

INDIAN DIGITAL PAYMENTS: AN EMPIRICAL EXPLORATION

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Abstract

In the contemporary landscape of digital transactions in India, various methods, such as mobile wallets, Unified Payments Interface (UPI), and digital banking platforms, have gained widespread adoption. While these avenues offer unprecedented financial inclusion, operational efficiency, speed, and user convenience, their proliferation has been accompanied by notable challenges. This research explores the multifaceted aspects of these digital transaction mechanisms, shedding light on their benefits and shortcomings. A critical analysis reveals inherent issues, including concerns related to privacy, security vulnerabilities, and the potential for fraudulent activities. Information security emerges as a pivotal focal point, encompassing data breaches, identity theft, and cyber threats that pose significant risks to users and the financial ecosystem. The study paves the way for nuanced recommendations and solutions to fortify the security infrastructure. The ultimate goal is to contribute to the ongoing discourse on shaping a safer, more efficient, and universally accessible digital transaction landscape in India.

Keywords: Digital transactions, financial inclusion, information security, security vulnerabilities

1 Introduction

The policy of demonetization in India had a profound impact on the nation's economy, driving the substantial growth of digital payments. Preceding demonetization, digital transactions constituted around 10% of the total, a figure that has more than doubled to over 20% in the years following the policy. This surge is attributed to various factors, including government initiatives like Digital India, Make in India, and Startup India, fostering a conducive environment for the development of startups and digitization across diverse sectors.

The surge in internet and smartphone usage has been instrumental in expanding the digital ecosystem. Government encouragement and increased internet and smartphone penetration have accelerated the adoption of digital technologies. Projections from the Internet and Mobile Association of India anticipate that the number of Internet users in the country will reach 800 million by 2023, contributing to a substantial increase in mobile wallet users, projected to reach 900 million by 2025.

In the 2017-18 Union Budget, the Indian government aimed to achieve 2,500 crore digital transactions, emphasizing the use of UPI, USSD, Aadhar Pay, IMPS, and debit cards. This initiative sought to propel the adoption of digital payments and reduce reliance on cash transactions, aligning with the government's broader digitization agenda. However, this surge in digitization has also brought about challenges, notably a rise in cyber fraud and data security breaches. As the country embraces digital

payments, addressing these cybersecurity concerns has become imperative. This study aims to delve into the benefits and potential vulnerabilities posed by current online transaction media, exploring existing official guidelines, policies, and best practices while proposing practical solutions to enhance cybersecurity.

2 Literature review

2.1 Digital Payment Methods

The developments in technology have significantly impacted multiple spheres of life. The onset of digital payments has completely revolutionized banking in our country. Digital Payments were encouraged by the Government of India after the announcement of demonetization on 8th November 2016 the basic objective behind the initiative of Digital Payments was to achieve a cashless economy in the long run.”¹ The government also launched the Digital India campaign to accelerate digitization. Some of the various methods of digital payments available in India currently are as follows:

1. Digital wallet payment system: this technique uses e-wallets to help facilitate transactions with only one limitation of transferring funds to the same service provider wallet. Mobile wallets in India are a fairly new mode of payment, it initially started in the last decade, when the Oxigen wallet was launched in 2004. Subsequently, other more popular wallets like PayTM were launched, currently, it has a subscriber base of almost 20 million users.
2. USSD code payments system: stands for Unstructured Supplementary Service Data where transactions take place through messages in the absence of an internet facility. It is a voice-era cellular technology with primitive security features in today's digital age.

3. Mobile Money Identifier: Usage of a seven-digit unique number issued by banks based on your phone numbers, mainly used for facilitating small interbank funds transfer.
4. UPI App-based payments platform: Unified Payments Interface (UPI) is a digital payment system through which a user can both send and receive money through a Virtual Payment Address (VPA)² that works on a real-time basis and facilitates transfers instantaneously and is in turn connected to all banking apps. This system effectively merges bank accounts into a simple mobile application, merging several features into one provisional system.

2.2 Financial Inclusivity

Digital finance plays a pivotal role in driving business innovations and reshaping the lives and economic landscape of individuals in emerging economies. By enhancing transparency and generating user information through digital payments, it lays the groundwork for novel financial services. Although awareness of digital finance services remains low, the government is actively implementing initiatives to educate rural Indian populations about the advantages of electronic transactions. Financial inclusion has evolved beyond being solely a social responsibility for banks; it is now seen as a lucrative business opportunity. Leveraging digital products, financial institutions are prioritizing the goal of expanding financial inclusion. To maximize the impact of these efforts, regulators and banks must collaborate seamlessly with local government agencies to conduct large-scale education campaigns for the masses.³

2.3 Cyber Security Concerns

Quality characteristics often play a crucial role in retaining customers to choose the

mobile wallet payment method for online transactions. Zhou⁴ reported that “structural assurance and information quality are the main factors affecting initial trust, whereas information quality and system quality significantly affect perceived usefulness”. Shah et al.⁵ depicted that in an online environment, a website design’s features significantly affect the website’s data protection, integrity, and confidentiality. Flavi’an and Guinal’iu,⁶ have written that “trust in the internet is particularly influenced by the security perceived by consumers regarding the handling of their private data”. According to the 2018 Thales data threat report, data breaches occur more often in India than the global average.⁷ The following are some incidents and trends that reinforce our apprehensions. Some payment systems in India suffer from vulnerabilities because they were not prospectively designed based on the ‘privacy by design’ principle.⁸

2.3.1 Data Breach

One of the most recurrent cyber security concerns is those of data breaches that often stem from bad data practices. Such poor practices often negatively impact multiple stakeholders ranging from consumers, markets, and even countries to unleash utter chaos. From a privacy perspective, bad practices include non consensual or excessive data collection, sharing, storage, and use; unchecked data brokerage; and failure to de-identify data.⁹ Reality is filled with horror stories of such data breaches; the 2016 security breach of Hitachi’s system which officially compromised 2.9 million debit cards across various bank accounts. is just one of many such stories.

2.3.2 Identity Theft

In India, “cyber fraud” in digital payments rose by around 25 percent (to 16,468 cases) in

FY 2015–16.¹⁷ moreover, during March–December 2017, the number of such cases for credit card, debit card, atm, and net-banking transactions rose to 22,740.¹⁸¹⁰

2.3.3 Existing Regulatory Frameworks

Finally, India needs a strong market regulator to shape the creation of a vibrant DFS sector focused on innovation and growth, and to protect the interests of consumers and the national economy.¹¹

3 Data and Methodology

Executing a systematic review, we adhere to the literature review methodologies outlined in.¹² Our research methodology consists of five sequential steps, guided by established practices. Firstly, we clearly define the scope of the review to facilitate the convergence of search outcomes. Subsequently, we systematically search literature databases using carefully crafted search strings comprising relevant keywords. After the search phase, a meticulous screening process is employed to refine the selection of articles for a more focused review. Following the screening, the chosen research articles are visually represented to clarify the core review questions. Ultimately, we undertake a comprehensive analysis and discussion of the results.

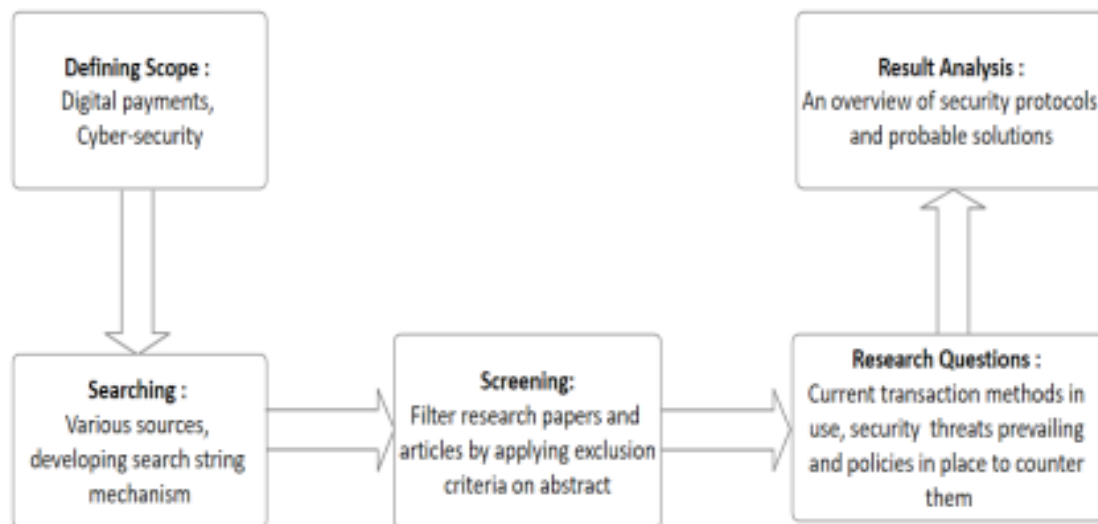


Figure 1: Research Methodology for systematic research methodology

3.1 Payment Methods in Use

3.1.1 Unified Payments Interface (UPI)

Unified Payments Interface (UPI) is a real-time payment system in India that facilitates seamless and instant fund transfers between different banks through mobile devices. UPI-enabled payments occur throughout the day and all 365 days a year. UPI allows users to transfer money between bank accounts using a UPI ID, which acts as an identifier for transactions. This eliminates the need to share sensitive bank account or IFSC code details. Users can link multiple bank accounts to a single UPI-enabled app and initiate transactions using a smartphone or feature phone. Payment can be done using a Virtual Payment Address (VPA). To use UPI services one must have a bank account and a mobile number registered with that bank account. It also caters to the “Peer to Peer” (P2P) collection request which can be scheduled and paid as per requirement and convenience.¹³ UPI has gained huge popularity among the masses for its user-friendly and safe interface and its adoption rates are growing as shown in Fig.

2.

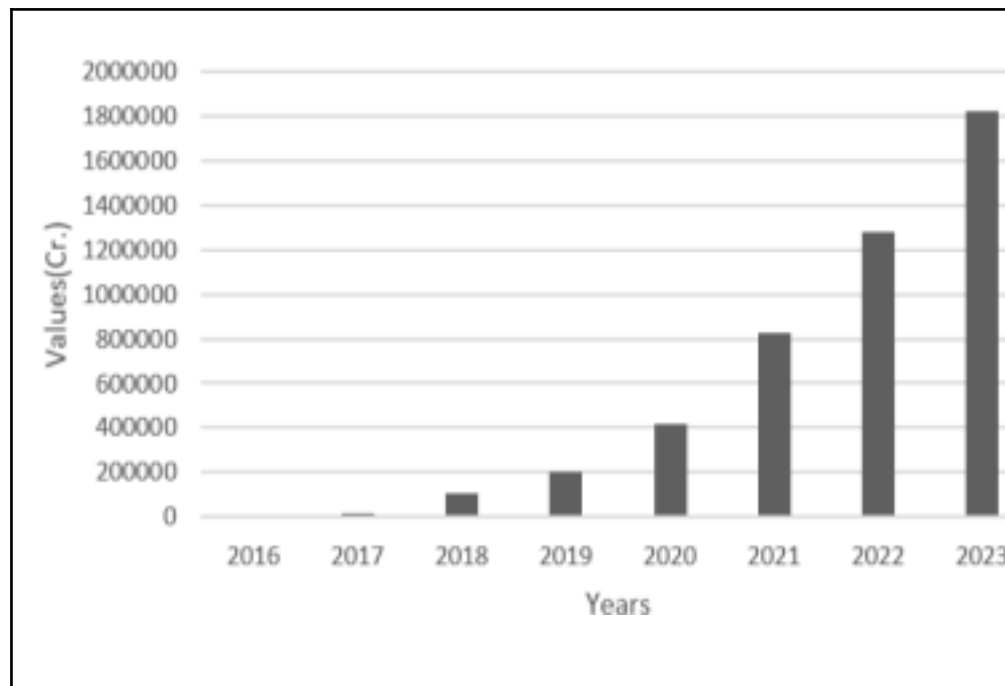


Figure 2: Total Value of Transactions via UPI (NPCI Website)

Benefits of UPI :

1. **Intuitive User Interface:** UPI applications boast a user-friendly design, ensuring effortless navigation and transaction completion for users.
2. **QR Code Enabled Payments:** UPI facilitates contactless transactions through QR code payments, providing a convenient method for users at diverse merchant locations.
3. **Interbank Transactions:** UPI offers seamless transactions between different banks and platforms, offering greater interoperability compared to mobile wallets with network restrictions.
4. **Wallet-Free Transactions:** UPI transactions are directly linked to users' bank accounts, eliminating the necessity to load or manage a separate wallet balance, a

feature distinct from mobile wallets.

5. Versatile Acceptance: With widespread acceptance among various merchants and platforms, UPI stands out as a versatile payment option, enhancing user convenience.

3.1.2 Aadhaar Enabled Payment Systems (AePS)

Aadhaar Enabled Payment System (AePS) is a secure and convenient method of financial transactions introduced by the Government of India. It leverages the unique 12-digit Aadhaar number, which is a biometric and demographic database, to enable individuals to make financial transactions through micro-ATMs.

Key features of AePS:

1. Biometric Authentication: AePS relies on biometric authentication using fingerprint or iris scans linked to the Aadhaar database. This ensures a secure and reliable method of verifying the identity of individuals.
2. Financial Inclusion: AePS plays a crucial role in promoting financial inclusion by providing basic banking services to individuals in remote and rural areas who may not have access to traditional banking infrastructure.
3. Transactions: Users can perform various banking transactions such as cash withdrawals, balance inquiries, and fund transfers using AePS. It acts as a bridge between banks and customers, facilitating transactions through Business Correspondents.
4. No Need for ATM Cards: AePS eliminates the need for traditional ATM cards and PINs, making it easier for individuals to access banking services, especially in

areas where physical infrastructure is limited.

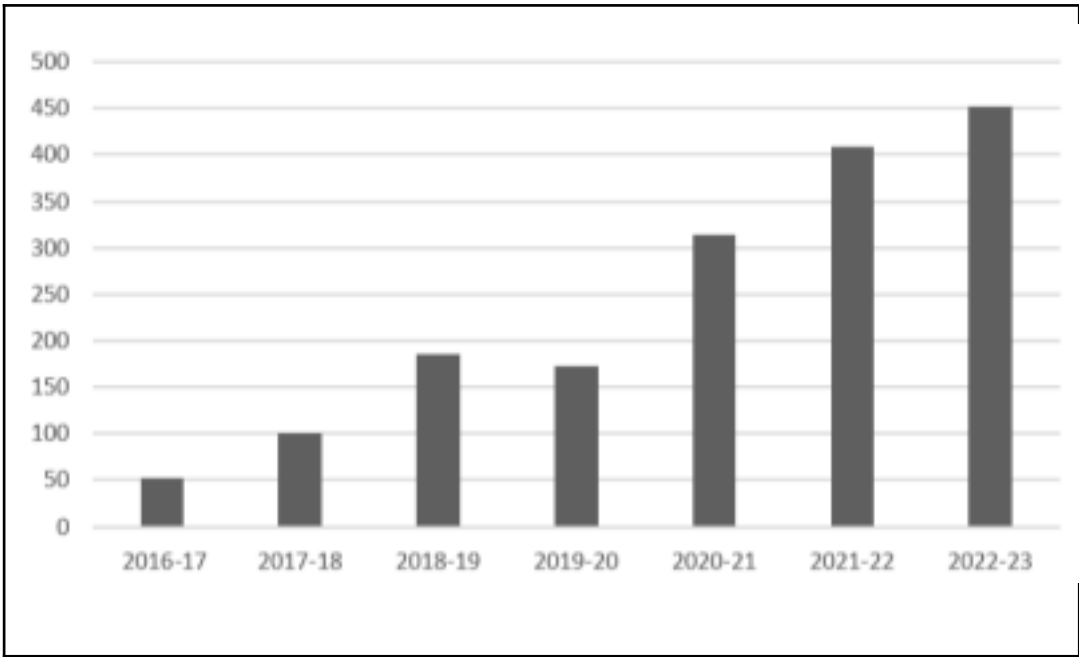


Figure 3: Total Value of Approved Transactions (NPCI Records)

AePS is steadily growing in popularity gaining traction among various banking sectors as well as commercial users. the percentage of inter-bank transactions (as shown in Table 2) (also known as off-us transactions) has risen from 7.49% in 2016-17 to 51.9% in 2022-23. Fig. 3 gives a clear picture of the growing potential of this faster and easier mode of transaction.

3.1.3 USSD

USSD (Unstructured Supplementary Service Data) based online payments refer to a mobile technology that allows users to perform financial transactions through text-based codes on their mobile devices. Unlike smartphone apps or internet connectivity-dependent services, USSD works on basic mobile phones with or without internet access. In the context of payments, users can dial a specific code, often starting with “*99#,” to access a menu and perform various financial transactions.¹⁴

USSD-based payments gained traction in India as they provide a simple and accessible platform for financial transactions, especially in areas where smartphone penetration and internet connectivity are limited. The Indian government introduced the National Unified USSD Platform (NUUP) to facilitate mobile banking and payments. This initiative, along with various USSD-based services offered by banks and financial institutions, has contributed to the growth of USSD-based payments, making them a popular choice for basic financial transactions, balance inquiries, fund transfers, and more.

Benefits of USSD:

1. Does not require an internet connection or data to work.
2. Reduces operating costs when it works as a self-service application for your customers.
3. Enhanced customer satisfaction when you give them the ability to serve themselves.
4. Works globally & economical.
5. Two-way communication is up to seven times faster than SMS.

3.1.4 Point of Sale (PoS)

Point of Sale (PoS) terminals are electronic devices used in retail and other businesses to facilitate transactions between customers and merchants. These terminals are commonly found at the checkout counter in retail stores, restaurants, and various service establishments. The primary function of a PoS terminal is to securely process payments, including credit card and debit card transactions.

Advantages of PoS Terminals:

1. Convenience: PoS terminals provide a quick and efficient way to process payments,

reducing transaction times and improving the overall customer experience.

2. **Payment Options:** They support various payment methods, including credit cards, debit cards, contactless payments, and mobile wallets, offering customers flexibility in how they pay.
3. **Record-keeping and Reporting:** PoS terminals automate record-keeping and generate detailed reports, helping businesses manage inventory, track sales, and analyze customer preferences.
4. **Reduced Cash Handling:** The use of PoS terminals can reduce the reliance on cash transactions, minimizing the risks associated with cash handling and theft.
5. **Integration with Business Systems:** PoS systems can integrate with other business management tools, such as inventory management and accounting software, streamlining overall business operations.

According to the data from the Reserve Bank of India (RBI), as of May 2022, there were 61.69 lakh PoS terminals in operation. The demand for contactless payments surged during the COVID-19 pandemic, leading to an increased requirement for POS terminals equipped with NFC, RFID, and other technologies capable of accepting payments from contactless chip cards or digital interface cards. The estimated size of the India PoS Terminals Market will be USD 33.26 billion in 2024, with a projected growth of USD 63.17 billion by 2029. This growth is attributed to the rising number of retail stores in India, driven by increased consumer purchases. The expansion of retail outlets has created a heightened demand for machines capable of processing payments.¹⁵

3.1.5 Internet Banking

Internet banking, also known as online banking, is a digital service that allows users to perform various financial transactions and banking activities over the Internet. Through secure online platforms provided by banks, customers can access their accounts, manage funds, and conduct financial transactions without the need to visit physical bank branches.

Advantages of Internet Banking

1. **Availability:** Banking services are accessible 24/7, year-round. Most services are not bound by time constraints, allowing you to check your account balance or transfer funds without waiting for the bank to open.
2. **User-Friendly:** Utilizing online banking services is straightforward and uncomplicated. Many individuals find online transactions more convenient than visiting a physical branch for the same services.
3. **Convenience:** There's no need to interrupt your daily tasks or stand in line at a bank branch. You can conduct transactions from any location, whether it's paying bills, managing recurring deposit instalments, or handling other financial activities via online banking.
4. **Time Efficiency:** Internet banking allows you to complete transactions swiftly, with funds transfer or opening a fixed deposit-taking only a few minutes. Transactions can be conducted promptly within the country using online platforms.
5. **Transaction Monitoring:** Unlike paper receipts from in-branch transactions that can be lost, all activities performed on a bank's internet banking portal are systematically recorded. This serves as a reliable record for transactions, including details like the payee's name, account number, transaction amount, date and time,

and any remarks, providing proof if necessary.

4 Security Issues and Vulnerabilities

The following table gives a systematic overview of various vulnerabilities that are prone to a threat to the currently active digital payment methods in India as discussed in the above section and their implications.

Payment Method	Vulnerability	Attack Method	Implication
UPI	•User biometric data •Centralized data storage •Lack of updated software for interfacing •Patch update downtime	•DDoS attack •Man in the middle attack •Internal network sniffer •Malware Injection	•Identity theft •Fraud & economic loss •Doxing(leak of personal sensitive and financial data) •Data Breach
AePS	•Inadequate identity verification or authentication processes •Centralized data storage •Insecure biometric information •Lack of user awareness	•DDoS attack •Man in the middle attack •Internal network sniffer •Malware Injection	•Identity theft & loss of reputation •Fraud & economic loss •Doxing(leak of personal sensitive and financial data) •Data Breach

USSD	•Insecure network & communication •Deficient cyber hygiene •Lack of user awareness and discretion •Outdated hardware and software	•DDoS & phishing attacks •Man in the middle attack •Internal network sniffer •Malware Injection	•Identity theft •Fraud & economic loss •Doxing(leak of personal sensitive and financial data) •Data Breach
PoS	•Card cloning •Insufficient encryption •Insecure network configurations •Lack of user awareness (weak passwords)	•DDoS & phishing •Man in the middle attack •Internal network sniffer •Malware Injection	•Identity theft •Fraud & economic loss •Doxing •Data Breach
Internet Banking	•Absence of 2-Factor Authentication •Lack of patched servers •Lack of sufficient encryption •Social Engineering & insider threat¹⁶	•Malware attacks •Phishing •SQL Injection •Distributed Denial of Service(DDoS)	•Identity theft & loss of reputation •Fraud & economic loss •Doxing(leak of personal sensitive and financial data) •Data Breach & disruption of service

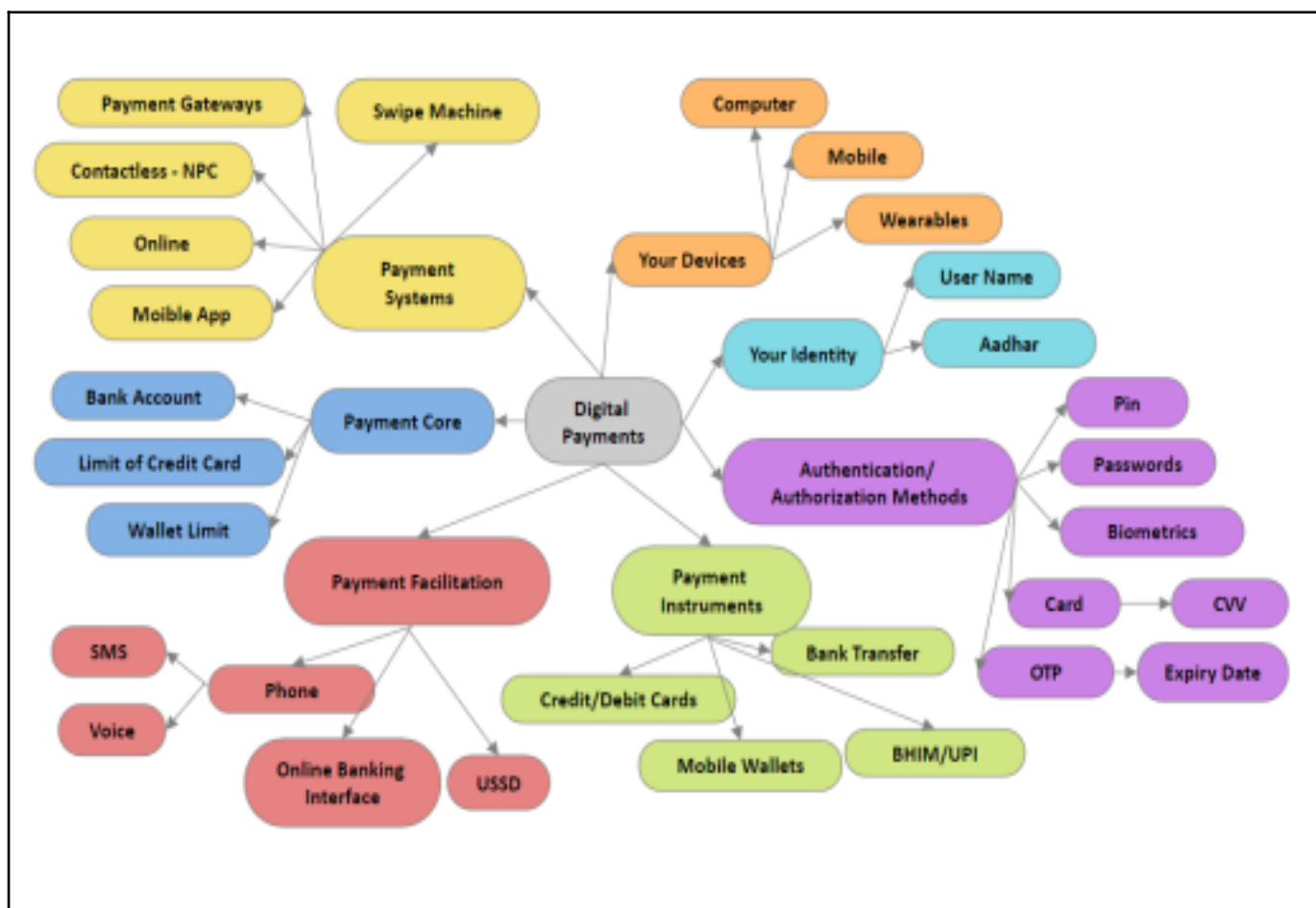


Figure 4: Indian Digital Payments Ecosystem

4.1 Current Government Policies in Place

India has been actively working on enhancing its cybersecurity framework, and several regulatory rules and guidelines are in place to address various aspects of cybersecurity. It's important to note that regulatory frameworks are subject to updates, amendments, and new introductions. Here is an overview of some key regulatory rules related to cybersecurity in India:

1. Information Technology (IT) Act, 2000: The Information Technology Act, 2000, is a

foundational legislation that legally recognizes electronic transactions and addresses cybersecurity concerns. It includes provisions related to unauthorized access, hacking, data protection, and penalties for cybercrime.

2. National Cyber Security Policy, 2013: The National Cyber Security Policy aims to create a secure and resilient cyberspace environment in India. It outlines strategies for enhancing the security posture of the country, including the protection of critical information infrastructure and the promotion of research and development in cybersecurity.
3. Data Protection Laws: India has been working on comprehensive data protection legislation, and the Personal Data Protection Bill, 2019, is under consideration. The bill outlines principles for the processing of personal data and includes provisions for the protection of sensitive personal data.
4. Reserve Bank of India (RBI) Guidelines: The RBI issues guidelines and circulars related to cybersecurity for banks and financial institutions. These guidelines cover areas such as cybersecurity risk management, cyber incident reporting, and the implementation of security measures for digital transactions.
5. Indian Computer Emergency Response Team (CERT-In): CERT-In, under the Ministry of Electronics and Information Technology, serves as the national nodal agency for responding to cybersecurity incidents. It issues advisories, alerts, and guidelines to enhance cybersecurity resilience across sectors.
6. Sector-Specific Regulations: Various sectors, such as telecommunications, energy, and healthcare, have specific regulations and guidelines addressing cybersecurity concerns. For example, the Telecom Regulatory Authority of India (TRAI) issues

recommendations on the security of telecommunication infrastructure.

7. National Cyber Coordination Centre (NCCC): The NCCC is responsible for providing real-time situational awareness and coordinating responses to cyber threats. It plays a crucial role in enhancing the overall cybersecurity posture of the nation.

4.2 Additional Methods to Secure Digital Transactions

In the dynamic realm of digital transactions, securing sensitive information is paramount. To fortify cybersecurity, organizations should adhere to key guidelines. Multi-factor authentication (MFA) adds an extra layer of security, deterring unauthorized access. Regular software updates patch known vulnerabilities, reducing the risk of exploitation. User education is crucial; comprehensive training on cybersecurity, recognizing phishing attempts, and maintaining strong passwords enhance the security posture. Encryption safeguards sensitive data during transmission and storage. Implementing secure network configurations and encrypted connections prevents unauthorized access. Proactive monitoring for anomalies detects potential threats. Regular security audits identify and address vulnerabilities. Ongoing user awareness programs cultivate a cybersecurity-conscious culture. An incident response plan is essential for effective security incident management. Collaboration with cybersecurity authorities and organizations ensures awareness of emerging threats. These guidelines collectively establish a resilient foundation for secure digital transactions in the ever-evolving digital landscape.

5 Conclusion

In summary, this paper has outlined security vulnerabilities in commonly used digital transaction methods in India. Despite challenges, it's crucial to recognize the significant benefits these methods offer. Digital transactions have revolutionized financial interactions, providing unparalleled convenience and accessibility. From the user-friendly UPI to the inclusive AePS, these methods extend banking services to remote areas. USSD-based payments cater to users without smartphones, while PoS systems streamline retail transactions. Internet Banking empowers individuals to manage finances remotely. Addressing security vulnerabilities requires ongoing improvement. Recommended measures, including Multi-Factor Authentication and regulatory compliance, strengthen these methods. Future efforts should focus on innovation, collaboration, and user awareness to foster a secure digital financial landscape. In essence, the advantages of digital transactions outweigh challenges. As we navigate this evolving landscape, collective efforts to address vulnerabilities will unlock the full potential, ensuring a secure, efficient, and inclusive financial future in India.

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