

## *Lecture 5*

### Application Domains II: M-Payment I

Mobile Business II (SS 2015)

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- Introduction
- Overview of M-Payment Solutions
- Technologies & Systems
- Conclusion

- Mobile Payment is that type of payment transaction processing in the course of which - within an electronic procedure - (at least) the payer employs **mobile communication techniques** in conjunction with **mobile devices** for **initiation, authorization or realization** of payment.

## Online Scenarios

### E-Commerce

- Using a traditional computer to purchase goods, services and information on the Internet.
- The mobile device is only used for the payment transaction

### M-Commerce

- Using a mobile device for both, the purchase of goods, services and information on the Internet, and the payment transaction
- Including mobile applications and mobile services, e.g. context-sensitive information

## Stationary Merchant Scenarios

### In person

- Traditional trade using transactions between a customer and cashier

### Vending Machine

- Traditional trade using transactions between a customer and vending machine

## C2C

### Money transfer

- Transferring money between persons

## Mobile Wallet

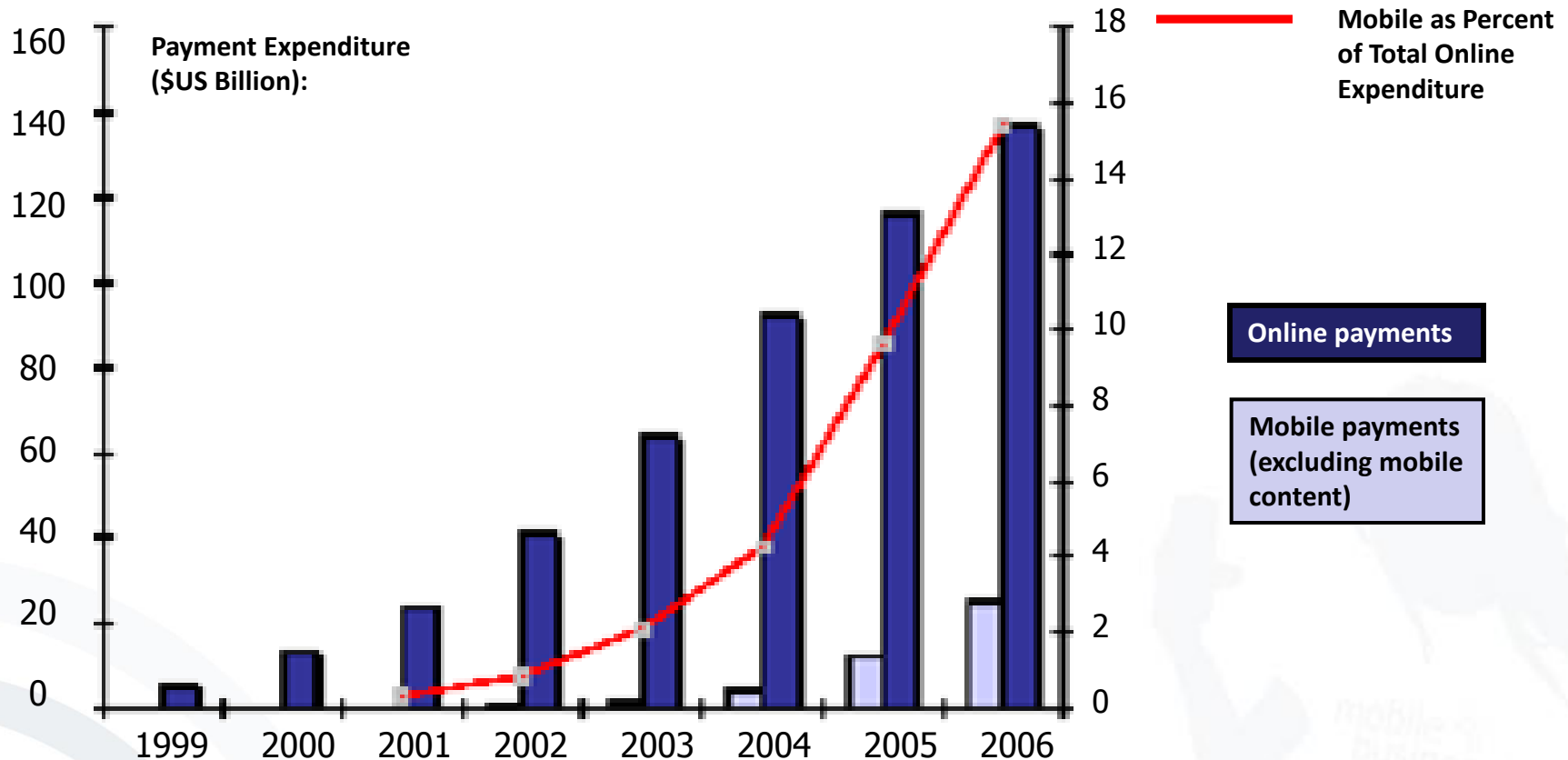
- Mobile wallets can be used for payments on the Internet, payments at the point of sale and for money transfers. In addition, they can include services such as couponing and ticketing.

- Frequently stated advantages for
  - ***Operator***: Improved customer churn rate
  - ***Financial Institutions***: New cash-flows, Cross-Selling
  - ***Customers***: Independence from place and time, convenience, security
  - ***Trade***: Electronic customer analysis (CRM) & decrease of transaction costs

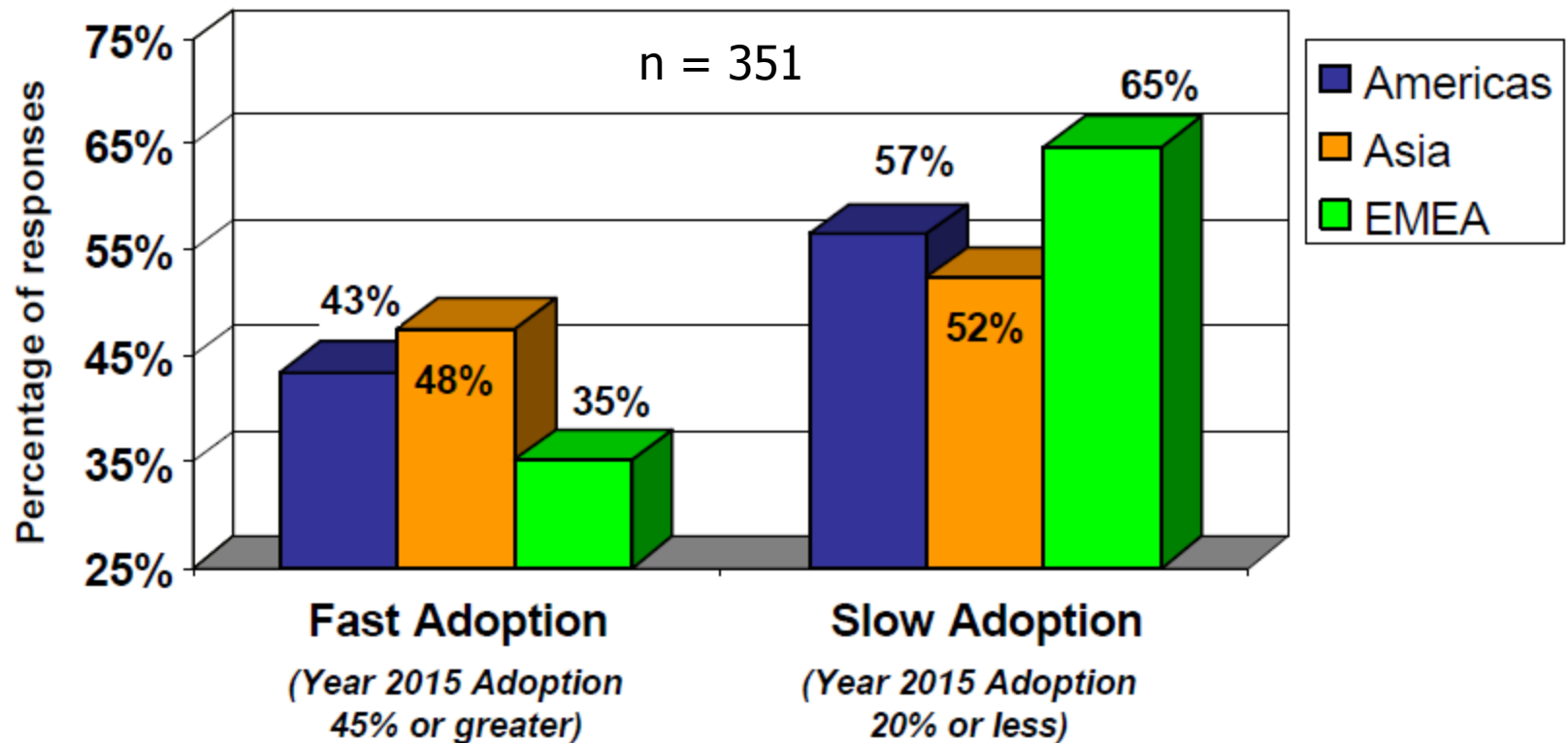
# consequently...

# Studies on M-Payment | 1

Statistics 1999-2002 and predictions 2002-2006



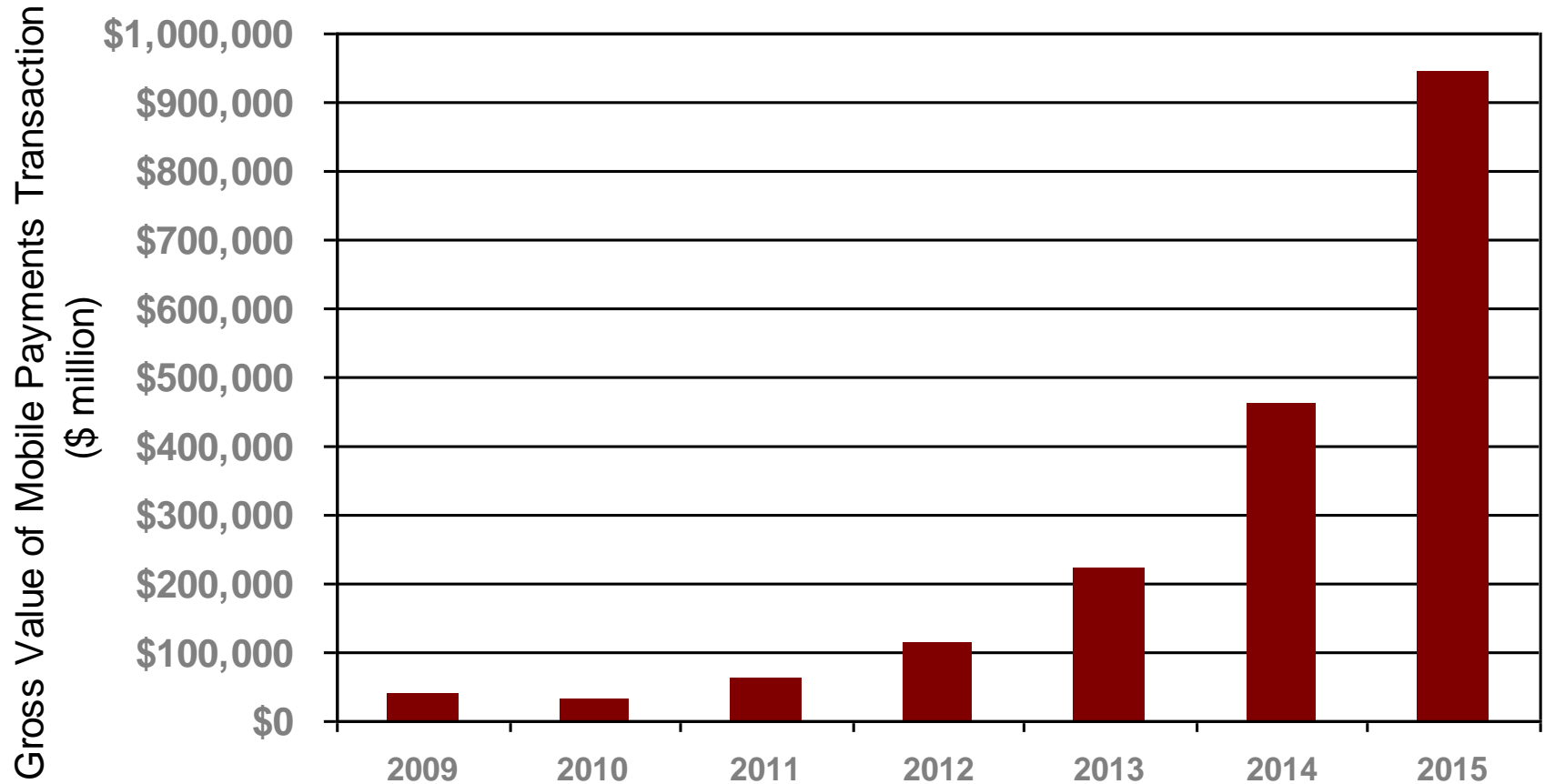
## Perception of the Adoption Curve for Online Mobile Payments by Geography





# Studies on M-Payment | 3

Globally to reach \$945 billion in 2015



Source: IE Market Research Corp., September 2011

- The conditions for mobile payment look promising:
  - Smartphones and Tablets spread rapidly.
  - Mobile Internet is available everywhere.
  - Technologies such as Quick Response (QR) Codes have been established.
  - Near Field Communication (NFC) seems close to a breakthrough.
  - Shopping on the Internet with mobile devices has long been part of everyday life.
- Under these circumstances, the expectation is obvious that also mobile payment now becomes established.

...but

- the reality is still somewhat different: Payment applications have been spread much more slowly than expected in Germany.














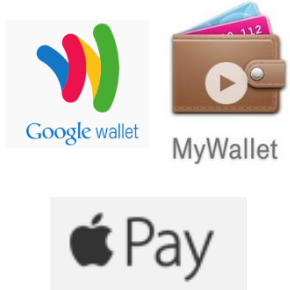
In 2014 ...

- ...the customer base for mobile payment systems in Germany is at about 176.000 (~0,2% of the population).
- ...the annual revenue for the provider of mobile payment systems in the B2C segment is on average 42 euros per customer.
- ...the market volume for M-Payment Apps in the B2C segment is only 7.4 million euros per year.
- ...over 80 companies offer solutions for mobile payment applications.

- The absence of *a single* established standard for the mobile handling of payments results in several problems:
  - ➡ No (consistent) accustomed usage schema from the customers' point of view (perceived ease of use; perceived self-efficacy)
  - ➡ Lack of trust in the security (perceived credibility).
  - ➡ Lack of M-Payment opportunities offered by merchants (perceived usefulness)
  - ➡ Lack of obvious advantages (perceived usefulness, perceived financial costs)

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## Overview of different mobile payment solutions

Contactless Credit Cards	Mobile Credit Card Readers	Closed Systems*	Mobile Online Payment	Mobile Wallet
  	  	 	   	 

\* either NFC- or QR-Code-based

- Credit Card Companies have been the first movers to use NFC technology to facilitate the payment process at the point of sale.
  - Modified POS terminals that are able to communicate via NFC technology
  - Modified credit cards / debit cards, which include an NFC chip
  - Basically a contactless substitute for swiping of the credit/debit cards
  - NFC-enabled cards can be as small as a typical SIM card, so that they fit into small devices (e.g. watches).
- Regarding the definition earlier in this lecture this solution is on the edge of an M-Payment scenario as the NFC card is on the edge of being a mobile device.



Visa  
payWave

MasterCard  
paypass™

[Source: Detecon 2014]



# M-Payment Solutions

## Mobile Credit Card Readers

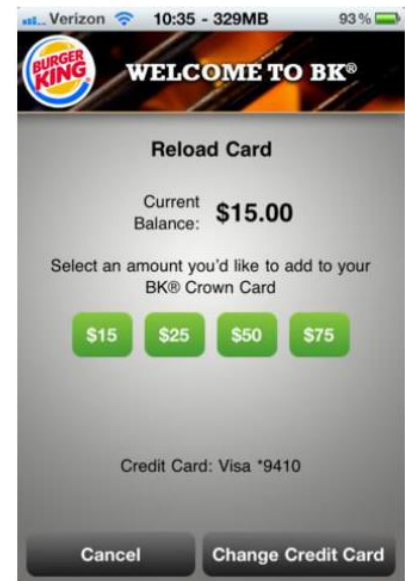
- Credit and debit cards can be processed by a mobile device by plugging a simple card reader into the earphone outlet.
- Enables small merchants and mobile businesses to accept credit / debit card payments



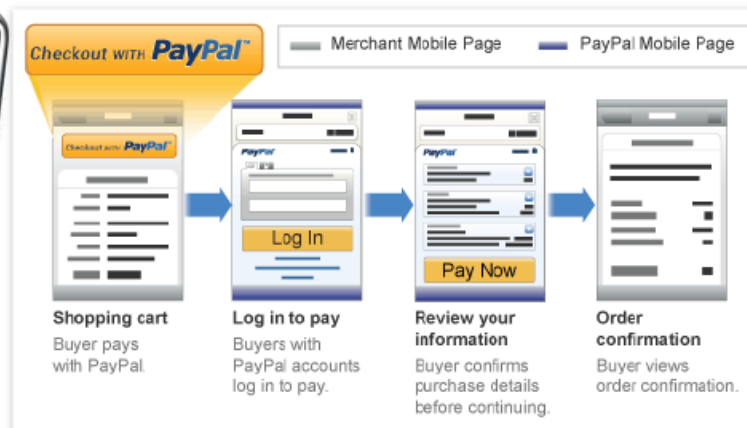


# M-Payment Solutions Closed Systems

- Modified POS terminals that
  - display QR Codes that can be scanned by smartphones (e.g. Burger King);
  - scan QR Codes from smartphone displays (e.g. Starbucks);
  - communicate via NFC (e.g. Best Buy).
- Usually prepaid solution — customers have to fill their accounts with the respective merchants before the purchase.



- Some providers of web payment services have extended their reach by developing apps for mobile devices.
- Mainly prepaid accounts or connected to credit cards or bank accounts
- Main use case: payments in online stores
- Additional use case: peer-to-peer money transfer



- By combining various payment methods and loyalty cards with secure communication technology (NFC), a virtual wallet can be created on a smartphone.
- Users can connect various payment methods / services to the wallet, e.g.:
  - credit / debit cards
  - loyalty cards (incl. coupons)
  - prepaid funds (Google, ISIS)
  - special offers



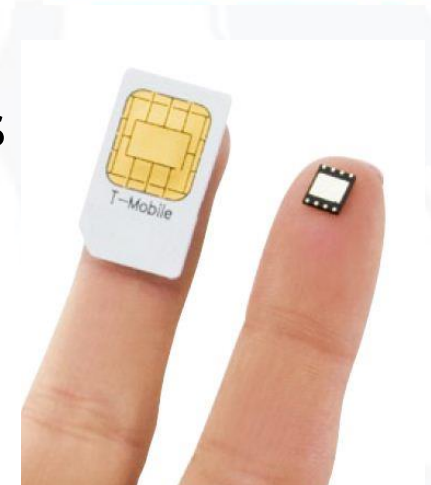
MyWallet



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# The Subscriber Identity Module (SIM)

- In GSM and UMTS since 1991, upcoming for WLAN
- **Represents contract between subscriber & network operator**
- Authorises a “phone” to use the network by linking it to a **subscription**
- By November 2014 more than **7.2 billion** mobile-cellular subscriptions  
[ITU2014, GSMAI2014]
- **More** countries with **SIM** infrastructure (219, 2013-Q3) **than** with **McDonald’s** (118, 2013-Q3) and **more than UN** member states (193, 2013-Q3) [GSM2013, McDonalds2013, UN2013]
- More and more called “Subscriber **Identification Module**” to reflect progress in the general field of **Identity Management**



- **SIMs are Smartcards:**
  - SIM cards serve as security medium.
  - Tamper-resistance prevents counterfeiting.
  - robust design
- Contain **International Mobile Subscriber Identity (IMSI)** for subscriber identification and the key  $K_i$  provided by the mobile operator
- Reliably execute computational functions for the mobile device

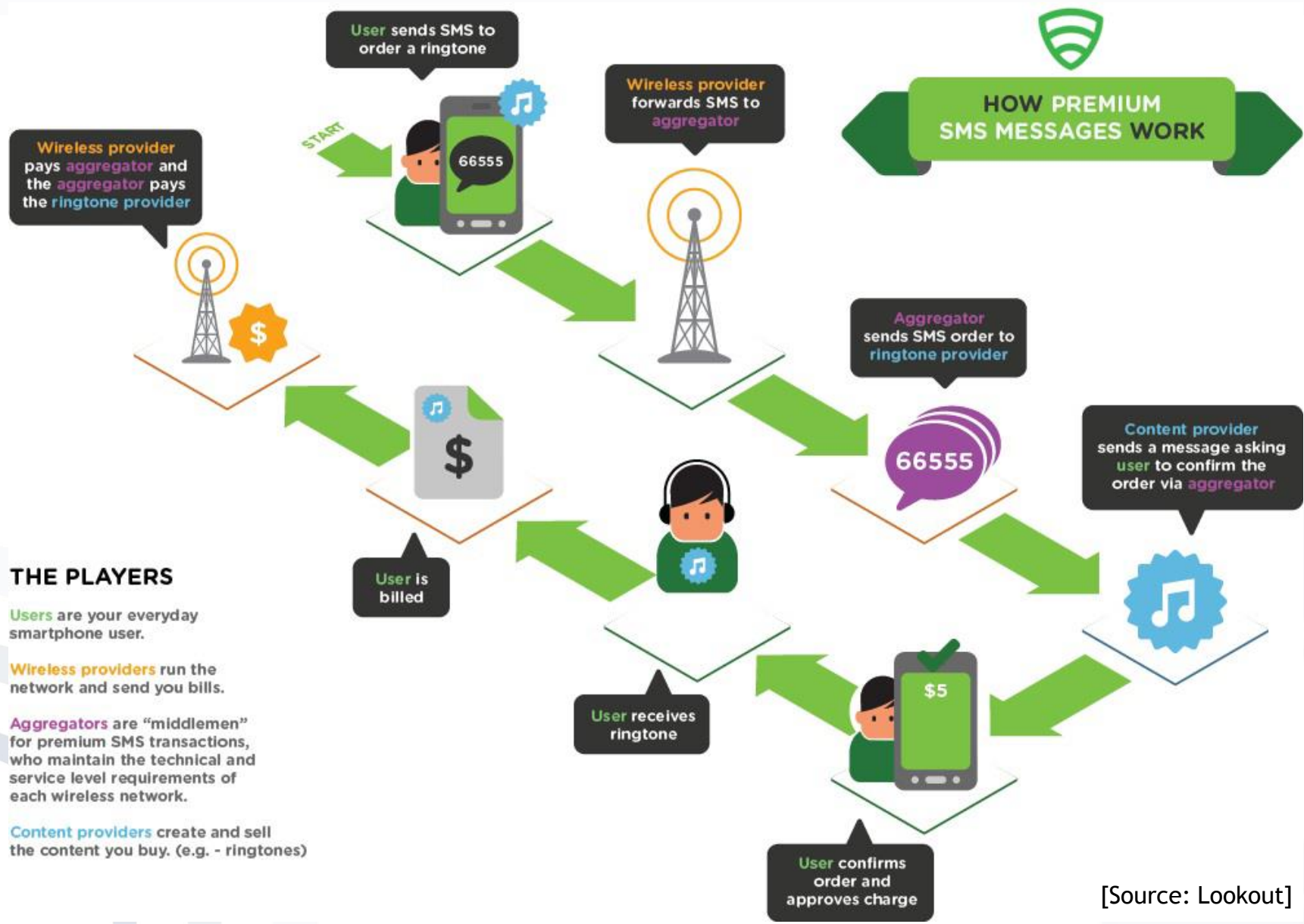


- SIM serves as „**identity card**“ for GSM cellular phone subscribers.
- SIM identifies the **issuer of the card** – important for the **billing of roaming subscribers** by roaming partner.
- SIM allows for **secure billing of roaming subscribers** through SIM-cryptography – important for card issuer.
- SIM contains additional **configuration data** of the GSM system.

- Protected data:
  - IMSI, PIN, PUK
  - A3, A8 crypto algorithms
  - List of subscribed services
  - Language used by the subscriber
- Dynamic data:
  - Cell information
  - Frequency information
  - Dynamically generated (session) keys
  - Attributes of GSM login
  - User data (address book, telephone list, SMS memory)



- **ETSI GSM 11.11** [GSM2006] specifies electrical as well as software interfaces between SIM and device.
  - A **serial interface** is used for accessing the card.
  - Communication through **SIM commands**
  - Device can access **files** or execute **actions** through SIM commands.
  - „SIM Application Toolkit“ allows for implementing of **additional applications** on a SIM.
- Meanwhile SIMs are available in different **form factors**
  - Same size as 'regular' smart cards (Full-size, FF).
  - Mini-SIM (2FF) introduced circa 1996
  - Micro-SIM (3FF) introduced in 2010
  - Nano-SIM (4FF) introduced in 2012



- In this system, the entire purchase process will be initiated and carried out directly on the mobile device.
- By sending a text message and a confirmation, the payment process is initiated.
- The user is billed by the mobile operator.
- All rates are assigned to the premium SMS number.

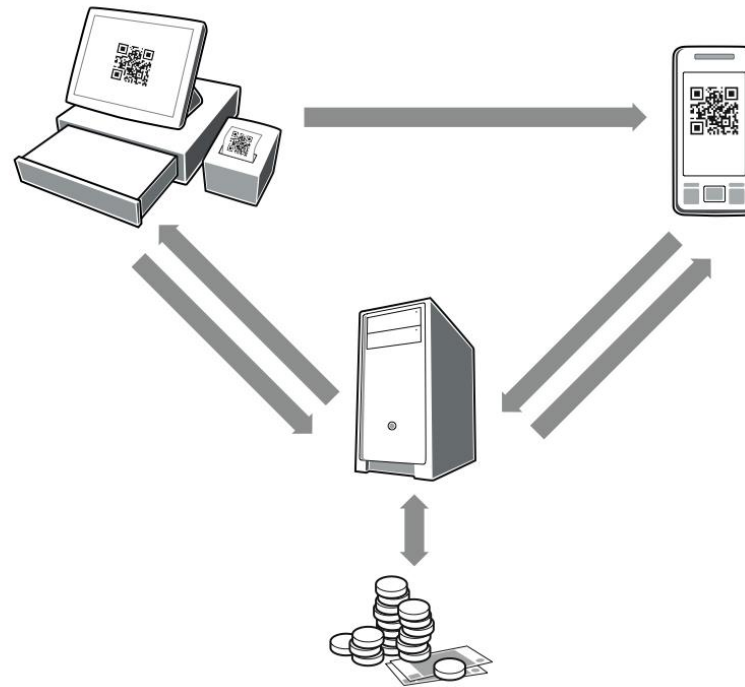
- The distribution of Apps through App Stores in terms of two-sided markets, results in the following advantage for M-Payment:
  - The user has an existing business relationship with the App Store provider.
  - This makes it easy and quick to be able to pay for services/third-party apps, without having to take a direct payment relationship with each and every provider itself.
  - The same is true for in-app purchases and digital content such as books, music, etc.

- Quick Response Codes (QR Codes) are two-dimensional barcodes that contain information that are machine-readable (e.g. with help of the optical camera of a mobile device).
- In the context of M-Payment QR Codes are typically used to identify a bill towards a server.



# QR-Code Payment

1. The seller generates a QR-code at the checkout, it is displayed or printed.



2. The buyer points a smartphone's camera at the QR-code, it is automatically scanned.

3. The authorization-server instantly matches the scanned QR-code with the payment-request from the seller and asks the buyer for confirmation.



## Advantages:

- Secure payment due to knowledge (PIN), ownership (Phone), and two-way communication
- No personal data is transferred to the seller.
- Quickly implementable software, no additional hardware is needed

## Disadvantages:

- Internet connection required
- Less convenient than NFC payment



# Near Field Communication (NFC)

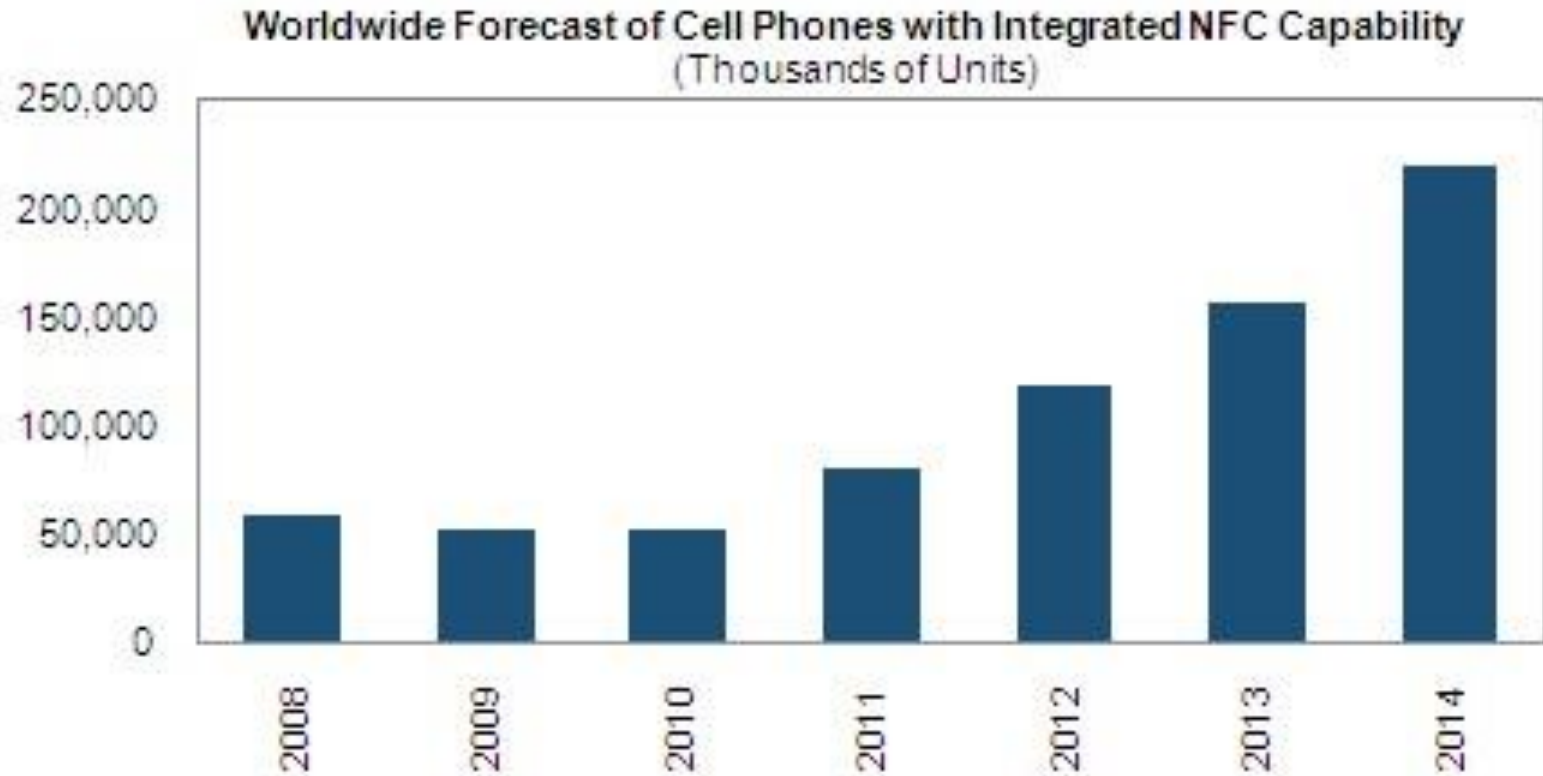
- NFC is a short-range (< 4 cm per design) wireless technology:
  - Communication mode of a device can be active or passive.
  - Magnetic induction between two loop antennas
  - Potential applications
    - Mobile Payment / Mobile Wallet
    - Mobile Marketing  
(e.g. redemption of digital coupons)
    - Mobile Ticketing
    - Access Control (e.g. e-Key)
    - Mobile Data User Exchange
    - ...

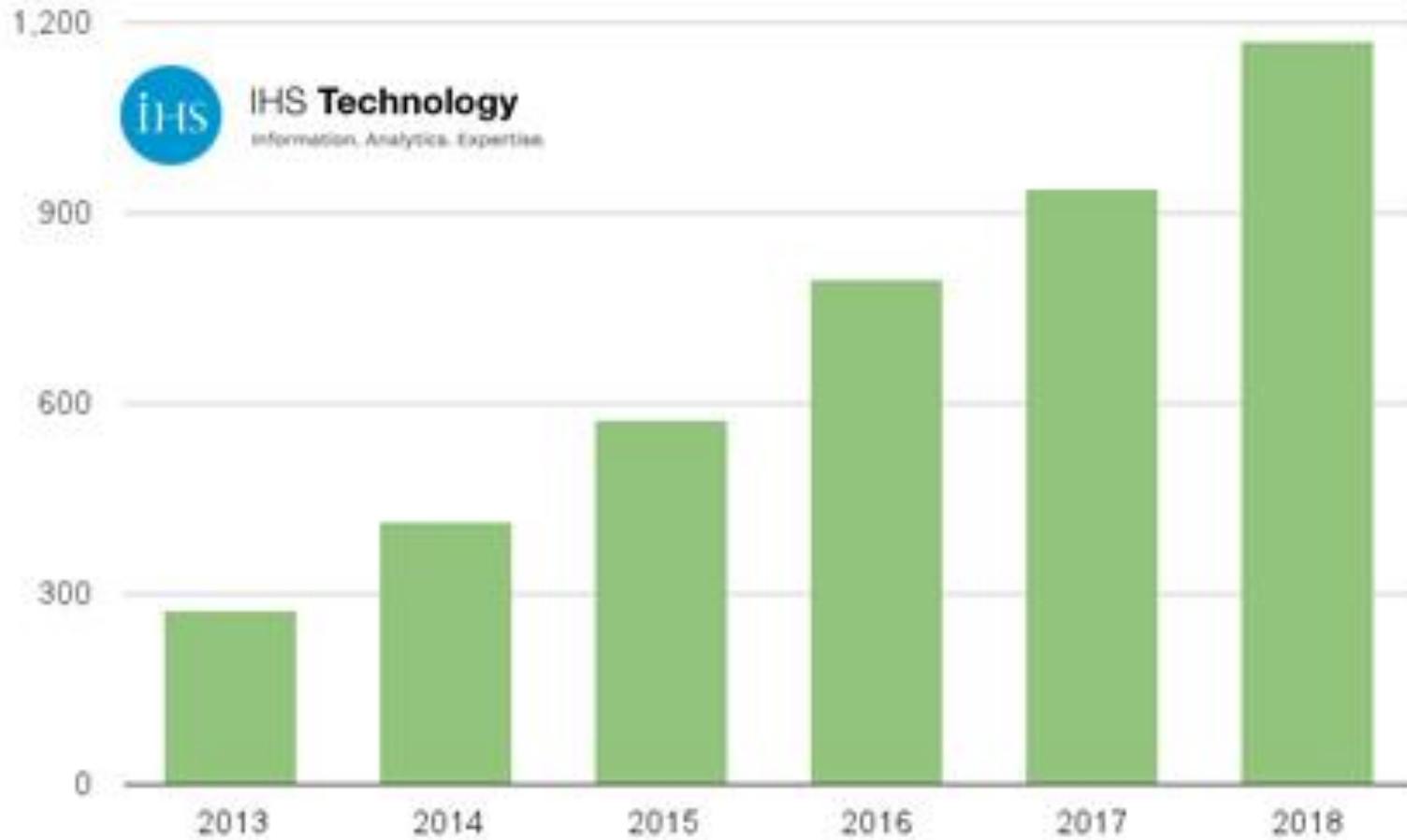


Source: techtickerblog.com (2011)



- Driven by NFC Forum
  - Founded in 2004 by equipment and credit card industry
  - MasterCard: Paypass
  - Visa: Visa & Wave
- Business Case
  - Replace card with mobile phone
  - Credit card contract extension with software update
  - Remote management (Update, Revocation)
- Mobile phone as security token
- Payment terminal is always online.



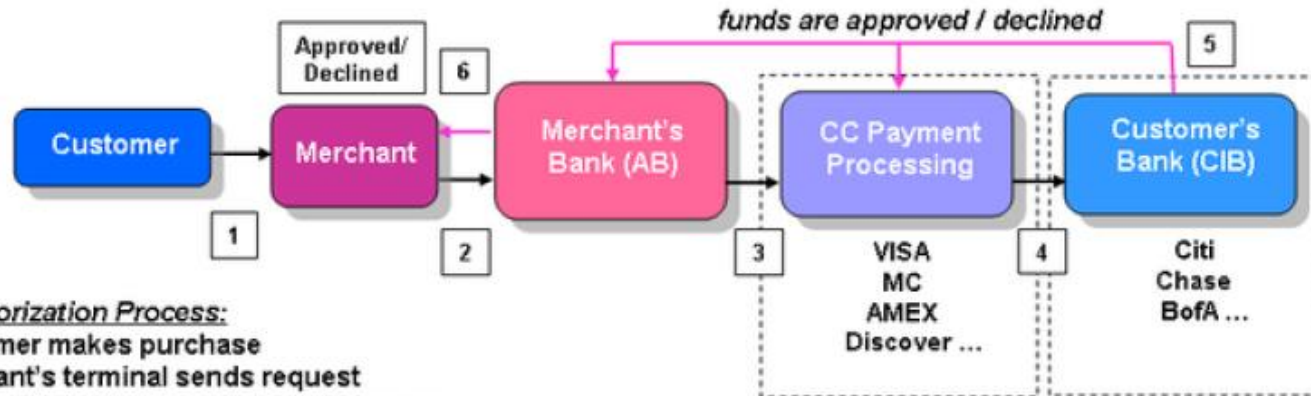


Forecast for world shipments of NFC handsets, in millions.

# General Credit Card Approval & Payment Process

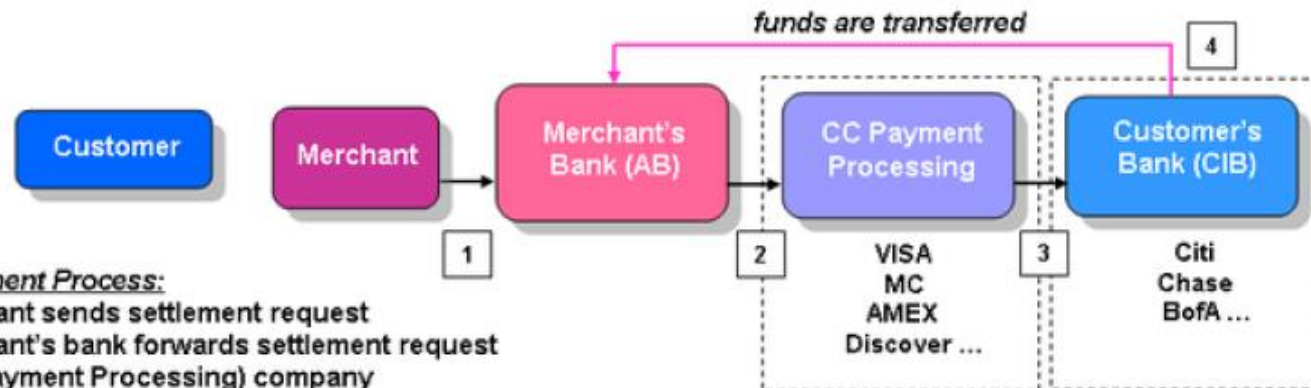
Source: Conkling 2011

## General Credit Card (CC) Approval/Payment Process



### Basic Authorization Process:

1. Customer makes purchase
2. Merchant's terminal sends request
3. Merchant's bank forwards to CC company
4. CC company forwards to Customer's bank
5. Customer's bank (determines: approval or decline) and CC company and merchant's bank are notified
6. Merchant's terminal is sent a message

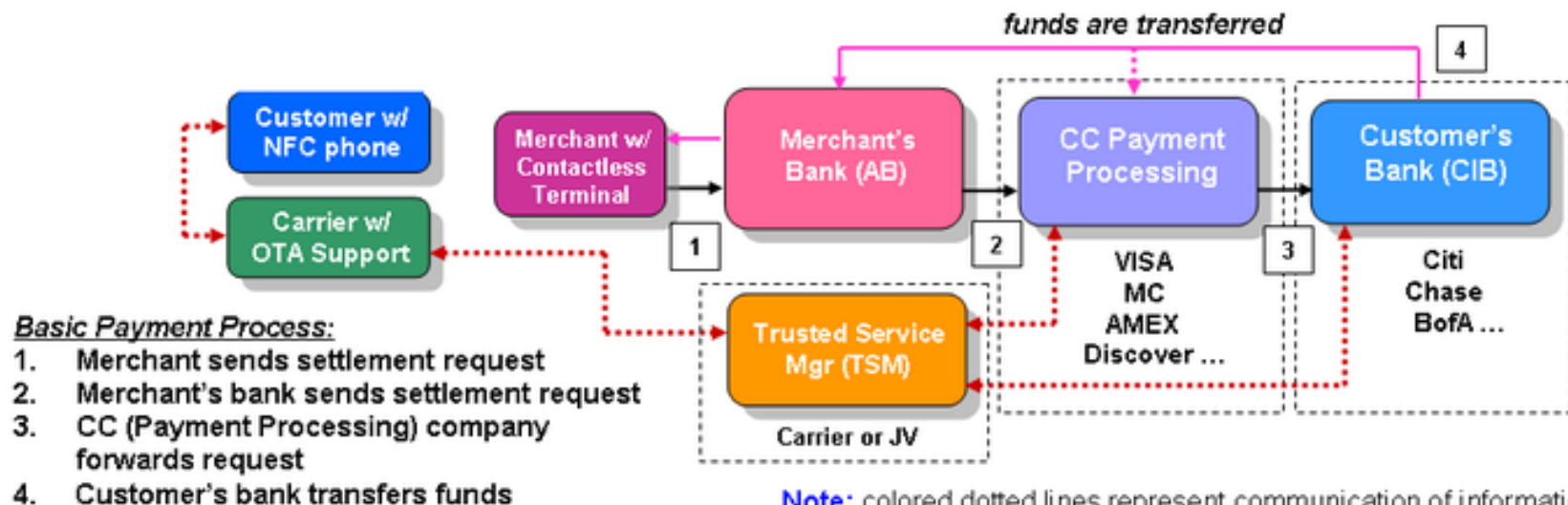
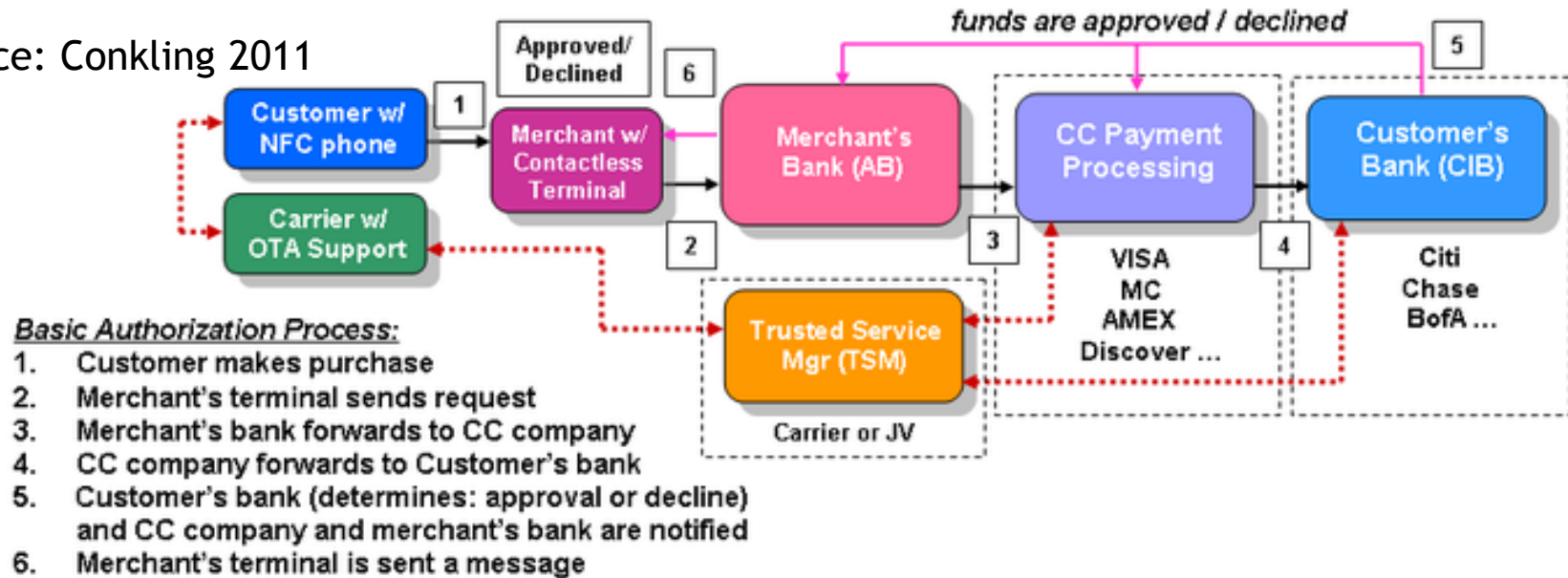


### Basic Payment Process:

1. Merchant sends settlement request
2. Merchant's bank forwards settlement request
3. CC (Payment Processing) company
4. Customer's bank transfers funds

# NFC Mobile Payment Approval & Payment Process

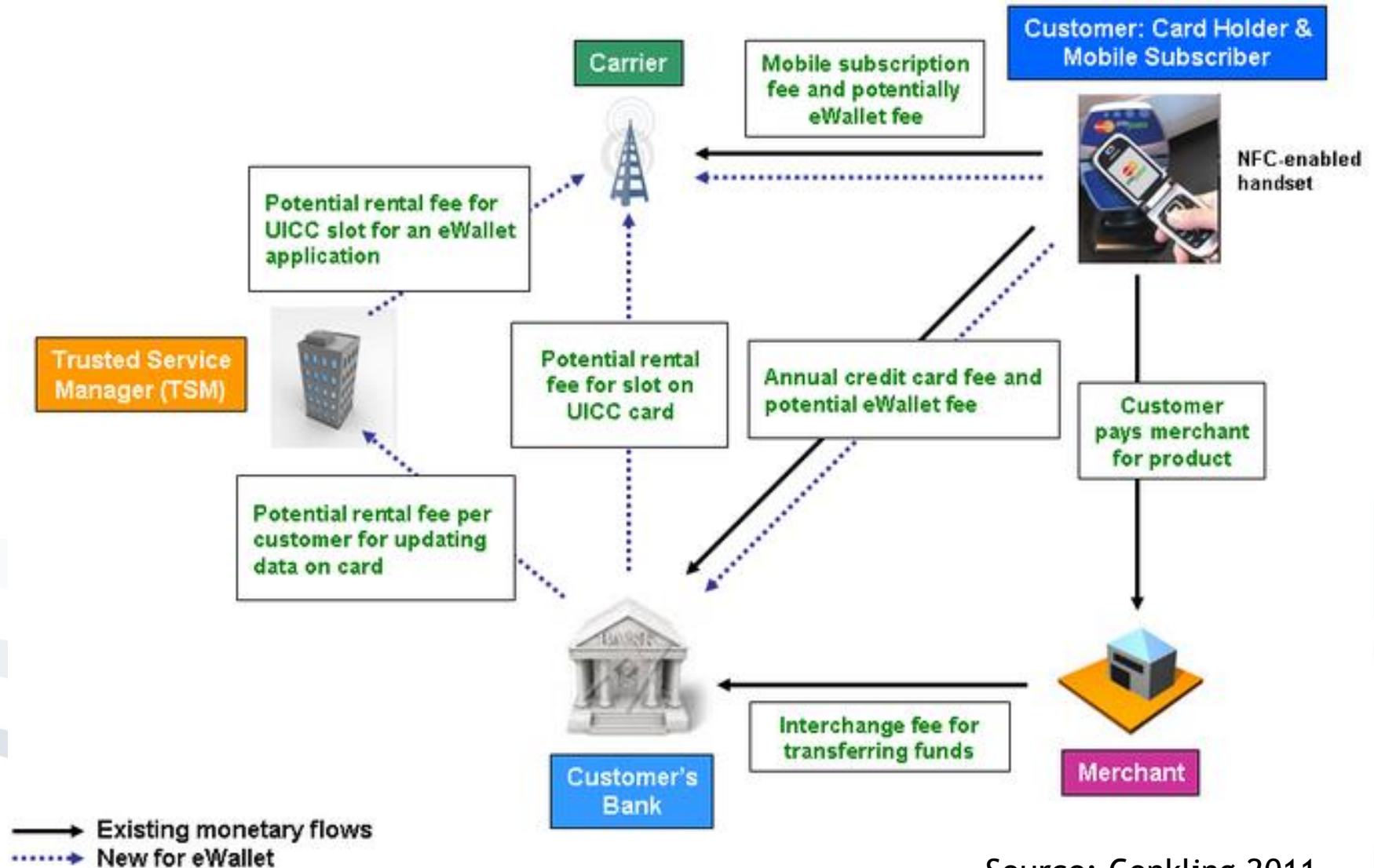
Source: Conkling 2011



**Note:** colored dotted lines represent communication of information



# Monetary Flow for NFC Mobile Payment



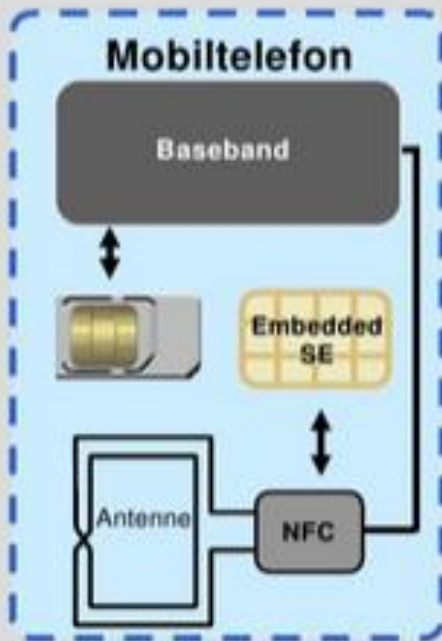
- Handsets
- Infrastructure
- Cooperation between:
  - Mobile Device manufacturer (NFC Chips in mobile devices)
  - SIM Card manufacturer (produce NFC-enabled SIM Cards)
  - Mobile Network Operators (replace old SIM Cards)
  - Financial Institutes
  - Merchants (offer Mobile Payment possibilities)
  - Customers (use Mobile Payment solutions)

- The combination of NFC and secure elements on smartphones is the key technological enabler for mobile wallets.
- Secure elements are hardware tokens, that enable secure mobile applications, services and payments.
- They can be provided as:
  - integrated non-replaceable hardware components or
  - Interchangeable hardware such as UICCs or mSD

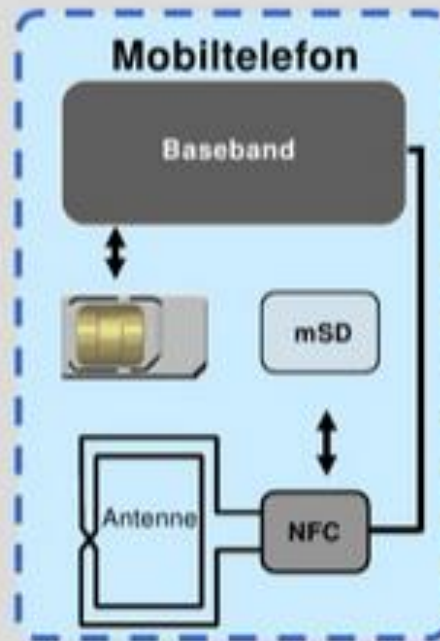


# Secure Elements / Wallets

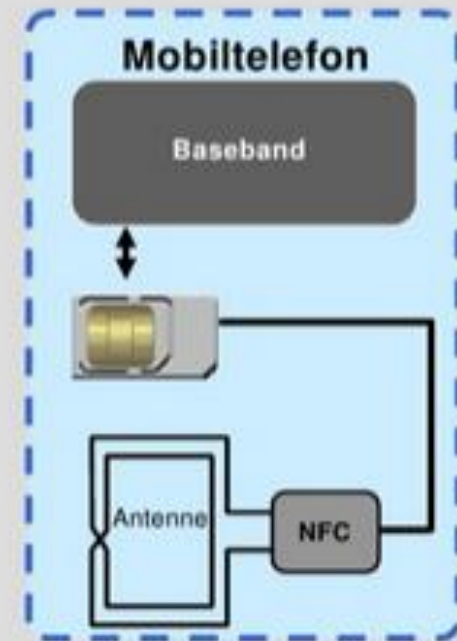
  
Embedded Secure Element



  
mSD Karte



  
UICC Karte



- There are good reasons for and against having the Secure Element stored in the SIM card of the smartphone. Mobile Operators try to leverage the advantages of the SIM model.



## Advantages

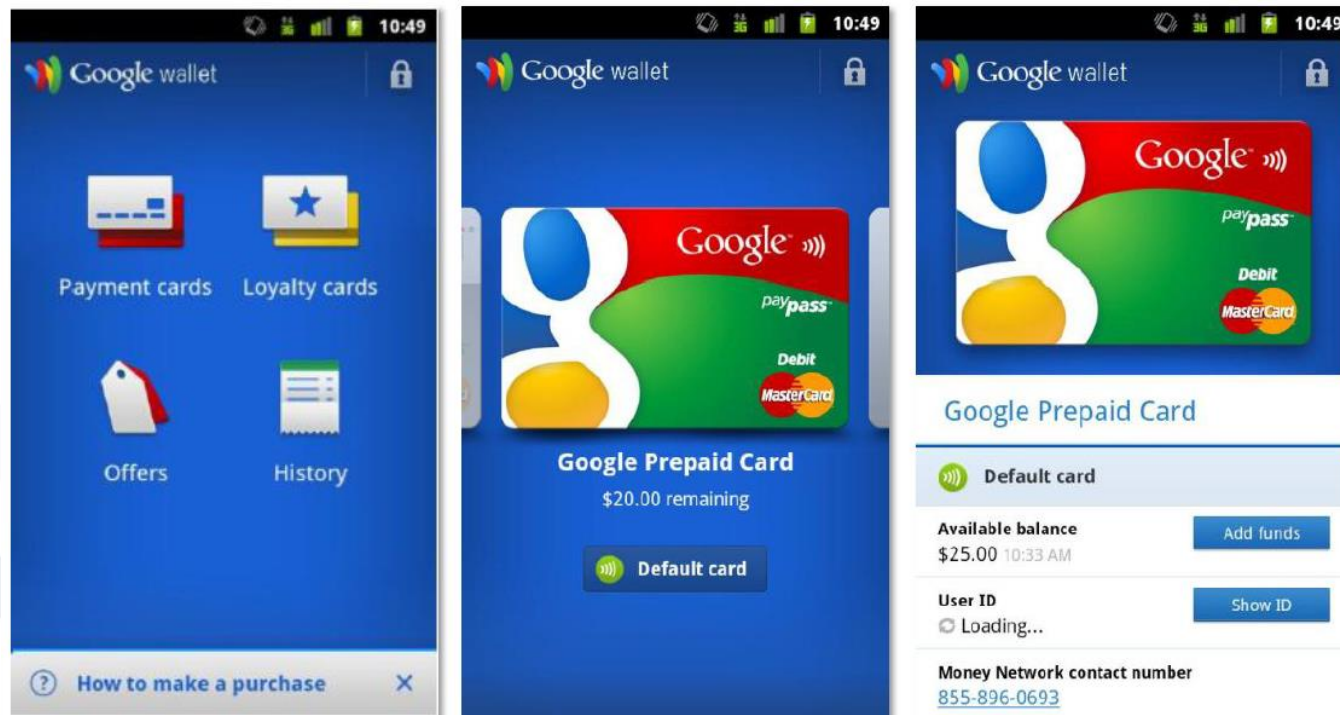
- **Customer support:** If the handset is lost users can call the operator to have their NFC apps disabled immediately.
- **Handset-agnostic:** Applications live in the SIM, not in the phone, so they are easily transferable to other devices.
- **Trust:** Users are more likely to trust an operator than an online brand when it comes to security.



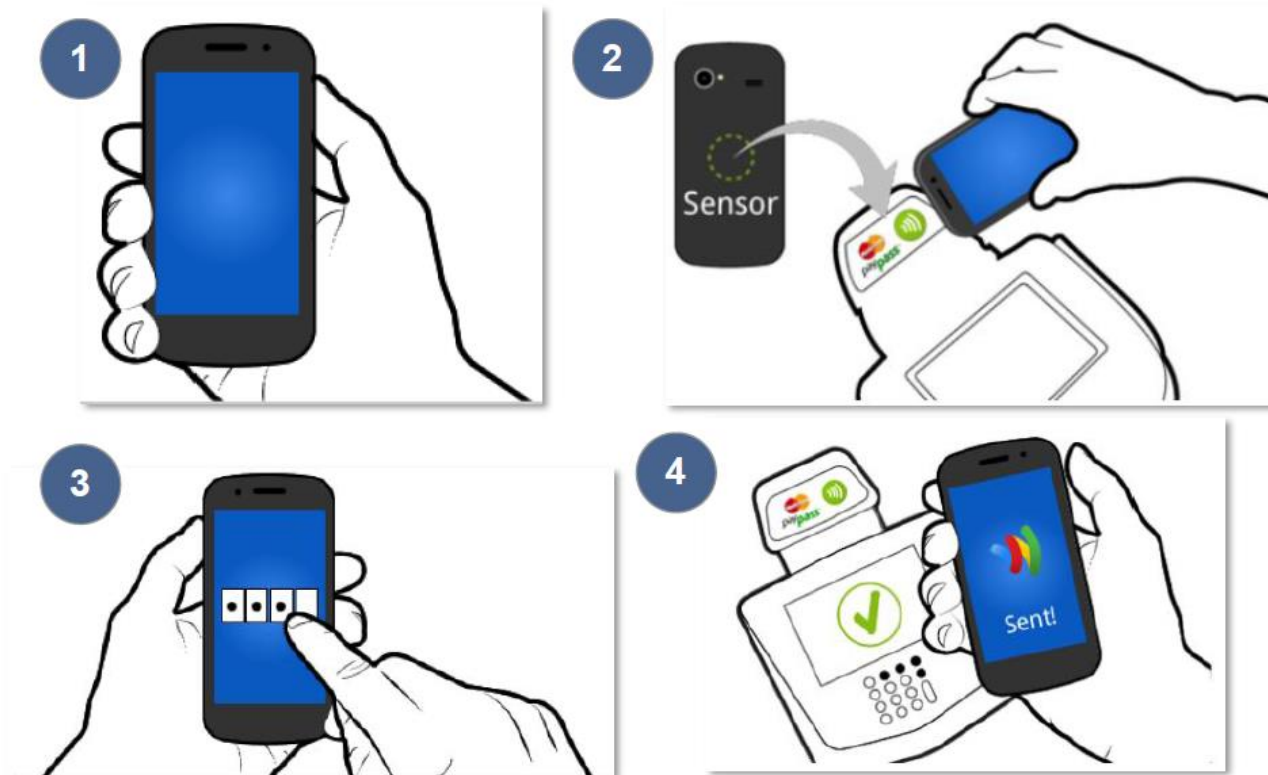
## Disadvantages

- **Not universal:** Secure services can be enabled on mobile networks only where operators can supply NFC SIM cards and the necessary TSM back end.
- **No single deal:** Separate SIM-space rental rates need to be negotiated with each operator.
- **Limited space:** Only an average of five applications can fit on a SIM.

- Mobile Wallets store payment cards and loyalty cards. Until recently, filling the wallet with prepaid funds was one of the most popular options.



- Paying with the mobile wallet is similar to paying with a credit card, but customers can choose the payment method / loyalty card from one single device.



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- The market for M-Payment is currently characterized by a variety of different technologies, infrastructures and providers.
- Each of them are having different competitive advantages.
- By now it's not sure which service(s) will succeed.
- But the number of providers and solutions is likely to consolidate.





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