Smart Card 101: Overview of Smart Card Technology

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APTA Fare Collection 101

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Giesecke & Devrient

Overview Contactless Card

Physical Characteristics

- Credit card sized device
- Contains one or more integrated circuits
- Data stored in chip's memory

Advantages

- Decreased dwell time at farebox
- Speedy, convenient, easy to use
- Card may remain in wallet during high speed communication
- Vandalism proof with robust cards & reader
- Reduced maintenance costs & extended life-time of the system

Contact vs Contactless

- Contact
  - Requires insertion into a reader
- Contactless
  - Must only be near proximity to the reader in order to exchange data

Types of chip cards

- Memory only Integrated Circuit Chip Card
  - “electronic magnetic stripes”
  - Higher data capacity than a magnetic stripe
  - Simply store data
  - Contain hardwired memory that cannot be overwritten

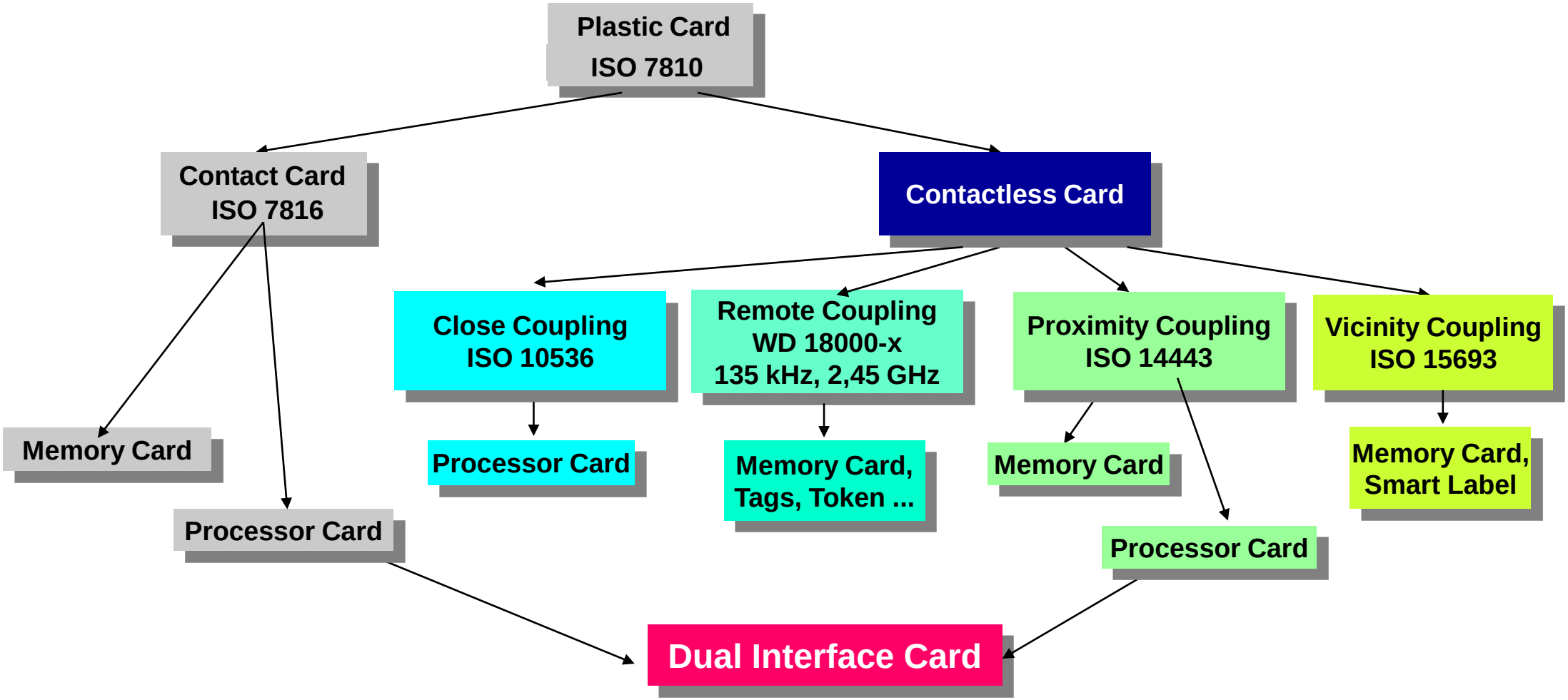
Types of chip cards – cont.

- Memory card with built-in logic
  - Provides authenticated access to the memory
  - Provides memory where one can read/write
  - Based on the access conditions, authentication needs to be performed before read/write
  - Example: MIFARE Classic 1K/4K

Types of chip cards - cont

- Microprocessor based chip
  - Contains microprocessor, operating system, read/write memory
  - ISO 14443A 1-4 compliant
  - Secure, high speed command set
  - Flexible file structure
  - Open crypto algorithm in hardware such as DES/3DES Or AES
  - Example: MIFARE DESFire

Contactless Card Types



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Contactless Card Types

	Memory	Microprocessor
Type A	**Mifare® 1K Mifare UL**	**Mifare DESFire, SmartMX, micropass (Inside), Infineon**
Type B		**Micropass (Inside), Infineon**
Other Types:	**Sony Felica**	
	Cubic GO CARD®	

ISO Standard

Not ISO Standard

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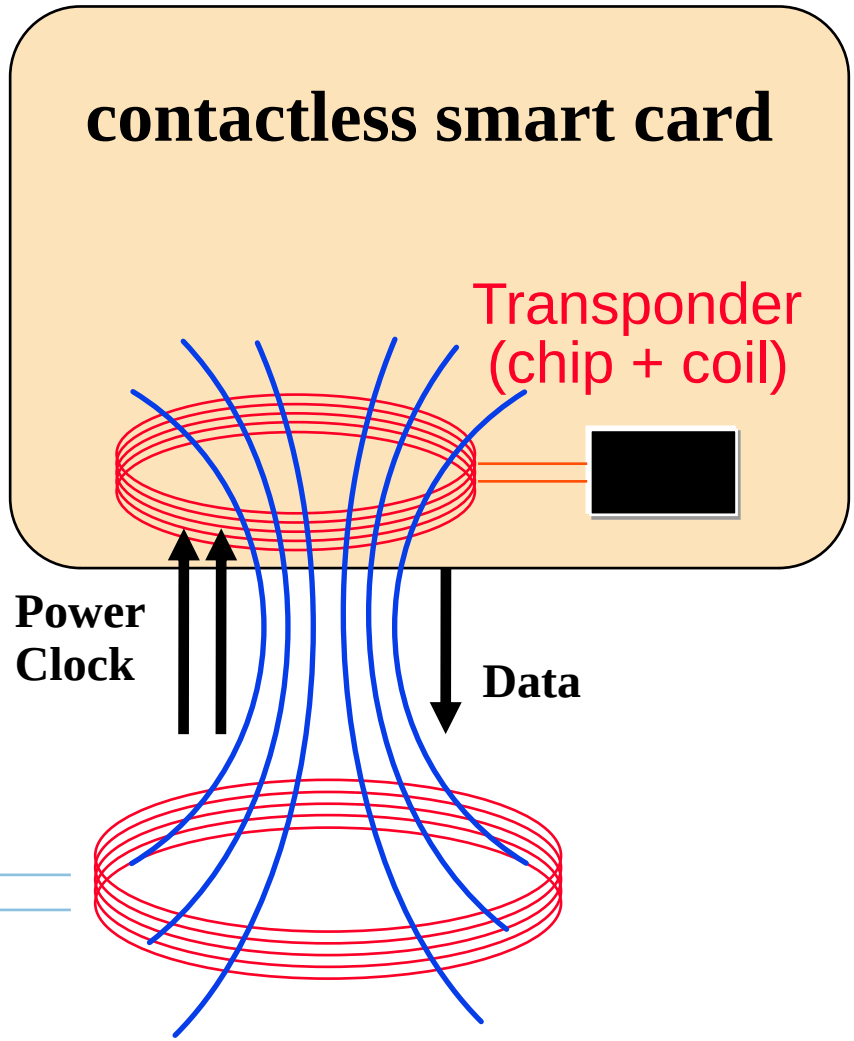
Contactless Card Technology

- Smart card transfers data using radio frequency technology via a transmitter and receiver



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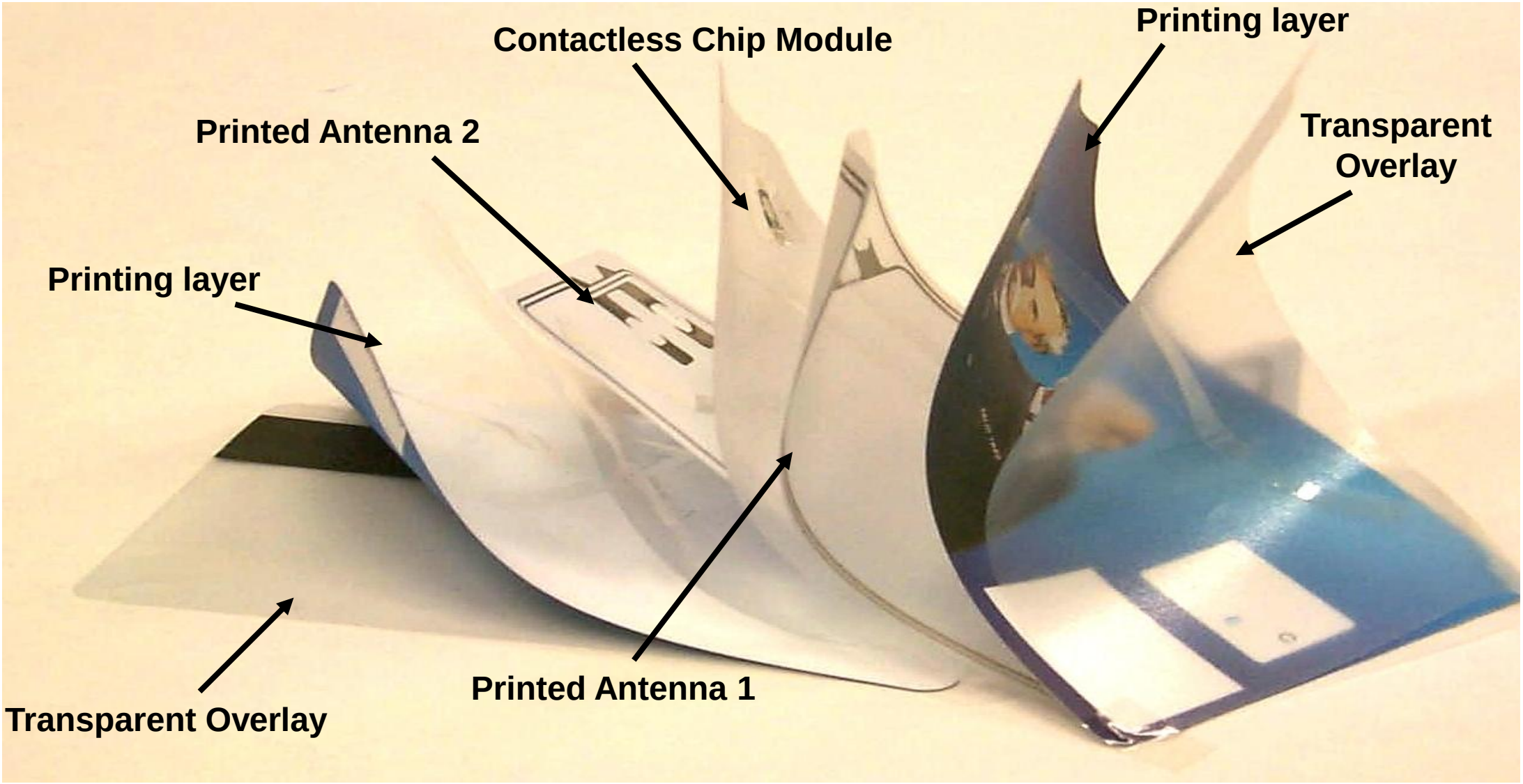
Contactless Cardbody Construction



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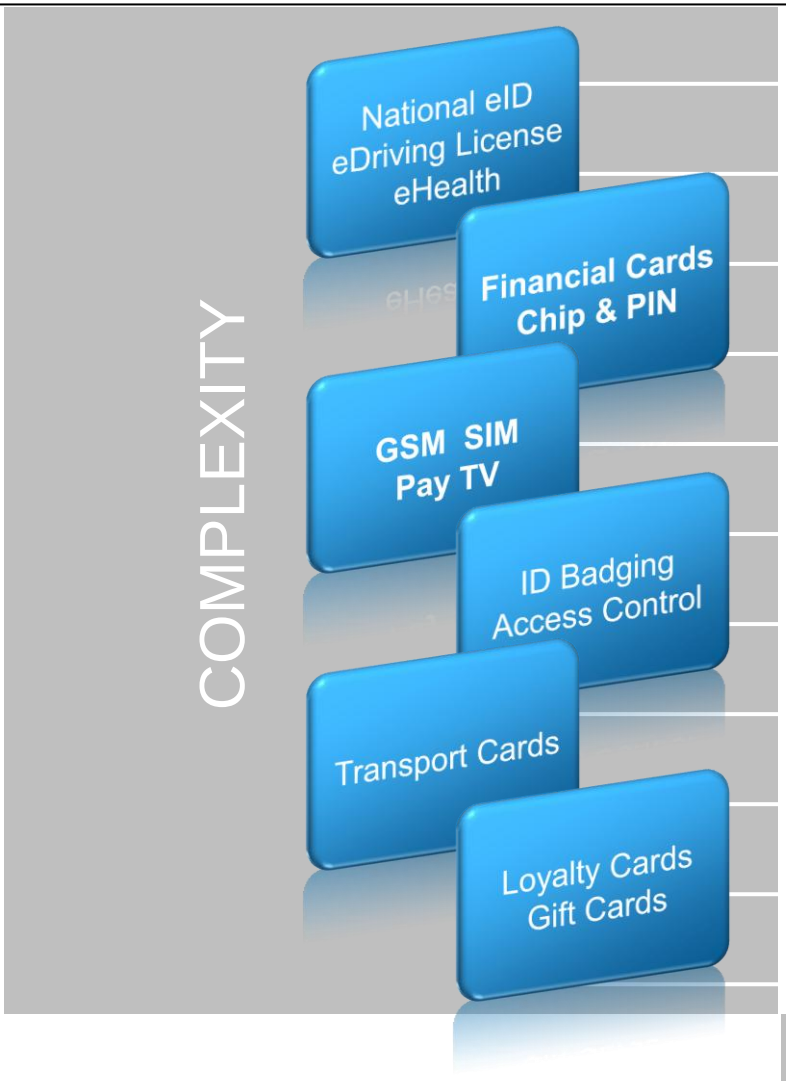
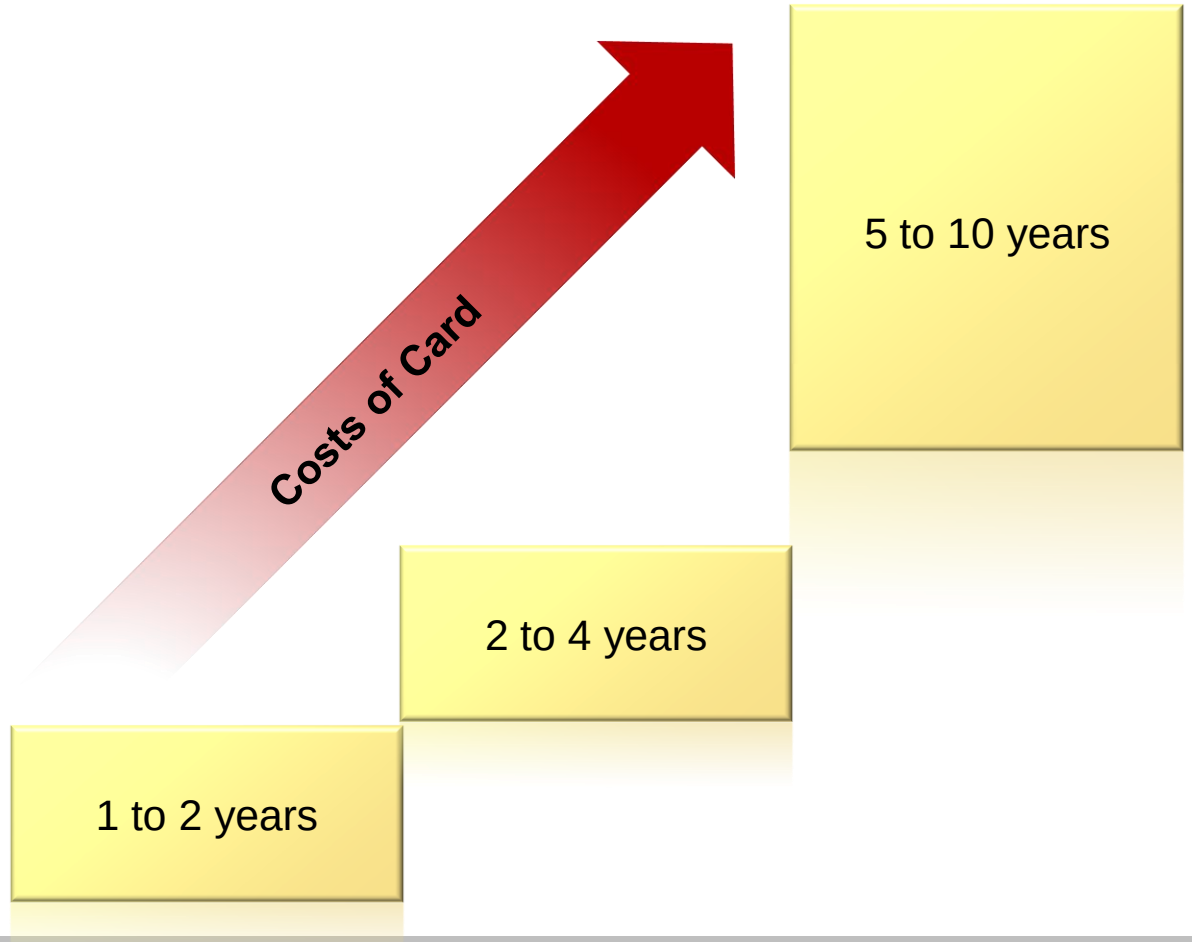
Cost vs. Complexity and Durability





DURABILITY

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Cost vs. Technology

	Contact-based	Contact-less	Dual Interface	Hybrid (2 chips)
Cost	A = 100%	A x 130 – 150 %	A x 150 – 170 %	A x 180 – 220 %

Cost of a smart card depends on various factors as the microprocessor, operating system, inlay and manufacturing costs vary case by case.

Standards & Interoperability

- ISO 7810/11 ➔ *Standard for ID cards and features*
- ISO 7816 ➔ *Standard for contact based smart cards*
- ISO 14443 ➔ *Standard for Type A & Type B contactless smart cards*

- Universal Transit Farecard Standards (UTFS)
- Contactless Fare Media Standard (CFMS)

Benefits of Contactless Card Systems

- **Vandalism proof bus or station equipment**
  - Less maintenance cost
  - More equipment availability
- **Same reader processes contactless cards and Limited Use tickets**
  - Less capital equipment cost
- **Convenient and easy to use**
  - **Customer satisfaction**
- **Secure**
  - More revenue
- **Modern Image**
- **Upgradable**

Evolution of Transit Fare Media

Coins

Tokens

Magnetic Stripe Cards

Contactless and Dual Interface Cards

Limited Use Contactless Cards

Other Form Factors
(contactless tokens and tags, NFC, microSD)

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Types of Fare Media

- Magnetic stripe cards
- Contact only cards
- Contactless cards
- Dual Interface cards
- Limited Use tickets
- Other form factors (contactless credit cards, NFC phones, microSD, mobile stickers, etc.)

Magnetic Stripe Cards

- The classic machine readable media
- Magnetic stripe can be encoded with fare data; expiry date, value, etc.
- Magnetic stripe is reuseable

Advantages

- No cash handling
- Provide improved ridership data
- Inexpensive for single or occasional use

Disadvantages

- Susceptible to fraudulent use
- Extensive reader maintenance required
- Dirt, grime or chemicals can interfere with the reader heads and degrade card and reader performance and reliability

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Contact Cards

- Smart card with an embedded memory or microprocessor and contact interface
- Contact points for power and data transfer
- Can be either memory or microprocessor
- Used as SIM cards, ID card (logical access), bank cards, loyalty cards, etc.

Advantages

- Reduced maintenance costs and extended life of system
- Easy handling and convenient
- Offers a step up in security from magnetic cards

Disadvantages

- Limited transaction speed unsuitable for high transaction volumes
- Physical contact between cards and readers reduce lifetime of cards and readers

Contactless Cards

- Card has one chip with contactless interface
- Most desirable smart card available today
- Widely used in transit and banking applications

Advantages

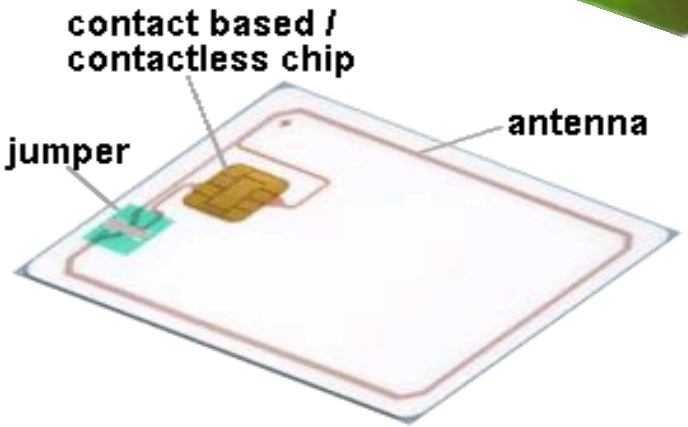
- Versatile
- Multi-application
- Cost effective
- Easy, fast and convenient to use

Disadvantages

- No identified disadvantage for transit
- Expensive for contactless credit or debit card applications

Dual Interface Cards

- Card has one chip that can be addressed by two interfaces
  - ISO 7816 for contact
  - ISO 14443 for contactless (13.56 MHz)
- Most versatile IC cards available
- Widely used in banking, retail and e-commerce



Advantages

- Versatile
- Multi-application
- Easy and convenient to use

Disadvantages

- Expensive
- Less reliable than other card types due to manufacturing complexity
- Contact applications may be uncertain or irrelevant for transit

Limited Use Ticket

- Similar to contactless cards, it has one chip with contactless interface
  - Small memory
  - Basic but sufficient security
  - Same ISO standard as other contactless cards (ISO 14443)
- Used mainly for single use rides, specific ticketing event, etc.

Advantages

- Low cost of ticket, and the reader
- Uses the same infrastructure as contactless cards (i.e., installation of an additional reader is not needed)
- Quick, seamless travel between bus and rail
- Lower maintenance cost than magnetic stripe tickets
- Serialized; fraudulent activities can be tracked

Disadvantage

- More expensive than magnetic stripe cards

Emerging Technologies and Trends

- Near Field Communications (NFC)
  - Phone is both card and terminal
- microSD with integrated antenna
  - Can change any mobile phone to an NFC phone
- Mobile phone sticker
  - Allows to use mobile devices for payment
- Open Payment
  - Bank cards can be used to pay transit fare
- Open Standard for Public Transport (OSTP)
  - Alternative transit contactless card technology

Thank You

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