THUNDERBIRD SCHOOL OF GLOBAL MANAGEMENT | Arizona State University | WISEASY Payment Innovator

The Future of Global Payments & Fourth Generation Payment Networks (4GPN)

REPORT JUNE 2025

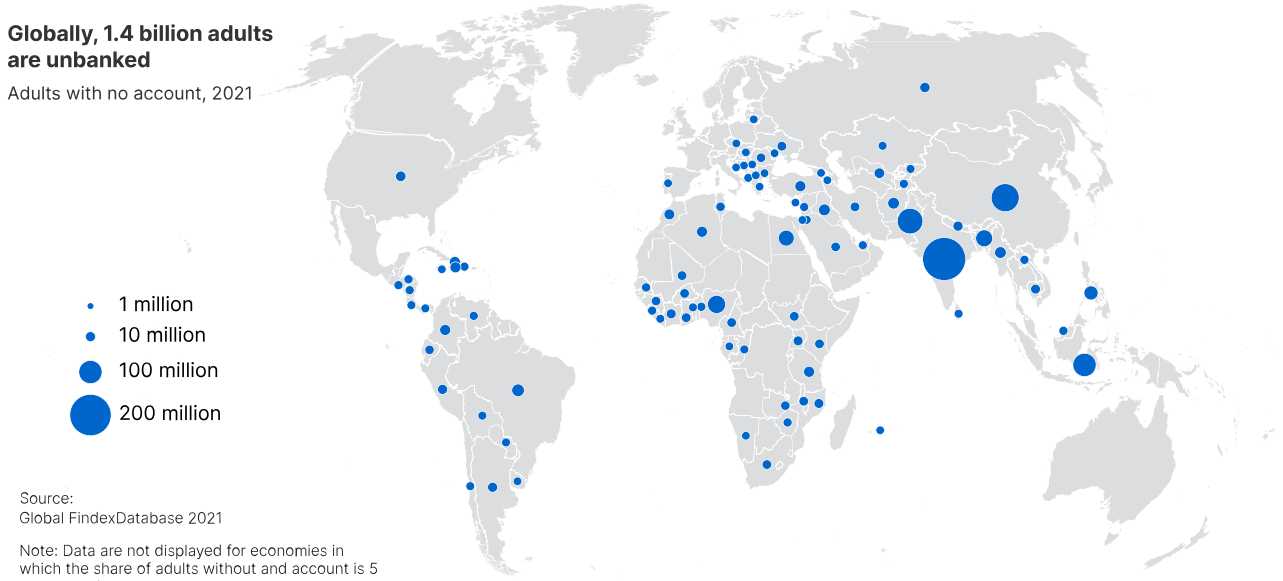
INDEX

01. OVERVIEW OF GLOBAL PAYMENTS INDUSTRY

The Fintech industry is revolutionizing the international financial landscape by expanding products and services to be more inclusive, more accessible, and more frictionless. According to the World Bank's Global Findex, there are 1.7 billion adults worldwide who do not have a bank account. However, of those 1.7 billion adults, 1.1 billion of them have a cell phone which allows them to have access to certain financial services. In emerging markets, particularly in Africa, Fintech companies offer opportunities to increase financial inclusion and economic development using mobile phones and telecom companies.

Globally, 1.4 billion adults are unbanked

Adults with no account, 2021



Source:
Global FindexDatabase 2021

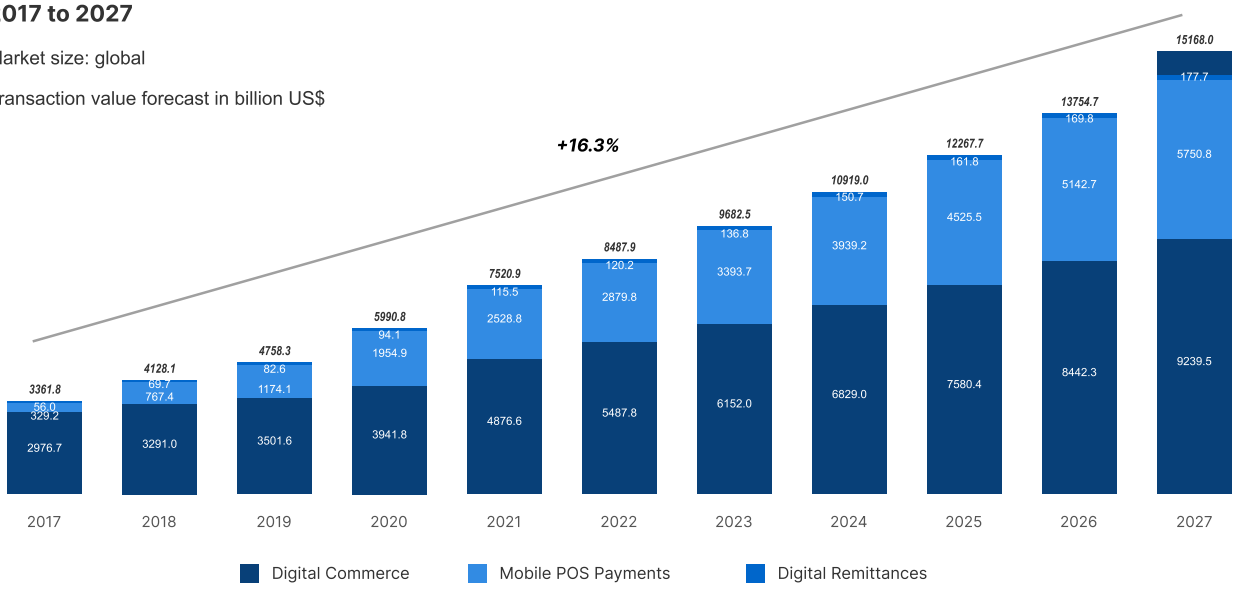
Note: Data are not displayed for economies in which the share of adults without and account is 5 percent or less.

According to a report by the McKinsey Institute, the Fintech industry could create 95 million new jobs and contribute to an estimated 6% of additional GDP in emerging economies by 2025. Recent advances in fintech have come from digital payments, government politics, and a new generation adopting mobile and internet-based financial services. Due to the economic and social implications of new fintech innovations, public authorities have to ensure adequate regulatory frameworks are put into place, ensure

The Digital Payments market transaction value is estimated to increase at a CAGR of 16.3% from 2017 to 2027

Market size: global

Transaction value forecast in billion US$



there is an environment conducive to technological innovations, and seize the opportunities offered by financial technologies. This will help reduce the financial inclusion gap and benefit small businesses, young people, rural populations, and especially women. The main players in the financial ecosystem, particularly central banks and private banks, whose main goals are money creation, supervision, and financial regulation, are being challenged by the changes fintech is bringing. The efforts put forth by fintech companies that favor digital financial inclusion ultimately contribute to achieving the first goal of the United Nations Sustainable Development Goals to eradicate poverty.

At the heart of these efforts is the rise of **Fourth Generation Payment Networks (4GPN)** - a new class of integrated payment ecosystems built on the convergence of IoT, cloud computing, and blockchain technologies. These networks unify traditional and emerging payment methods including cards, biometrics, and digital currencies, into a secure, flexible, and scalable platform designed to simplify financial complexity and extend inclusion across all market environments.

The Digital Payments industry had a global transaction value of 9.68 trillion USD in 2023 as seen in the graph below and currently makes up the largest share within the FinTech market.[1] Within the digital payments industry, mobile POS payments made up 3.39 trillion USD in 2023 with an expected transaction value of 5.75 trillion USD in 2027. As the fintech industry continues to expand, digital payments are expected to continue capturing the largest transaction value through 2028.[2]

The main trends identified in the digital payment industry as of 2024 include mobile solutions, digital wallets, API developments, security & biometrics, blockchain & distributed ledger, and A2A payments. These trends are predicted to change the landscape of the digital payments industry in the coming years.

02. MOBILE SOLUTIONS

Mobile finance and payment solutions cover a range of technologies and services that help with financial transactions and money management using mobile devices like smartphones and tablets. These solutions include mobile payment, mobile banking, mobile money transfer, and mobile wallets.

Mobile devices have become increasingly popular for making payments because they are convenient, easy to use, and widely accessible. Two main factors contributing to the rise of mobile payment solutions are the growth of FinTech services and the impact of Covid-19.

FinTech services and innovations enable mobile devices to handle transactions more smoothly and offer convenient online banking and payment services. Additionally, the Covid-19 pandemic has prompted the World Health Organization and governments to promote new payment methods to replace physical cash, which has significantly boosted the adoption of mobile solutions in recent years.[3]

2.1.1 Market Overview

According to the Mobile Wallet Market Size report conducted by Global Market Insights, the Mobile Wallet Market size was valued at USD 318.5 billion in 2022 and is predicted to register at a CAGR of 18.5% between 2023 and 2032, driven by the widespread adoption of smartphones and internet connectivity. The Asia-Pacific region holds more than 55% of the global market share for mobile payments, indicating its position as a leading market with fierce competition and several established players.[4]

2.1.2 Challenges and Potential

Financial inclusion is a key challenge in the payment chain. It involves ensuring that individuals with financial accounts not only have access to payment services but also the ability to save money and utilize other financial services. Mobile solutions are playing a significant role in providing access to financial services for both banked and unbanked populations worldwide, offering greater convenience and accessibility at lower costs. The rise of numerous Fintech companies has led to disruptive and innovative solutions in the payment and financial industry. One such example is M-Pesa, which was introduced by Safaricom, a telecommunications

1 Fintech: Market Data Analysis & Forecast by Statistica 2023. Statistica.
2 Bionducci, L., Botta, A., Bruno, P., Denecker, O., Gathinji, C., Jain, R., Nadeau, M. C., & Sattanathan, B. (2023). On the cusp of the next payments era: Future opportunities for banks. In McKinsey & Company.
3 THE MANY FACES OF GLOBAL MOBILE PAYMENTS. (2022). Statista.
4 Wadhwani, P. (2023). Mobile Wallet Market Size & Forecast, 2023 – 2032. In Global Market Insights Inc.

company in Kenya, in 2007. M-Pesa is a mobile money transfer service that allows users to send money through mobile messages to their contacts, make various payments, and even deposit cash in exchange for electronic money at authorized agents. Transactions on M-Pesa are secured with a PIN and confirmed through SMS by both parties. The service has gained widespread popularity across the African continent, with 51 million users in 2024.[5]

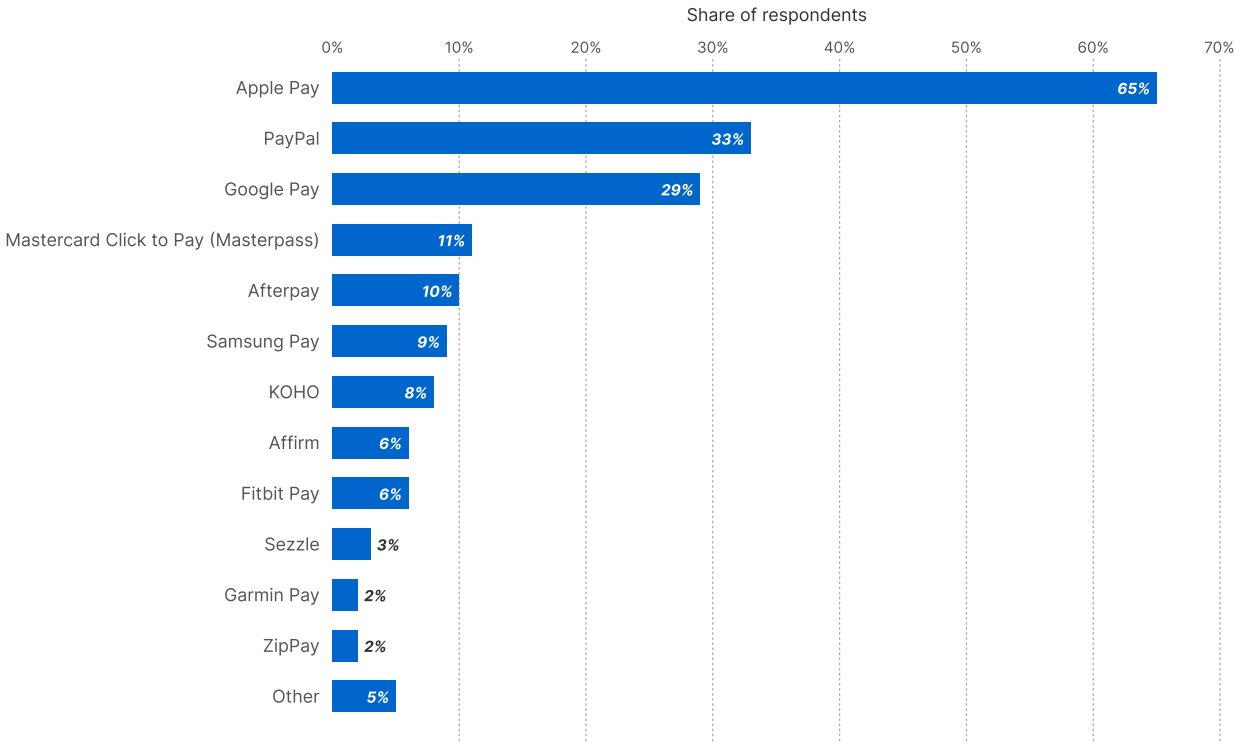
2.1.3 Regional Trends

Europe: Europe recorded a transaction value of 1.55 trillion USD in 2022. The highest transaction values were generated by the United Kingdom and Germany, totaling 392.3 billion USD and 232.5 billion USD, respectively. With a CAGR of 15.1% in the global digital payment market, Europe is forecast to have the strongest annual growth rate between 2022 and 2027 and is expected to generate a market volume of 3.12 trillion USD by 2027. [6]

Based on a survey conducted by Statista in March 2024, 67% of UK respondents are users of Apple Pay, 33% of Google Pay, and 30% PayPal. In Germany, the majority of respondents are PayPal users (49%), followed by Apple Pay (43%), and Google Pay (33%).[7]

North America: In the global digital payment market, the U.S. is projected to have an average annual growth rate of 14.9% between 2022 and 2027 and a total market volume of 3.52 trillion USD by 2027.[8] Traditionally, the United States uses more credit payments than debit payments. However, the COVID-19 pandemic has changed this, and sources indicate that debit spending may exceed credit spending for the first time in the US. According to Statista Consumer Insights, 65% of respondents ranging from age 18 to 64 reported to be users of Apple Pay, resulting in its ranking as the most used mobile payment brand at POS in Canada in 2024, followed by Paypal (33%) and Google Pay(29%).[9] While Apple Pay takes the lead at POS payments, PayPal is the most popular brand when it comes to e-commerce payments(80%), followed by Interac(53%), Apple Pay (34%), and Google Pay(30%).

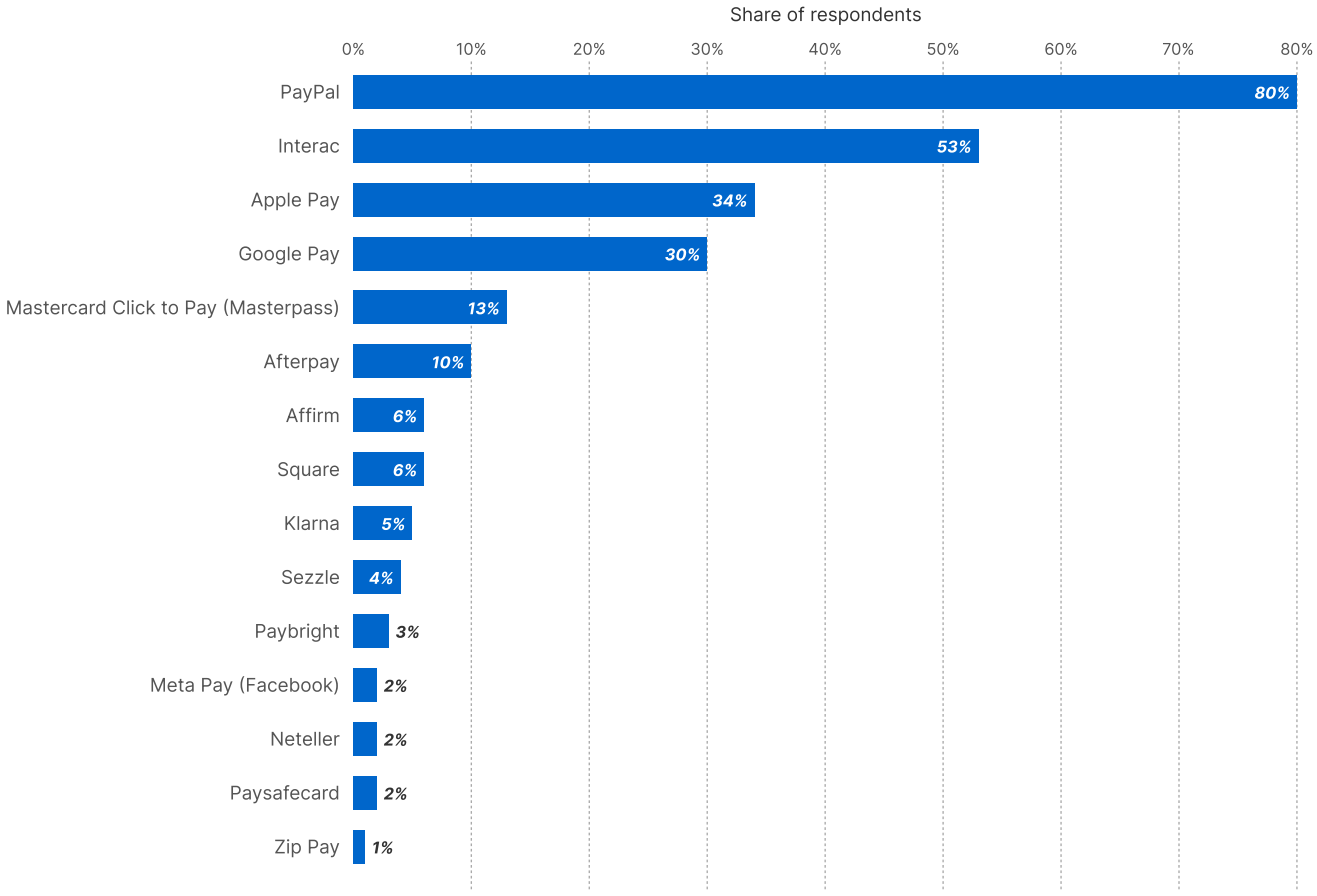
Biggest contactless payment brands at POS in Canada as of March 2024



5 Vodafone - M-Pesa Official website.
6 Fintech: Market Data Analysis & Forecast. (2023). In Statista.
7 Digital shopping behavior in Europe. (2023).p.43,44,45. In Statista.
8 Fintech: Market Data Analysis & Forecast. (2023), p 31. In Statista.
9 Digital payment types in Canada. (2024). p.15,16. In Statista.

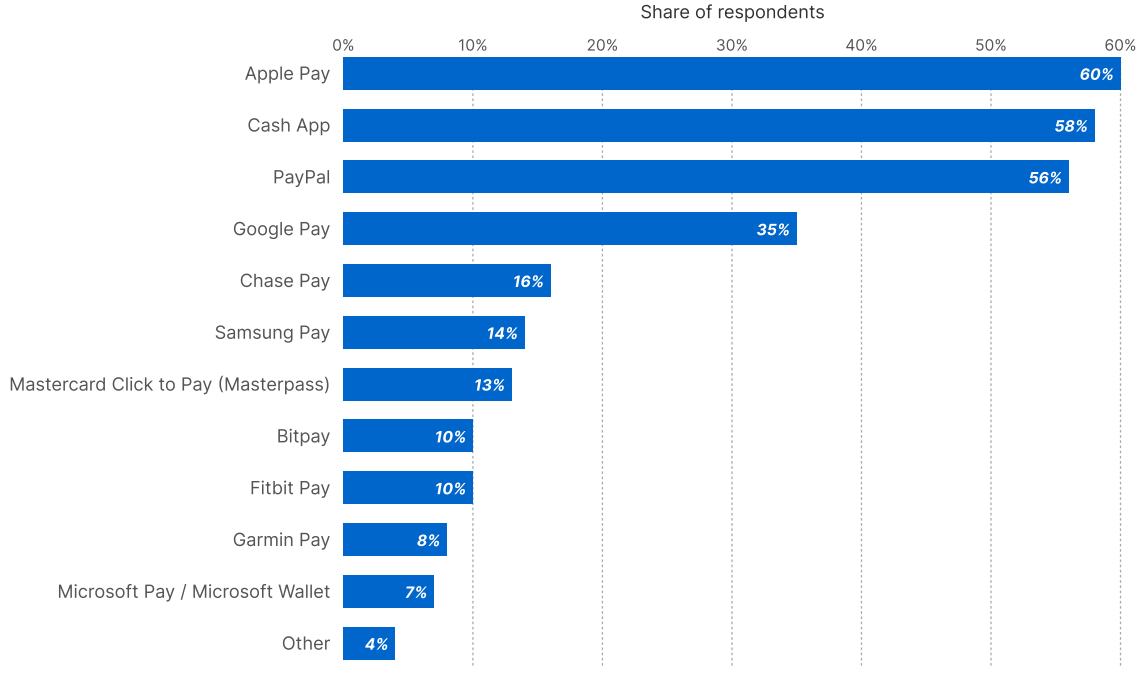
Biggest e-commerce payment brands in Canada as of March 2024

Biggest e-commerce payment brands in Canada 2024

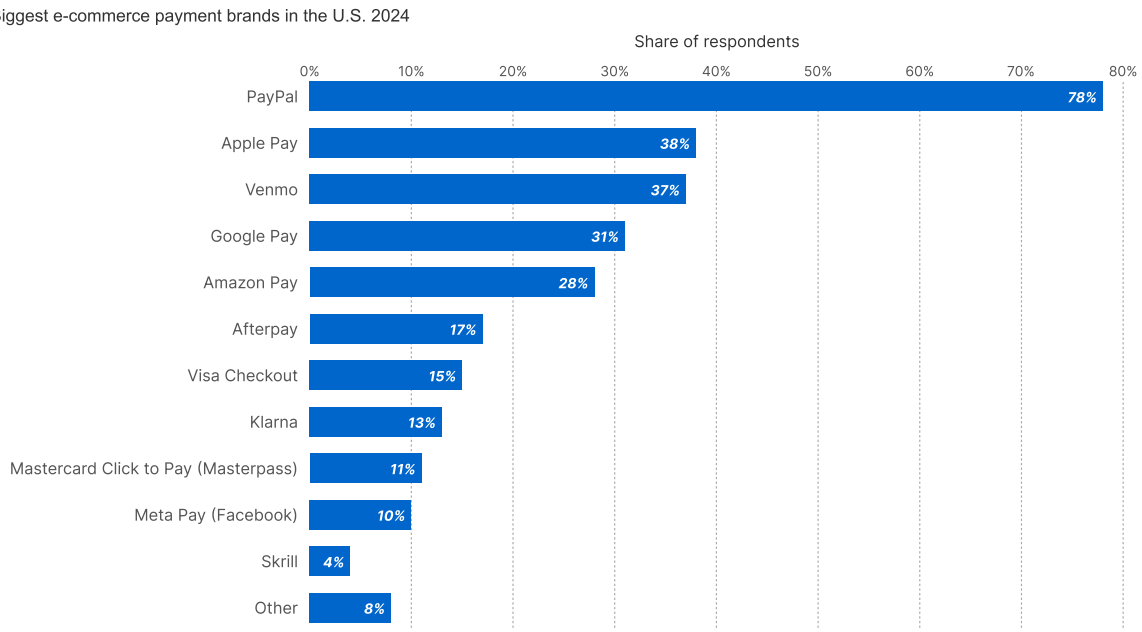


Biggest contactless payment brands at POS in the U.S. as of March 2024

Biggest contactless payment brands at POS in the U.S. 2024



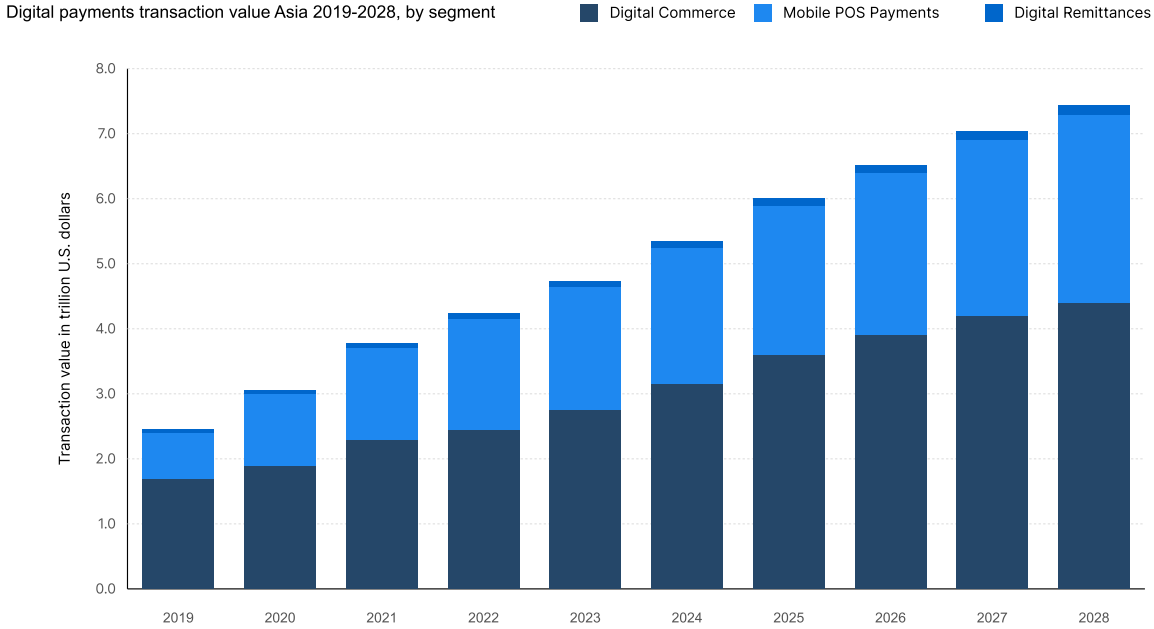
Biggest e-commerce payment brands in the U.S. as of March 2024



A similar survey was conducted in the US in 2024, with 2436 respondents aged 18 to 64. According to Statista Consumer Insights, Apple Pay is the most used mobile payment brand at POS in the US (60% of respondents used it in the past 12 months), followed by Cash App(58%), Paypal(56%), and Google Pay(35%). The most used e-commerce payment brand in the U.S. in 2024 is PayPal(78% of respondents used it for online payment), followed by Apple Pay(38%), Venmo(37%), Google Pay (31%).[10]

Apple Pay dominates the mobile payment market at point-of-sale (POS) in North America, with widespread usage among consumers. Additionally, PayPal boasts a strong presence in e-commerce payments and is a significant player in POS transactions in the region. Google Pay consistently ranks among the top four in both POS and e-commerce payments. While both Canada and the U.S. exhibit similar tendencies in mobile payments, there are still notable differences between the two countries. In the Canadian market, Interac plays a significant role in e-commerce payments. Meanwhile, in the U.S., Cash App and Venmo are the preferred choices, especially for POS (Cash App at 58%) and e-commerce payments (Venmo at 37%).

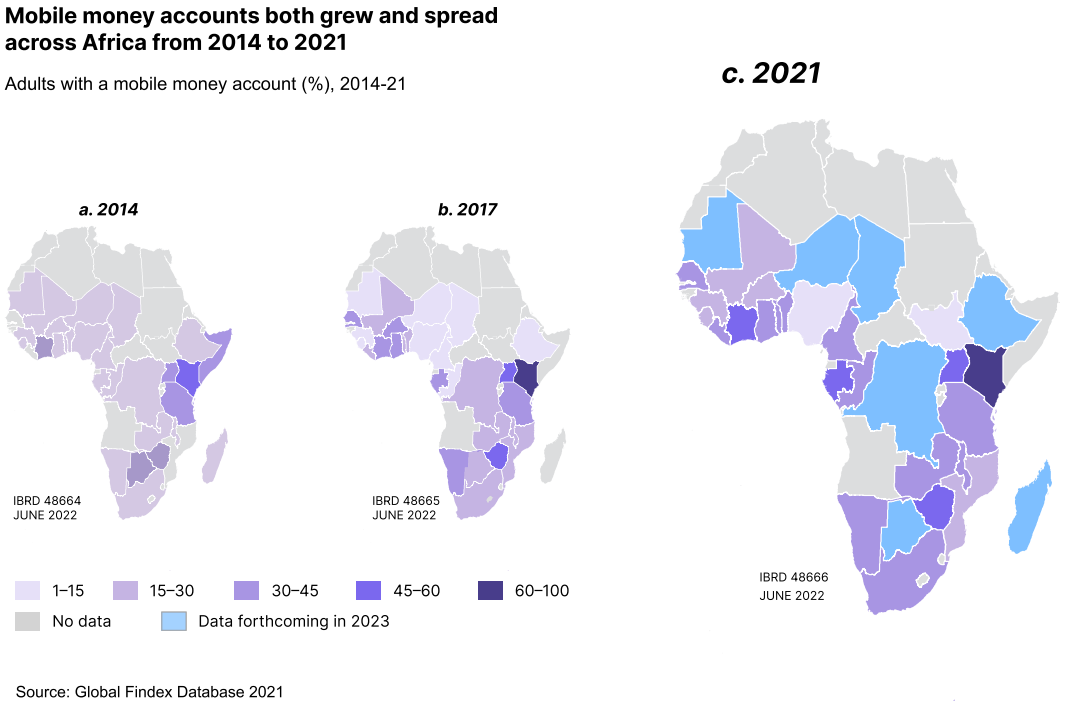
Transaction value of digital payments in Asia from 2019 to 2028, by *segment (in trillion U.S. dollars)*



10 Digital payment types in the United States. (2024). p.23, 24. In Statista.

APAC: The APAC region has shown high adoption rates of mobile payments and rapid development in mobile solutions. Mobile solutions like super apps are well-developed in these nations which allow consumers to access multiple types of services all within one app. The graph to the right shows the largest share of the digital payments industry in APAC is attributed to digital commerce. Both the digital commerce and mobile POS payments sectors show consistent projected growth through 2028.[11]

LATAM: Over the past two years (2022 & 2023), debit cards have surpassed cash to become the most popular way to pay for goods and services among Latin Americans. At the same time, mobile payments have also become increasingly popular, especially in countries like Argentina and Peru. This trend is part of a larger movement called "bancarization," which aims to provide banking and financial services, including online banking, to people who previously did not have this access. Until recently, many people in the region were used to using cash for transactions. In 2019, only about 30-50% of the population in several Latin American countries had a bank account, compared to over 90% in more developed countries like Spain, the UK, and the US. By 2021, the percentage of people in Latin America and the Caribbean with a bank account had increased to about 73 percent. This growth was largely due to the introduction of new payment options and the impact of the COVID-19 pandemic, which led many Latin Americans to try online banking and e-commerce when physical bank branches and stores were closed during lockdowns. After the pandemic, many people continued to use these mobile financial services.[12]



Source: Global Findex Database 2021

MEA: In the Middle East and North Africa region, digital payments are the most popular banking service among customers. The adoption rate of financial technology in the MENA region is particularly high among younger banking customers and has been steadily increasing over the past few years thanks to the widespread use of smartphones. Fintech is a rapidly expanding sector within Islam-dominated countries in the region where there are over 145 Islamic fintech companies providing financial services that adhere to Muslim religious principles and ethical standards.[13] Mobile money accounts have also been becoming more widely adopted in the Sub-Saharan Africa region in recent years as seen in the graphic above.

2.1.4 Buy Now Pay Later (BNPL)

BNPL is a type of short-term lending offered to businesses at the point of sale. It allows buyers to spread costs or delay payments while merchants are paid upfront, thereby improving cash flow for all parties. BNPL is becoming popular among merchants and consumers, especially for Gen Z and millennials, as the credit alternative to credit cards and revolving credit. Buy Now Pay Later has offered many who do not have access to traditional financing. Buy Now Pay Later can be implemented through either online options

11 Transaction value of digital payments in Asia from 2019 to 2028, by segment. (2024, January). Statista.
12 Cabrera, F., Mizrahi, N., Moreno, J., & Zabaleta, P. (2024, May 7). The rapid evolution of payments in Latin America. McKinsey & Company.
13 Digital Payments - Asia | Statista Market Forecast. Statista.

such as Paypal, Klarna or others while checking out online, or it can be available at the Point of Sale Terminal while checking out in-store.

Buy Now Pay Later is very similar to Equated Monthly Installments (EMI) however there are a few main differences between the services. EMI financing is a traditional form of financing for larger purchases such as car loans, education loans or home appliances where the repayment period is several months to a year. EMI also includes a credit check which takes into account whether the user will be likely to pay back the loan. Unlike BNPL, EMI involves interest that is either fixed or variable that is added to the principal amount but spread out through the payments. What this means is that BNPL and EMI are similar in that they are both structured payments over a period of time. The main difference is that BNPL does not include interest within the payment as most BNPL provides don't include interest but do include late fees.

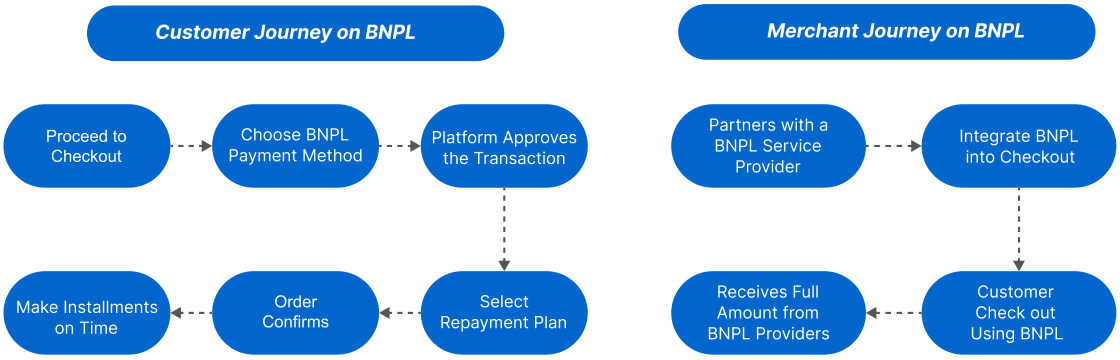
In summary, BNPL and EMI are installment payments, however BNPL is a short term customer friendly option for smaller purchases and EMI is for larger purchases with structured long term repayments with interest.

The payments chain faces many challenges in regards to friction whether that be through higher merchant fees, processing times or even user experience. BNPL positions itself as an alternative to traditional purchase financing directly competing with other payment forms such as credit cards, debit cards and other payment methods.

2.1.5 BNPL Benefits

BNPL is making lending more accessible to consumers across various products and services. BNPL can fund unbanked or financially underserved consumers and increase the potential for every merchant category. BNPL shifts costs of financing from consumer to merchant or 3rd party. BNPL Offers unsecured loans to consumers regardless of creditworthiness. The rise of inflation and interest rates in 2022 led to BNPL as a way for consumers to purchase. From a consumer perspective, BNPL allows for a more accessible range of products without needing a background credit check. Another advantage is that there are no or very low interest rates as compared to credit cards, and generally have fast approval.

The Flow of Transactions in a BNPL App



(Technolab, 2023)[14]

Above highlights how a BNPL service would be used from both a customer perspective as well as a merchant perspective. The customer is able to use BNPL as a payment method at checkout, selects the repayment plan, makes the order and then will continue to make the payments. Merchants will partner with a BNPL service, integrate the payment method into their checkout and then once customers use the service, the merchant receives the entire transaction at once.

BNPL provides benefits for merchants by making products more accessible to consumers. It allows the merchant to increase sales as customers are now given an option to purchase items normally out of their price ranges. From a merchant perspective, it allows for improved cash flows for the business and more access to customer segments. With the implementation of this technology gaining access to an unbanked population would be possible if implemented and marketed correctly.

14 Kidecha, S. (2023b, August 4). Buy now pay later business model: How does it work?. Kody Technolab.

BNPL vs credit cards

Is BNPL the solution across the whole payment life-cycle above credit cards?

End-to-end payment journey	Key players in the value chain	Key metric	BNPL	Credit cards
Pre-purchase	Issuer	Better credit checks/lower risk		✓
		Access to new customer segments	✓	
	Merchant	Better rates to charge merchants	✓	
		Lower fees (costs)		✓
		Higher volumes	✓	
		Better engagement with customers	✓	
		Lower cost	✓	
At purchase	Customer	More accessible	✓	
	Issuer	Better cash flow (slower payment to merchant)		✓
	Merchant	Quicker payment by issuer	✓	
	Customer	Better cash flow options	✓	
Post-purchase	Issuer	Higher chance of collection		✓
		Quicker collection		✓
	Merchant	Higher chance of returns	✓	
	Customer	Better payment terms	✓	

Above is a graph that outlines the benefits and comparisons in the payment chain of how BNPL compares to traditional credit card usage. The Chart allows for easy understanding of how BNPL benefits merchants through more customer segments, issuers achieve better rates to charge merchants, and customers get more access to products normally out of their price ranges.[15]

2.1.6 BNPL Challenges

Buy Now Pay Later is not without challenges to both the merchant, customer and creating a more seamless payment process.

From the perspective of merchants, the largest challenge they face is a higher fee when compared to credit cards. This fee varies between 2% and 8%, depending on the BNPL provider. This results in more friction for the merchant, leaving them with higher fees when compared to alternatives such as credit and debit. Implementation of BNPL software providers in purchasing locations either online or in person can pose a challenge. Finally, future regulation can change the landscape of whether BNPL will become widely accepted due to providing unsecured loans with little consequences. Many governments have questioned whether providing unsecured loans will result in more defaults and debt within their countries. With tightening regulation, BNPL could be heavily reduced in many markets that have already adopted the payment system.[16]

On the consumer's side, BNPL can cause challenges due to its position as a no-interest credit option, which raises questions about financial responsibility. As younger generations may not always be as financially savvy, they don't fully understand that BNPL is a loan and how missed payments can impact their future. Customers can register with multiple BNPL service providers without a record of their various accounts, which means they can face debt across many platforms. Overall, BNPL is very new, and regulations are impending to provide consumer rights.

2.1.7 BNPL User Demographics

15 'Buy Now Pay Later' The future of BNPL in the Middle East. (2023). Deloitte. Retrieved June 14, 2024, from

16 Buy Now Pay Later: What are the risks and benefits to consumers? - The Behavioural Insights Team. (2023, December 6). The Behavioural Insights Team.

In a PYMNTS 2024 report titled, Consumer Financing Trends Driving the Evolution of Pay Later Plans, they find that Generation Z is one of the biggest users of BNPL plans. BNPL plans attract those with less credit history and fluctuating budgets. Gen Z has expressed that BNPL is a priority, with 31% of this demographic indicating they would prefer to switch to merchants that provide this service for payment flexibility.[17]

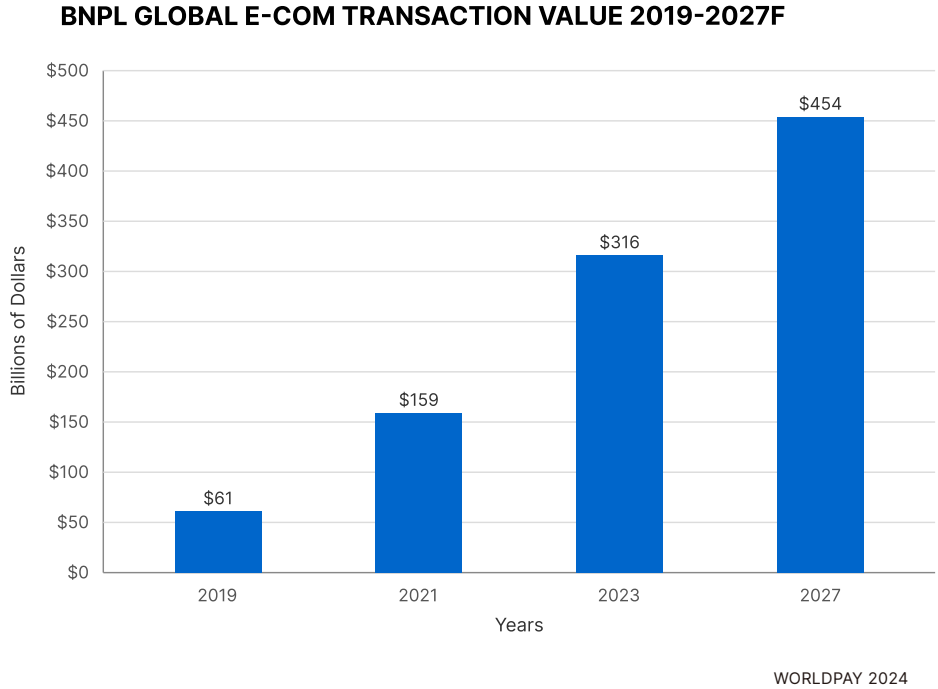
When analyzing a breakdown of the average BNPL, there is one main characteristic of the user: they are from a high-income country such as Australia, New Zealand, Germany, and Sweden. The average US BNPL user:

- Gender: Woman
- Income: USD $50,000 - $100,000 of BNPL
- Age: Between 18-35 (GenZ or Millenial)
- Average Yearly BNPL Spend: $688
- Financial Status: Paycheck to Paycheck
- Purchases of BNPL: Retail

Through a study by the Consumer Financial Protection Bureau in 2021, 50.5% of BNPL purchases were for retail purposes. This is a decrease from the previous year in which 57.0% of BNPL purchases were retail-related. At the same time, they reported an increase in BNPL for travel, entertainment services, automotive health and everyday purchases.[18]

2.1.8 BNPL Market Overview

As projected by Worldpay in their 2024 Global Payments Report, BNPL global transaction values grew 18% in 2022-23 to reach a 5% share of global e-commerce spending, or over $316 billion USD. They project growth in the forecast period from 2024 to 2027 to grow at 9% CAGR and to continue to retain 5% global share through 2027. Both sources report that BNPL will continue to grow at the very least 9% CAGR from now to 2027 and to hold around 5% of e-commerce options globally.[19] The global e-commerce transaction value of Buy Now Pay Later is expected to reach USD $454 billion by 2027. The projected growth of BNPL suggests that there is still consumer demand for the service in the market.



17 REDEFINING RETAIL: CONSUMER FINANCE TRENDS DRIVING THE EVOLUTION OF PAY LATER PLANS. PYMNTS.
18 Buy Now, Pay Later: Market trends and consumer impacts | Consumer Financial Protection Bureau. (2022, September 15).Consumer Financial Protection Bureau.
19 Global Payments Report 2024 | Worldpay.

2.1.9 Popular BNPL Providers:

Klarna - Serving more than 147 million global shoppers and 450k retail partners, Klarna is the Swedish payment service provider that offers customers the option to pay for their purchases in three equal, interest-free installments. It also allows you to offer your customers a 'Pay in 30 days' option and 36 months financing.

Tamara - One of the leading BNPL providers in MENA, used by thousands of leading retailers across the region to offer flexible finance options to their customers.

Afterpay - An Australian company that allows customers to pay for their purchases in four interest-free installments over six weeks. Afterpay charges merchants a percentage of each transaction +30 cents (operates under Clearpay in Europe).

Zip (formerly QuadPay) - Another Australian BNPL service that allows customers to pay for their purchases in four interest-free installments, Zip charges a merchant fee based on the interest fee period you offer your customers. Transaction fees are limited to 30 cents per sale, which gets cheaper the more customers use the service.

Laybuy - A New Zealand-based BNPL service that allows customers to pay for their purchases in six interest-free installments. Laybuy also gives you access to a Merchant Dashboard that you can use to analyze sales performance and shopper behavior.

Zebit - a US-based service that offers no-credit-needed financing options for customers and the ability for your customers to pay over six months. Once an order is accepted (subject to an evaluation and underwritten at checkout) your customer pays between 20% and 35% upfront, and the remainder in installments as often as they get paid.

PayPal - although not known predominantly as a BNPL provider, PayPal offers its own interest free installment loan service called Pay in 4. It's available for purchases between 30 USD and 1,500 USD and doesn't charge late fees.[20]

2.1.10 BNPL Regional Trends

United States - BNPL is seeing increasing usage in the United States from younger generations. Younger consumers are more likely than older to have all five mobile and digital payments (digital wallets, OEM wallet, retailer digital wallet or app, social payments, and crypto wallets). Consumers with higher incomes are more likely than those with lower incomes to have mobile and digital payment methods. Similarly, women are more likely than men to have B2C payment apps, while men are more likely than women to have a crypto wallet, indicating that gender plays a role in mobile payment choices. When exploring who is the main user of BNPL, women are more likely than men to have used the service in the past year.[21]

Europe - According to an article by Visa in 2022, Buy Now Pay Later: a threat or an opportunity?, The size of the UK BNPL market in 2020 is 6.4 billion pounds, with an annual growth rate of 200%-300%.[22] They also mention other top global BNPL markets as a percent of total e-commerce to be: Sweden 25%, Germany 20%, Norway 18%, Australia 10%. While BNPL is still a small share of e-commerce it has been growing rapidly in European countries. In the UK due to the economic downturn during Covid, BNPL usage increased for grocery purchases. While Europe is interested in BNPL programs, the adoption of the service is regionally focused. In the e-commerce space in Europe, BNPL is expected to decrease from 9% in 2023 to an expected 8% in 2027.

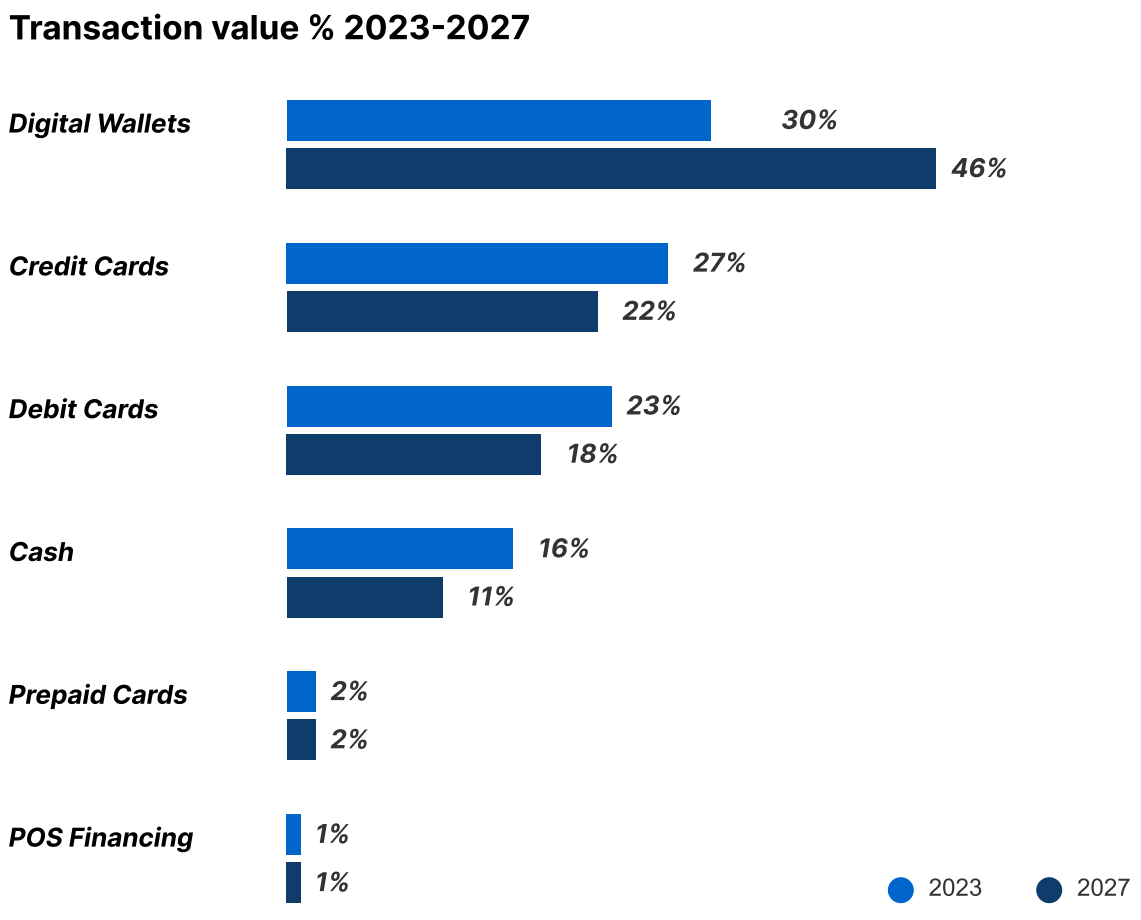
APAC - In 2023, BNPL accounted for 4% of regional online spend, with over 120 billion USD in transaction value. BNPL is forecasted to have a 16% CAGR through 2027 for the region.[23] According to Euromonitor, "The Philippines and Indonesia have percentages of unbanked and underserved populations of 76% and 67%, while Vietnam, Malaysia and Thailand follow closely behind with 47%, 40% and 25%, respectively."[24] Using BNPL has opportunities to provide alternative financial solutions to the unbanked. The use of partnerships through banks or fintechs is a way they suggest expanding into the Asia Pacific region.

Latin America - The adoption of BNPL services is less than 1% of global e-commerce revenue in Latin America and are not expected to increase between 2023 and 2027. While adoption of the service as a whole is low compared to the world, according to research done by GlobeNewswire, LATM BNPL schemes are expected to grow from 22 billion USD in 2024 to 63.4 billion USD in 2029. The service is expected to grow at 23.6% CAGR between the 2024 to 2029 period for the Latin American region.[25] The growth will increase significantly for the service, yet the overall adoption of the service across Latin America will not significantly impact POS financing market share.[26]

20 How does buy now pay later (BNPL) work for merchants? | Checkout.com.
21 Adopt Mobile and Digital Payment Tech Selectively to Address U.S. Consumer Preferences. Gartner.
22 Buy Now Pay Later: A Threat or an Opportunity? (2022). Visa. Retrieved June 14, 2024.
23 Global Payments Report 2024 | Worldpay.
24 Lau, J. (2024, May 3). Three Key Strategies for BNPL in Emerging Markets in Southeast Asia. Euromonitor.
25 Markets, R. A. (2024, February 20). Latin America Buy Now Pay Later Business Report 2024: BNPL Payments to Grow by 32.8% to Reach $22 Billion this Year - Forecasts to 2029. GlobeNewswire News Room.
26 Yahoo is part of the Yahoo family of brands. Yahoo.com.

03. DIGITAL WALLETS

In 2023 digital wallets made up over 10.8T USD (or 30%) of global POS spending as seen in the graph on the right. This is still the fastest-growing payment method and is expected to account for over 19T USD in global POS spending by 2027 with an expected CAGR of 16%. Digital wallets can be funded through a variety of options including debit cards, credit cards, the balance within the app (ex. Apple cash), direct debit from a bank account, QR (Quick Response) codes, a prepaid card, or cryptocurrencies. The two main types of digital wallets are device-based and internet-based. Device-based digital wallets require near field communication technology and work when a customer waves their phone near a contactless reader. Internet-based digital wallets let customers add card information to a personal account or profile so that their payment information is kept on file and used when the customer makes a purchase online. Some smartphone providers such as Apple, Google, and Samsung provide digital wallet applications preloaded onto smartphones, and have consequently become some of the leading digital wallet providers. Apple Pay and Samsung Pay are examples of device-based digital wallets because they require a phone or connected device such as an Apple Watch to make a payment in store. Google Wallet and PayPal offer apps that can be added to a phone and then used as a digital wallet in store. PayPal, Google Wallet, and Apple Pay are also examples of internet based digital wallets because consumers are able to load their information into the wallet and when making purchases online they do not have to provide their information to each website they make purchases from but can instead use their digital wallet.



When using physical payment methods such as cash and cards there are potential downsides. In some areas, if it is obvious someone is carrying cash they have a higher chance of getting robbed and it presents hygiene concerns especially since the covid pandemic, so it has consequently become used less in recent years. Cards are also not completely secure since the information can be stolen through skimming or shimming. Card skimming happens when devices that record card information are added to a card reader so when a consumer swipes or inserts their card at a POS terminal, their information is stolen and can then be used for fraudulent transactions.[27] Chip cards are now generally considered to be safer than magnetic strip cards because they generate a different token for each transaction. However, a technique called shimming allows thieves to steal information from a chip card.

27 Thangavelu, P. (2023, December 22). Can chip cards be skimmed? Bankrate.

Shimming uses a thin reader called a "shim" which fits into a card reader slot. Shims contain a microchip and flash storage that can capture and save card information from a chip card.

The information captured by the shim includes the details required to authenticate and process future transactions using the card details. Once the shim is retrieved, the thieves can create forged cards with magnetic stripes which gives them a tool for swiping their cards containing stolen information.

A more secure alternative to physical cards and cash are digital wallets. This payment method doesn't require a consumer to insert a card into a reader, but instead the consumer can tap their digital wallet payment on the card reader and a one-time token is generated for the transaction to go through. Digital wallets use various technologies such as near-field communication, secure magnetic transmission, and, and QR codes to ensure secure payment experiences. The near-field communication interacts with the merchant's payment terminal during an in-person purchase. Then, once the customer verifies the transaction through a password or a form of biometric security, the payment tokenization securely transmits the payment information to complete the transaction. Digital wallets can help build trust with security-conscious consumers as they offer security measures through encryption, tokenization, multi-factor authentication, and biometrics. They also provide a more convenient and seamless experience for users as it eliminates the need to carry cards or cash.

3.1.1 Tap to Pay

The tap to pay method uses near field communication (NFC) which is a specific form of radio frequency identification (RFID). In this transaction it doesn't just send static data when a card is swiped but also sends a cryptogram which is a unique stream of numbers to verify your card is valid. This method is more secure than swiping a card because it doesn't just send static data but also sends the cryptogram. Tap to pay can be completed with a physical card that has a chip or digitally by uploading a payment method to a digital wallet and using that form of payment to tap against the POS terminal.

3.1.2 QR (Quick Response) Payments

One increasingly popular form of payment within digital wallets is QR code payment. These types of apps allow users to store their payment information, whether that be a card or bank account, and then complete a transaction in seconds by scanning a QR code or presenting their own code at the POS terminal. The recent gain in popularity is fueled by the increase of smartphone usage, the adoption of digital payments, and the ease of use QR payments offer. Since so many people already use their mobile phones so often, QR code payments are a seamless, user-friendly, and secure option for consumers. As a result, many businesses are implementing QR code payment systems so that they can serve those who wish to use mobile payment options. Customers paying with QR codes may scan a merchant's QR code or present their own QR code. Once the QR code is scanned the customer may verify the transaction through an extra security measure such as a password or face ID. Some common QR payment platforms are Alipay (China), WeChat Pay (China), SGQR (Singapore), and QRIS (Indonesia). One of the barriers to growth of this payment method is the lack of standardization. Different QR code payment providers use different QR code payment gateway, standards, and protocols which causes the market to become more fragmented. Users then have to have multiple applications to scan different QR codes which is inconvenient. This can be overcome in the future by establishing a universal standard for QR codes that works across different payment providers. Currently the largest QR code payment market is APAC with the largest amount of growth expected to be seen in the US and Canada through 2030.[28]

3.1.3 Regional Trends[29]

APAC: Digital wallets represented over 50% of the spending in 2023, which is the highest of any region. They were the most popular payment option at POS in China and India but by 2027 are expected to be the leading option in most APAC countries. The APAC market is expected to continue growing to maintain the largest percentage of transaction values out of all regions through 2027.

LATAM: Digital wallets are projected to become the leading form of POS payment method by 2027. In 2023, digital wallets were the fourth most popular option representing 15% of all POS transaction value after credit cards, cash, and debit cards.

Europe: Digital wallet use at POS terminals is projected to increase at a CAGR of 24% through 2027, which would double its transaction value from 13% to about 27% of POS transactions. Europe uses a primarily card-based payments system which works well for them, so people are slower to move toward digital wallets or other payment options.

28 QR Code Payment Market Size, Share & Trends Analysis Report By Offerings, By Solution, By Payment Type, By Transaction Channel, By End-user, By Region, And Segment Forecasts, 2023 - 2030.
29 Global Payments Report 2024 | Worldpay.

MEA: In 2023, digital wallets were the third most popular payment option for the region behind cash and debit cards. They represented 18% of POS transaction value in 2023 but are expected to reach 33% by 2027, which would make it the most popular payment at POS terminals.

North America: There is a projected CAGR of 23% for digital wallets in the region through 2027. The US has been slower to adopt the digital wallet option since consumers are used to paying through physical cards.

04. API DEVELOPMENTS

There have been 7 major trends identified within API developments that have been seen in 2024. The first trend is a shift from the "does-it-all" approach of API lifecycle management to an "unbundling" approach that is more tailored to suit the company's specific needs. The tools need to be composable and support open standards such as OpenAPI or AsynchAPI. This allows consumers and API developers to benefit from vendors who are constantly inventing or improving tools. This shift can also help in creating a more frictionless experience for API developers.

The second trend is the integration of AI and APIs. Generative and predictive AI-led automation opportunities including API auto-discovery, AI-enabled API design, and even self-governing APIs are now speeding up and streamlining workflows in the development lifecycle. Integrating AI can create challenges due to data dispersion and varying formats across diverse systems. Developers can work to overcome these challenges through continuous monitoring and testing, which is crucial to guarantee integrity and effectiveness.

As we see support for multiple approaches to development on the rise, there is a balance of both top-down and bottom-up API development. The goal is to maintain visibility and governance across the API portfolio while supporting workflows in a frictionless way. There is a trend toward business preference for real-time integration using APIs which is also increasing the need for better API management and automation to improve business objectives while also adhering to regulatory requirements.

In 2023 many companies made efforts to overcome some of the barriers to API reuse such as building trust and communication between providers and consumers, ensuring better API quality and reliability, and improving API discovery. This trend is continuing in 2024 with API product managers trying to use governance guidelines to curate their APIs into products for reuse. Another variation on this trend has been API product managers being enabled to market and socialize curated APIs across multiple consumer portals and collaborate directly with those consumers. In addition, developers are focusing on improved visibility and tracking so they can accurately monitor successful API consumption and reuse.

Flexibility within APIs and their architecture is another key trend for companies looking to remain up to date in the changing digital landscape. Many companies are trying to increase flexibility on IT architecture by supporting different cloud environments, and increase flexibility of the API format by increasing portability into any format deployed to any runtime without compromising speed, reliability, or compliance. Companies are now looking for ways to better quantify and optimize their value delivery from their API portfolios through better reporting and metrics. There is a shift away from reporting siloes in specific API tools and a move towards a unified view and tracking approach.

Metrics are becoming more mature with more focus on coverage maturity against the business capability models, governance compliance, targets for improving efficiency and increased ruse, minimized security risks, and elimination of duplication and API redundancy.

The last trend that is expected to become more widely adopted this year is the need for separate, yet connected, API catalog and API consumption portals so that customers can have an experience that is more tailored to them. The content of APIs can be curated to suit the consumers needs and show the appropriate level of technicality based on the audience. This is becoming especially important as portals become a place for less-technical users such as product owners, compliance, and support team roles.[30]

4.1.1 Expert Interviews

Our team conducted two interviews, the first Christopher McDaniel, current Head of Technology at Intercon-Security Systems Inc. He specializes in AI, IoT, Blockchain, Cloud Computing, Mobile and Internet-related technologies, and many other infrastructure specialties.

30 Sindall, G. (2024, March 22). Checking in on 2024 API Trends. digitalML.

In 2011 he worked as the Head of Service Innovation for Visa for 5 years, working on SOA Integration, Cloud Computing, and Digital Wallet technology. During our interview, he made it clear that there was a focus on using AI to help create APIs. He made it clear that most programmers, even if they don't want to admit it, use tools such as ChatGPT in order to quickly create APIs, which would normally have taken longer to create. He stated that using AI tools is a very useful way of creating frameworks in order to reduce the workload down the line. He admits that while not perfect, using tools to generate code is much easier and accurate enough that it provides programmers with a framework to work with in order to build APIs.

Another trend Chris McDaniel brought up in terms of API was the use of REST APIs. From our research, we see that this form of API is used to integrate new applications with existing software systems; this allows for leveraging existing code instead of creating new code from scratch. The main feature of REST API is that servers do not save client data between requests.

Our second interview with Henry Liu, Product Director at Wiseasy, also brought more insights into API development and trends. He suggested that in terms of software, the focus is on updating the rules and adhering to them so that each side can communicate. He also mentions that the use of AI in creating APIs has increased and helps free up his and others' time so he can focus elsewhere.

05. SECURITY

Two major security trends in the digital payment industry are the use of Artificial Intelligence for fraud detection and the use of biometric measures for authentication.

5.1.1 Artificial Intelligence in Fraud Detection

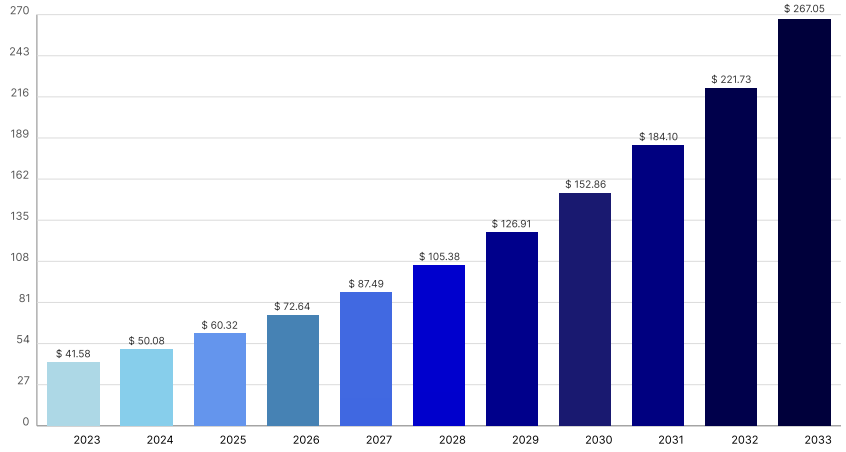
Artificial Intelligence and Machine Learning specialize in analyzing large volumes of data which can be particularly useful for detecting fraudulent activities by analyzing transactions, identifying patterns, and identifying any abnormalities that could be fraudulent. There are a few challenges to be overcome in adopting AI which include data privacy and security and bias.

Since AI and ML heavily rely on collecting and analyzing data, this raises concerns about data privacy and security. To overcome this challenge, fintech organizations must implement data security and protection measures and comply with all regulations to gain customer trust and avoid any potential legal issues. The second challenge is avoiding inadvertent biases in AI algorithms which can be caused by bias in the data used to train them or human error. This issue may not be able to be completely eliminated but can be addressed by trying to develop algorithms that are transparent and as free from bias as possible, and regularly audit the models.[31]

5.1.2 Biometrics Market Overview

Biometrics data is an alternative to traditional authentication methods such as passwords or IDs which can be lost or stolen. Biometric authentication relies on features unique to each individual such as fingerprints, facial recognition, voice recognition, iris detection, or palm recognition. When an individual needs to be identified one or more of these features are compared with the stored records to verify a person's identity. Biometrics offers a balance between security and a seamless user experience.

BIOMETRIC MARKET SIZE 2023 TO 2033 (USD BILLION) Source: https://www.precedenceresearch.com/biometric-market

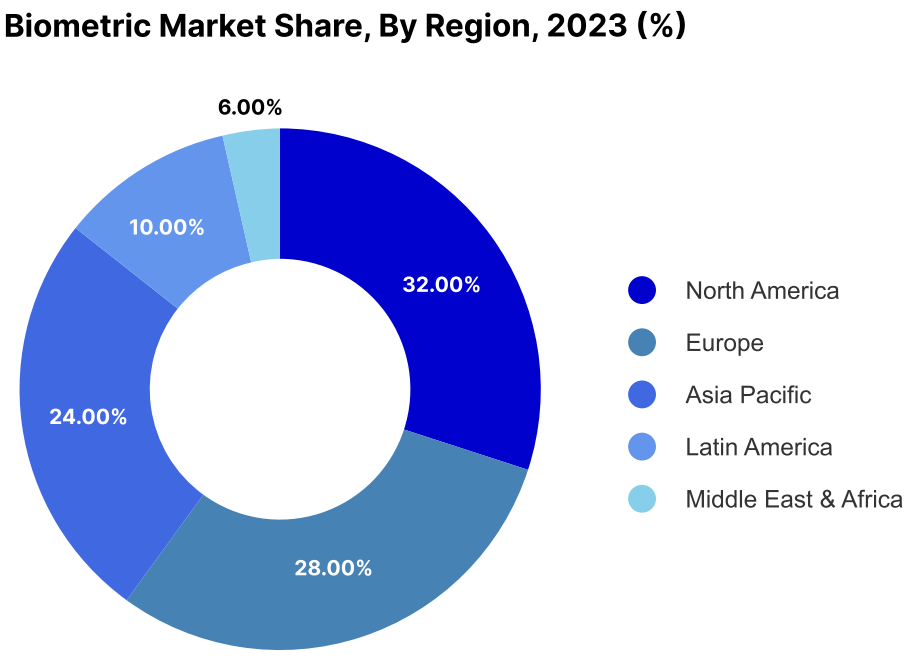


31 Maleh, Y., Zhang, J., & Hansali, A. (2024). Advances in Emerging Financial Technology and Digital Money. CRC Press.

From 2024 to 2033 the annual growth rate of the biometric market is expected to be 20.44%, meaning the market size will reach 267.05B USD in 2033. Some factors that could potentially hinder the growth of this market include a lack of public trust, legislation and governance, and concerns over data sharing.

5.1.3 Regional Trends

In 2023, North America had the biggest biometric market share mainly due to its strong technological infrastructure and high awareness and acceptance of security solutions. Europe also had a notable amount of growth in the market due to increased emphasis on security measures, digital transformation, and regulatory support. The Asia-Pacific market is expected to have significant growth in the coming years due to government initiatives, rising security concerns, and a growing demand for advanced authentication solutions.[32]



32 Biometrics Market Size to Hit USD 267.05 Billion by 2033. (2024, February 27).

5.1.4 Existing Biometric Recognition Systems[33]

Biometric System	Strengths	Weaknesses
Facial recognition	There are lots of already existing digital facial images which can be used for algorithm training. Almost all phones, tablets, and laptops have built-in front-facing cameras making it convenient to collect a live facial recognition sample to compare against a template. Can be used simultaneously with other modalities such as voice and keystroke pattern recognition to improve matching performance and liveness detection.	There are environmental capture conditions such as lighting or shadows that can create challenges in accurate matching. The high availability of facial images on social media sites means people can easily obtain images of other people that can be used for fraud.
Iris Recognition	No physical contact required (more sanitary). Accurate matching performance. The iris is protected by the cornea so it doesn't change much with age. Difficult to imitate.	Requires IR light source and sensor which cannot be found in a regular camera. Usually requires close proximity to the camera which is not always easy and may be uncomfortable for users.
Palmprint	Uses stable characteristics such as textures, local orientation features, and lines. It is user friendly and cannot be easily captured by a hidden camera.	Cannot be used in liveness detection.
Palm Vein or dorsal hand vein	Vein structures do not move much with age, so this method could be used consistently throughout a person's life. Can successfully protect against impersonation.	Mass training of data is usually unavailable or difficult for hand vein recognition tasks, making implementation difficult.
Fingerprint	Difficult to imitate another person. Easy to use for customers and reduces the need to remember multiple passwords. They have become a cost effective biometric option to implement.	If fingers are dirty, wet, or damaged in some way (ex. a cut across the finger), the scanner may not recognize the fingerprint.
Voice Recognition	Widely accessible on mobile phones since all phones already have microphones. Cost-effective to integrate into other devices such as automobiles and home appliances. Convenient for users. This method is contactless, which makes it more hygienic.	Not as accurate as other biometric modalities such as facial recognition. Background noise can impact the matching performance, making it less ideal for noisy environments or public spaces.

33 Biometrics, A. (2024, May 9). Biometrics Software Simplified. Aware.

06. BLOCKCHAIN & DISTRIBUTED LEDGER

Blockchain is a distributed ledger technology that can be used to execute, store, and verify transactions of every kind. It allows parties to make and verify transactions or contracts instantly without the approval of a central authority. There are a lot of potential use cases for this technology that can be broken down into four main areas: money transfer, buying and selling stocks, insurance contracts, and buying and selling physical goods or energy.

Blockchain essentially uses cryptography and complex algorithms to allow transactions to be shared across a network of computers and then authenticated by the network participants. The technology enables faster and more efficient financial processes, enhances the capabilities of FinTech platforms, and provides transparency. In other words, the application of distributed ledger technology allows for much faster payment processing and significantly lowers the cost of every transaction by removing the multiple intermediaries in the traditional payment value chain and because it does not need third parties for verification.

Decentralized finance, often abbreviated as DeFi, encompasses a new wave of financial service offerings constructed on blockchain and web3 technologies. These products leverage the capabilities of web3 to enable peer-to-peer transactions and lending, bypassing traditional banks and financial institutions with their associated high fees. Over the past few years, these products have gained considerable investment, making them more accessible in 2024. In other words, leveraging the features of blockchain could be a potential direction for achieving the 'frictionless' payment. [34]

6.1.1 Market Overview

The 2023 revenue of the blockchain market reached a notable 12.4 billion USD and is anticipated to experience a compound annual growth rate (CAGR) of over 57% throughout the forecast period of 2030. The market's projected expansion is attributed to the increasing utilization of technology, particularly for the purpose of rendering illiquid assets, such as real estate and fine art, more attainable through asset tokenization. Additionally, the market is expected to be underpinned by the adoption of blockchain-as-a-service by small and medium enterprises, enabling them to seamlessly integrate the technology into their operations without substantial in-house infrastructure requirements.

6.1.2 Challenges and Potential

For quite some time, banks globally have been working to address the constraints imposed by traditional monetary policies. The existing system faces security concerns and comes with high maintenance costs. It currently takes days and at times even weeks, to send money abroad, with intermediaries charging significant fees. Regulations mandate that banks record everything from stock trades to money transfers, leading to substantial compliance expenses.

Blockchain technology eliminates the need for third-party clearance, leading to huge cost savings. McKinsey estimates that blockchain technology could save banks up to $4 billion in cross-border payment processing, $1 billion in decreased operating expenses, and $2-3 billion in regulatory fines. Blockchain technology has the potential to reduce yearly fraud losses by $7 to $9 billion. Blockchain technology can save costs and simplify KYC compliance processes.

Goldman Sachs estimates that adopting blockchain for KYC could reduce bank personnel needs by 10% and save up to $160 million annually.[35]

Cross-border transactions and remittances have been one of the challenging issues in the payment chain and have historically entailed extended processing times and imposed substantial transaction fees on the transferees. Despite a projected global commerce market valuation of US$290 trillion by 2023, the realm of cross-border payments remains beset with formidable challenges. As evidenced by a PYMNT survey, the failure rate for cross-border payments stands at approximately 11%, resulting in a considerable US$3.8 billion loss in sales in 2023, with no discernible specific causes for transactional failures identified.[36]

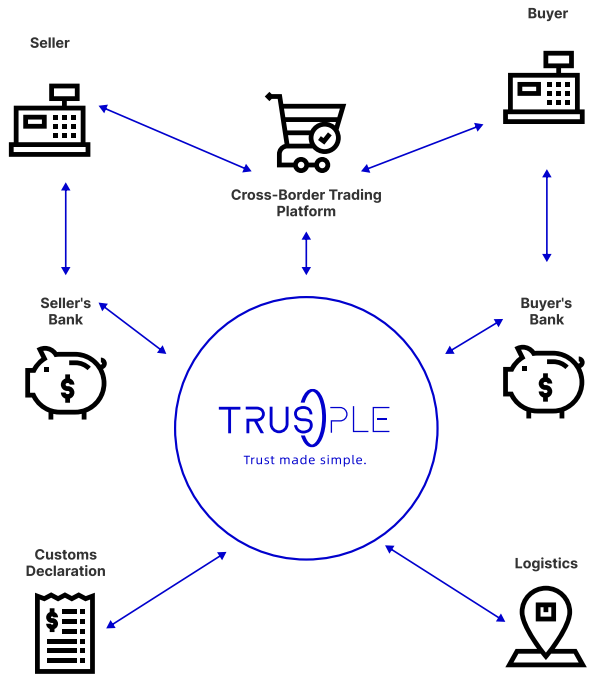
In 2020, Ant Group, the parent company of Alibaba and a leading company in the development of tech-driven financial inclusive services, launched Trusple, a B2B international trade and financial service platform. The platform, powered by AntChain, is based on blockchain technology and aims to make cross border transactions easier, at the same time reducing costs in payment processes for small-to-medium enterprises(SMEs). The lack of trust among global trading partners has been a long-time challenge for SMEs. It

34 Marr, B. (2023, December 7). The 6 Most Important Web3, Blockchain And Cryptocurrency Trends In 2024. Forbes.
35 FinTech: in-depth market analysis Market Insights report. (2023).p.71 In Statista.
36 Blockchain May Solve the Cross-Border Payments Puzzle. (2024, May 29). PYMNTS.com.

can lead to delays in shipments and payment settlements, resulting in pressure on SME's finances and cashflow. The "Trusted" system leverages blockchain technology and digitalizes the entire trading process, involving all key stakeholders. For example, when a seller and buyer agree and submit the contract on "Trusple," banks will then automatically make payments according to the contract terms. This eliminates the need for the seller to chase payments and reduces the accounts receivable turnover.

Additionally, the transaction records of both sellers and buyers in the "Trusple" system becomes a crucial source for credit lending underwriting, improving cash flow and boosting growth.[37] [38]

Blockchain "Trusple" System



6.1.3 Regional Trends[39]

Europe: In 2023, Europe became the second-largest market for blockchain, driven by the technology's fit with the region's focus on citizen-centric, sustainable, and transparent policies. The EU has adopted a unified stance on technology, exemplified by the introduction of the Markets in Crypto-Assets (MiCA) regulation, which provides a tailored framework for digital assets. This regulatory clarity is attracting blockchain ventures and is expected to boost adoption in Europe more than in the US.

North America: North America continues to lead in technological innovation, accounting for more than 40% of total revenues in 2023. The US is at the forefront of blockchain-related venture funding, benefiting from early adoption and the presence of significant blockchain-native firms and major tech companies, giving it a competitive edge. Businesses in the US are pioneers in implementing blockchain applications.

APAC: The Asia-Pacific region is set to experience the fastest growth through 2030. This growth is driven by supportive regulations, strong government initiatives, and an expanding middle class seeking better financial services. Significant investments by the Chinese government, such as the Blockchain-based Service Network, are expected to boost the market in the region.

LATAM: The market in South and Central America is gaining traction due to the growing number of small and medium enterprises adopting digital solutions to enhance their IT infrastructure. This strategic move aims to support business growth and better meet customer demands.

MEA: In the Middle East and Africa, there is a rising interest in blockchain solutions for the retail industry. This interest is fueled by initiatives to digitize and optimize supply chains and business operations. It is projected that the blockchain market in the MEA region will expand from 2.4 billion USD in 2023 to 23.28 billion USD by 2029, with a compound annual growth rate (CAGR) of 42.65% during this period.[40] The rapid growth is being driven by the increasing interest and adoption of blockchain solutions across various sectors in the region. Countries in the Gulf Cooperation Council (GCC) are emerging as early adopters of blockchain technology, exploring use cases in areas such as finance, government services, and supply chain management. South Africa is also positioning itself as a blockchain hub, with several initiatives and startups focused on leveraging the technology.[41]

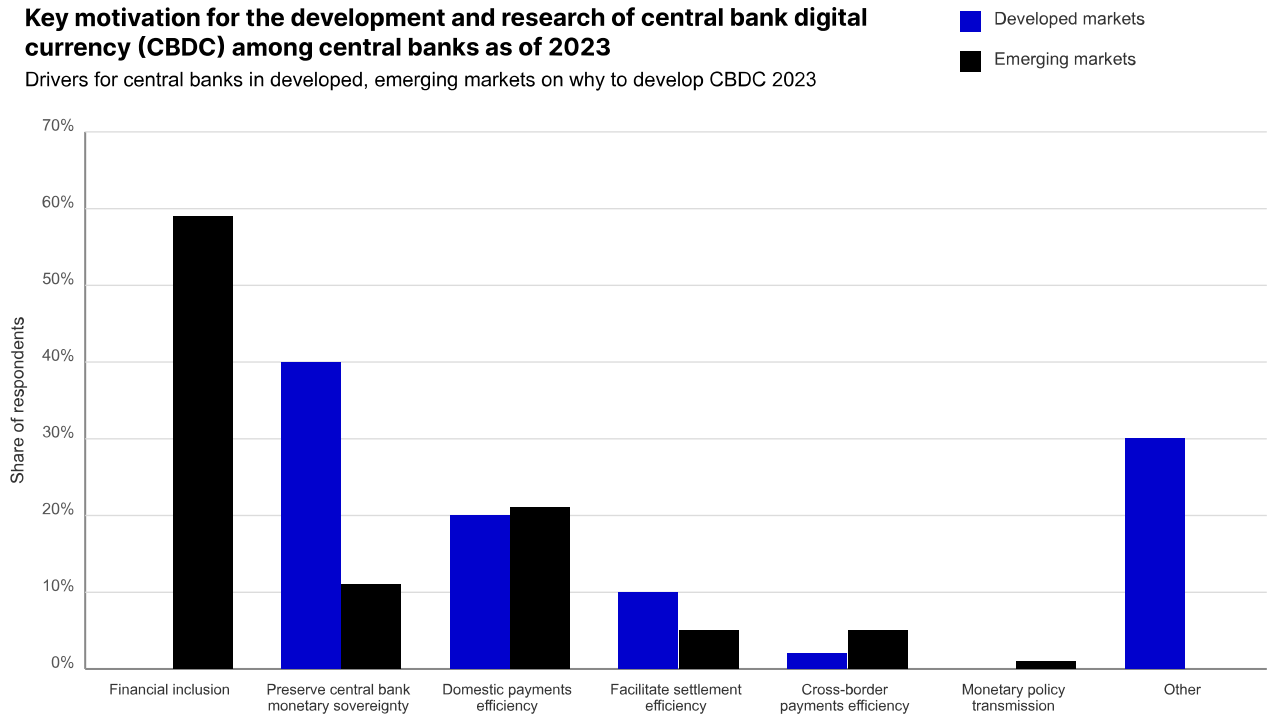
37 Ant Group Launches "Trusple," an AntChain-Powered Global Trade and Financial Services Platform for SMEs and Financial Institutions. (2020, September 20). Businesswire. Retrieved June 20, 2024.
38 Embedded Finance Revolutionising Cross- Border Transaction. (2023).p.56 In Euromonitor International.
39 Blockchain Market Trends and Analysis by Region, Application, Vertical and Segment Forecast to 2030. (2024, May 22). Market Research Reports & Consulting | GlobalData UK Ltd.
40 Gajakosh, Y. (2024, March 4). Blockchain – Middle East & Africa – Trend. Ruskin Felix Consulting.
41 Blockchain Technology Market Outlook, Trends, Analysis 2024. (n.d.). Transparency Market Research.

6.1.4 Central Bank Digital Currencies (CBDCs)

CBDCs are a type of virtual coin developed, issued and regulated by a country's central bank or monetary authority. The main difference between CBDCs and cryptocurrency is that CBDCs are wholly controlled by the central bank. This allows for CBDCs to target domestic payment challenges as well as cross border payments in the future.

In the IMF's report, Central Bank Digital Currency's role in Promoting Financial Inclusion, it was found that in 2022, 93% of central banks are exploring CBDCs and 58% consider that they are likely or might possibly issue a retail CBDC in the short or medium term.[42] Financial inclusion is one of the key driving forces behind CBDCs in low-income nations. In contrast, CBDCs implementation in higher-income countries is focused on combating privately issued digital currencies and have garnered much interest as an alternative payment method. More recently, central banks have been exploring guaranteed digital currencies that are transparent, secure, easily accessible, and more stable than private cryptocurrencies.

As seen below by Statistica, close to 60% of emerging markets are primarily focused on creating financial inclusion, while 40% of developed markets are focused on maintaining their central bank monetary sovereignty. In contrast, developed markets focus on keeping the current monetary system around the central banks.



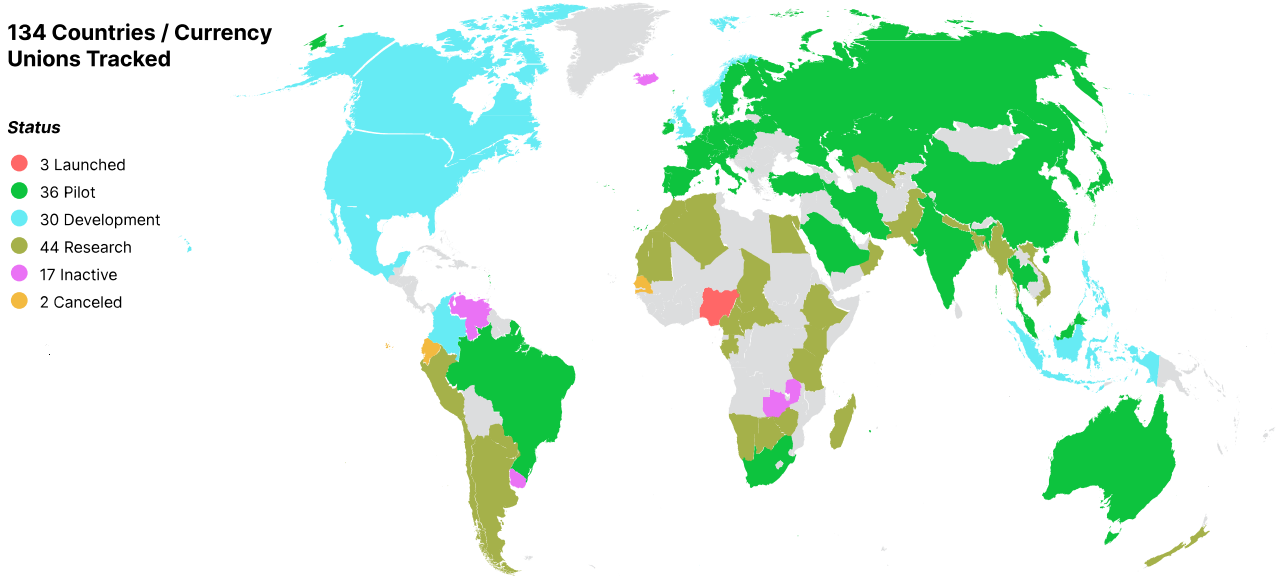
Description: Improving cross-border payments was not being listed as an important objective for central banks as of 2023 in why they should develop a CBDC. A survey held over the course of that year revealed that the preservation of the central bank's role in money provision was a significant driver behind central bank digital currencies in developed countries. Emerging markets saw CBDC as a tool to make financial inclusion happen. "Other" on the source states, consisted of various objectives
Sources: Official Monetary and Financial Institutions Forum; Statista

Governments are focusing on implementing CBDCs due to some of the benefits they provide such as increased safety and efficiency, no imposed fees, higher financial inclusion, no middlemen, less costly, easier implementation of monetary policies, and security through distributed ledger technology. The purpose of CBDCs is to enable low-cost instant settlements that reduce risk and provide a more integrated and seamless experience.

Cross-border payments have higher costs, low speeds, limited access, and low transparency. In an OMFIF survey of Central Banks, they reported that 42% of central bank respondents found that the main challenge of cross-border payments is transaction costs, followed by 18% or respondents stating regulatory complicity, and 15% reporting processing time as the main challenge. CBDCs aim to lower costs for maintaining physical bank accounts and transaction fees. By reducing intermediaries, CBDC networks may be able to reduce cross-border and domestic transactions by allowing direct access to central bank settlement accounts.

42 Lannquist, A., & Tan, B. (2023). Central Bank Digital Currency's Role in Promoting Financial Inclusion. In the International Monetary Fund.

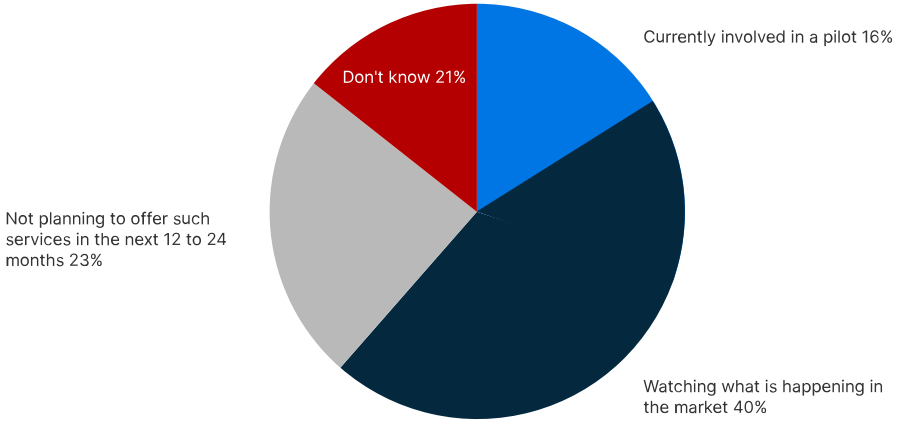
Among OMFIF central Bank respondents to the survey, only 7% have launched a CBDC already, a further 7% expect to have one within the next two years. A further 27% will launch a CBDC in three to five years, meaning more than 40% expect to have an operational digital currency by 2028. Within a decade, close to 70% of respondents will have a CBDC.[43] CBDC is in the innovation phase, this is indicative of many Banks supporting the concept in the future but hesitant to spend the resources until it is proven to be successful. This is further supported by a Statista Report, which breaks down the willingness of Banks to adopt digital assets and implement to create financial inclusion. The map below shows that 134 countries currently have begun research or pilots into CBDCs. Most countries are looking to test the e-currencies as a way to decide if this is a possible solution to increasing financial inclusion and cross-border transactions.[44]



While many countries and banks are starting to research the feasibility of CBDCs as a payment solution, many are hesitant. In the graph below, a survey of Central Banks found that 40% of banks surveyed are currently watching the market without plans for now.

Approaches taken by banks on future adoption of digital assets - cryptocurrency, stablecoin, central bank digital currency (CBDC) - as of 2023

Opinion of banks whether to adopt digital assets (crypto, stablecoin, CBDC) 2023-2025



Description: More than half of global banks survey in 2023 were either involved in a pilot involving digital assets or kept a close eye on what is happening in the market. The source listed this as "significant curiosity," but did add that none of the banks they had interviewed offered any services surrounding central bank digital currency (CBDC), stablecoins, or cryptocurrency. It adds this may stem from industry uncertainty, as not many business cases were observed.
Source(s): Aite-Novarica Group; Finastra

43 Fitzgerald, J. (2023, December 18). Future of payments 2023. OMFIF.

44 Central Bank Digital Currency (CBDC) Tracker.

There are many reasons to hesitate in such a new form of issuing currencies and attempting to replace the current status quo.[45]

6.1.5 CBDCs and Financial Inclusion in Emerging Markets

The current use cases of CBDCs are broken down into two categories. Retail use case and Wholesale use cases. Retail use cases focus on improving financial exchanges between individuals. Retail focuses on including faster, safer payment and aiming to allow for direct stimulus payments.

Wholesale use cases aim to improve interbank systems by building interoperability between financial ecosystems. Below are two case examples of how retail and wholesale CBDC is being used:[46]

RETAIL CBDC USE CASE
China is a CBDC development frontrunner. The People's Bank of China (PBoC) has been testing its e-Yuan CNY digital currency since 2014. The Ren min bi (RMB,¥) backs the centralized digital currency. E-Yuan's primary function is to provide domestic retail payments for public transport and shopping. Travelers are allowed to hold e-Yuan via registering an e-Yuan wallet through authorized traditional banks and on line banks in China. In addition, consumers make e-Yuan transactions via payment platforms, such as WeChat, an e-CNY app launched by PBoC. A significant e-Yuan feature is that small-amount transactions are entirely anonymous. However, large-amount transactions must be traceable. Following two years of pilots in an increasing number of cities across China, 13.61 billion of e-CNY were in circulation at the end of 2022, representing 0.13% of the total central bank money in circulation.

WHOLESALE CBDC USE CASE
Hong Kong, China, Thailand, and the UAE entered a pilot phase for CBDC developments in Q3 2022 via the Project mBridge trial platform, a DLT-based platform to support real-time crossborder payments. The project is among the first multi-CBDC efforts to initiate and settle real-time cross-border transactions on behalf of corporates. Today, 20 commercial banks from four different jurisdictions have processed more than 160 payments and foreign exchange (FX) transactions via Payment-versus-Payment (PvP), with a total value of HKD 171 million (USO 218 million). Project mBridge participants include 20 commercial banks, the BIS Innovation Hub Hong Kong Centre, the Hong Kong Monetary Authority (HKMA), the Bank ofThailand, the Digital Currency Institute of the People's Bank of China, and the Central Bank of the United Arab Emirates.

6.1.6 CBDC Benefits

The goals and benefits of CBDC are to improve payment processing and settlement time to less than a few seconds using a non-distributed ledger. This could potentially resolve some payment challenges, such as coordination of national wholesale, and could lead to more efficient cross-currency and cross-border payments. CBDCs enable financial institutions to settle bank transactions directly, and payment processors can eliminate intermediaries and make real-time transaction settlements possible. Internationally compatible CBDC would decrease reliance on costly money transfer services. Widespread adoption could allow for the inclusion of unbanked and underbanked populations by enabling access to lines of credit and liquidity. CBDCs could provide access to safer, instant, and more efficient digital payments for all populations, including underbanked and unbanked. Governments design CBDCs to be on par with sovereign money with payment guaranteed by the central bank.

6.1.7 CBDC Challenges

There are a few challenges facing the implementation of CBDCs and how they will impact the government, banks, and citizens. The first challenge is legal and regulatory constraints regarding how the Central Banks can and will regulate digital currencies that they implement. The second challenge is that CBDCs have the potential to threaten privatized banking within the country and reduce the financial stability of banking. Financial literacy among users will be a challenge for implementing a CBDC. Not everyone can understand the impact or the need to be financially literate, so they may not adopt the technology. Creating infrastructure that can support digital currencies for the different use cases from wholesale to retail is another challenge of adopting a CBDC. Finally, the two most important challenges for the adoption of the technology are user trust and the monetary authority of the coins. The population is unlikely to adopt a technology they don't trust, especially when the federal government controls the entire currency. This brings about government issues increasing or decreasing the digital currencies and the possibility of controlling who is allowed access.[47]

45 Cross-border payment trends | Statista. Statista.
46 Building Central Bank Digital Currency (CBDC) | Capgemini. (2024, June 10). Capgemini.
47 Saudi Central Bank. CBDC and Its Associated Motivations and Challenges, Accessed 14 June 2024.

07. ACCOUNT-TO-ACCOUNT (A2A)

A2A payments are direct electronic payments made from one party to another while bypassing card network rails. A2A payments are being embedded in apps and online services and use push and pull in order to initiate bank payments.

Countries that have adopted A2A in apps are Pix in Brazil, IDEAL in the Netherlands, BLIK in Poland and UPI in India. These countries A2A payment methods are government backed which has helped increase the adoption of this payment form in those countries.In 2023, A2A payments accounted for an estimated 7% of global e-commerce transaction value, or approximately 449 billion USD and are expected to grow to 8% by 2027. A2A payments are becoming dominant in places like Brazil and India, where cash transactions are historically common, but have had less success to date in card-saturated markets such as the UK and USA.[48]

7.1.1 A2A Benefits

There are multiple benefits to adopting A2A payments including a lower transaction cost and government backing. Typically, merchants take 2% to 3.5% of the cost when handling a card transaction. However, when using A2A, the transaction cost can be fixed to a fee of 40 or 50 cents per API call.[49] A2A solutions often mimic the benefits of card payments – such as variable recurring payments – while offering merchants instant settlement and, critically, lower transaction fees. Government backing is a reason for A2A schemes to be successful in cash-heavy markets that are looking to go digital.

7.1.2 Regional Trends

Europe - In Europe, A2A payments are the leading online payment method in the Netherlands, Norway, Poland, and Sweden. In Europe, A2A accounted for 18% of ecommerce transaction value in 2023. Worldpay estimates the growth of A2A in Europe to be slower and only to reach 19% of all transactions in e-commerce value in 2027.

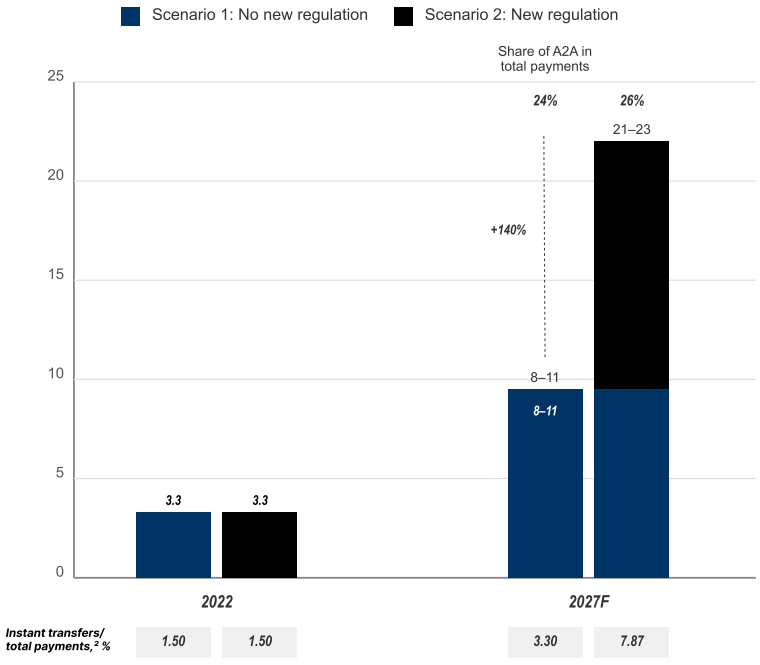
The adoption of A2A in Europe is due to the European Payments Initiative (EPI), a European Central Bank-backed payment system that integrates an interbank network. The European Central Bank has backed EPI in developing Wero, a payment solution based on instant payment schemes. The aim of EPI is to have a unified pan-European payment system that offers a consistent digital payment solution across all retail scenarios, such as P2P, POS, and e-commerce. For consumers, this will allow for easy access and simplicity in payments. For merchants, it provides a seamless, unified payment solution that would be available for all consumers. The current founding members of EPI are BBVA, BNP Paribas, Groupe BPCE, CaixaBank, Commerzbank, Crédit Agricole, Crédit Mutuel, Deutsche Bank, Deutcher Sparkassen- und Giroverband, DZ BANK Group, ING, KBC Group, La Banque Postale, Banco Santander, Société Générale, UniCredit.[50]

48 Global payments report 2024. Worldpay.
49 Dresner, A., & Gandhi, A. (2024, January 9). The role of US open banking in catalyzing the adoption of A2A payments. McKinsey & Company.
50 Changing the way Europe pays. European Payments Initiative. (2024, June 12).

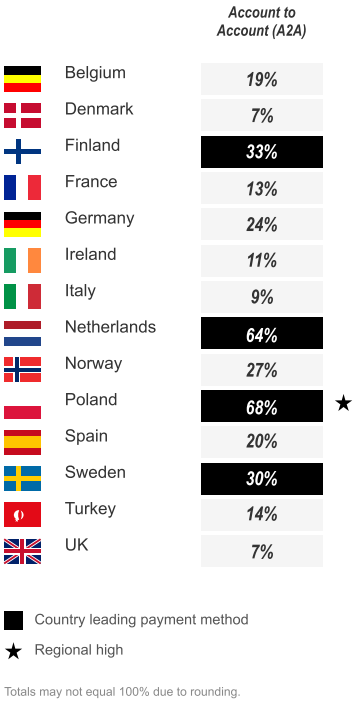
The European Payment Initiative is able to leverage the Single Euro Payments Area instant payments region.The hope is that with the support of the European Union there will be a large increase in adoption of the innovative technology. McKinsey indicates that "if regulators proceed with anticipated actions to encourage adoption, this share could rise to 45 percent of SEPA's 23 billion annual transactions and a far higher share of A2A payments including transfers done through Automated Clearing House (ACH), real-time gross settlements (RTGS), and instant payments." [51] [52]

If new favourable regulations are issued, as anticipated, instant payments volumes could double the current forecast for 2027.

Number of instant payments transactions, Eurozone,[1] 2022 and 2027F, billions



EUROPE E-COM PAYMENT METHODS



Totals may not equal 100% due to rounding.

APAC - One of the largest adopters of A2A payments in Asia Pacific is India with the creation of a Unified Payments Interface (UPI), which powers many bank accounts through a single application. This system has merged several banking features to allow for seamless routing to merchants and peer-to-peer payments through push and pull requests. It offers immediate money transfer on the mobile device 24 hours a day 7 days a week, 365 days a year between participating banks. The UPI system of A2A has helped to eliminate carrying physical cash. It uses two-factor authentication (2FA)for security purposes and other biometric authentication, such as fingerprint to reduce risks of unauthorized payments.

UPI is currently compatible with NEOPAY (UA), Mercury Payment Services (UAE), NETS (Singapore) Banking Computer Services Pte Ltd (Singapore), Nepal SBI Bank ltd. (Nepal), Royal Monetary Authority of Bhutan (Bhutan). These partnerships allow those using UPI to either pay in locations in these countries using UPI powered apps or for cross-border transfers.[53]

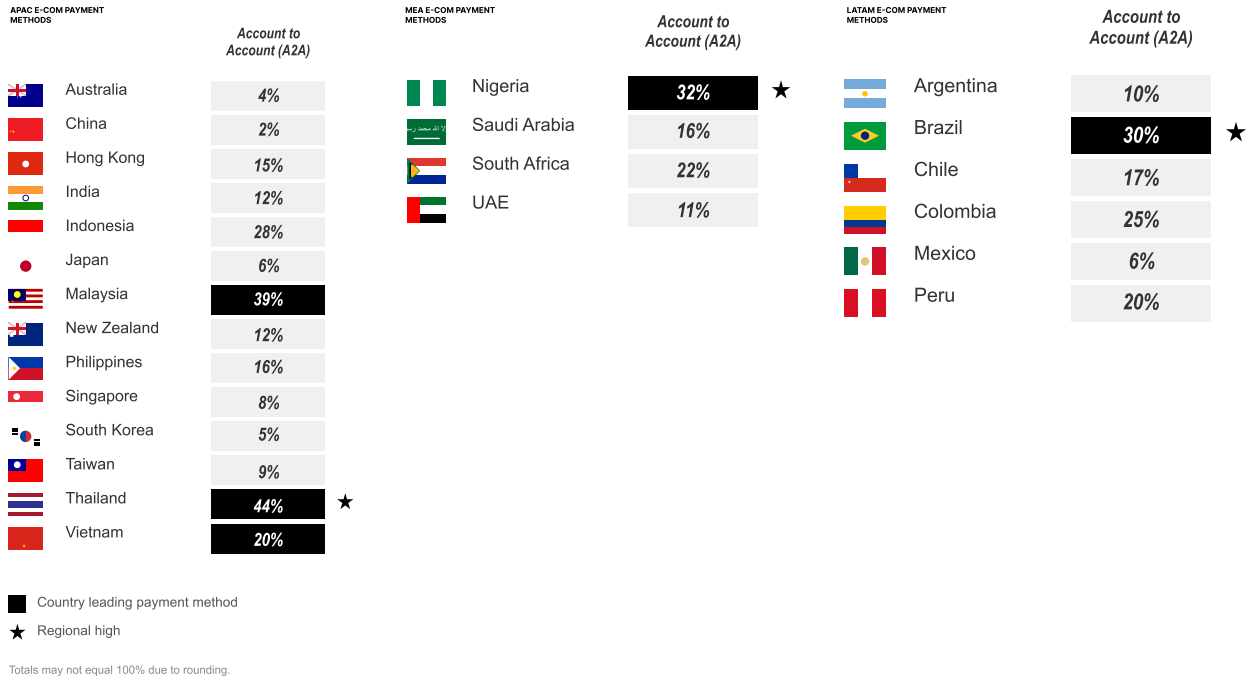
MEA - A2A payments are set to benefit from the introduction of new real-time payment systems and initiatives aimed at enabling interoperability between domestic schemes throughout the region.

Representing 18% of regional e-commerce spending in 2023, A2A transaction values in the region are projected to grow at a 17% compound annual growth rate (CAGR) through 2027.

LATAM - In 2023, LATAM had the highest A2A payment penetration globally, accounting for 20% of regional e-commerce transaction value. The widespread success of Brazil's instant payment system, Pix, has significantly boosted online A2A payments across LATAM. Brazil led the region in A2A adoption, with 30% of transaction value in 2023, making it the country's second most popular online payment method. A2A payments are also gaining traction in Colombia, where 25% of online spending is facilitated by the A2A

51 On the cusp of the next payments era: Future opportunities for banks. (2023). In The 2023 McKinsey Global Payments Report. McKinsey & Company.
52 Major eurozone banks start the implementation phase of the European payments initiative. ThePaypers.
53 UPI: Unified Payments Interface - instant mobile payments: NPCI. National Payments Corporation of India (NPCI).

service PSE, and in Peru, where 20% of online spending is driven by A2A apps Yape and PLIN, as well as local banking apps.



7.1.3 A2A Payment Providers

As Real Time Payment (RTP) rails have increased in popularity backed by the government, a few main providers have emerged globally. Below are a few key players that are being highlighted due to their increasing number of transactions and adoption in their country.

Below is a chart indicating the countries with the most amount of RTP transactions in 2023 with the top 3 being India, Brazil and Thailand which all have government backed A2A payment systems.

The five countries with the highest number of real-time payment (RTP) transactions worldwide in 2023 [54]

Top five countries in the world with the most real-time payments (RTP) in 2023

Country	*Number of transactions (in millions)*	*Percentage change compared to previous year*
India	129300	44.60%
Brazil	37400	77.90%
Thailand	20400	37.50%
China	17200	3.80%
South Korea	9100	11.40%

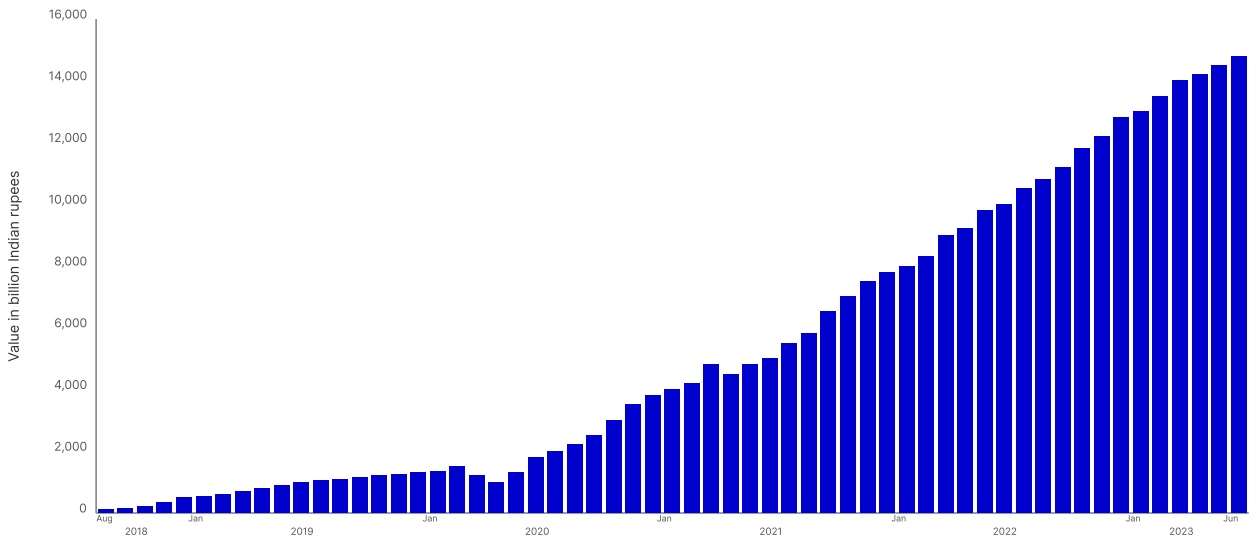
54 Mobile payments worldwide. Statista.

1) Universal Payment Interface (UPI) - India

India is one of the largest adopters of A2A payments in the Asia Pacific region, thanks to the Unified Payments Interface (UPI). This system integrates multiple banking features into a single application, enabling seamless routing to merchants and peer-to-peer payments through push and pull requests. UPI facilitates instant money transfers via mobile devices around the clock, 365 days a year, between participating banks. By promoting digital transactions, UPI has significantly reduced the need for physical cash. It employs two-factor authentication (2FA) and biometric authentication, such as fingerprints, to enhance security and minimize the risk of unauthorized payments.[55]

Value of monthly Unified Payments Interface (UPI) transactions in India from August 2018 to June 2023 (in billion Indian rupees)

Value of monthly UPI transactions India 2018-2023



UPI was launched in 2016 and backed by India's central government. It is compatible with digital wallets including Amazon Pay, PhonePe, Paytm and Google Pay. UPI's goal is to eventually replace cash at E-Com and POS with digital instant payments. Currently, in India digital wallets are accounting for greater than 50% of POS and E-Commerce transactions. India's Unified Payment Interface is continuously growing, the growth can be seen on the graph below as more and more users adopt A2A through UPI as their main form of payment. The monthly UPI transactions in India from 2018 to 2023 are increasing as more and more people adopt and use the government backed system.[56] [57]

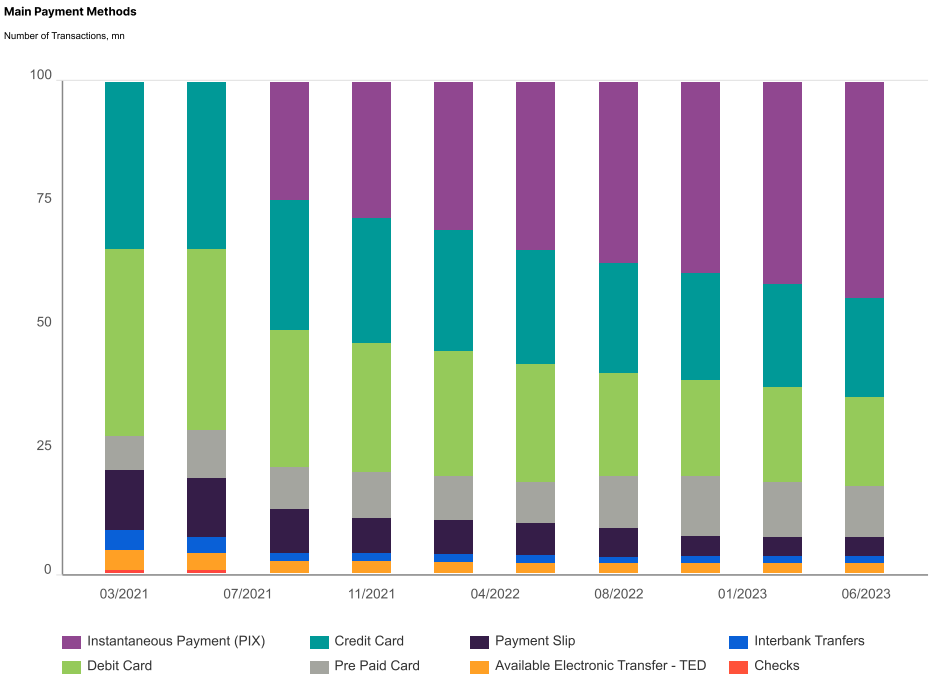
2) PIX (Brazil)

PIX is an instant payment system that is sponsored by the Central Bank of Brazil that enables users (people, companies and governmental bodies) to send and receive payments in a few seconds 24 hours a day 7 days a week. Launched in 2020, PIX is creating value by reducing the intermediaries which allows for lower acceptance costs for merchants.

The aim of PIX is to digitize retail payments, financial inclusion, lower financial costs, increased security and experience.[58]

In Brazil, Instant payments through PIX have reached a share of 53% of transactions in 2023 with a growth rate of 162% year over year. The push for an A2A system by the Brazilian government was successful in allowing for non cash direct payments. Other countries are implementing similar systems in order to create a more frictionless transaction for merchants and consumers alike.[59]

55 UPI: Unified Payments Interface - instant mobile payments: NPCI. National Payments Corporation of India (NPCI).
56 Global payments report 2024. Worldpay.
57 Mobile payments worldwide. Statista.
58 Banco Central do brasil.
59 Markets, I. E. Brazil's instant payments pix keep disrupting the Transactions System Three Year post-launch. info.ceicdata.com.



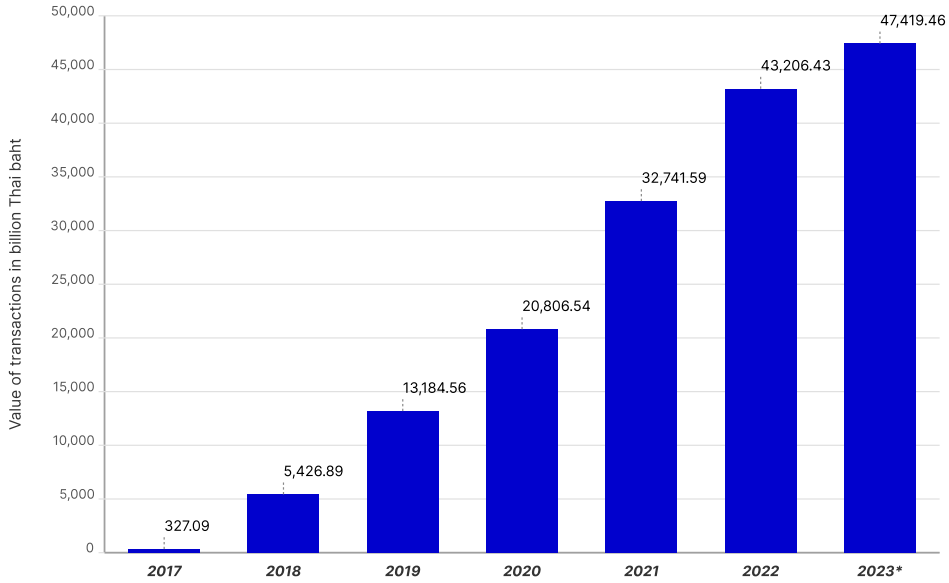
3) Prompt Pay (Thailand)

Prompt Pay, launched in 2016 is a Thailand Government backed payment system infrastructure that allows Thai citizens to transfer money using their ID, mobile phone number and bank account through digital channels with lower fees. The government uses PromptPay as a social welfare disbursement by transferring money directly using the recipient's ID number.

PromptPay also offers other services such as P2P transfers, w-wallet top ups, cross bank bill payments, Thai QR compatibility and some cross border payments. So far the adoption of PromptPay has helped digitize Thailand as well as create a more efficient payment system. Using A2A with digital wallet integration and acceptance has allowed real time payments to both decrease merchant costs and increase financial inclusion.[60]

Value of PromptPay transactions in Thailand from 2017 to 2023 (in billion Thai baht)

Value of PromptPay transactions Thailand 2017-2023



Description: In 2023, PromptPay transactions amounted to approximately 47.42 trillion baht in Thailand. PromptPay is an online payment system based on internet banking, mobile banking, or ATM services.
Source(s): Bank of Thailand

60 PromptPay.

Above can be seen the value of PromptPay transactions from 2017 to 2023 and that there has been a steady increase each year. The goal of PromptPay has been to digitize Thailand through the use of an easy real time payment system.

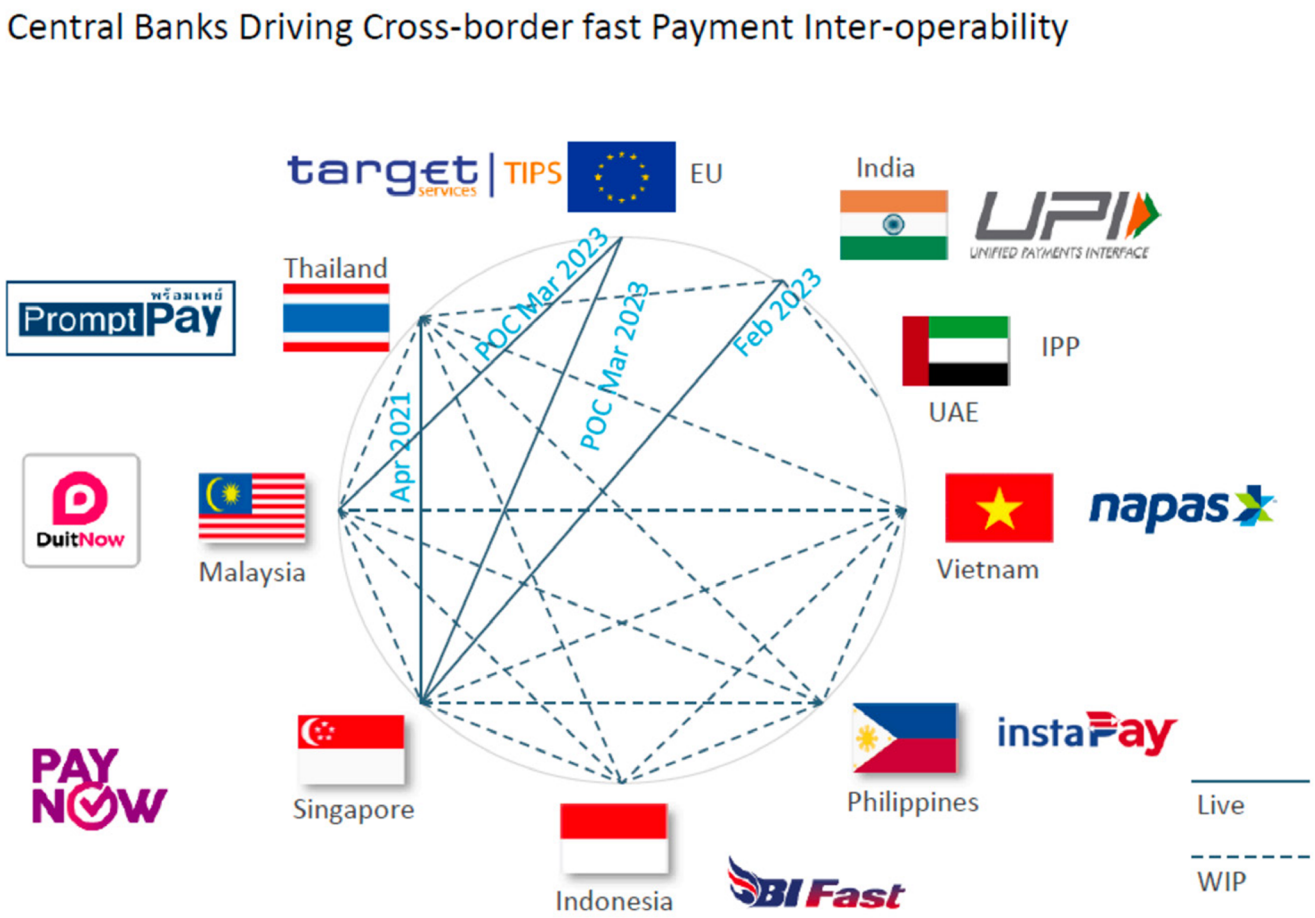
4) PayNow (Singapore)

Paynow launched in 2017 provides P2P transfer services to customers of 10 participating banks (Bank of China, CIMB Bank Berhad, Citibank Singapore Limited, DBS Bank/POSB, HSBC,Industrial andCommercial Bank of China Limited, Maybank, OCBC Bank, Standard Chartered Bank, UOB) and 4 non financial institutions (GrabPay, LiquidPay, Singtel Dash and Xfers).

PayNow allows users to send and receive Singaporean Dollars from either bank or e-wallet through the participating banks or NFIs using their phone number, Singapore NRIC/FIN or virtual payment address instantly. PayNow has implemented QR codes for making transfers by allowing users to scan PayNow QR codes using their mobile banking applications.

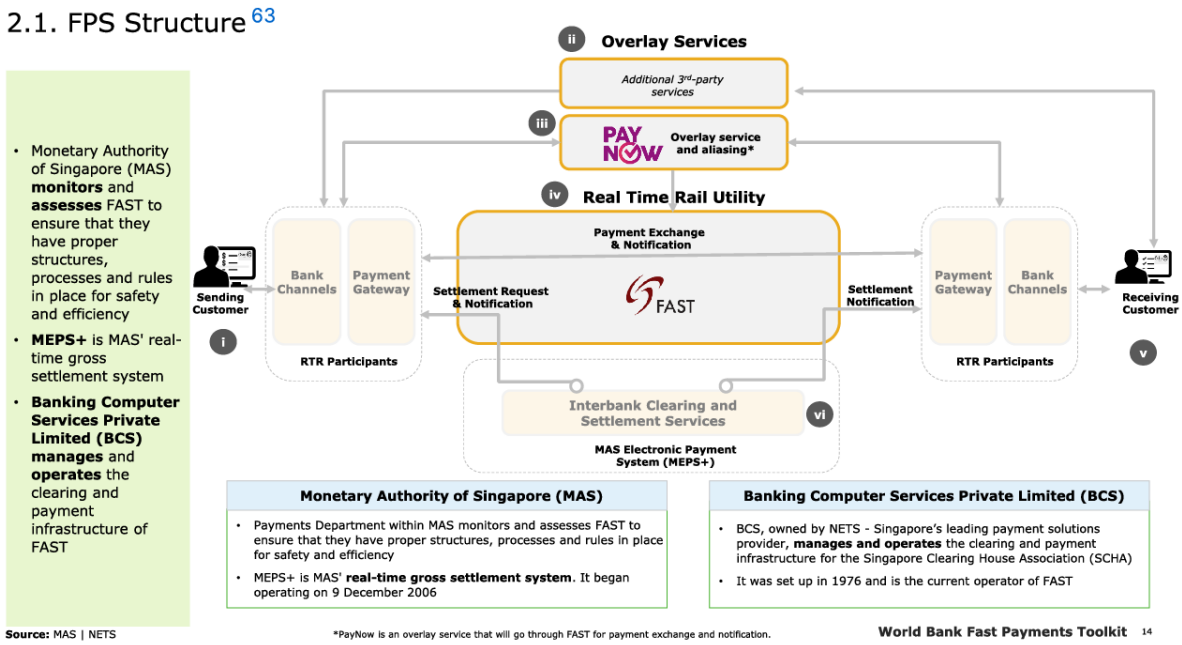
In addition, PayNow has partnered with PromptPay allowing for easy cross border payments, transfers and currency exchange. They have also partnered with India's UPI system to allow Singaporeans and Indians easy cross border payments. Below is a Chart showing the different APAC connected real time payment services as well as those planned to be connected in the future.[61] [62]

As of 2021 PayNow has over 3 million mobile phone numbers registered and 164,000 PayNow SGQR registrations. Their goal is to drive adoption by increasing interoperability and participation by banks and nonbanks as well as establish more cross border linkages.



61 The Association of Banks of Singapore PromptPay. ABS.
62 Embedded finance revolutionising cross-border transaction. Euromonitor.

2.1. FPS Structure [63]



63 Case study: Singapore. The Association of Banks of Singapore PromptPay. ABS.

08. FOURTH GENERATION PAYMENT NETWORKS

The evolution of payment systems is marked by a transition towards integrated, versatile frameworks that cater to an increasingly complex global financial ecosystem. This paper explores the architecture and implications of 4th generation payment networks (4GPN), which represent the confluence of decentralized and centralized monetary flows, advanced biometric technologies, and digital wallets. These networks are engineered to facilitate comprehensive financial inclusivity and operational efficiency.

8.1.1 What are 4th Generation Payment Networks?

Fourth-generation payment networks epitomize the synthesis of cutting-edge technologies including the Internet of Things (IoT), cloud computing, and blockchain. Unlike their predecessors, 4GPN embody an open, unified payment ecosystem that supports a myriad of payment modalities, ranging from traditional bank cards to innovative biometric solutions.

Innovative Integration: 4GPN transcend conventional financial boundaries by amalgamating diverse payment instruments within a single framework. This integration includes both decentralized and centralized digital currencies, thereby addressing the complexities of modern financial systems. The seamless fusion of various payment tools into a unified platform empowers stakeholders—banks, merchants, mobile operators, and fintech developers—enabling them to navigate the multifaceted landscape of global finance with enhanced agility and assured security.

Technological Foundations: The architectural backbone of 4GPN leverages the latest advancements in IoT, cloud computing, and blockchain technologies. This foundation fosters an open, unified payment ecosystem, distinctly equipped to support diversified payment methods within a shared network. This innovative structure emerges from the burgeoning demands for payment flexibility and the intricate operations inherent to comprehensive financial services.

Strategic Implications: The deployment of 4GPN significantly mitigates the operational complexities associated with traditional payment systems. By providing a cohesive platform that accommodates a broad spectrum of payment mechanisms, 4GPN facilitate a more efficient transaction environment. This environment not only enhances user experience but also propels financial inclusion by integrating cutting-edge technological solutions accessible across various demographics.

As financial systems worldwide continue to evolve, the integration of robust, scalable, and secure payment networks like 4GPN will be pivotal in shaping the future of global commerce. These networks promise to transform the payment landscape by offering unprecedented levels of integration, security, and efficiency, thereby reinforcing the infrastructural backbone necessary for supporting the next generation of financial transactions.

8.1.2 Integration and Innovation in Fourth-Generation Payment Networks

This section delineates the conceptual and operational frameworks of fourth-generation payment networks (4GPN), which integrate both traditional and innovative payment mechanisms within a unified system. By leveraging state-of-the-art technologies such as the Internet of Things (IoT), cloud computing, and blockchain, these networks are distinctly positioned to transform the global financial landscape.

The rapid evolution of payment technologies has necessitated the development of more robust, scalable, and secure payment infrastructures. Fourth-generation payment networks are at the forefront of this evolution, bridging the gap between traditional financial instruments and modern digital solutions.

Comprehensive Integration: These networks unify diverse payment methods—decentralized and centralized digital currencies, bank cards, and biometric recognition—creating a seamless and frictionless payment ecosystem.

Technological Synergy: The architecture of 4GPN is underpinned by the latest advancements in IoT, cloud computing, and blockchain technologies. This synergy creates an open, unified payment ecosystem capable of supporting a wide range of payment modalities within the same network. The inherent flexibility and openness of 4GPN stem from the growing demands for innovative payment solutions and the operational complexities associated with delivering comprehensive financial services.

Strategic Advantages: By facilitating the integration of multiple payment systems, 4GPN enhance operational efficiencies and foster a more inclusive financial environment. This unified approach not only simplifies transactions for users but also enhances security and scalability across the financial sector. The adaptability of 4GPN to incorporate new technologies and payment forms positions them as essential components in the future development of global financial infrastructure.

The architectural integrity of 4GPN is defined by several key attributes below, that underpin their functionality and efficiency. These networks are designed to address the emerging demands of a digital economy, necessitating a framework that supports vast, complex transactional ecosystems.

8.1.3 Key Architectural Features of Fourth-Generation Payment Networks

1. Mashup Networks: By integrating diverse payment networks with varying data structures and protocols, the mashup architecture ensures **smooth data flow and consistency**, adhering to ACID properties (Atomicity, Consistency, Isolation, Durability).

2. Unified: A core concept of the 4th-generation payment networks is the establishment of **a single, unified network supporting all payment methods.** Unified payment gateways seamlessly connect to diverse payment switches and gateways, enabling comprehensive acceptance unmatched by traditional bank card or mobile wallet networks. This holistic integration not only enhances operational efficiency but also broadens market accessibility, setting a new standard for global payment systems.

3. Smart Merchant Endpoints: Modern all-in-one POS terminals, capable of accepting a variety of payment instruments, are integrated with merchant business systems to provide a **seamless, user-friendly payment experience**. These terminals include smart EMV POS devices as well as ECR terminals with soft-POS functionality. This convergence of technology and usability ensures a frictionless payment experience that is both secure and user-friendly, fostering greater engagement and satisfaction among end-users.

4.Cloud-based: Leveraging cloud infrastructure for data processing, ledger management, and billing ensures the networks are both reliable and efficient, even when handling **vast volumes of complex mixed transactions.**

5.Open System: The networks act as **an inclusive infrastructure**, accessible to all payment service entities, including card acquirers, mobile wallet operators, cryptocurrency organizations, and private application developers, fostering an ecosystem of collaboration and innovation.

8.1.4 Comparative Evolution of Payment Network Generations

	1st Generation	2nd Generation	3rd Generation	4th Generation
Payment Media Used by Consumers	Magnetic Cards	IC Cards (Contact & Contactless)	Mobile Phones (QR & NFC by Apps)	Biometric Methods (Recognition by Devices)
Payment Acceptance Devices Used by Merchants	Devices with Magnetic Stripe Reader	Devices with IC Card Reader	All-in-one Android Devices with Multi-functional Payment Apps	All-in-one Devices with Intelligent Apps & Biometric Sensors
Data Transmission Methods	Analog Data Transmission by PSTN Lines	Modem Data Transmission by Telephone Networks	Digital Data Transmission by Mobile Internet	Digital Data Transmission by Mobile Internet
Transaction Data Processing Technologies	Mainframe & Minicomputers	PC Servers	Cloud Computing	Cloud Computing & Blockchain Networks
Network Architectures	Centralized Networks	Distributed Star Networks	Distributed Star Networks	Mashup Networks
Main Improvements	From 0 to 1 of electronic payment networks	Secured Payment Networks	Coverage and Integration	Cryptocurrency Innovation

09. SUMMARY

The global payments industry is undergoing rapid transformation driven by digitalization, mobile technology, and fintech innovation. Mobile solutions, digital wallets, QR payments, andbuy-now-pay-later schemes are reshaping consumer behavior and improving financial inclusion, especially in emerging markets. Technological advancements in biometric security, artificial intelligence, and blockchain are strengthening payment infrastructure, while Account-to-Account (A2A) payments and central bank digital currencies (CBDCs) are redefining money movement and regulatory frameworks.

Mobile payment solutions, including mobile wallets and contactless payment systems, have become fundamental in streamlining digital transactions. The Asia-Pacific region leads in mobile payment adoption, with significant market penetration facilitated by smartphone proliferation and government-backed digital initiatives. Meanwhile, Buy Now, Pay Later (BNPL) services are redefining consumer credit access by providing alternative lending mechanisms, though they also pose regulatory and financial risks.

Digital wallets are increasingly dominating the payments ecosystem, contributing to over 30% of global point-of-sale (POS) transactions. They offer secure, frictionless payment experiences through technologies such as near-field communication (NFC) and QR codes. The rapid adoption of digital wallets in emerging economies demonstrates their role in enhancing financial inclusion by bridging the gap between traditional banking and underserved populations.

API developments are another key driver of financial innovation, enabling seamless integration between payment platforms and third-party services. Companies are embracing AI-enhanced API development to streamline financial operations, enhance customer experiences, and improve security protocols. Expert insights highlight a growing emphasis on real-time integration, automation, and flexible API architectures, underscoring the need for standardized regulatory compliance frameworks.

Security remains a paramount concern, with artificial intelligence (AI) and biometrics playing crucial roles in fraud detection and user authentication. AI-driven fraud prevention mechanisms analyze transaction patterns in real-time to mitigate risks, while biometric technologies, such as facial recognition, fingerprint scanning, and voice authentication, offer secure, user-friendly alternatives to traditional verification methods. The biometric payments market is expected to experience substantial growth, particularly in North America and Asia-Pacific, as concerns over security breaches and identity theft intensify.

Blockchain and distributed ledger technologies are poised to revolutionize financial transactions by offering decentralized, transparent, and immutable payment mechanisms. With applications in cross-border payments, asset tokenization, and decentralized finance (DeFi), blockchain solutions are driving cost reductions and operational efficiencies. The emergence of Central Bank Digital Currencies (CBDCs) reflects a global shift toward government-backed digital assets designed to enhance financial inclusion and economic stability. However, regulatory and infrastructural challenges remain key barriers to widespread adoption. Account-to-account (A2A) payments are gaining traction as a low-cost alternative to card-based transactions, particularly in regions with government-supported digital payment systems such as Brazil, India, and the Netherlands. A2A transactions leverage open banking frameworks to facilitate real-time, secure, and efficient money transfers, further reducing reliance on traditional banking intermediaries.

A notable paradigm shift is the emergence of **Fourth Generation Payment Networks (4GPN)** which represent a next-generation, unified payment ecosystem built on **IoT, cloud computing, and blockchain technologies**. Unlike previous systems, 4GPN seamlessly integrate diverse payment modalities, including cards, biometrics, centralized and decentralized currencies, into a single, open platform.

This innovative structure reduces operational complexity, enhances security, and empowers banks, fintechs, merchants, and mobile operators to operate more efficiently. By enabling flexible, real-time transactions across varied environments, 4GPN serve as a strategic foundation for inclusive, scalable, and future-ready global commerce.

10. CONCLUSION

The evolution of digital payments is reshaping the global financial landscape, presenting both opportunities and challenges for industry stakeholders. The rapid proliferation of mobile solutions, BNPL services, digital wallets, and A2A transactions signifies a shift toward more inclusive and efficient financial ecosystems. FinTech innovations are not only streamlining payment processes but also expanding access to financial services, particularly in underserved markets.

Security remains a critical factor in maintaining consumer trust, with AI and biometric technologies emerging as essential tools for fraud prevention and authentication. As cyber threats evolve, financial institutions must prioritize advanced security protocols to safeguard digital transactions and user data.

Blockchain technology, CBDCs and stablecoins hold transformative potential, particularly in addressing cross-border payment inefficiencies and enhancing monetary sovereignty. However, regulatory uncertainties and infrastructural constraints must be addressed to ensure their successful integration into mainstream financial systems.

As the payments landscape continues to evolve, the industry must prioritize agility, interoperability, and inclusion. The convergence of mobile payments, digital wallets, and intelligent infrastructure is pushing the boundaries of what's possible. Emerging economies, supported by fintech and smart regulation, are leading innovation in accessibility and usage.

Fourth Generation Payment Networks (4GPN) will be a defining force in this transformation, by setting new benchmarks for how digital payments are conducted in real-world, everyday environments. By leveraging 4G networks and cloud-based validation, 4GPN ensure speed, reliability, and security in diverse use cases, from dense urban markets to rural villages. Stakeholders, from governments to private sector innovators, must now align on scalable models that uphold security, trust, and financial empowerment for all.

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