more precise macroeconomic management.

Finally, the e-CNY is "technically ready for cross-border use," despite being primarily intended for domestic use. In terms of whether the e-CNY will be employed in cross-border payments or to promote RMB internationalization, the PBOC White Paper is hesitant. In reality, China has already begun testing cross-border CBDC transactions with the BIS, Hong Kong, Thailand, and the United Arab Emirates, which would allow near-instantaneous transactions to be paid outside of conventional payment networks.

In conclusion, it appears that the e-CNY is still a work in progress. It's evident that it'll use a two-tiered architecture, but it's less clear if its infrastructure will be centralized or distributed, or where its access system will sit on the account-to-token spectrum. Despite these difficulties, its architecture anticipates the impact on commercial banks by incorporating a tiered wallet system that also includes KYC features. Despite the fact that PBOC promotes users' capacity to keep some degree of controllable anonymity, the e-proclivity CNY's for

surveillance and control is clear. Finally, while the e-CNY is primarily intended for use as a domestic retail currency, the PBOC has already begun to look at foreign possibilities.

The situation in other countries is also developing: in the United Kingdom, The Bank of England recently issued a Discussion Paper on opportunities, challenges, and design of central bank digital currency; Sweden's central bank is planning to build a pilot platform for a digital currency known as the e-krona; Brazil is studying a CBDC to improve the efficiency of the monetary function; in South Africa, the South African Reserve Bank has invited bids from private companies to develop the infrastructure necessary for a CBDC; in Australia the Reserve Bank of Australia has been working on an all-digital version of the Australian dollar.

4.5 The Libra Case

The Libra project is the most well-known and, without a doubt, the most publicized stablecoin venture. Libra was introduced in June 2019 by the Libra Association, a group of largely US-based firms based in Switzerland. There are presently 27 companies in the Libra consortium, including Facebook's subsidiary Novi, Spotify, and Uber. Libra aspires to build a global payment infrastructure based on its own currency, the Libra tokens. The program aims to improve cross-border payment efficiency while also promoting financial inclusion. According to the World Bank, cross-border payment firms typically charge a 7% fee for international money transfers (see World Bank, 2019). The existing system's enormous inefficiencies are revealed by such large transaction costs combined with normally lengthy payment processing. The Libra Association aims to promote financial inclusion by developing a safe and user-friendly digital payment system that can be used on mobile phones and incorporated into social media platforms like Facebook, WhatsApp, and Instagram. Currently, 1.7 billion individuals around the world are financially excluded due to a lack of bank accounts. Two-thirds of them hold cellphones (World Bank, 2018), which they might use to perform transactions in Libra and gain financial inclusion.

Libra is a payment system that is designed to maintain its value over time. The proceeds raised from the sale of the Libra tokens will be invested primarily in short-term government bonds and partially in bank deposits to maintain price stability. As a result, Libra will be fully backed by liquid and stable assets. The Libra platform will have two types of stablecoins, according to

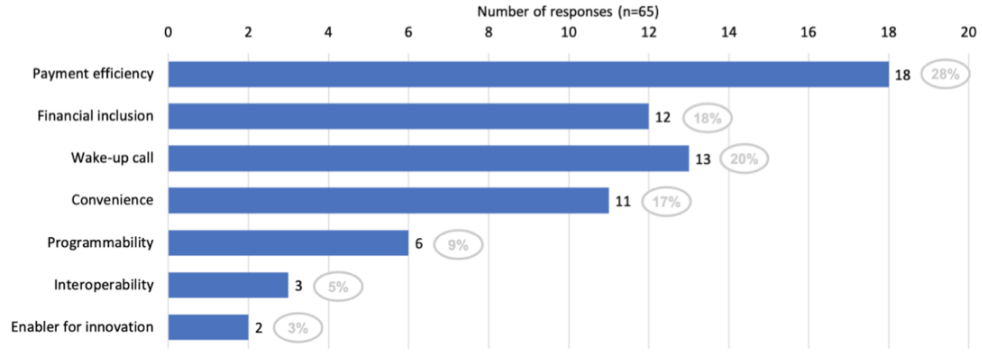
the present plan. To begin, there will be single-currency stablecoins, which are backed by a single currency. The Libra Euro, which is backed by Euro units, and the Libra-Dollar, which is backed by US dollar units, are two examples. Second, there will be a "multi-currency stablecoin," or "Libra Coin," backed by a basket of currencies analogous to the International Monetary Fund's special drawing rights (SDR) (IMF).

The single-currency stablecoins will be backed by (at least) 20% bank deposits denominated in the fiat currency in question and (more than) 80% short-term government bonds. The Libra Euro will be backed by Euro bank deposits and Euro area government bonds in the case of the Eurozone. The "Libra Coin," a multi-currency stablecoin, will be made up of multiple single-currency stablecoins and will thus be indirectly backed by a currency basket. The multi-currency stablecoin creation is highly automated, with a smart contract creating the multi-currency stablecoins without the need for human intervention.

According to the declared goals of the Libra Association, Libra will be utilized mostly in emerging and developing economies, where national currencies are often weak, making Libra's stability particularly valuable. The multi-currency Libra Coin, which is backed by a currency basket that includes strong currencies like the Euro and the US dollar, is an appealing means of payment and a store of value in this situation. Single-currency stablecoins are anticipated to be of special relevance in developed countries. Libra has the advantage of being based on a DLT, allowing it to be utilized as "programmable money." When a specific event X occurs, Libra payments, for example, might be configured to automatically execute a following transaction Y. Interest payments and other financial transactions, for example, might be substantially automated in this fashion, resulting in efficiency improvements that are particularly appealing to the industrial and financial sectors.

Analyzing a report made by the Frankfurt School Blockchain Center, the majority of the experts polled believe that Libra's primary users would be end users. Merchants, according to some analysts, will be further adopters since they are required to establish large-scale Libra payment systems. Merchants are encouraged to adopt the Libra payment system because it is projected to be less expensive than using credit or debit cards. Other analysts believe that the industry will eventually adopt Libra since the programmability aspect may be beneficial to corporations. Firms will accelerate their plans to deploy IoT and smart contracts in connection with Libra, according to mostly industry specialists.

(Source: Frankfurt School Blockchain Center)



Graphic 1.3

The Libra initiative, according to analysts, has several advantages. The most noted benefit is increased efficiency in payment transactions, with 18 experts stating that Libra will enable faster and cheaper transactions, particularly for cross-border payments. In this context, 11 experts state that Libra will provide more convenient transactions than currently available payment methods. According to non-financial industry experts, such convenience could be especially helpful for e-commerce use cases. Libra's high interoperability, according to three experts, is a significant benefit over CBDCs, which are likely limited in their global application. Libra has a substantial advantage in the context of financial inclusion, according to 12 experts. They emphasize the enormous benefits for countries where the percentage of people without bank accounts is particularly large. Libra, as a worldwide stablecoin, has the potential to give simple and convenient access to a financial system and a stable currency that can be used as both a means of payment and a store of value.

Another advantage of Libra, according to analysts, is that it will increase competition in the payments business as a result of its disruptive impact.

Despite the fact that Libra is thought to be advantageous in a variety of ways, experts warn that there are a number of potential risks. The most serious concern is that Libra will use its market dominance to its advantage. Experts emphasize the relevance of network effects in payment systems, claiming that the "network effect will be there from the outset, in an ideal form." Libra is expected to become dominant, according to specialists. As a result, many analysts are concerned that the Libra Association would take advantage of its market position.

Similarly, such anxiety derives from the fact that if Libra reaches a high number of users, it will centralize vast amounts of data.

When examining the possible impact of Libra, experts say it's important to distinguish between developing and industrial regions. Several experts believe that the impact of Libra's debut in developed countries will be minor. The general consensus is that industrialized countries do not require a new payment system like Libra because they already have effective banking institutions in place. As a result, several analysts predict that individuals will stick with their current retail banks and not use Libra much. Nonetheless, some analysts suggest that clients have a motive to switch their payment service providers from a bank to the Libra Association because of Libra's high convenience and predicted low transaction costs.

Libra is expected to have a greater influence on developing countries than in developed countries, according to experts. Domestic currencies (volatile and weak) are likely to be replaced with Libra in poor countries. As a result, such substitution has far-reaching implications for the monetary system and monetary policy of developing country central banks. Furthermore, because banking systems in developing nations are generally underdeveloped and thus inefficient, analysts predict that people would switch to Libra. They also state that Libra will be a desirable form of payment and a reliable store of value. Experts agree that Libra will promote financial inclusion and have a beneficial impact on economic growth.

5. Conclusion

As a replacement for cash and checks, digital payments were created. We can define digital payments as a collection of various tools used to make electronic payments for products and services. The electronic payment ecosystem, often known as e-payment, began with the advent of the internet; without it, this type of system would not exist.

Token-based systems, often known as e-coins, were used in the majority of first-generation systems. So, this study starts with an analysis and an evidence of the differences between token based-systems and account-based systems. Token-based systems rely on tokens to provide purchasing power. To pay merchants in general, customers buy tokens from a broker. The merchants then send the tokens they have received to the broker, who pays the merchants. Instead, in account-based systems, customers and merchants both have accounts with a broker or bank, and customers authorize the broker to transfer payments to merchant accounts.

Then in order to understand how the business works today, is important to evidence how all it started, with an analysis of the major players in the industry, Visa and Mastercard.

In 1951, the Franklin National Bank (presently European American Bank) issued the first modern credit card, which was accepted by local merchants. Over 100 additional banks began issuing cards in a short amount of time. Cardholders were not charged any fees or interest if they paid their bills immediately after receiving them. The issuing bank charged merchants a fee for every transaction done on the card. Customer volume was modest, and bank revenues were minimal, because these cards could only be used within a specific geographic region.

The BankAmericard was the first modern-day credit card issued by a third-party bank, and it was launched in 1958.

Starting from the historical timeline, today digital payments companies follow a scheme for their business. A card scheme, which is a payment network linked to payment cards such as debit or credit cards, can be joined by a bank or any other eligible financial institution. When someone joins a card scheme, they receive the capacity to issue cards and recruit merchants from the scheme's network. Visa and MasterCard are two of the world's most well-known card systems (or card brands). Their cards handle billions of transactions each year. They follow the Four Party Scheme.

Cryptocurrencies instead are digital assets created by a private entity to use as a store of value for the purchase and sale of goods and services. Unlike today's money, a pure cryptocurrency is not produced by a central authority, and its value is transferred and recorded on a blockchain, an open public ledger. The currency's provenance and transfer of ownership are likewise secured and verified via cryptography.

There are dozens of cryptocurrencies, the most well-known of which being Bitcoin, Ethereum, Binance Coin, and Cardano. A distinction must be made, however, between a cryptocurrency, often known as a coin, and a token.

A cryptocurrency is the native currency of the blockchain on which it is created and traded, and it has its own blockchain. In contrast, a token is a monetary unit that represents projects built on top of an existing blockchain.

It’s evident that stablecoins are fundamental during the study of the cryptocurrencies. Unlike bitcoin and other speculative coins, stablecoins are theoretically linked to underlying assets to reduce price volatility. They have become the favored currency for acquiring other cryptocurrencies because of their stability.

Blockchain is the technology that underpins dozens of other cryptocurrencies, and it has a lot of potential beyond that.

One of the most talked-about inventions of the twenty-first century is blockchain technology. Blockchains, which were first developed to support Bitcoin, now power dozens of other cryptocurrencies, and developers are working to integrate the technology into fields like medicine, art, and banking.

A blockchain is a distributed ledger of transactions that is impossible to hack or alter. It is maintained by a network of computers. Individuals can conduct secure transactions with one another without the assistance of a government, bank, or other third party.

Global stablecoins (GSCs) have attracted significant global political, regulatory, and supervisory attention following Facebook's proposal for the creation of Libra, a combination of a private cryptocurrency fixed in value to major fiat currencies mated with its own and other global electronic payment and identification systems. Aside from the high-profile example of Libra and other potential GSCs, how crypto-assets should be regulated has been a key issue of regulators and market participants all over the world since the launch of Bitcoin in 2009, and notably during the crypto bubble of 2018.

Policymaking on digital assets is fragmented around the world, in part due to a rush to keep up with market shifts and emerging threats. A lack of a governing organization to oversee a really global endeavor is another concern. There is no equivalent body for digital assets to the Basel Committee on Banking Supervision, which brings together banking regulators to agree on worldwide norms.

Credit card corporations aren't waiting to be disrupted when it comes to bitcoin.

Visa and Mastercard have been working on new solutions to better integrate cryptocurrency into their companies for some years.

While incumbents have been a recurring theme as new technologies have grown, it appears that the world's top credit-card organizations, which operate payment networks that span the globe and connect millions of businesses and billions of individuals, are fighting hard to avoid this fate.

Mastercard's plan appears to be clear: he supports bitcoin and blockchain, and he's developing new tactics to connect his company to these emerging technologies, including a series of collaborations.

Almost all financial services companies are prepared for a technological disruption that might disrupt business as usual. Banks are understanding that being branchless and just doing business online is the way of the future, while brokerages are striving to "democratize" investing with easy trading apps and algorithm-based robo-advisors. Visa is well aware of the situation.

Another important theme is linked to CBDCs. Both Visa and Mastercard are valuating strategies and partnerships to develop it.

So, after an analysis in this thesis of the interaction between the most important players in the digital payments industry, with partnerships and strategies, the future trend of the industry is now clearer than the past considerations. Visa and Mastercard are facing the new challenges linked to the cryptocurrencies and to the CBDCs. With several initiatives and partnerships, they are pushing a continuous development.

Digital currencies issued by central banks are on the way. A growing number of central bank governors and board members have given public comments about CBDCs, according to recent research from the Bank for International Settlements (BIS). Many of these, particularly those dealing with retail CBDCs, took a critical or dismissive posture in 2017 and 2018. Since late 2018, the number of speeches in which retail wholesale CBDCs were mentioned positively has

increased, and there have now been more positive remarks than unfavorable statements. Expirations and studies will lead to the concretization of the notion of money created by central banks in a short period, as well as the establishment of a legislative and economic framework that fully welcomes this innovation while balancing the potential risks.

As a result, it's critical to be prepared, choosing the correct technological solution to spread the CBDC's functionality as widely as possible. CBDCs have the potential to be a disruptive force in the current payment system and banking sector, delivering considerable benefits in terms of efficiency and cost reduction. The CBDC method would result in a frictionless user experience and near-frictionless backend operations.

The possible hazards of cryptocurrencies to instruments, activities, and entities that fall under the core and ancillary functions of central banks over which they have regulatory, supervisory, or oversight powers were investigated in this thesis. It was discovered that cryptocurrencies could have both direct and indirect effects on central banks. Direct consequences primarily involve the threats to price stability and monetary policy behavior. Furthermore, threats to the central bank's monopoly on issuing banknotes and coins are taken into account as a direct consequence because such a monopoly would be critical to the conduct of monetary policy and the goal of price stability.

The indirect consequences, on the other hand, are mostly the result of the interface between banking and payment systems and cryptocurrencies, both of which are under the jurisdiction of central banks. As a result, according to this article, regulatory responses to such difficulties might take two major forms: direct and indirect regulatory, supervisory, and oversight actions. Direct technical and regulatory measures are examples of direct measures.

Because future developments may necessitate such adjustments, the thesis emphasized some of the legal changes that the possible expanded use and adoption of private cryptocurrencies, as well as the prospective issue of CBDC, may necessitate.

Finally, financial institutions and significant participants in the payments sector must be prepared for the changes that will occur and be willing to scale up or play a specific role if new business opportunities arise.

Bibliography

Ahmar, Gina, “Digitizing the Dollar: Privacy Considerations and Policy Prescriptions for a U.S. Central Bank Digital Currency”, (May 1, 2021). Hastings Business Law Journal, Vol. 18, No. 1, 2022, Available at SSRN: https://ssrn.com/abstract=4000826.

Aspan M., “How Caitlin Long turned Wyoming into crypto country”, (July 29, 2021) available at https://fortune.com/2021/07/29/caitlin-long-wyoming-crypto/.

Athanassiou P., *Hedge Fund Regulation in the European Union: Current Trends and Future Prospects,* Alphen aan den Rijn, The Netherlands: Kluwer Law International, 2009.

Bellamy, E., *Looking Backwards from 2000 to 1887*. Strelbytskyy Multimedia Publishing, 2020.

Bindseil, Ulrich, “Central Bank Digital Currency - Financial System Implications and Control”, (July 30, 2019). Available at SSRN: https://ssrn.com/abstract=3385283 or http://dx.doi.org/10.2139/ssrn.3385283

Böhle K., “The innovation dynamics of internet payment systems development”, (2002). Report Nr. 63, Institute for Prospective Technological Studies, April 2002

“Central Bank Digital Currency, PwC Overview”. Available at https://www.pwc.com/it/it/publications/assets/docs/central-bank-digital-currency.pdf

Chaum D., “Blind Signatures for Untraceable Payments”. In: Chaum D., Rivest R.L., Sherman A.T. (eds) Advances in Cryptology. Springer, Boston, MA, (1983). Available at https://doi.org/10.1007/978-1-4757-0602-4_18

Croft J., “Which real-world assets are being tokenised?”, (November 30, 2021). Available at https://www.ft.com/content/ac33fb51-53a4-49a0-a4c4-fb92dc6ee241

Dai W., “B-Money”, (1998), available at http://www.weidai.com/bmoney.txt

Dhamodharan R., “Making it easier for everyone to buy NFTs”, (January 18, 2022); available at https://www.mastercard.com/news/perspectives/2022/coinbase-nft-marketplace-making-it-easier-for-everyone-to-buy-nfts/

Dhamodharan R., “Why Mastercard is bringing crypto onto its network”, (February 10, 2021); available at https://www.mastercard.com/news/perspectives/2021/why-mastercard-is-bringing-crypto-onto-our-network/.

Guanyu Fangfan Bitebi Fengxian de Tongzhi, *Notice on Preventing Bitcoin Risks,* PBOC, MIIT, CBRC, CSRC, CIRC, December 3, 2012.

Hollerith D., Visa, Consensys partner to build tech for central bank digital currencies, in “*Yahoo!Finance”*, (January 13, 2022).

Laband, Jake, “Existential Threat or Digital Yawn: Evaluating China's Central Bank Digital Currency”, (December 20, 2021). Harvard International Law Journal, Forthcoming, Available at SSRN: https://ssrn.com/abstract=3990141 or http://dx.doi.org/10.2139/ssrn.3990141

Ladani N., “DAOs Are Taking Over, With New Wyoming Law”, (October 7, 2021); available at https://finance.yahoo.com/news/daos-taking-over-wyoming-law-194516224.html.

Law L., Sabett S., Solinas J., “How to Make a Mint: The Cryptography of Anonymous Electronic Cash”, National Security Agency Office of Information Security Research and Technology Cryptology Division, (18 June 1996).

Mashayekhi R., “Visa’s embrace of crypto is starting to pay off”, (July 16, 2021). Available at https://fortune.com/2021/07/15/visa-crypto-payments-fintech-cryptocurrency/.

Mastercard history available on these links:

https://brand.mastercard.com/brandcenter-ca/more-about-our-brands/brand-history.html; http://www.fundinguniverse.com/company-histories/mastercard-international-inc-history/.

Nabilou, Hossein, “Central Bank Digital Currencies: Preliminary Legal Observations”, (February 6, 2019). Journal of Banking Regulation (2019), Available at SSRN: https://ssrn.com/abstract=3329993 or http://dx.doi.org/10.2139/ssrn.3329993.

Nabilou H. and Pacces A.M., "*The Hedge Fund Regulation Dilemma: Direct Vs. Indirect Regulation," William & Mary Business Law Review* 6, no. I (2015).

Parhonyi R., Nieuwenhuis LJM., Pras A. *The fall and rise of micropayment systems*. In Lammer T, editor, Handbuch E-Money, E-Payment & M-Payment. Heidelberg, Germany: Springer. 2006. p. 343-361. https://doi.org/10.1007/3-7908-1652-3_25.

Ricks, Morgan and Crawford, John and Menand, Lev, “FedAccounts: Digital Dollars”, (April 15, 2020). Vanderbilt Law Research Paper 18-33, UC Hastings Research Paper No. 287, George Washington Law Review, Forthcoming, Available at SSRN: https://ssrn.com/abstract=3192162 or http://dx.doi.org/10.2139/ssrn.3192162.

Rubin B.F., “Making the creator economy mainstream: Why Coinbase is getting into NFTs”, (January 18, 2022). Available at https://www.mastercard.com/news/perspectives/2022/coinbase-nft-creator-economy-prakash-hariramani/.

Sandner, Philipp and Gross, Jonas and Grale, Lena and Schulden, Philipp, “The Digital Programmable Euro, Libra and CBDC: Implications for European Banks”, (July 29, 2020). Available at SSRN: https://ssrn.com/abstract=3663142 or http://dx.doi.org/10.2139/ssrn.3663142.

Stafford P., “Cryptocurrencies: how do they work and what are the risks?”, (October 21, 2021). Available at https://www.ft.com/content/c717654d-1847-4832-afd8-844176daae09.

Stiglitz J.E., *The Euro: How a Common Currency Threatens the Future of Europe*, New York: W.W. Norton & Company, 2016.

Venkataramakrishnan S., "What are stablecoins for — and how stable are they?", (October 21, 2021). Available at https://www.ft.com/content/16a5f891-0a59-47a1-8e62-b9039d91b8c3.

Visa history available on these links:
https://www.visa.co.uk/about-visa/our_business/history-of-visa.html;
http://www.fundinguniverse.com/company-histories/visa-international-history/.

Zetzsche, Dirk Andreas and Annunziata, Filippo and Annunziata, Filippo and Arner, Douglas W. and Arner, Douglas W. and Buckley, Ross P., "The Markets in Crypto-Assets Regulation (MICA) and the EU Digital Finance Strategy", (November 5, 2020). European Banking Institute Working Paper Series No. 2020/77, University of Luxembourg Law Working Paper Series No. 2020-018, University of Hong Kong Faculty of Law Research Paper No. 2020/059, Available at SSRN: https://ssrn.com/abstract=3725395 or http://dx.doi.org/10.2139/ssrn.3725395.

Zetzsche, Dirk Andreas and Buckley, Ross P. and Arner, Douglas W. and Arner, Douglas W., "Regulating LIBRA: The Transformative Potential of Facebook's Cryptocurrency and Possible Regulatory Responses", (July 11, 2019). European Banking Institute Working Paper Series 2019/44, University of New South Wales Law Research Series UNSWLRS 19-47 , University of Hong Kong Faculty of Law Research Paper No. 2019/042, University of Luxembourg Faculty of Law Research Paper, Oxford Journal of Legal Studies (Forthcoming), Available at SSRN: https://ssrn.com/abstract=3414401.