mobile business

Lecture 6

Application Domains II: M-Payment I

Mobile Business II (SS 2023)

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

Mobile Payment is the "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".

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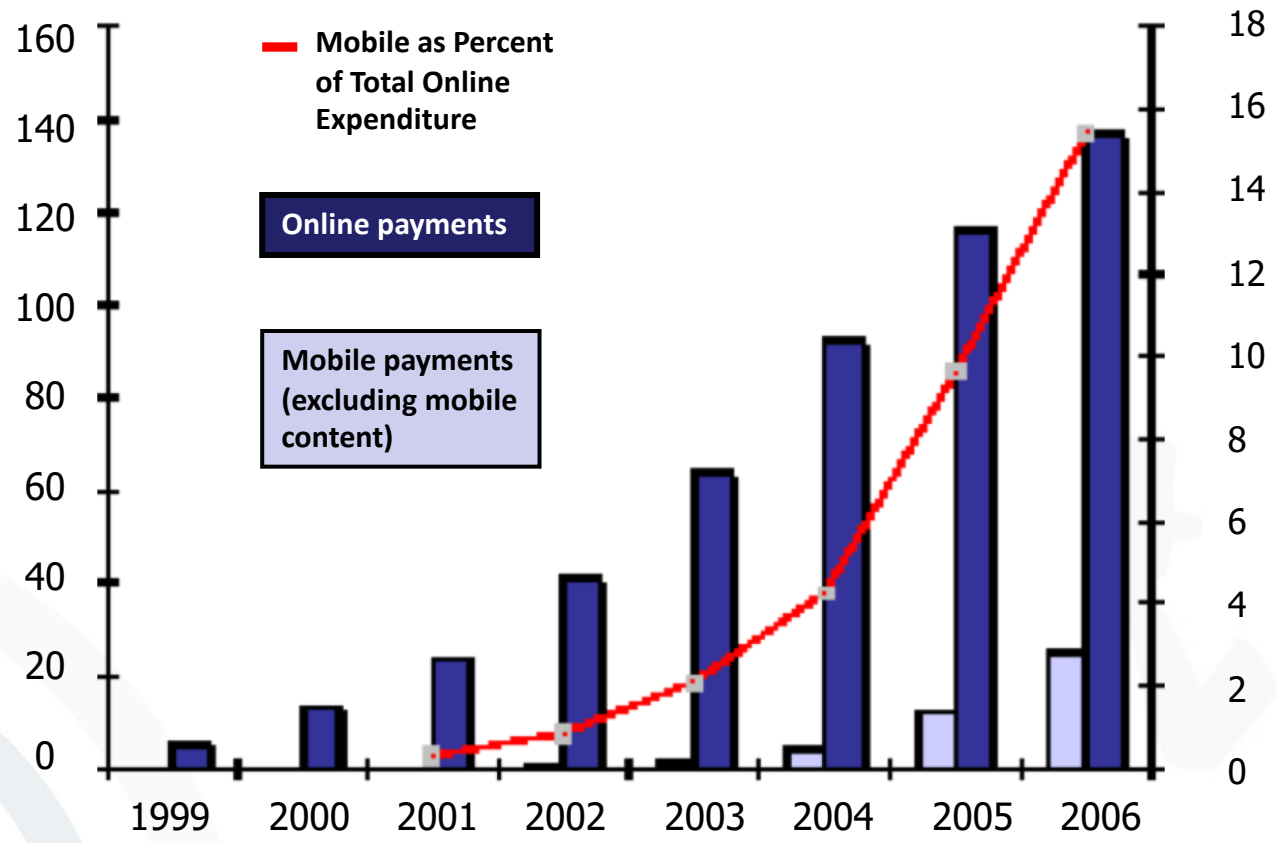| Online Scenarios		Stationary Merchant Scenarios		C2C
E-Commerce	**M-Commerce**	**In person**	**Vending Machine**	**Money transfer**
▪ Using a traditional computer to purchase goods, services and information on the Internet. ▪ The mobile device is only used for the payment transaction	▪ Using a mobile device for both the purchase of goods, services and information on the Internet, as well as for the payment transaction ▪ Including mobile applications and mobile services, e.g. context-sensitive information	▪ Traditional trade with transactions between a customer and cashier	▪ Traditional trade with transactions between a customer and vending machine	▪ 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) and decrease of transaction costs
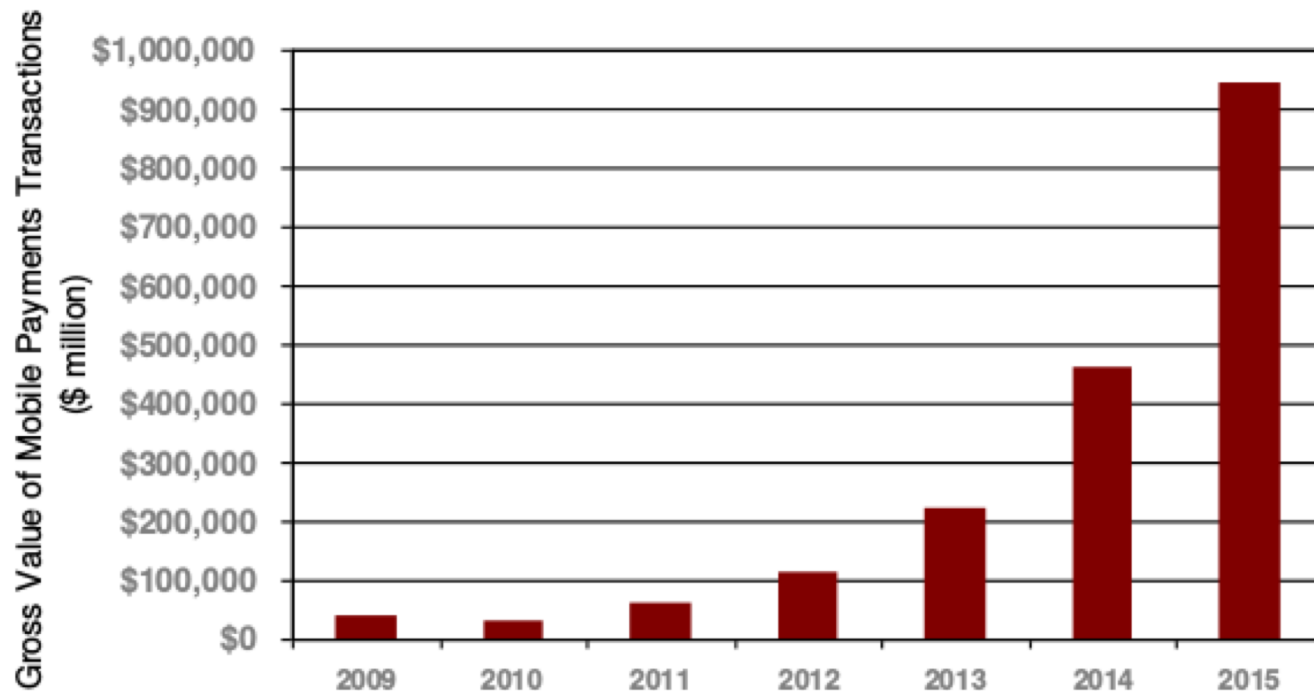
consequently...

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Payment Expenditure ($US Billion):

— **Mobile as Percent of Total Online Expenditure**

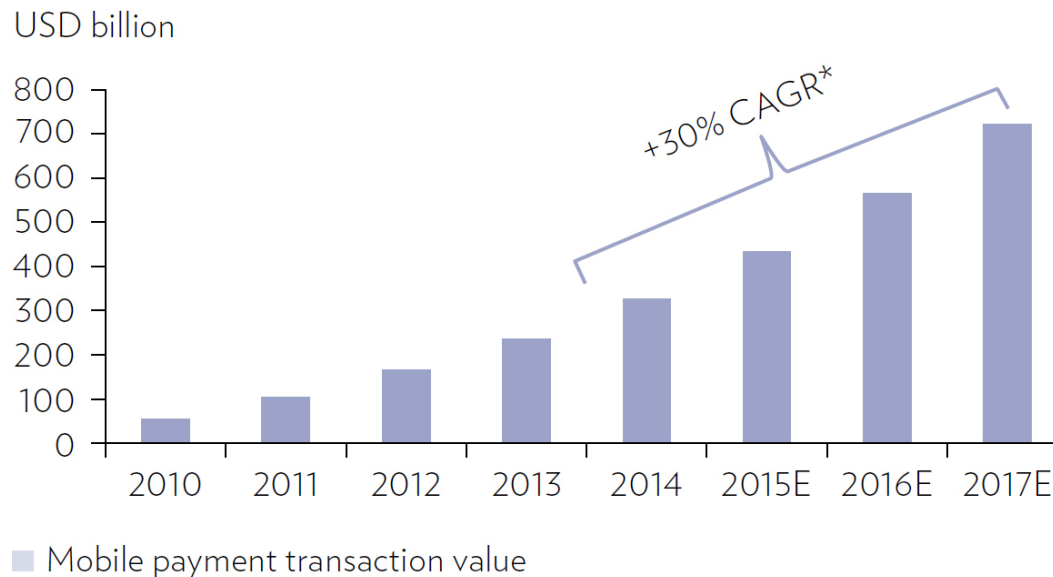**Online payments**

Mobile payments (excluding mobile content)

- Predictions from **2011:** globally to reach **$945 billion in 2015**

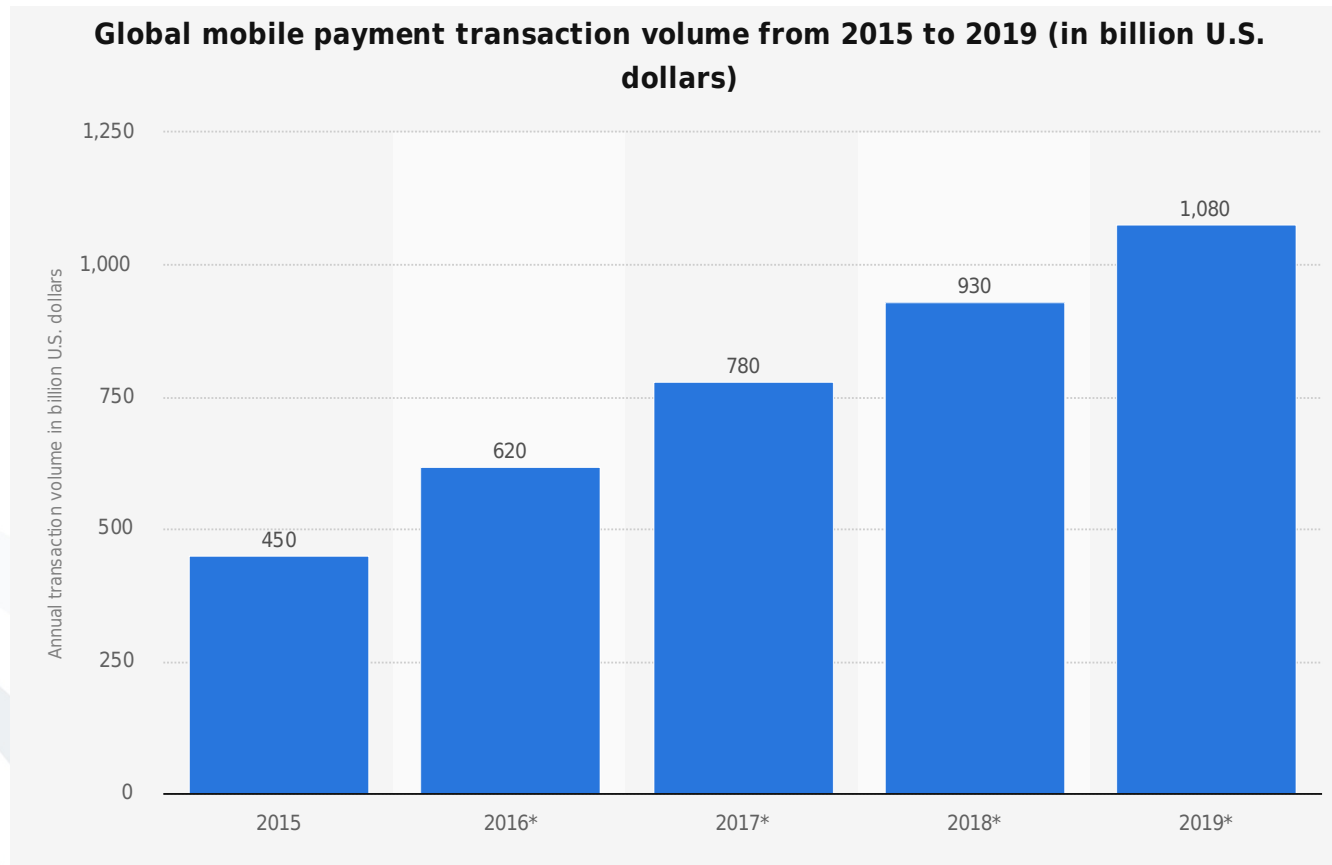**Chart 1:** Gross Value of Mobile Payments Transactions, 2009 - 2015

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- Predictions from **2014**: globally to reach **$740 billion in 2017**
  ~$450 billion in 2015

USD billion

Mobile payment transaction value

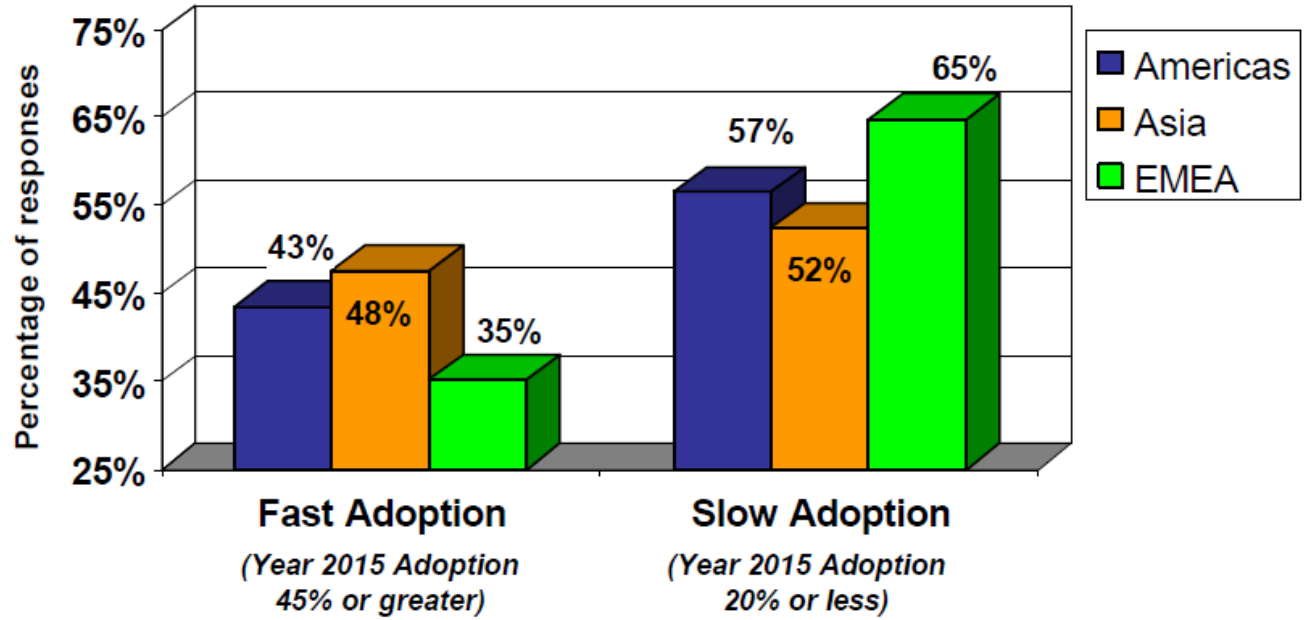* CAGR=Compound annual growth rate
Source: Gartner, Deutsche Bank, Julius Baer

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- Predictions from **2015**: globally to reach **$1,080 billion in 2019**
  ~$780 billion in 2017

Global mobile payment transaction volume from 2015 to 2019 (in billion U.S. dollars)

Annual transaction volume in billion U.S. dollars

Year	Value
2015	450
2016*	620
2017*	780
2018*	930
2019*	1,080

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- Transaction value in the Mobile POS Payments segment is projected to reach **US$3.30 tn in 2023**.
- Transaction value is expected to show an annual growth rate **(CAGR 2023-2027) of 14.00%** resulting in a projected total amount of **US$5.58 tn by 2027**.
- In the Mobile POS Payments segment, the number of users is expected to amount to **1.94 bn users by 2027**.
- The average transaction value per user in the Mobile POS Payments segment is expected to amount to **US$2.05 k in 2023**.
- From a global comparison perspective it is shown that the highest transaction value in 2023 is reached in **China** (US$1.649 tn).

Source: **[Statista2023]**   11

Perception of the Adoption Curve for Online Mobile Payments by Geography

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Figure 36. Mobile payments transaction value by region, global, 2009–2016

Transaction value ($ millions)

Worldwide CAGR: 58%

North America CAGR: 126%

Legend: Western Europe, North America, Asia Pacific, Eastern Europe, Middle East, Africa, Latin America

Source: Sandy Shen, *Forecast: Mobile payment, worldwide, 2009–2016*, Gartner, May 9, 2012; Deloitte analysis.

Graphic: Deloitte University Press | DUPress.com

- The conditions for mobile payment look promising:
  - rapid spread of smartphones and tablets
  - mobile Internet available everywhere
  - establishment of Quick Response (QR) Codes technologies
  - seemingly breakthrough of Near Field Communication (NFC)
  - 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.

Germany (~82m)

Very slow spread of m-payment applications

In 2019

- transaction value $118,404m
- average transaction value per user $471,4

In 2017
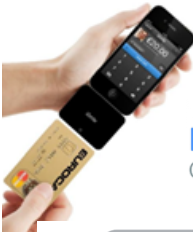
- transaction value $70m
- average transaction value per user $78,09

In addition, in 2016 [PWC2016]

- 70% have not used m-payment.
- 10% never heard of m-payment.

Estonia (~1.3m)

One of the most advanced e-societies in the world

In 2019

- transaction value $802m
- average transaction value per user $1089,55

In 2017

- transaction value $34m
- average transaction value per user $475,43

- The absence of **a single** established standard for the mobile handling of payment 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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Contactless Payment Cards	Mobile Card Readers	Closed Systems*	Mobile Online Payment	Mobile Wallet

*NFC- or QR-Code-based

- Credit Card Companies were the first to use NFC technology to facilitate the payment process at the point of sale:
  - Modified credit/debit cards include an NFC chip
  - Modified POS terminals are able to communicate via NFC technology

    (Contactless substitute for swiping of the credit/debit cards)
  - NFC-cards can be as small as a typical SIM card, so that they fit into small devices (e.g. watches).
- NFC-card is on the edge of being a mobile payment scenario (according to the definition of mobile payment on slide 3), as not fully accepted as mobile device.

- Credit/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

- Modified POS terminals
  - 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.
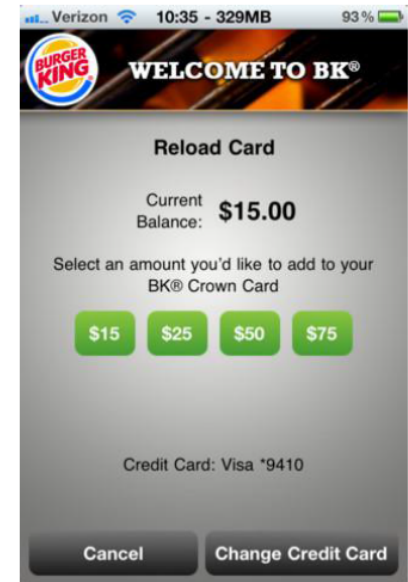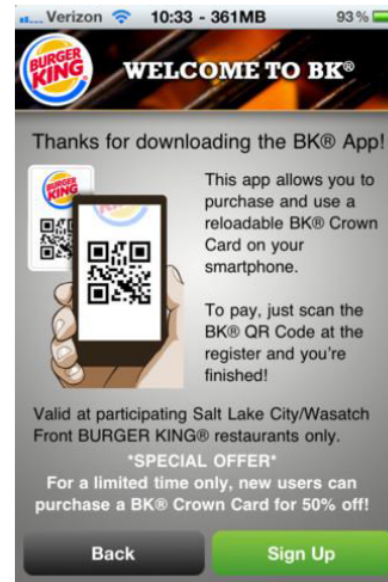
- Providers of web payment services extended to apps for mobile devices.

- 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
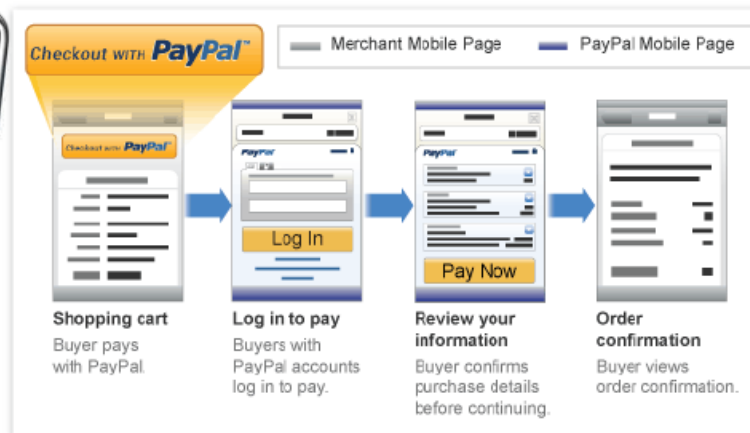
- By combining various payment methods and loyalty cards with secure communication technology (NFC), a virtual wallet can be created on a smartphone.

- 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
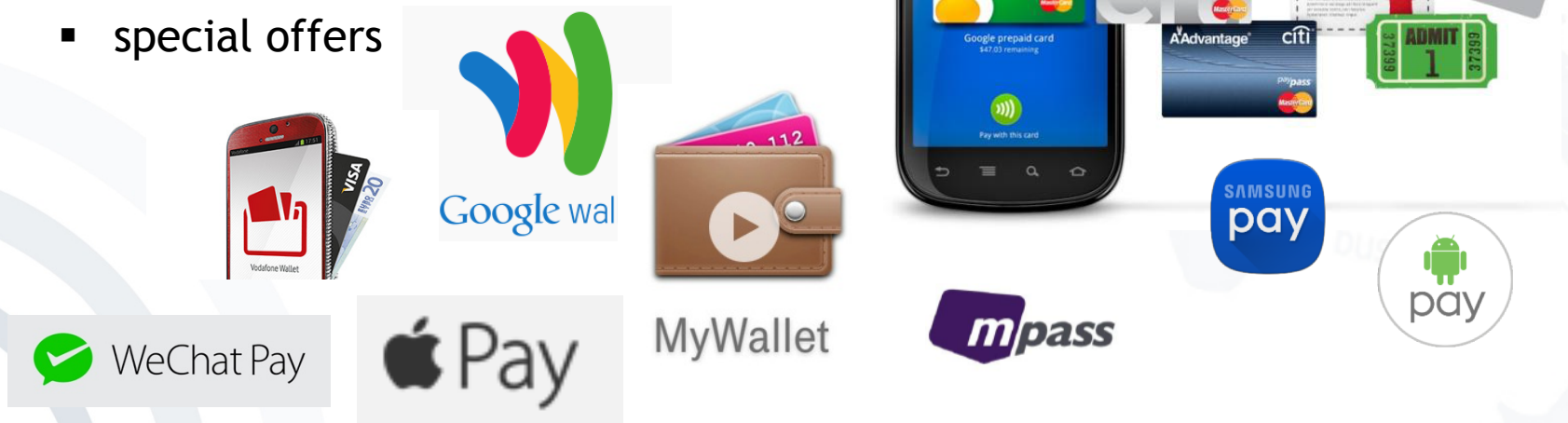
- Typical transactions: filling the wallet with prepaid funds, scanning 2D barcodes (Apple Wallet), transfer money between friends (Dwolla, Venmo)
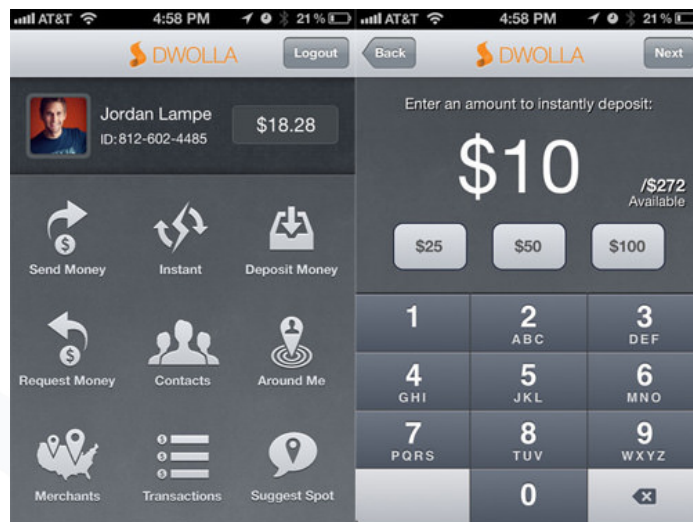
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- In GSM since 1991, and used in all further mobile networks
- **Represents** contract **between subscriber & network operator**
- Authorises **a "phone"** to **use** the network by linking it to a **subscription**
- By 2018 around **5.1 billion** mobile broadband subscribers (forecast to grow to **5.9 billion** by 2025) with $**1.03 trillion** mobile operator revenue [GSMAI2019]
- More countries with SIM infrastructure (ca. 240, 2019-Q2) than McDonalds (121, 2019-Q2) and UN-members (193, 2019-Q2) [GSM2019, Wiki2019, UN2019]
- More and more called "Subscriber **Identification** Module" to reflect progress in the general field of **Identity Management**

- **SIM**s are **Smartcards:**
    - serve as security medium
    - tamper-resistance prevents counterfeiting
    - robust design

- Contain **International Mobile Subscriber Identity (IMSI)** for subscriber identification and the key **Ki** 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.

- (Rather) **static** data:
  - IMSI, PIN, PUK
  - A3, A8 crypto algorithms
  - List of allocated (subscribed) services
  - Language preferred 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.

- SIMs are available in different **formats** [WikiSIMs2017]
  - Full-size (1FF) - same size as 'regular' smart cards (since 1991)
  - Mini-SIM (2FF) (since 1996)
  - Micro-SIM (3FF) (since 2003)
  - Nano-SIM (4FF) (since 2012)
  - Embedded-SIM (eSIM) (since 2013)

HOW PREMIUM SMS MESSAGES WORK

User sends SMS to order a ringtone

Wireless provider forwards SMS to aggregator

Wireless provider pays aggregator and the aggregator pays the ringtone provider

Aggregator sends SMS order to ringtone provider

Content provider sends a message asking user to confirm the order via aggregator

User is billed

User receives ringtone

User confirms order and approves charge

THE PLAYERS

Users are your everyday smartphone user.

Wireless providers run the network and send you bills.

Aggregators are "middlemen" for premium SMS transactions, who maintain the technical and service level requirements of each wireless network.

Content providers create and sell the content you buy. (e.g. - ringtones)

Source: Lookout, Inc.   31

- 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 advantages for M-Payment:

  - The user has an existing business relationship with the App Store provider.

  - The payment for services or third-party apps is easier and faster, as a direct payment relationship does not need to be established with every provider.

  - The same is true for in-app purchases and digital content such as books, music, etc.

- Barcodes are a means of representing data in an optical, machine-readable fashion.

- Types
  - one-dimensional
  - two-dimensional (Quick Response Codes or QR Codes)

- In the context of M-Payment, QR Codes are typically used to identify a bill towards a server.

one-dimensional
Barcode

two-dimensional
Barcode (QR Code)

- Connect to your bank account via Blue Code and get a personal barcode

- The barcode is scanned from the smartphone when you make a payment

http://www.megaplex.at/inhalt/blue-code

- Anonymous and fully secure*

  - Blue Code does not store/receive customer or banking data.

  - Short lifespan of barcode

- Works only with German and Austrian bank accounts

BLUE CODE®

* Not so much according to **[Penz2017]**

1. The seller generates a QR-code at the checkout, it is displayed or printed.
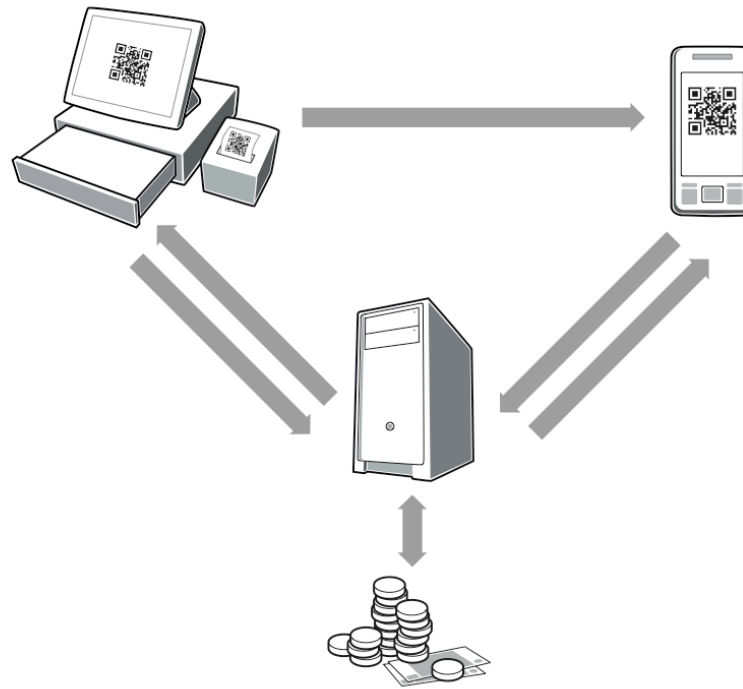
2. The buyer points a smartphone's camera at the QR-code, it is automatically scanned.

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

- NFC: <u>N</u>ear <u>F</u>ield <u>C</u>ommunication

- 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

    - …

https://techtickerblog.com/

- 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
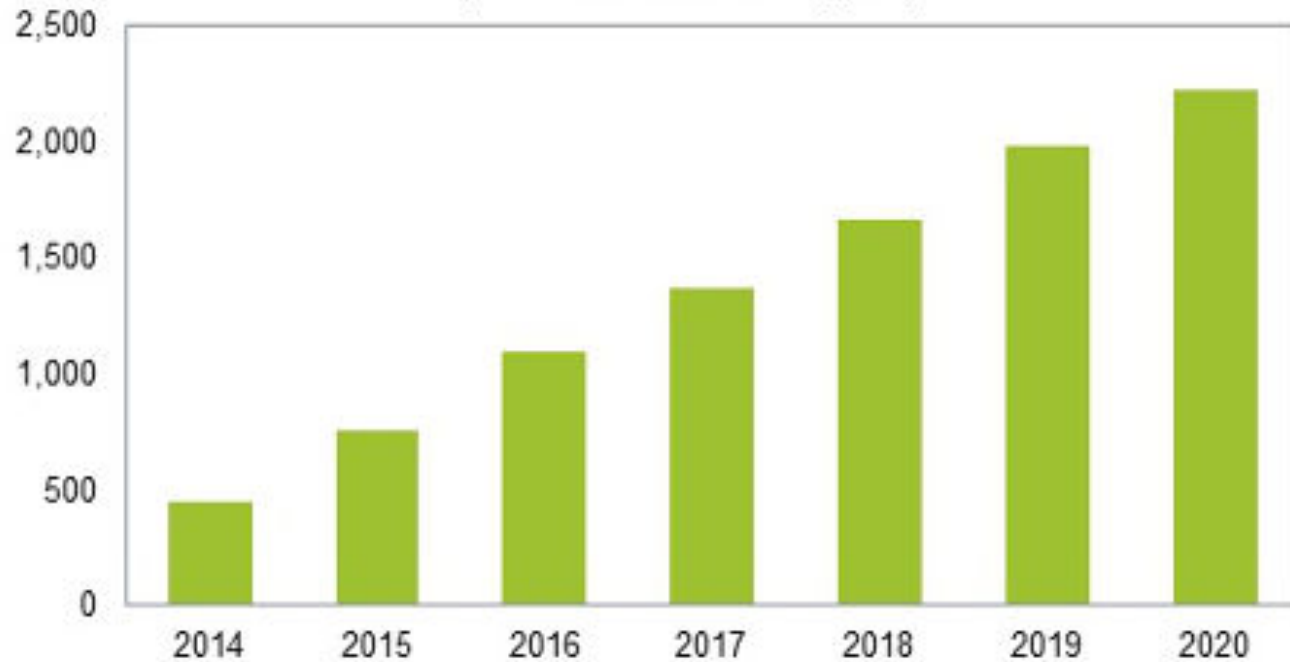- Payment terminal is **always online**

Worldwide Forecast of Cell Phones with Integrated NFC Capability
(Thousands of Units)
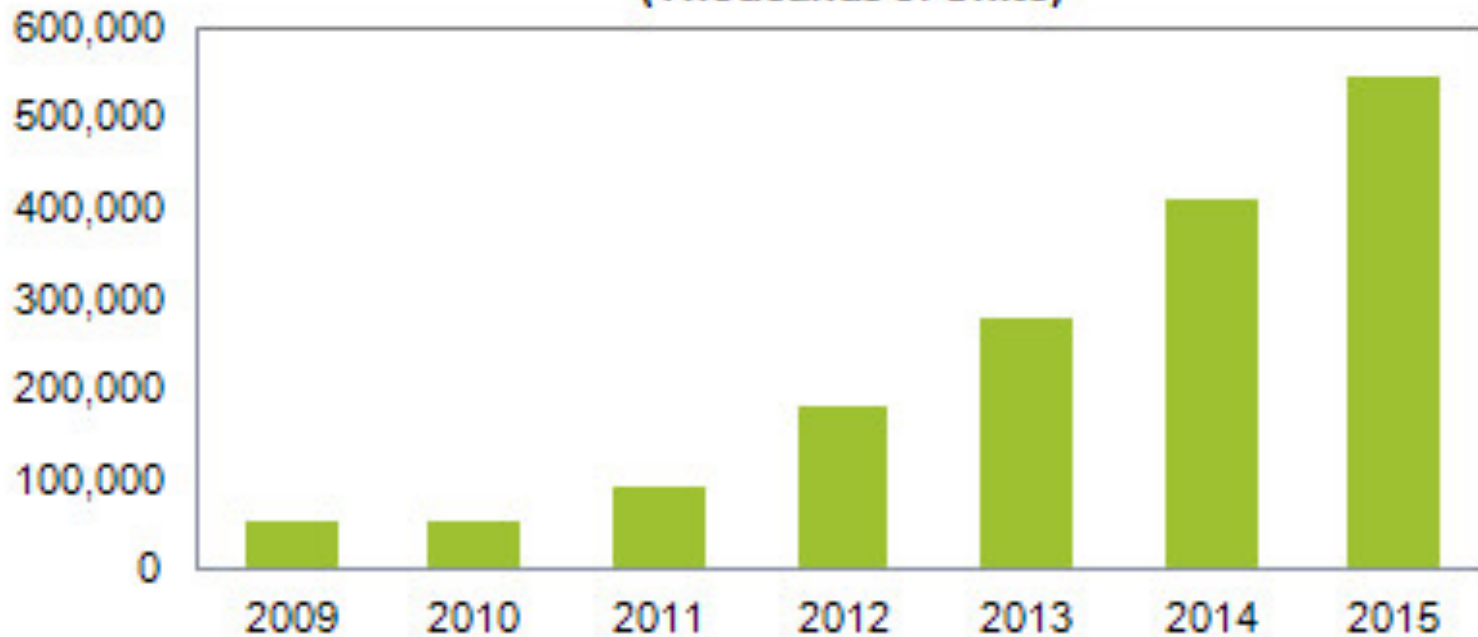
Source: IHS iSuppli September 2011

World Shipment of NFC-enabled Cellular Handsets (in Millions of Units Shipped)

General Credit Card Approval & Payment Process
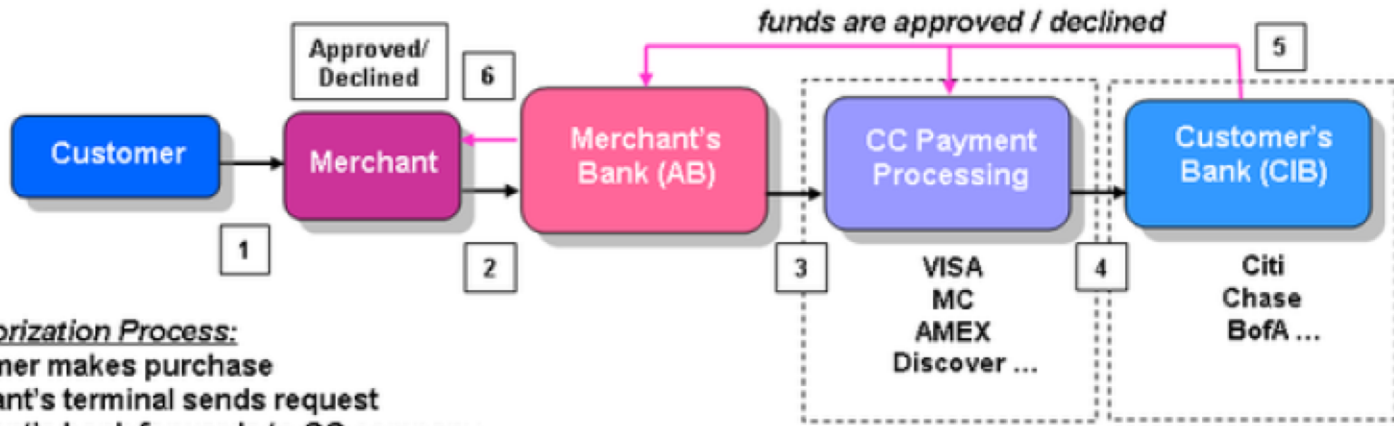
Basic Authorization Process:
1. Customer makes purchase
2. Merchant's terminal sends request
3. Merchant's bank forwards to CC company
4. CC company forwards to Customer's bank
5. Customer's bank (determines: approval or decline) and CC company and merchant's bank are notified
6. Merchant's terminal 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

Basic Authorization Process:

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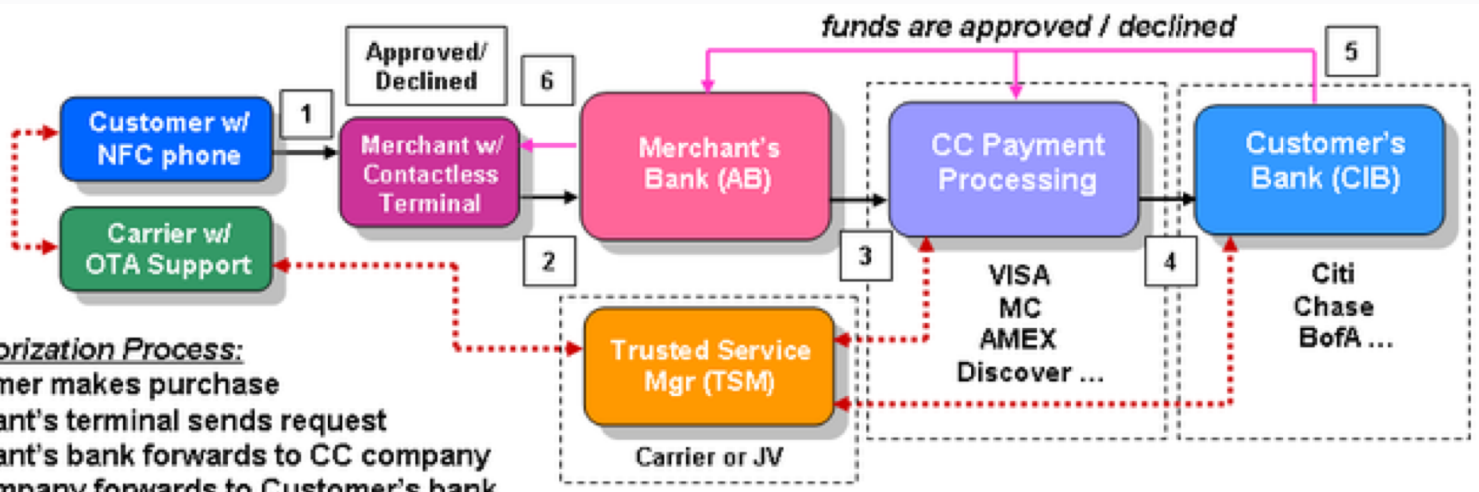4. CC company forwards to Customer's bank
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Source: **[Conkling2011]**
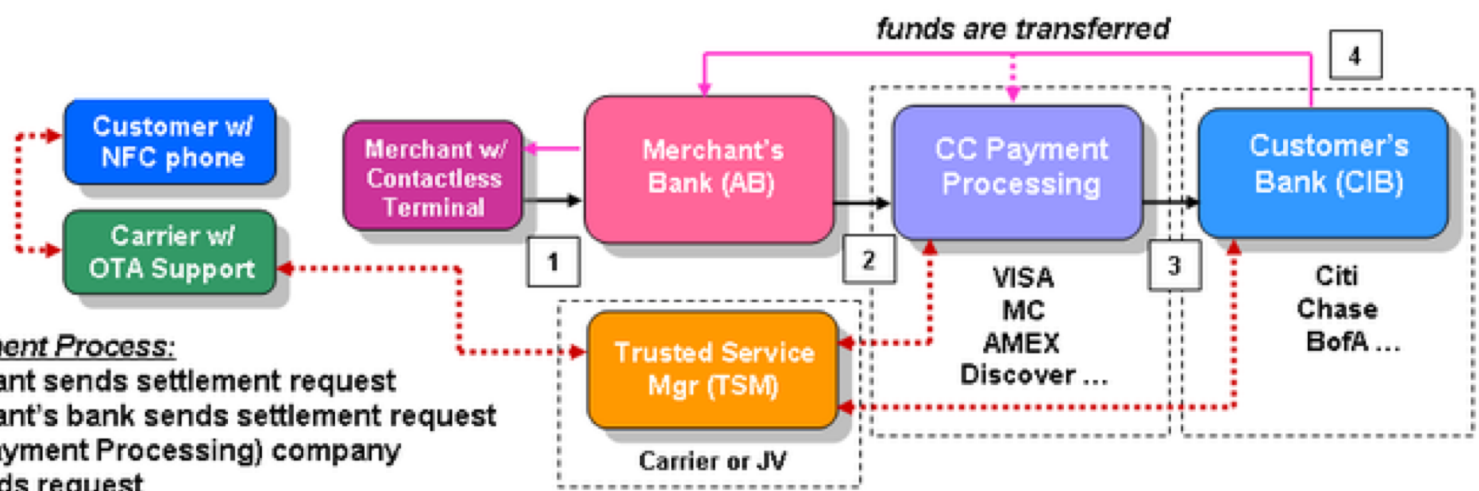
Basic Payment Process:

1. Merchant sends settlement request
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Note: colored dotted lines represent communication of information

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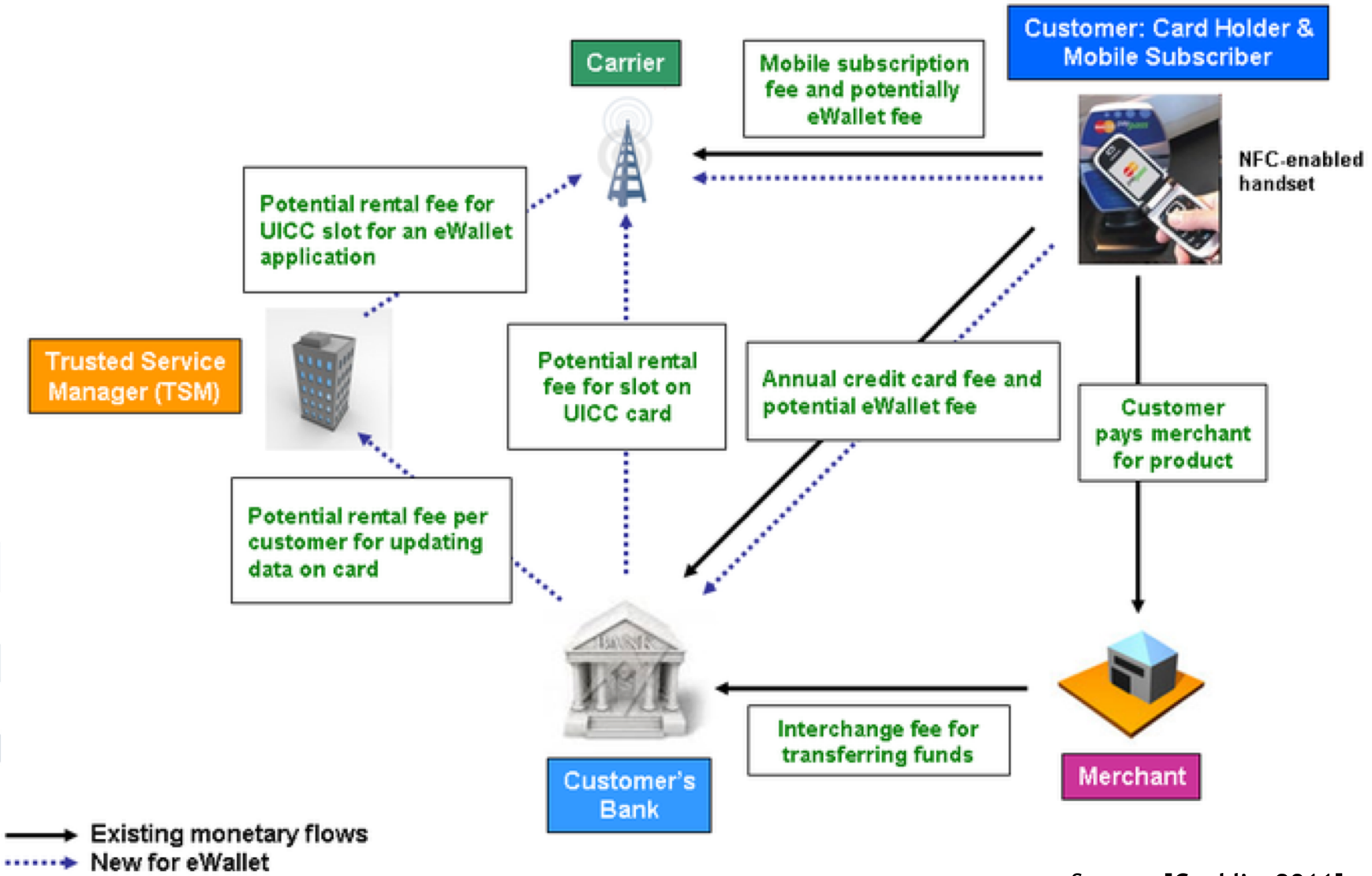
- Handsets

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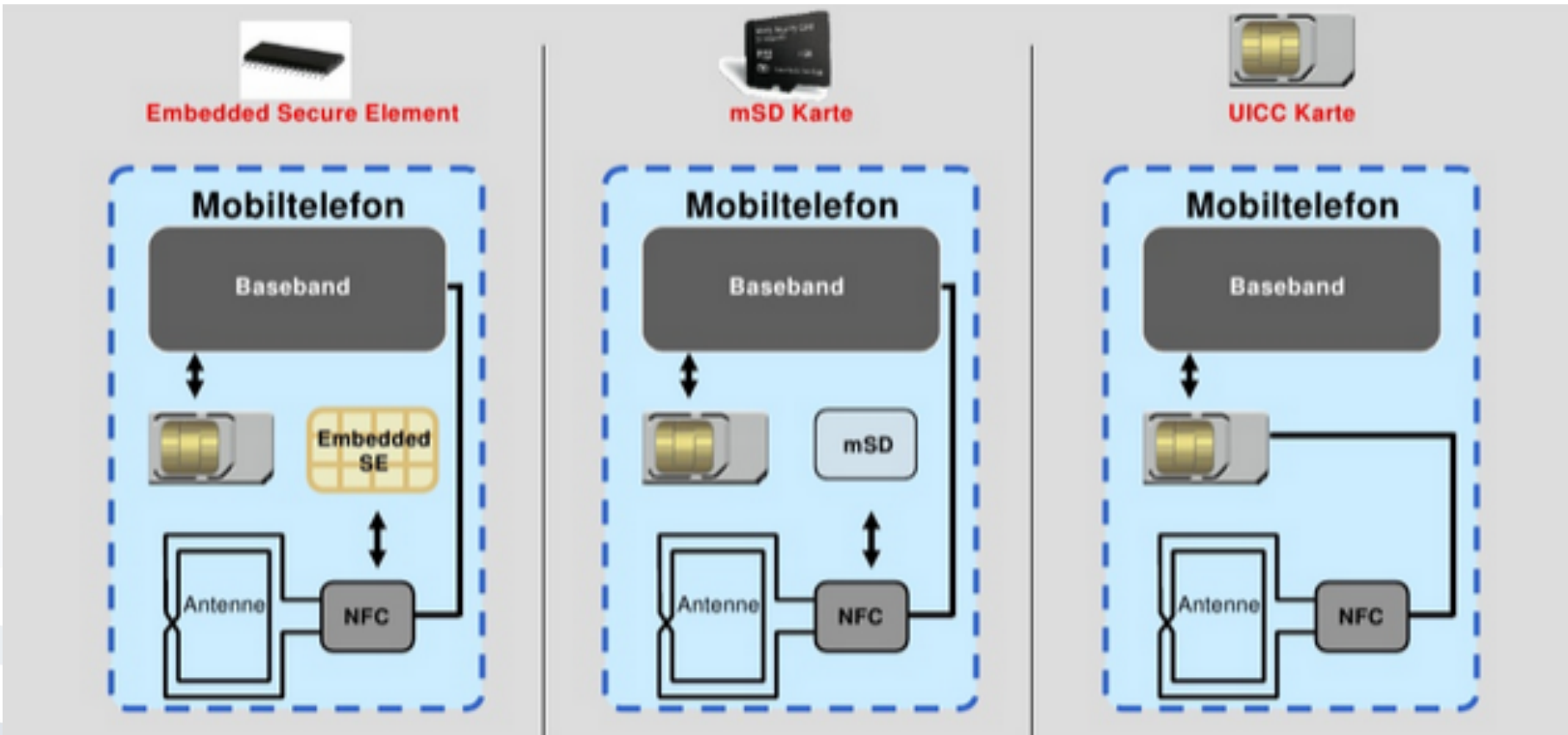
- There are good reasons for and against having the Secure Element integrated with the SIM card of the smartphone. Mobile Operators try to leverage the advantages of the SIM model.

✔ Advantages	✘ Disadvantages
- **Customer support:** If the handset is lost users can call the network 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 a mobile operator than an online brand when it comes to security.	- **Not universal:** Secure services can be enabled on mobile networks only where mobile 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 mobile operator. - **Limited space:** Only an average of five applications can fit on a SIM. - **Unclear future:** Insecure future of hardware SIM

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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.

[JuliusBär2014] Julius Bär. (2014). *Digital Payments: Mobile Payments*. Available at
https://www.juliusbaer.com/investors/en/news/detail/item/digital-payments-mobile-payments/

[Conkling2011] Conkling, C. *Mobile Payments and the Market Potential*. Available at
http://craigconkling.blogspot.de/2011/01/nfc-and-mobile-payment-initiative-4.html

[EdgarDunn2006] Edgar, Dunn & Company. *Mobile Payment Study*, 2006.

[EffingRankl2008] Effing, W. and Rankl, W. *Handbuch der Chipkarten: Aufbau – Funktionsweise – Einsatz von Smart cards*, Hanser-Verlag 2008.

[FrostSullivan2002] Frost & Sullivan. *Mobile Commerce Payment*. 13 May 2002.

[GSMAI2017] GSMA Intelligence. *Definitive data and analysis for the mobile industry*. Available
at http://gsmaintelligence.com (Last accessed 4 April 2017)

[GSMA2015] *One billion new unique mobile subscribers by 2020, finds new GSMA study*. May 2015. Available
at http://www.gsma.com/newsroom/press-release/one-billion-new-unique-mobile-subscribers-by-2020-gsma/

[Kröger2014] Kröger, F. Detecon – Mobile Payment Solutions. Presentation in the course: Strategies for Mobile Business, 2014.

[IEMR2011] IE Market Research. *3Q.2011 Global & Regional Mobile Payments Market Forecast*. Available at
http://i.co.uk/wp-content/uploads/2011/11/3Q2011GlobalMobilePaymentMarketForecastOverview-September6-2011.pdf (Last accessed 13-04-2017)

[iSuppli2010] *Cell Phone Mobile Payment Market Set for Take Off*. Available at www.isuppli.com/mobile-and-wireless-communications/news/pages/cell-phone-mobile-payment-market-set-for-take-off.aspx

[ITU2016] International Telecommunications Union (ITU). *ICT Facts and Figures 2016*. Available
at http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2016.pdf

[Penz2017] Robert Penz Blog. *Blue Code mobile payment – All show and no substance [3. Update]*. Available at
http://robert.penz.name/1273/blue-code-mobile-payment-all-show-and-no-substance/ (Last accessed 4 April 2017)

[Pousttchi2003] Pousttchi, K. *Conditions for acceptance and usage of mobile payment procedures*. Published in: Second International Conference on Mobile Business (mBusiness), Vienna/Austria, June 2003, pp. 201-210.

[PWC2014] *Mobile Payment in Deutschland 2020 - Marktpotenzial und Erfolgsfaktoren*. July 2014. Available at http://www.pwc.de/de/digitale-transformation/assets/pwc-analyse-mobile-payment.pdf

[PWC2016] *Mobile Payment Repräsentative Bevölkerungsbefragung 2016*. January 2016. Available at http://www.pwc.de/de/digitale-transformation/assets/pwc-bevoelkerungsbefragung-mobile-payment-2016.pdf

[Statista2015] Statista. *Global mobile payment revenue 2015-2019*. Available at https://www.statista.com/statistics/226530/mobile-payment-transaction-volume-forecast/ (Last accessed 13-04-2017)

[Statista2017] Statista. *Mobile Payments*. Available at https://www.statista.com/outlook/331/mobile-payments (Last accessed 13-04-2017)

[Statista2023] Statista. Mobile POS Payments – Worldwide. Accessed 20-04-2023 (https://www.statista.com/outlook/dmo/fintech/digital-payments/mobile-pos-payments/worldwide)

[UN2017] United Nations (UN). *Growth in United Nations membership, 1945-present*. Available at http://www.un.org/en/sections/member-states/growth-united-nations-membership-1945-present/index.html (Last accessed 04-04-2017)

[WikiMD2017] Wikipedia. *List of countries with McDonalds restaurants*. Available at https://en.wikipedia.org/wiki/List_of_countries_with_McDonald's_restaurants (Last accessed 04-04-2017)

[WikiSIMs2017] Wikipedia. *Subscribers identity module*. Available at https://en.wikipedia.org/wiki/List_of_countries_with_McDonald's_restaurants (Last accessed 04-04-2017)