A Technical Seminar Report on

UPI NETWORK

In partial fulfilment of the requirement for the award of degree of

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By

KARNEKOTA UDAYKUMAR

HT.NO:21D41A0599

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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(An Autonomous Institution under UGC, accredited by NBA, Affiliated to JNTUH)

Sheriguda,Ibrahimpatnam

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CERTIFICATE

Certified that the Technical Seminar Work entitled " UPI Network " is a Bonafide work carried out by **KARNEKOTA UDAYKUMAR(21D41A0599)** in partial fulfilment for the award   of **BACHELOR OF TECHNOLOGY** in **COMPUTER SCIENCE AND TECHNOLOGY** Of SICET, Hyderabad for the academic year 2024-2025. The Technical seminar report   has   been approved as it satisfies academic requirements in respect of the work prescribed for   the   **IV YEAR, I-SEMESTER** of **B.TECH** course.

STAFF MEMBER IN-CHARGE   **HOD**

Prof..CH. G. V. N. PRASAD

ABSTRACT

The Unified Payments Interface (UPI) has revolutionized the landscape of digital transactions in India. Launched by the National Payments Corporation of India (NPCI) in April 2016, UPI enables seamless, instant transfer of funds between bank accounts via a mobile platform. Unlike traditional banking methods, UPI does not require details such as the recipient's bank account number or IFSC code. Instead, it operates using a Virtual Payment Address (VPA), which simplifies the process and enhances security. The adoption of UPI has seen exponential growth, with millions of transactions being processed daily, owing to its convenience, interoperability, and robust security features. One of the standout features of UPI is its ability to integrate multiple bank accounts into a single mobile application, facilitating real-time fund transfers and payments. The system's architecture supports peer-topeer (P2P) as well as peerto-merchant (P2M) transactions, making it a versatile tool for both personal and business use. Moreover, UPI's interoperability allows different banks to communicate and perform transactions seamlessly, which has been a significant driver in its widespread acceptance. Security is a cornerstone of UPI, employing two-factor authentication and end-to-end encryption to protect user data and transactions. The impact of UPI on the Indian economy is profound, promoting financial inclusion by making banking services accessible to the unbanked and underbanked populations. It has also played a critical role in the government's push towards a cashless economy, reducing the reliance on physical currency and enhancing transparency in financial transactions. The introduction of UPI 2.0 has further expanded its capabilities, including features like overdraft accounts, one-time mandates, and invoice-in-theinbox, which cater to a broader range of financial needs.

ACKNOWLEDGMENT

With great pleasure I want to take this opportunity to express our heartfelt gratitude to all the people who helped in making this seminar a success. I thank the almighty for giving us the courage & perseverance in completing the seminar. Iam highly indebted to, Prof.CH.GVN.PRASAD, Head of the Department of Computer Science & Engineering, for providing valuable guidance at every stage of this seminar. I would like to thank the Teaching & Non-Teaching staff of Department of Computer Science & Engineering for sharing their knowledge with me. Last but not the least I express my sincere thanks to everyone who helped directly or indirectly for the presentation of this seminar.

K.Udaykumar,

21D41A0599.

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1.INTRUDUCTION

UPI, short for Unified Payments Interface, is a game-changer technology that works through a UPI-enabled smartphone application for real time digital payments, allowing you to send and receive money, make instant bill payments, and authorise transactions on a single application in a single step.

Users can check account balances, manage multiple bank accounts and transact through multiple payment methods without the need to carry debit or credit cards, hence simplifying the payment experience end-to-end. In a departure from conventional methods like NEFT or RTGS, UPI has streamlined the payments ecosystem, removing the constraints of time for both individuals and businesses.

UPI works on a highly secure, layered architecture with multiple levels of encryption, ensuring the confidentiality and integrity of data during transactions.

For sending and receiving money, UPI relies on the PUSH and PULL mechanism respectively.

To send money, the users use a UPI-enabled app and select the Pay or Send option. After providing the recipient's details such as UPI ID or mobile number, and the desired amount, they select the bank account or wallet from which the money is to be debited. Finally, they enter the UPI pin to confirm the transfer, post which the transaction request is forwarded to their chosen PSP.

To receive money, the recipients log into the UPI-enabled app and select the collector request money option. After providing the payer's Virtual Payment Address (VPA) and the desired amount, they select their bank account in which the money is to be credited. A money request message goes to the payer, post which they enter the UPI PIN to authorize the transaction request.

2.UNIFIED PAYMENTS INTERFACE (UPI):

The Unified Payments Interface is an architecture built with the motivation to become a less cash society and improve the participation of people into a financial society which has a majority in electronic payments. As of November 2017, the number of mobile phones in the country has almost equalled the population of the country, a staggering statistic. As of 2016, the total number of smartphones in the country is 251.79 million, which is expected to reach 340 million by the end of 2018. Thus it can be said that on an average, every person has a mobile phone and every household has one smartphone. It is a brain child of the National Payments Corporation of India (NPCI).
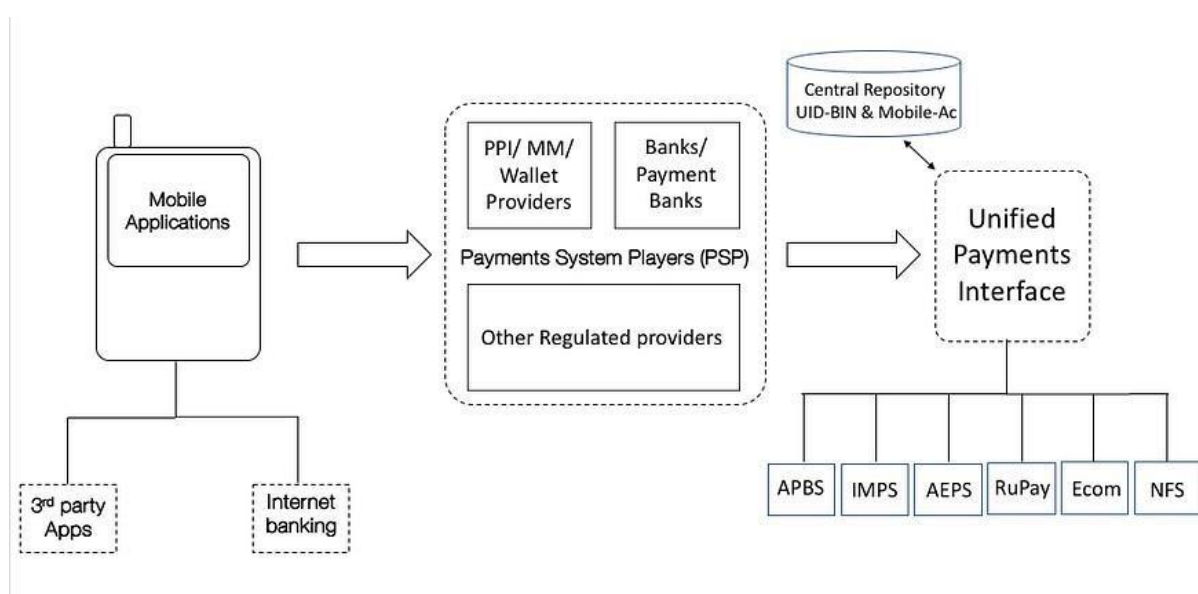

FIG. 1. UPI Architecture

The UPI is a system developed primarily for mobile phone users, migrating the bank onto the screens of your mobile. The main reason for the development of UPI was the financial inclusion of the people of this country. If transactions can be made quick and effortless, with the 1-click 2-Factor authentication, then more and more people will use such a simple interface. The key features of UPI are the following:

- All payments can be made using a mobile phone which include person to person, person to merchant and merchant to person transactions.

- Payments can be made using a 1-click 2-factor authentication with the two factors being the mobile number and a PIN/Biometrics.

- The Push-Pull feature enables a person/merchant to pay as well as request and collect payment.

- The unification of Aadhar Card, Bank Account Number, Mobile Number and E-mail ID into one virtual alias for one or multiple bank accounts. This alias helps protect the Bank account details and other details during third party transactions.

- The Collect feature helps set a date for payment, without blocking the amount of money to be paid till that date. It acts like the snooze button for your alarm, which wakes you up after a snooze time without blocking your sleep.

- The UPI interface helps banks and other applications use a standard set of APIs to build a payments app.

The UPI uses existing payment systems like the Immediate Payment Services (IMPS), Aadhar Enabled Payments Service(AEPS) etc, to ensure the integrity of the transactions. These payment systems are integrated by using a common Interface, which is the UPI. This interface offers instant payment using the mobile phone, which is a Value-Added Service.

2.1. Source and Recipient:

For a transaction to take place, the account details of the payer and payee are required to authenticate, initiate and complete the transaction. A Payment System Player (PSP) converts these details into a virtual address which can be used to route the money from one account to the other. APIs are provided with a translator by the PSPs to understand these Virtual Addresses and convert them into Bank Account details.

2.2. Authentication of the transaction:

The 2-factor authentication scheme is heavily used by major banking institutions and applications to regulate transactions. Of the two authentications, one is done by the PSPs, who check for the usage of correct mobile phone as the most common method of authentication. The second authentication is done by financial institutions like banks who are the payment account providers. The use of Aadhar Number for authentication, with the help of the UIDAI, is the most dormant mechanism.

With the PSP authentication not requiring the intervention of the mobile phone user, this authentication came to be known as the 1-click 2-factor authentication, with the banking institutes asking for a M-PIN or OTP to be entered as a means for verification.

Users can check account balances, manage multiple bank accounts and transact through multiple payment methods without the need to carry debit or credit cards, hence simplifying the payment experience end-to-end. In a departure from conventional methods like NEFT or RTGS, UPI has streamlined the payments ecosystem, removing the constraints of time for both individuals and businesses.

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- **What is Unified Payments Interface (UPI)?**

Unified Payments Interface (UPI) is a real-time payment system in India that enables seamless money transfers from one bank account to another instantly and free of charge through a mobile device.

Users can transfer money to each other with the help of a unique UPI ID or a Virtual Payment Address (VPA). Users can also transfer money by selecting receiver's contact from their phone book or entering the receiver's contact number.

UPI streamlines the process of transferring funds between individuals and businesses, enabling individuals to make online purchases, pay utility bills, and shop at brick-and-mortar stores through QR codes, VPAs, or UPI registered mobile numbers. ***Related Read:*** *What is UPI Lite? How Does it Work, and its Benefits*

How Unified Payments Interface (UPI) Works?

Unified Payments Interface (UPI) brings together multiple bank accounts into a single UPI enabled mobile application, merging a range of features from any participating bank, thereby enabling seamless fund transfers for customers and merchants.

For sending and receiving money, UPI relies on the **PUSH and PULL mechanism** respectively.

To send money, the users use a UPI-enabled app and select the Pay or Send option. After providing the recipient's details such as UPI ID or mobile number, and the desired amount, they select the bank account or wallet from which the money is to be debited. Finally, they enter the UPI pin to confirm the transfer, post which the transaction request is forwarded to their chosen PSP.

To receive money, the recipients log into the UPI-enabled app and select the collect or request money option. After providing the payer's Virtual Payment Address (VPA) and the desired amount, they select their bank account in which the money is to be credited. A money request message goes to the payer, post which they enter the UPI PIN to authorize the transaction request.

Understand the UPI transaction flow in detail further in the article.

3.UPI Transaction Flow

## 3.1. PUSH: Streamlined Payment Initiation and Authorisation

Push transactions in UPI refer to the process of initiating a payment from the sender's end to transfer money to a recipient. This method is commonly used when customers need to pay for goods, services, bills, or send money to friends and family.

Phase 1: Transaction Initiation and Authorisation

1. Customers use their UPI-enabled apps to initiate transactions, providing recipient details, amount, and an optional note.

2. The customer's app forwards the transaction request to their chosen PSP. The PSP acts as an intermediary in the transaction process.

3. The PSP routes the request to the NPCI, which oversees UPI transactions.

4. The issuing bank, or the sender's bank, verifies the transaction's authenticity, balance, and customer credentials.

5. Once verified, the issuing bank authorises the transaction and generates a digital signature to ensure security.

Phase 2: Verification and Fund Transfer

1. The PSP shares the sender's bank details with the **UPI system** for verification and routing.

2. The NPCI checks the sender's account details, account balance, and fund availability.

3. If funds are available, the NPCI triggers the funds' deduction from the sender's account.

4. The acquiring bank, or receiver's bank, receives the transaction amount and credits it to the payee's account.

5. The UPI server sends a response to the customer's app, confirming the successful transaction and providing a reference ID.

UPI – Intent
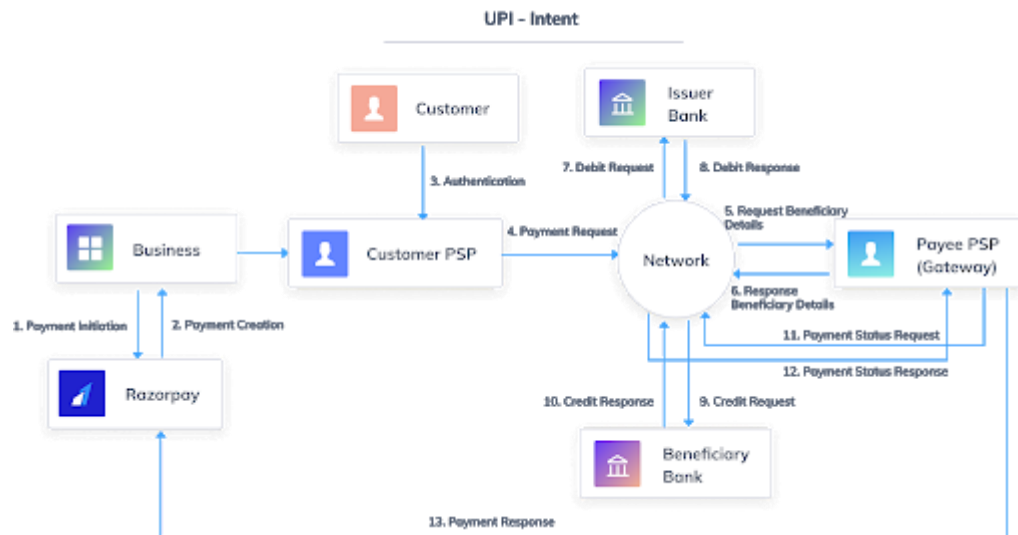
3.2. PULL: Controlled Payment Requests and Execution

Pull transactions involve the recipient initiating a request for funds from the sender. This method is often used for bill payments, collecting payments from customers, or receiving money from friends and family. The recipient generates a payment request, and the sender can then approve and execute the payment.

In the PULL method, transaction initiation and execution are controlled by the recipient, ensuring secure and authorised fund retrieval.

Phase 1: Transaction Initiation and Payment Message Flow

1. **Recipient Initiation:** The recipient generates a payment request with the required details through their UPI-enabled app.

2. **Payment Message Flow:** The payment request flows through the recipient's app to the NPCI, signalling the intention to pull funds from the payer.

Phase 2: Transaction Flow between Banks

1. The payment request reaches the creditor's bank, which forwards it to the debtor's bank through the NPCI.

2. A merchant generates a payment request for a customer's bill. The merchant's bank sends the request to the customer's bank (debtor's bank) through the NPCI.

3. The debtor's bank verifies the request and checks the customer's account details and available balance.

4. If the customer's account has sufficient funds, the debtor's bank approves the transaction and confirms it with the NPCI.

5. The debtor's bank transfers the requested amount to the creditor's bank, completing the transaction.

List of major UPI apps and their respective sponsor banks:

UPI App/PSPs	Sponsor Banks	Handles
	Axis	@okaxis
	ICICI	@okicici
	HDFC	@okhdfcbank
Google Pay	SBI	@oksbi
Phonepe	@ybl	Yes

4.National Payments Corporation of India (NPCI):

NPCI is the central governmental organization which regulates all retail payments and settlement systems in the country. Set up by the Reserve Bank of India RBI) and Indian Banks Association(IBA), the NPCI was created to handle the process and issues related to payments in India. It is a Not-for-Profit company which provides guidelines for all the banking and financial institutions of the country.NPCI is owned by ten major banking institutions of the country and is backed by the RBI.

The NPCI is responsible for the development of the Unified Payments System (UPI) which has thrust its drive to move towards a cashless economy closer to reality. It is also responsible for developing a network of domestic card payment called RuPay. Along with RuPay, NPCI has also developed the Kisan Card, which is now being offered by 43 banks.

4.1. Payment System Player:

Payment System Player, or PSP, is a middle man who offers a merchant the ability to accept payments via multiple payment methods. A PSP partners with banks and other financial institutions like e-wallets, adds the capability to accept payments from these organization and offers this service to merchants.

A PSP supports multiple payment methods, relieving the merchant from the hassle of setting up multiple payment methods for the numerous payment methods available. Not only multiple payment methods, a PSP supports multiple currencies as welt establish a global payment network.

From the perspective of UPI, the PSP is a company or entity which provides payment solutions to the banks and the customers. PSPs are the mobile application developers who build their application on the Unified Payments Interface and acquire customer for this application. They link their bank accounts and accept a variety of payment methods for the transactions. Sometimes, banks themselves have a PSP department which handles the payments for them.

4.2. Protocol for a successful transaction

1. Transaction initiation using the PSP device by the payer.

2. Device authentication using the mobile number.

3. A Pay request is initiated to the PSP system of the Payer.

4. First factor authentication done by the Payer PSP system.

5. NPCI receives a Payment request from the Payer PSP system.

6. The Payee address is received by the NPCI.

7. A request is sent to the account of the payer to debit the money.

8. The financial institute authenticates the bank account details of the payer by matching it with the virtual address provided.

9. The money is deducted from the Payers account.

10. The financial institution sends a confirmation of Debit to the NPCI.

11. NPCI sends a request to credit the debited amount from the Payers address to the Payees address.

12. The financial institution in which Payees account exist credits the account with the money.

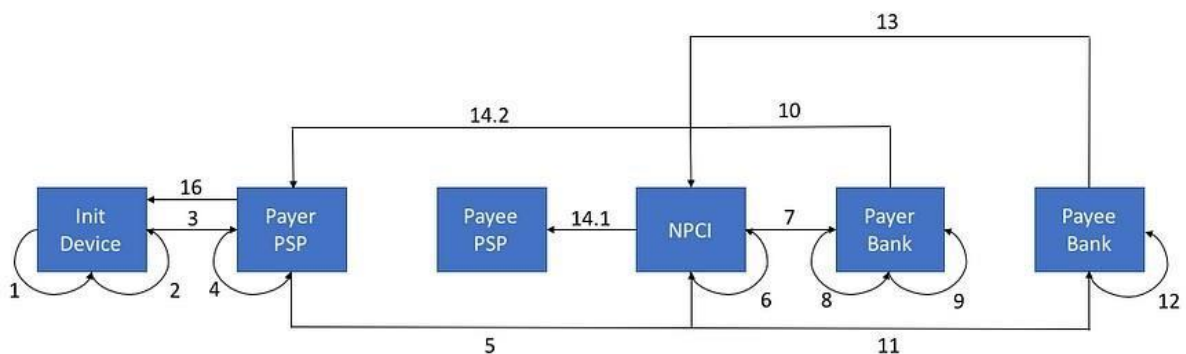13. The financial institution sends a confirmation of credit to the NPCI.

FIG. 2. Process Map for a successful Transaction.

4.3. Protocol to send a Collect request:

1. Collect request initiated using the PSP device by the payee.

2. Collect request is sent to the PSP system of the Payee.

3. First factor Authentication done by the Payee PSP system.

4. NPCI receives Collect request from Payees PSP system.

5. The Payers address is received by the NPCI.

6. A request is sent to the Payers account to debit the money.

7. The financial institute authenticates the bank account details of the payer by matching it with the virtual address provided.

8. The money is deducted from the Payers account.

9. The financial institution sends a confirmation of Debit to the NPCI.

10. NPCI sends a request to credit the debited amount from the Payers address to the Payees address.

11. The financial institution in which Payees account exist credits the account with the money.

12. The financial institution sends a confirmation of credit to the NPCI.

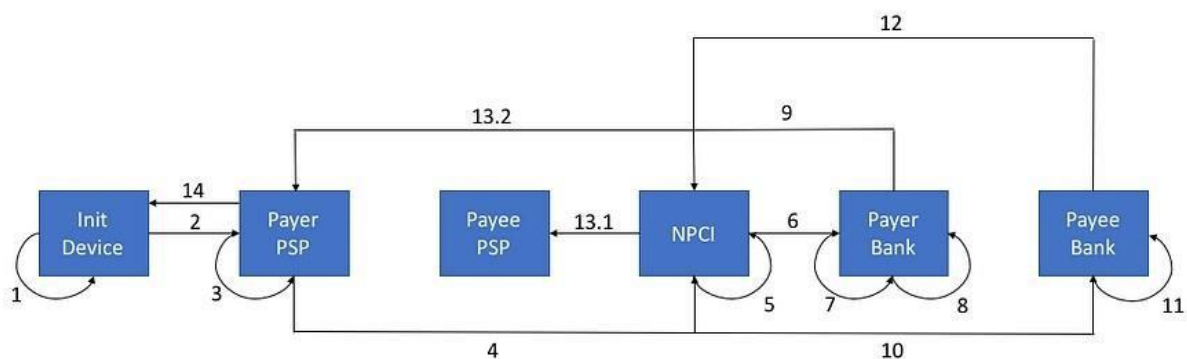13. NPCI sends Pay response to both the Payee and Payers PSP.

FIG. 3. Process Map for a successful Transaction.

5. CONCLUSION

We have proposed Graphical passwords a new security primitive relying on unsolved hard Al problems. The notion of this scheme introduces a new family of graphical passwords, which adopts a new approach to counter online guessing attacks: a new image, which is also a password challenge, is used for every login attempt to make trials of an   online

guessing   attack computationally   independent of   each   other. A password can be found only probabilistically by automatic online guessing attacks including brute-force attacks, a desired security property that other text password schemes lack. Hotspots in images can no longer be exploited to mount automatic online guessing attacks, an inherent vulnerability in many graphical password systems. Graphical password forces adversaries to resort to significantly less efficient and much more costly human based attacks. In addition to offering protection from online guessing attacks.

Graphical password is also resistant to Captcha relay attacks, and, if combined with dual-view technologies, shoulder-surfing attacks. Graphical password can also help reduce spam emails sent from a Web email service.

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