CS431 – Mobile Computing and Application Development

Topic 3:   Mobile Payments

Agenda

- What is a m-Payment?
- Overview of m-Payments
- Importance of Mobile Payments
- M-Payments and m-Banking
- e-Wallets and m-Wallets
- Models of mobile payments
- Mobile payments technologies
- Case studies
- Issues and challenges

Current Generation

Mobile Banking Apps

- Banking transactions using a phone
  - View account balances
  - Transfer money
- Web applications designed to be viewed within the mobile browser
  - Or a WebView inside a native mobile app

Mobile Banking Apps

- Back-end components are the same as for desktop online banking
- Similar vulnerabilities
- But with mobile, must also consider device theft
  - Sensitive information may be stored on the device improperly
  - **Not using a password**

What is a m-Payment?

According to Gartner [1]:

Gartner IT Glossary > Mobile Payment

Mobile Payment

Gartner defines **mobile payment** as transactions conducted using a mobile phone and payment instruments that include:

- Banking instruments such as cash, bank account or debit/credit card, and
- Stored value accounts (SVAs) such as transport card, gift card, Paypal or mobile wallet

and exclude transactions that use:

- Carrier billing using the telecom's billing system with no integration of the bank's payment infrastructure, or
- Telebanking by using the mobile phone to call the service center via an interactive voice response (IVR) system. However, IVR used in combination with other mobile channels such as Short Message Service (SMS) or Unstructured Structured Service Data (USSD) is included.

Be carful about this one, it is not necessarily to be a phone.
It could be other mobile device like tablet or notebook for instance!

What is a m-Payment?

A payment transaction that involves the use of a mobile device, including mobile phones PDAs or any other handheld device.

- In 1997, Finnish people were able to pay for soft drinks in vending machines via SMS. Thanks to Nokia!

- In 1997 also, Merita Bank (in Finland!) introduced the first mobile-phone-based banking service via SMS [2].

Overview of m-Payments

- Mobile payments usually involve at least three parties:
  a <u>mobile user</u>, a <u>merchant</u>, and a <u>financial institution</u>.

  The place we are buying from

- Sometime a trusted third party (TTP) is involved to authenticate and authorize users to secure a payment transaction.

- There are two types of electronic payments in general:
  1. **Pre-Paid** where a certain amount of money is taken away from the customer before a payment is made.
  2. **Real-time** where a customer's account is involved in each payment transaction.

Importance of Mobile Payments

- A number of benefits to consumers, retailers, manufacturers, financial institutions and indeed to network operators All parties will get the money immediately

- A key facilitator for many m-commerce services that can improve user acceptance of these services

- "Mobile payments users should exceed 190 million users In 2012" [3].

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In 2015, and according to Gartner:

"By 2018, <u>50% of consumers</u> in mature markets will use smartphones or wearables for mobile payments" [4].
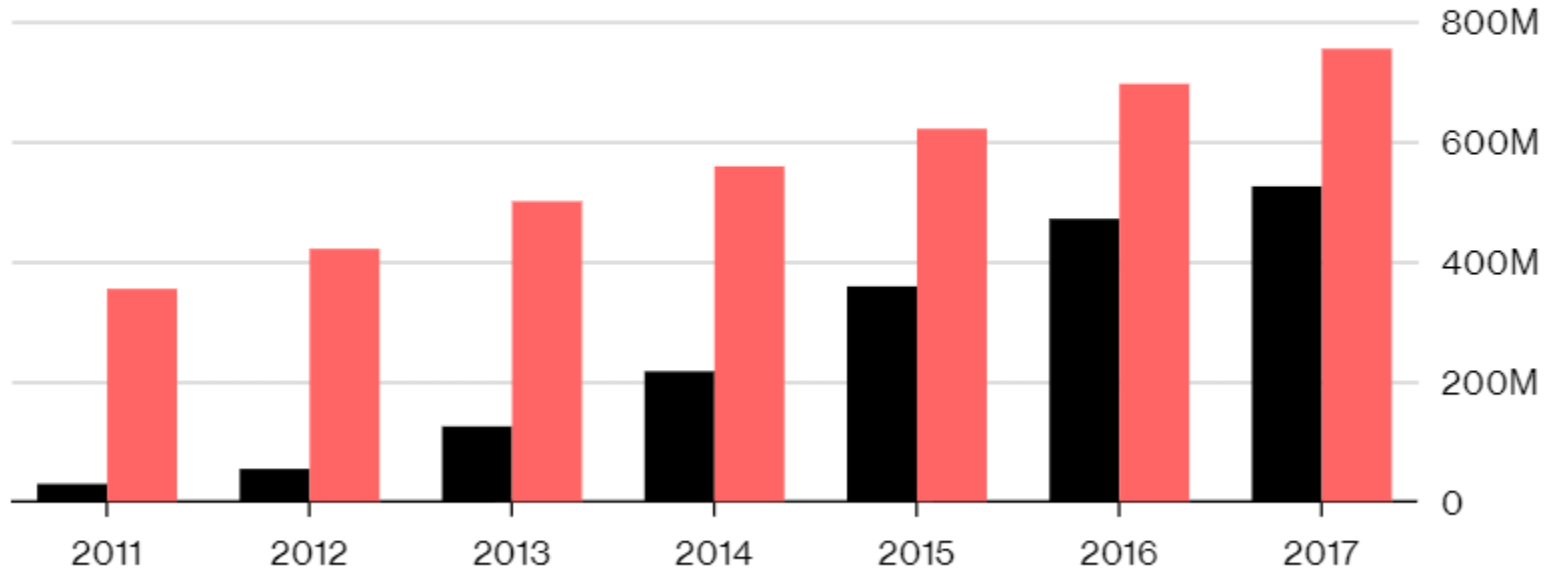
According to Bloomberg [5]:

China's Mobile Leap

Alipay and WeChat Pay caught on rapidly among Chinese smart-phone users

■ Mobile payment users ■ Mobile internet users

Source: China Internet Network Information Center

According to Mobile transaction:

"statistics show that a third of UK consumers are now using their NFC-enabled phones for contactless payments in stores. Apple Pay, with their 'limitless' transactions, has even caused a 11% increase in the average mobile transaction total in the last half of 2017, as more and more people feel secure using their smartphones for point-of-sale transactions." [6]

m-Payments and m-Banking

Are they the same?

No. They are different.

Mobile Banking

Access to banking services via a mobile device.

Mobile Payments

Transactions involving transfer of funds to pay for goods or services via a mobile device.

They are also different in user experience and business model [7]

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What E-Wallets Are

- An Electronic Wallet is any device or software which allows a user to store, manipulate, and pay with various types of payment instruments such as electronic cash and credit cards.

- They make it unnecessary to retype credit card numbers and addresses each time a purchase is made.

- E-Wallets are software programs that run on a user's personal computer.

E- Wallet

- Today, It integrated into a variety of devices, such as cell phones and PDAs.

- A digital wallet (or e-wallet) is a software-based system that securely stores users' payment information and passwords for numerous payment methods and websites.

E-Wallets

E-Wallets in KSA

1. STC Pay
2. UrPay
3. Mobily Pay
4. Alinma Pay
5. Friendi Pay
6. Liv. KSA
7. Meem

Type of E-Wallet

- **Closed Wallet :**
    - A closed wallet is made to be used only for the purchases in that company.
    - You cannot withdraw the money you've topped up, but the value will not expire.
    - Usually closed wallets give loyalty rewards and discounts coupons that can be claimed and used through their platform.
- **Open Wallet :**
    - Open wallet enable purchase from any merchants that accepts cards.
    - With open wallets you can withdraw from ATMs

e-Wallets and m-Wallets

e-Wallet

- Banks and card organizations (e.g. Visa, MasterCard) introduced the first e-Wallet (AKA digital wallet and virtual wallet).

  The outcome ➔ low level of adoption

- Hi-Tech companies attempted to compete by offering to store the credit card details (who remembers *Microsoft Wallet*?)

  The outcome ➔low level of adoption (again!)

- Third parities companies offered wallets and keeping these sensitive information (i.e. card details) on the user's hard drive

  The outcome ➔ no better luck :< Low level of adoption!

Guess why? | One of the main reasons is that many Internet users were not convinced that it is "need-to-have"!

e-Wallets and m-Wallets – Cont.

m-Wallet

- Mobile wallets have the potential to achieve a better adoption level!!

Why?

Many mobile users might consider these wallets as "need-to-have".

But why?

- Who wants for instance to enter his/her credit card details in every transaction via typical mobile phones with small screen and tiny keypad?

- Think about urgent purchases at emergency situations, or see next slide!

Mobile Wallet

- The mobile wallet is an app that can be installed on a smartphone or it is an existing built-in feature of a smartphone.

- A mobile wallet stores credit card, debit card, coupons, or reward cards information.

- Once the app is installed and the user inputs payment information, the wallet stores this information by linking a personal identification format such as a number or key, QR code or an image of the owner to each card that is stored.

e-Wallets and m-Wallets – Cont.

Imagine you want to pay the parking fees but you don't have enough coins!

and you don't have enough credit on your mobile phone to make a call and pay over the phone!

e-Wallet and m-Wallet – Cont.

How about this:

"Drivers can pay parking fees via mobile phone and extend their parking time via SMS while they shop." [8]

Even better:

Scanning the phone in front of ticket machines!

Your turn….!

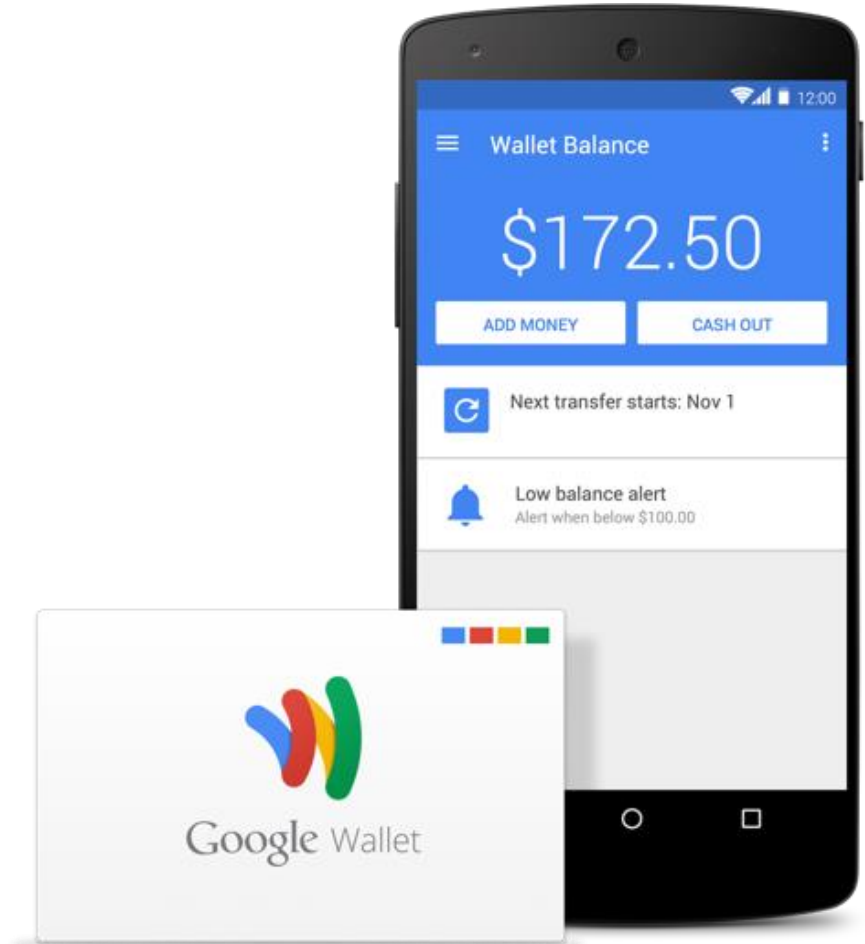**Identify what is the difference between *Microsoft Wallet* and *Google Wallet* , and investigate where are m-Wallets now…………………………….**

Class activity:
Search and discuss in 10 minutes (max!)

Contactless Payment Google Wallet

- Started in 2011
- Supports all major credit cards
- Card # stored in the cloud
- A virtual account number is sent to the contactless POS terminal via NFC

Android Pay

- Google's new payment system

- Will let developers use it in various ways through an API

- "will tokenize card numbers, in the same way that Apple Pay and Samsung Pay do, meaning it generates a one-time payment token...for each transaction"

- No timeline for release yet, more info. expected at Google I/O

Apple Pay

- Released on Oct 20, 2014
- With iPhone 6 and Apple Watch
- Customer payment information is kept from retailer
- creates a "dynamic security code [...] generated for each transaction"

Samsung Pay

- To be available in summer 2015
- Only on Samsung Galaxy S6
- Works with NFC or magstripe readers
  - 90% of merchants

Samsung Pay

Apple Pay vs. Google Pay vs. Samsung Pay: Mobile payments compared

MOBILE PAYMENTS COMPARISON

	Samsung Pay	Apple Pay	Google Pay
Compatible devices	Samsung Galaxy phones since the Galaxy Note 5, Gear Watch and Gear Watch Active, Gear S2 and S3	Apple iPhones since the SE, Apple Watch, MacBook Pro with TouchID, iPads since 5th generation, iPad Pro and iPad Mini	Android phones with NFC and HCE support running KitKat (4.4) or higher
Availability (see note below)	24 countries worldwide	41 countries worldwide	29 countries worldwide
Authentication	Fingerprint, PIN or iris	FaceID or fingerprint	Fingerprint, PIN, pattern or password
Where can you use?	Works with NFC, magnetic stripe or EMV terminals, in-app purchases	Works with NFC terminals, in-app purchases and web purchases in Safari	Works with NFC terminals, in-app and web purchases
Cards	Credit, debit, loyalty and gift cards	Credit, debit and loyalty cards	Credit, debit, loyalty and gift cards
Which banks?	Wide variety of banks: full list here; PayPal	Wide variety of banks: full list here	Wide variety of banks: full list here; PayPal

Models of Mobile Payments

There primary models for mobile payments include:

- Payments via SMS

- Payments via mobile web

- Contactless technologies based payments ✓ The trend

- Direct Mobile Billing ✖ (According to Gartner)

The Trend….

iPhone uses fingerprint recognition to finalise each Apple Pay payment

Contactless Technologies

- In addition to mobile broadband and SMS technologies, contactless technologies (e.g. RFID, Sony's Felica technology [9] and NFC) are key technologies for mobile payments.

- Contactless technologies can be divided into two categories with respect to reading distance:
  - **Vicinity** – reading distance is 1 - 1.5 <u>meters</u>.
  - **Proximity** –reading distance is usually 7.5 <u>centimeters.</u>

- Examples for contactless technologies include:
  - **RFID** – Radio Frequency Identification
  - **NFC**– Near Field Communication

Contactless Technologies - Cont.

- **RFID** communication standard is an application of contactless technology with both types. However, it is a one way (code to reader) communication standard.

- **NFC** or Near Field Communication is a two way contactless communication standard. It is the European equivalent of Sony's Felica technology [11], which is based on RFID. Felica was introduced in July 2004!

  NFC is often compared to **Bluetooth**, however NFC can be used even if the device is switched off!

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RFID Examples

NFC Examples

NFC

- When a user makes a payment to a merchant, the mobile app uses a technology called near-field communication (NFC), which uses radio frequencies to communicate between devices.

- NFC uses the personal identification format created for the user to communicate the payment information to the merchant's POS (point-of-service) terminal.

- The information transfer is usually triggered when the user waves or holds an NFC-enabled mobile device over the store's NFC reader

Contactless Technologies - Cont.

NFC Forum adds support for Type V tags

By Sarah Clark ✉ • 17 June 2015, 15:39

The **NFC Forum** has released a new candidate specification that extends the functionality of NFC devices to include formal support for a new category of NFC tag. NCI 2.0 also enables tag data stored on an NFC device, such as an airline boarding pass, to be read even when a passenger's smartphone is switched off.

Source: http://www.nfcworld.com/2015/06/17/336050/nfc-forum-adds-support-for-type-v-tags/

Case Studies for Mobile Contactless Technologies

Case study 1: Sony's Felica

A smart card that has many uses including e-money.
For instance: For student identification:

"Finland: Student ID Card
In Finland, 20 universities and colleges adopted
FeliCa-based student ID cards with an e-money
function that can be used for access control and
cashless payments at campus cafeterias." [12]

In July 2004, NTT DoCoMo releases second mobile phone (mova P506iC)
equipped with the Sony FeliCa chip!!

Read the following article:
"*Mobile FeliCa, 5 years of mobile contactless business in Japan*" [13]

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Case Study 2: VeriFone Mobile Wallets (NFC-Based)

According to VeriFone:

> " Jupiter Research has also projected that NFC Mobile Payments will exceed $30 Billion by 2012." - September 2009

> " Yankee Group predicts the value of NFC-based transactions is likely to increase from USD 27 million in 2010 to USD 40 billion in 2014."

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Another Case Study..

Google Wallet Vulnerabilities

PIN Storage Vulnerability

- PIN entry required for transactions
- Only six tries permitted
- But an attacker who steals a device and then roots it can extract the PIN from the salted hash
  - Because it's not stored on the SE
  - Storing it on the SE would make banks liable for breaches due to stolen PINs
  - Links Ch 9s, 9t

Google's Response

- Don't run Google Wallet on rooted phones
    - Not very reassuring since the thief can root your phone
- Much better to perform PIN storage and verification on the SE
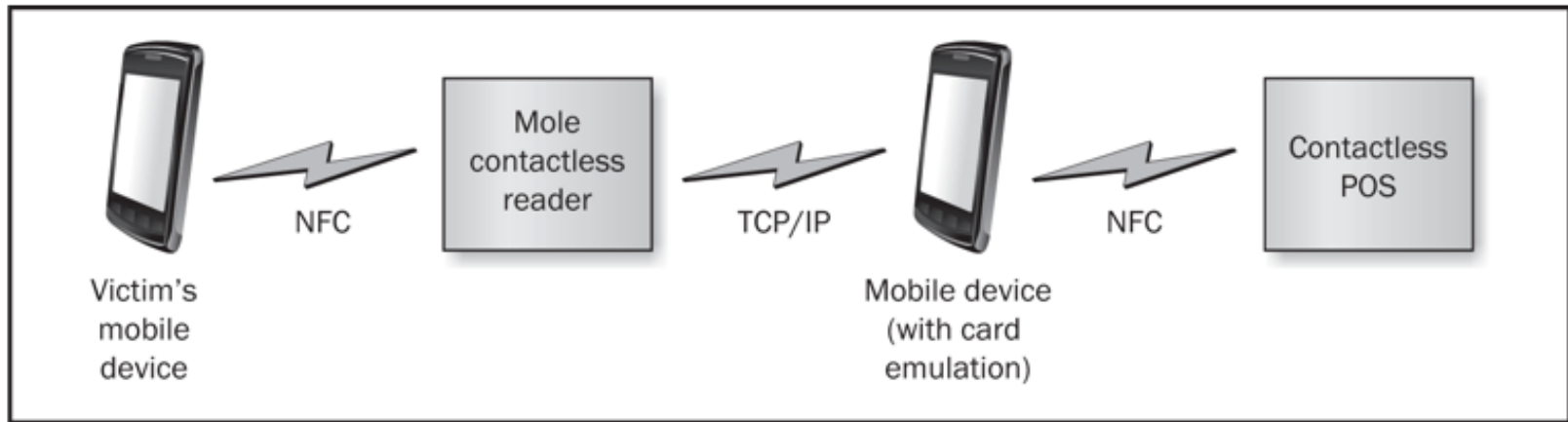   - Also store the PIN try counter on the SE

Countermeasures for Google Wallet Cracker

- Don't root your device
- Enable Android lock screen
- Disable ADB debugging
- Keep up-to-date with patches

Relay Attacks (MITM)

Figure 9-5 A relay attack against a NFC-based mobile payments application

- "Mole" reader gets close to target mobile device
- Attacker's mobile gets near POS terminal
- APDUs are passed via TCP/IP

Relay Attack Limitations

- Target's mobile payment app must be unlocked
- Google Wallet requires entry of a PIN to unlock

Issues and Challenges…

- **Security challenges:** as in other mechanisms, mobile payments have to be secure and traceable. This include securing the customer information and also securing the payment details.

- **Potential solutions:**

  - Biometric-enabled payment system

  - Login Features (user name and password)

  - Require a user PIN per transaction

Issues and Challenges – Cont.

- The diversity of mobile devices and platforms.

- Customers should be given payment options (e.g. Credit Card, Debit Card, … etc.)

- Usability, functionality, reliability,…… you name it!

- Lack of participation by merchants is a big challenge (catch-22!)

In this lecture we have discussed:

- What is a m-Payment?

- Importance of mobile payments

- The difference between m-Payments and m-Banking

- e-Wallets and m-Wallets

- Models of mobile payments

- Relevant technologies

- Case studies

- Some of the Issues and challenges

References And Additional Resources

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[2] Neal Leavitt, 2010, "Payment Applications Make E-Commerce Mobile", IEEE.

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Questions?