Evolution of Digital Payment Systems and a Breakthrough

ABSTRACT

This study examines the development of digital payment systems with the evolution of communication technologies, financial institutions and fintech companies. Also, this study analyzes the expected effects of developing payment systems and fintech applications. The study defines different types of digital payment systems, compares general characteristics of digital payments, provides a timeline of developments for digital payment systems and compares most used digital payment applications. The payments market is changing in line with consumer behavior. Cashless economies, mobile banking, instant payments, digital commerce, and the growing impact of regulatory agencies are a few trends affecting the payments market. Contactless payments also make the payment process easier and more convenient for consumers who benefit from shorter lines, cash-on-hand issue elimination, and faster moving queues. The Asia-Pacific region is anticipated to witness significant growth in the market such as China and India. Digital and mobile wallets account for 58% of regional e-commerce payments in the region and are expected to reach 68.2% by 2023. The e-commerce sector is witnessing a spike in demand as consumers order essential items such as food and clothes through e-commerce websites, where most consumers prefer the digital mode of payment. Transition towards the cashless economy, emergence of new online financial institutions, a decentralized monetary governance with the adoption of blockchain and cryptocurrencies are envisioned. Advancements in payment technologies as well as digital payment systems adoption will create momentum and create further investments towards digitalization of monetary exchange. It is concluded that evolution of digital payment systems will extend convenience, return, convergence, cross-border and time limitless transaction. Inclusion of the unbanked is expected to drive growth and create new opportunities. There is a clear transition towards a cashless economy with the increasing adoption of digital payment systems by all spenders. Speed, privacy, convenience, security and decentralization will mean a wider inclusion for all global citizens; even including some unbanked population. Decentralization and blockchain will mean a blur in distribution of wealth, some money leaving the traditional banking systems. Digital payment systems provide a wide range of transaction options to its users; swiped credit cards, electronic checks, mobile wallets and contactless payment. By 2050s, the circulation of physical money is expected to vanish, leaving its place to virtual currencies changed on digital platforms.

Keywords: Digital payments, online transactions, digital wallets, e-payment, cashless economy

1. INTRODUCTION

Money has been a medium of exchange throughout the history. Money enables the ability to buy foods and services, it has a store of value that provides purchasing power. Money has different values for today and tomorrow and it provides a unit of account to measure value. Payment systems enables money to function as media of exchange which transfers value

from one account to another. All systems apart from the physical exchange of money (banknotes or coins) requires a ledger for record keeping

As financial systems became more complex and interconnected, ledgers also became deeper, connected. Technological developments, communication technologies and internet brough new innovations to payment systems and central monetary transactions. As all businesses digitized, so did banking and financial industries and financial technology (FinTech) developments introduced new payment systems as well as new currencies.

This study focuses on the developments on digital payment systems, how digital systems work, what are the most widely used digital payment infrastructures throughout the world and where the overall value exchange is going in the future.

Tangible financial transactions were made using cash or coins. Digital payments are all transactions where the value is transferred from one account to the other using digital payment technologies. Until recently, digital payments were usually limited to electronic money transfers. With fintech developments and the emergence of cryptocurrency, digital payment systems carry a wider meaning. Intangible digital transfer of money or digital currency from one account to another using digital payment systems are all digital payments. Electronic payments may be defined as an electronic value transfer of a payment from the payer to the recipient through an electronic payment mechanism. The e-payment service comes with a web-based user interface that allows customers to access, manage their bank accounts and transactions remotely (Hidayanto, et al.). The use of internet and technology in modern banking services including electronic payment systems improves banking performance and serves for convenience, the second best feature of digital payment after speed.

Digital payments have subsets depending on the platform and/or technology the value is transferred.

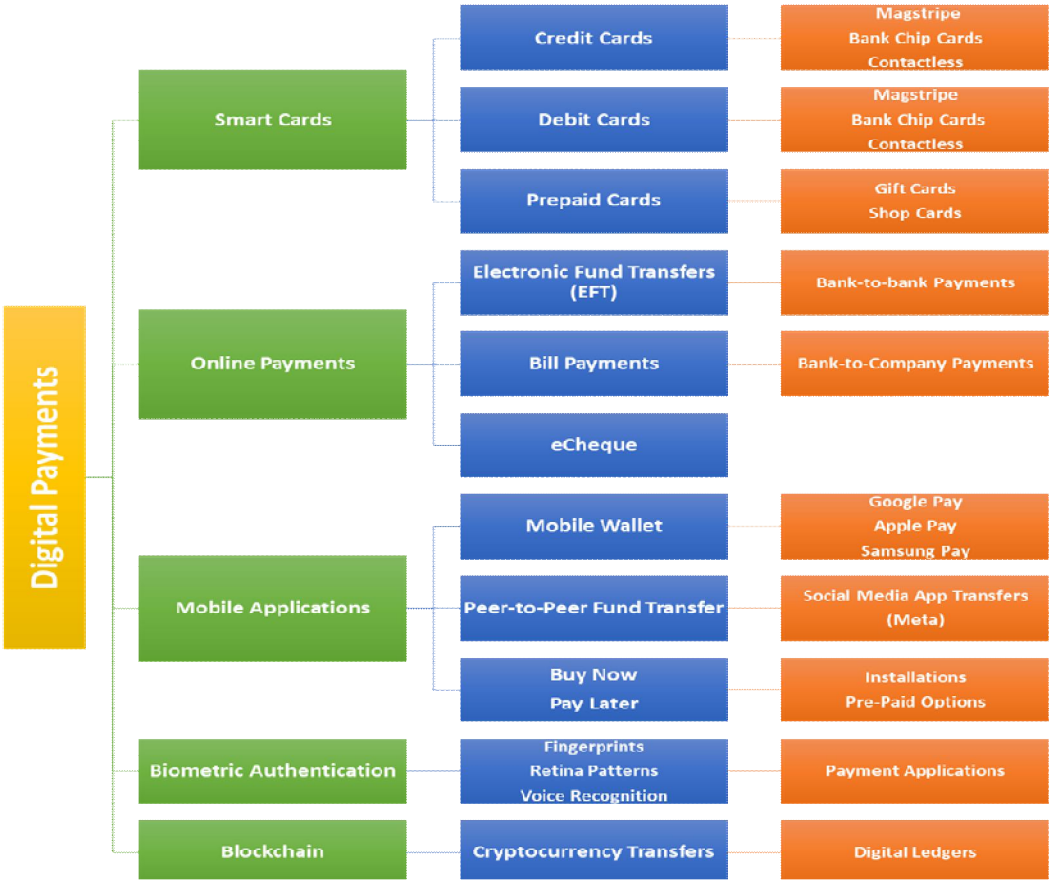


Figure 1. Types of Digital Payments

Smart cards that are commonly used in everyday life by people and businesses such as credit cards and debit cards are the most basic type of digital payments. Smart cards are usually provided by traditional banks and widely accepted globally. Usage of smart cards are highly traceable. Even though smart cards are the most basic form of digital payment systems, they have been also evolving with technology. Mobile POS (point-of-sale) machines facilitates easy payment and NFC (near-field-communication) technology allows contactless payments.

Online payment is still the most widely used form of digital payment system globally. With globalization and cross-border trade, businesses as well as individuals adapted to online payment systems provided by banks. EFT (electronic fund transfer) via IBANs (International Bank Account Number) are the most accepted form of payment in today's world. Global banking systems record all monetary transactions that are made through online channels, and they are almost 100% traceable.

Mobile payment technologies enable users to transfer funds and value through electronic mobile devices such as smartphones, tablets or smartwatches. Mobile payment applications can also be used to transfer money to family and friends. Mobile payments are financially regulated and widely used bu unbanked communities in developing countries.

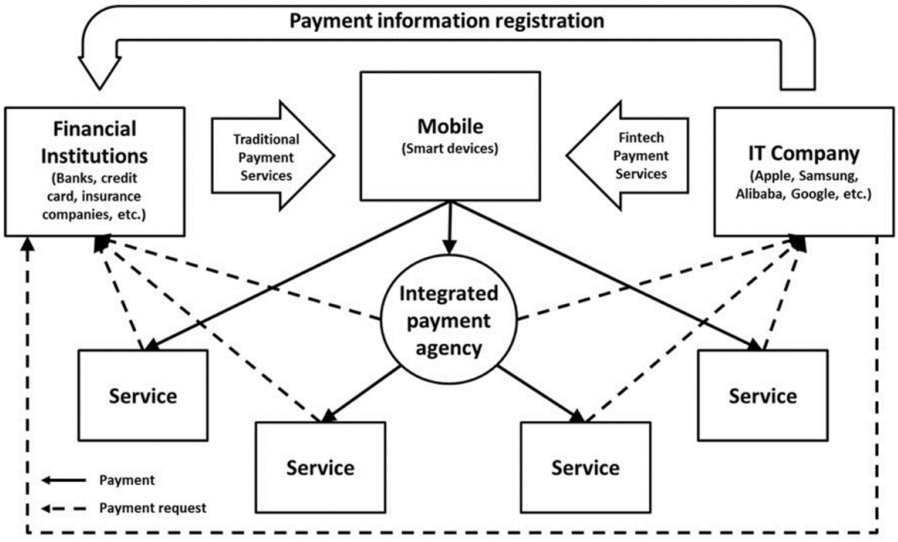
2. CHARACTERISTICS OF DIGITAL PAYMENT SYSTEMS

According to Karnoukos and Fokus (2004), mobile payment services need to have following characteristics:

- **Simplicity & Usability:** M-payment application should be simple and convenient
- **Universality:** Service should provide domestic, regional and global coverage for transactions between people and businesses
- **Interoperability:** Development should be based on international standards and open technologies that allow different systems to interact with each other
- **Security, Privacy & Trust:** Users should be able to trust a mobile application to share their security details and make monetary transfers. Privacy for transactions and anonymity is important as well as security against outside attacks.
- **Cost:** Mobile payment systems should cost less-to-none compared to other existing payment mechanisms
- **Speed:** Transaction speeds should be acceptable to users
- **Cross Border Payments:** Mobile payment application should be globally recognized and used world-wide to be accepted.

Mobile Wallets provided by technology moguls like Apple, Google and Samsung accelerated the shift from traditional banks to alternative fintech companies and applications. These wallets introduced new stakeholders such as mobile network operators, mobile device manufacturers and software providers to financial systems.

Figure 1 summarizes the exchange between different parties and services through mobile payment systems with financial, mobile and technology exchange actors.



Source: Kang, et.al, 2018

Figure 2. Basic Operations Mechanism for Digital Payment Systems

Digital payment systems are compared and evaluated based on common characteristics. Authenticity is important for checking identity and providing personal account information. Privacy is one of the key elements that needs to be established for all monetary transactions. Integrity of the system infrastructure is a standard for security whereas non-

repudiation is a requirement for the completion of the payment. Expansion of the payment system is a customer expectation along with transaction efficiency. For providing a global service, compatibility and acceptability of the systems is also a requirement.

Transaction costs are still a competitive topic and an important revenue stream for online and mobile payment systems. Most banks have been charging their customers for money transfers, especially for international transactions but new players such as blockchain instruments are creating a disruption at transaction costs. Atomic exchange, user range and value mobility are commercial characteristics usually determined by the service provider whereas anonymity, convenience and mobility are shared standards in today's digital payment ecosystem.

Table 1. Comparison of Electronic Check Systems and Online Card Payments

	Electronic Check System	Online Credit Card Payment (VCC & SLL)
Authenticity	Good:Uses digital signatures and digital certification to check identitiy	VCC (good) uses card number and PIN to check identity. SLL(fair) only uses account information
Privacy	Fair: Uses asymmetrical golden keys to calculate and send information but payment account info is at risk of theft	VCC (good) actual card number is not sent through the internet. SLL (fair) uses actual card number to make a transaction
Integrity	Good: Uses information certification number and assymmetrical golden keys for increased security and ensure the integrity of transaction information	Good: VCC and SLL both uses Hash function to ensure integrity
Non-Repudiation	Good: Uses digital signatures and digital checks to ensure non-repudiation	None: Cardholder can use the card without additional integrity
Expansion	Good: Consumer and store electronic checkbooks complete the transaction. Financial systems provide check certification and exchange	Very Good: Both VCC and SLL are globally accepted and used
Transaction Efficiency	Good: Transaction efficiency decreases if the transaction is offline	Good: Both VCC and SLL create efficient transactions
Compatibity	Good: Compatible with actual check accounts and traditional financial organizations	Good: VCC and SLL are compatible with all types of browsers
Acceptability	Poor: Consumer and store must both install a smart card reader	Good: Both VCC and SLL are widely accessible
Transaction Cost	Normal: Low transaction costs but using parties are responsible for obtaining smart cardsi digital certification and other fixed costs	Normal: VCC and SLL online transaction costs are about the same as regular credit card costs
Atomic Exchange	None: Use check first, pay later	None: Consume first, pay later for both
User Range	Fair: Limited to users with check accounts	Fair: Both are limited to people who are credit card owners
Value Mobility	Users endorse their limit and limits are transferrable among parties	None: Value cannot be transferred among different parties for online transactions
Financial Risk	Fair: Consumer can stop check payments for fraudulent transactions	Low: Most risk is carried by credit card industry
Anonymity	None. All check users need to sign their own names	VCC (good) companies cannot obtain information about consumer VCC account and distributors cannot obtain details about the spending habits. SLL (fair) companies can obtain information about consumer VCC account and distributors cannot obtain details about the spending habits.
Convenience	Fair: Consumer should apply for an electronic checkbook to a bank	VCC (fair) consumer needs to apply for a VCC account besides having a credit card. SLL (good) consumer can make transactions if they have a credit card.
Mobility	Good: Includes signing and certification	Good: Both VCC and SLL carry no limit on where they can bue used.

Source: Adapted from Lee, et.al, 2011

3. HISTORICAL EVOLUTION OF DIGITAL PAYMENT SYSTEMS

Historically, non-physical exchange of cash dates back to 1872 to Western Union's 1st wire transfer by using a telegraph network. But it was almost a decade later when alternative payment system creation gained pace with the installation of the 1st ATM by Barclays Bank.

In 1977, Merita Bank in Finland introduced mobile banking with SMS which paved the way to todays' mobile wallets and biometric authentication via mobile devices.

It was in 1995 when the 1st contactless payment was done at Seoul Bus Transport with an implemented chip. In 1999, PayPay launched its electronic money transfer service which is still widely used today. By millennium, WU.com was launched, Western Union's online payment website. On 2003, Chinese E-commerce giant introduced AliPay, the first mobile payment platform. NTT Docomo launched the very first mobile wallet in Japan in 2004. By 2005, two-thirds of American adults owned a cell phone. As mobile communications and internet usage increased, payment applications around these technologies also increased.

A very important milestone for new-age digital payment systems is the launch of Bitcoin in 2009. Since then, developments in cryptocurrency, blockchain usage and a transition towards a decentralized monetary system globally increased. Cryptocurrency mining, alternative token exchange and crypto-exchange has grown exponentially since the 1st launch of Bitcoin and is now considered to be the next-generation base of cashless economy for the future.

Below shape explains historical evolution of digital payment systems:

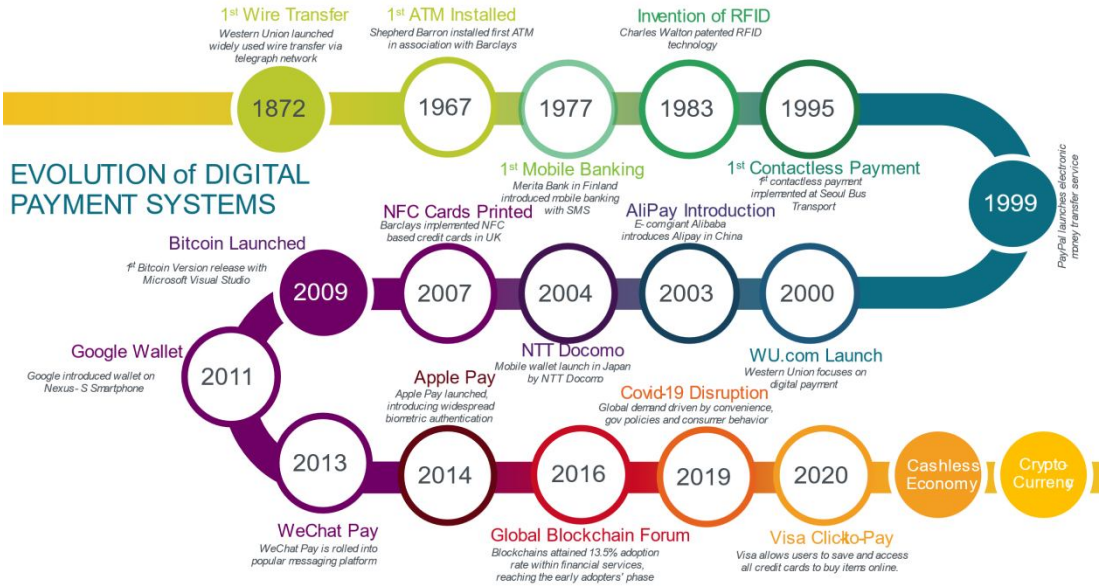


Figure 3. Evolution of Digital Payment Systems

Smart device producers like Apple and Samsung, marketplaces like Amazon and Alibaba, and Google introduced their own wallets in the second half of 2010. Apple introduced biometric authentication via finger prints in 2014. Face recognition followed afterwards.

In 2016, it was announced at Global Blockchain Forum that blockchain adoption rate reached 13.5% within financial services, surpassing the early adopters' phase. Digital payment systems on all platforms, from mobile to online to blockchain had their largest disruption after Covid-19 global pandemic. People of all ages transitioned to online payments, mobile transactions and to a paper-free digital phase for convenience, speed and hygiene.

The trend towards a transition to digital payment systems will continue in the near future. Contactless cards, tap-to-pay systems, biometric payment cards (i.e fingerprints, face recognition) and mobile wallet usage will become mainstream for financial exchange.

4. COMPARISON OF MOBILE PAYMENT APPLICATIONS

A mobile payment is a transfer of funds from one account to another for a product or a service through a portable electronic device. There are different mobile payment technologies that enable money transfer to friend, family or businesses. Online commerce, marketplaces and e-commerce platforms have adopted and enabled mobile payment systems as a natural result; semi-forcefully adopting their users.

Mobile payments became popular in Asia and Europe before becoming common in USA and Canada (Grant, 2021). Traditional Banks have adopted to online payment technologies as new players emerged in digital payments. Since 2014, technology-based applications such as PayPal and Apple Pay developed systems that allowed users to make payment by passing their smartphone screen under store barcodes or tap their phones against contactless terminals.

Payment applications uses iOS for Apple phones and Android for other phones as operating systems. They enable international and domestic payments. There are some fees reflected on top of payments, depending on where the money is transferred and to whom. Payment method is usually easy by tapping a few touch screens, providing speed and convenience to its users. Transaction time depends on the payment application's terms, the corresponding account's availability and the payment application.

Physical wallets and plastic cards will disappear in the near future with the further penetration of payment applications. Biometric authentication such as fingerprints and face recognition will provide further privacy, security and decrease risk of fraud in transfers. Blockchain backed digital applications will change the whole record keeping systems, forcing banks to digitalize as well.

Below table provides a comparison to top 10 most widely used digital applications.

Table 2. Payment Applications Comparison

#	Payment Apps	Fees	Operating Systems	Transaction Type	Payment Mehtod	Transaction Time
1	**PayPal**	Free to send to friends and family in the U.S. Users pay 2.90% plus a fixed fee to send money via a credit card. Charges 5% to send international personal transactions	iOS and Android	Domestic and Foreign Send payments by tapping "Send" or you can request money by tapping "Request Money."	Send payments by tapping "Send" or you can request money by tapping "Request Money."	Typically a day, sometimes longer Instant transfer (paid option) or could take a few business days
2	**Venmo**	No fees through the app transfer. 3% transfer fee through credit card transfers. Instant pay feature costs 1% of the total cost.	iOS and Android	Only domestic	Standard bank transfer through the ACH network or can keep money in Venmo or your bank account	Usually 30 minutes for Instant transfer option; standard bank transfer method takes between 1-3 business days.
3	**Cash App**	No (yes for credit card usage)	iOS and Android	Only domestic	Maximum transfer amount is $7,500 and lower limits apply without verification, users can buy and sell Bitcoin	Within minutes
4	**Zelle**	No fees for sending or receiving money via Zelle	iOS and Android	Only domestic	Most US large banks like Chase, Bank of America, Citi Bank and Wells Fargo offer Zelle	Within minutes
5	**Google Pay**	No fees to send money to friends and family on Google Pay	iOS and Android	Domestic and some foreign transactions	Google Pay is unique in its integrations with other Google products, including Gmail. Using Google Pay, you can send and receive money pay entering someone's Gmail address.	Within 24-hours or within 3-5 days. Depends on the transaction
6	**Meta Messenger**	Meta account users can send money easily to businesses and friends who are on Meta, no fees	iOS and Android	Domestic and some foreign transactions	Payment information is kept private unlike some other apps that have a public option but a debit card should be linked to a Meta account	May take up to 5 days to receive funds
7	**QuickBooks Online Mobile**	ACH bank transfers: 1% (max $10); Card (Swiped): 2.4% plus 25 cents; Card (Invoiced): 2.9% plus 25 cents; Card (Keyed): 3.4% plus 25 cents	iOS and Android	Domestic and some foreign transactions	Easy acception of credit card payments with QuickBooks' Online Payments app. Send customers a "Pay Now" link.	Funds arrive in user bank account the next business day with the GoPayment app.
8	**Wise**	Yes. Fees vary with country and currency	iOS and Android	Most used for international payments	Wise Batch Payment tool for payroll allows employers to pay in more than 45 currencies.	Up to 2 business days, depending on the receiver country
9	**Stripe**	Costs 2.9% plus 30 cents for each successful card charge	iOS and Android	Accepts all major debit and credit cards from customers in every country	Comprehensive dashboard offers many payment methods from mobile device.	Instant Payouts (for a 1% fee of the payout amount) to send earnings to a debit card or bank account within minutes; subject to daily payout limits.
10	**FreshBooks**	Charges 2.9% plus 30 cents on all credit card transactions (American Express at 3.5% plus 30 cents) and bank transfers (ACH) at 1%	iOS and Android	Connects with over 14,000 banks through ACH payments and credit cards	Edit, deliver, track, and successfully follow up on invoices more efficiently through FreshBooks Payments, powered by WePay.	Two business days

Source: Adapted from Investopedia and the Balance Websites

5. CONCLUSION

A product or a service that has a value needed a form of exchange since the discovery of money by Lydians in BC 700. For decades, the exchange happened on physical medium with coins or cash. As centralized systems emerged, accounting and bookkeeping developed, and banks played a major role as authorities for monetary transactions. Developments in world wide web, telecommunication technologies and smart devices, financial institutions changed form and structure too.

From swiped credit cards to electronic checks, from mobile wallets to contactless payment options; digital payment systems provide a wide range of transaction options to its users. There is a clear transition towards a cashless economy with the increasing adoption of digital payment systems by all spenders. Speed, privacy, convenience, security and decentralization will mean a wider inclusion for all global citizens; even including some unbanked population. On the other hand, decentralization and blockchain will mean a blur in distribution of wealth, some money leaving the traditional banking systems.

Each technology introduced adds value to transaction and spending experience of the individuals. The fact that users do not count a physical dime while paying creates a virtual feeling which makes spending easier. Tech-savvy generations that are becoming financially responsible are born into such applications will carry the flag even further, creating an accelerated decline for the use of traditional payment methods. By 2050s, the circulation of physical money will almost vanish, leaving its place to virtual currencies changed on digital platforms.

- There is a clear transition towards a cashless economy with the increasing adoption of digital payment systems by all spenders.
- Speed, privacy, convenience, security and decentralization will mean a wider inclusion for all global citizens; even including some unbanked population.
- Decentralization and blockchain will mean a blur in distribution of wealth, some money leaving the traditional banking systems.
- Digital payment systems provide a wide range of transaction options to its users; swiped credit cards, electronic checks, mobile wallets and contactless payment.
- By 2050s, the circulation of physical money is expected to vanish, leaving its place to virtual currencies changed on digital platforms.

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