Near Field Communication (NFC) Application

資應所

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Outline

- What is NFC?
- How does NFC works?
- Applications
  - Star Wars CommTech
  - NFC in Cars
  - Apple Wallet
- Industry Analysis
- Conclusion
- References

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- **What is NFC?**
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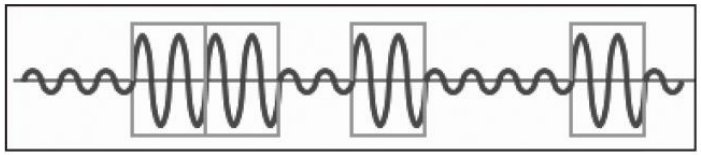
What is NFC? (1/4)

A short-range radio technology that enables communication between devices that are held in close proximity.

- **Features**
  - Frequency: 13.56 MHz (based on High Frequency RFID)
  - Range: 0-10 cm
  - Specification:
    ISO/IEC 14443 (for smart cards which store information)
    ISO/IEC 18000-3 (for RFID tags in smart devices)
  - Transmission Rate: Up to 424 Kbit/s
  - Allow two-way communication
  - Apply ASK (amplitude shift keying) modulation for low speed transmission



What is NFC? (2/4)

- **History**
  - Developed by Sony, Nokia and Philips
  - The first device to use an early version of NFC was a Star Wars toy from 1997, which used an early version of the technology called CommTech to give voice to the figures
  - NFC Forum was formed in 2014 by the companies to promote implementation and standardization of NFC technology to ensure interoperability between devices and services.
  - NFC Innovation Award

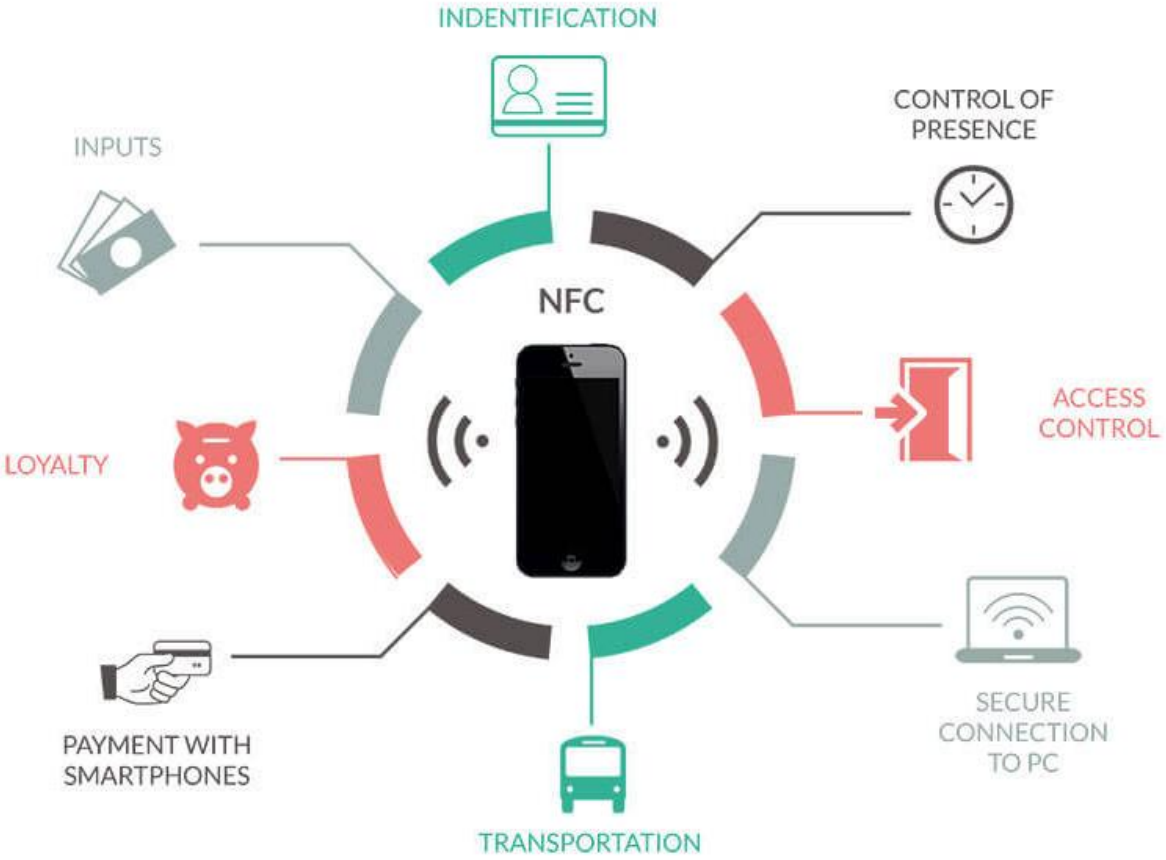
NFC FORUM

What is NFC? (3/4)

- **Scenario**

What is NFC? (4/4)

- **Applications**



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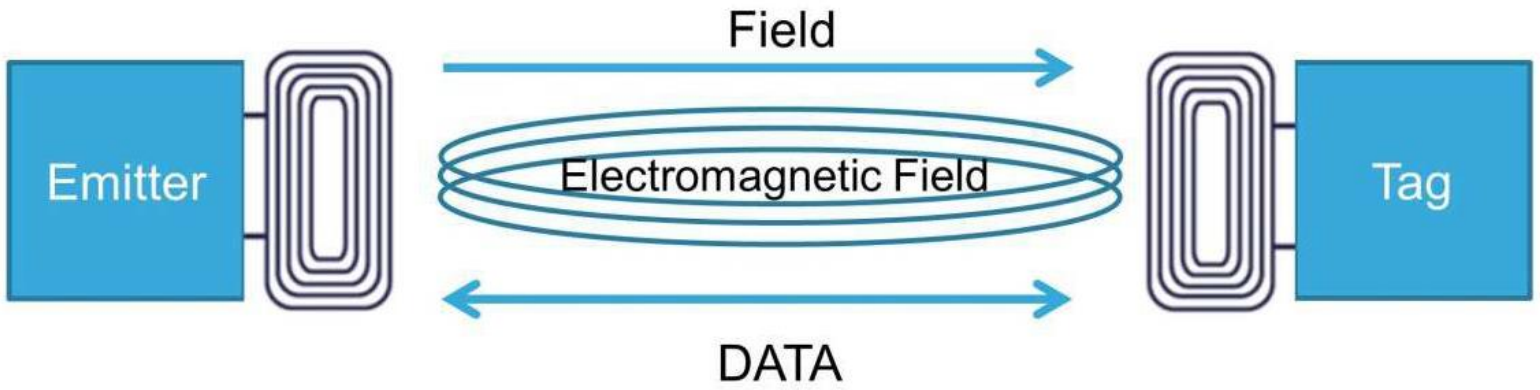
How does NFC works? (1/7)

- **Emitter/Master**
  - The initiator, which actively generates an RF field
- **Tag/Slave**
  - The target, which is passively powered by electromagnetic induction between two loop antennas



How does NFC works? (2/7)

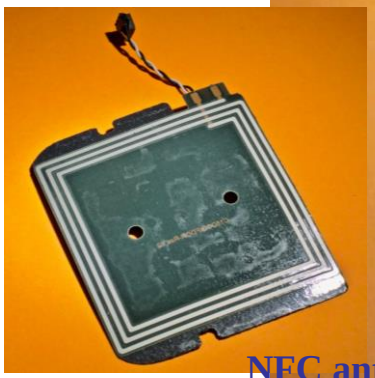
- **Square Contactless and Chip Reader**
  - Accepts NFC- and EMV-based payments

How does NFC works? (3/7)

- The top of the PCB

Chip reader for chip-based cards (mounted to the PCB via surface-mount pins and some glue)

Freescale K21 microcontroller (ARM Cortext-M4-based, handling the USB/Bluetooth interface)

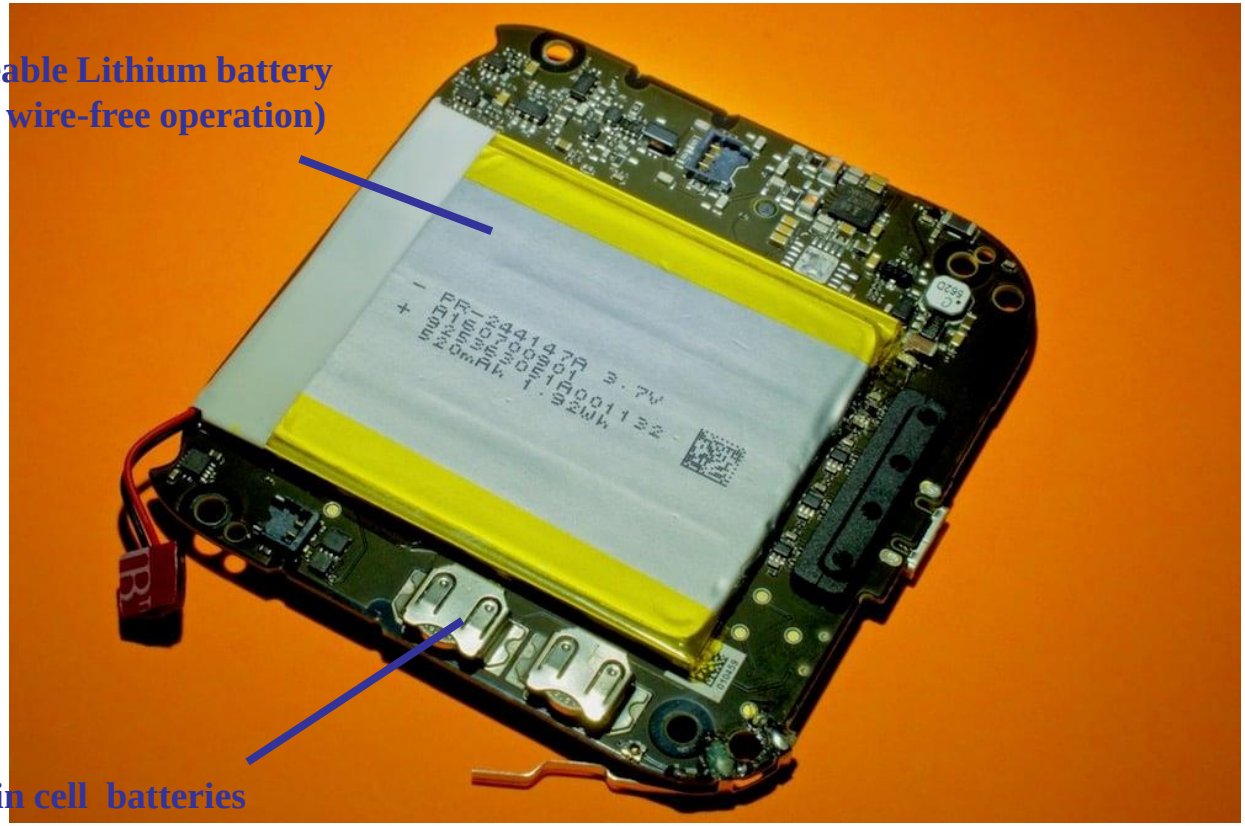


NFC antenna (located on the top of the plastic housing)

Custom Square IC (handles the communication with the payment methods)

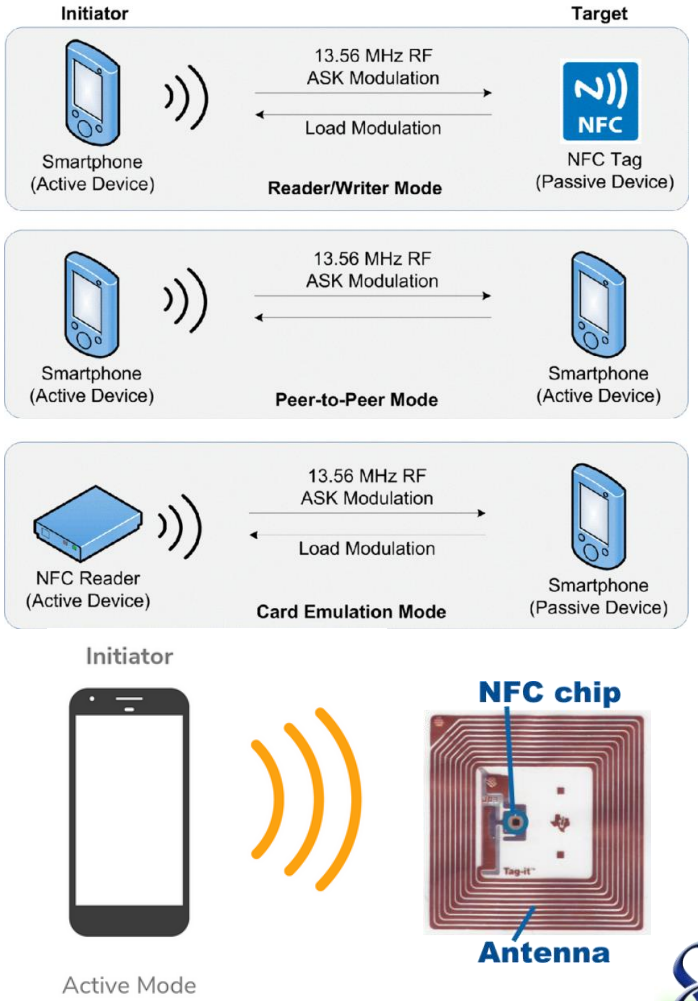
How does NFC works? (4/7)

- **The bottom of the PCB**



How does NFC works? (5/7)

- **NFC Reader Chip**
  - The main controller of the communication system
  - Powers up and exchanges information with one or more NFC tags
- **NFC Tag Chip**
  - Powered by the magnetic field generated by the NFC reader
  - Two types of NFC tags:
    - Single-interface NFC chip
    - Dual-interface NFC chip
- **NFC Controller Chip**
  - Combines both an NFC reader and an NFC tag for an integrated solution



How does NFC works? (6/7)

- **Single-interface NFC chip**
  - A passive device embedded in an NFC tag
  - Enables the exchange of data between the tag and the reader once being activated
  - NFC is the only wireless technology that can be used to interact with NFC tags

For example, when an NFC-enabled smartphone is brought within reading distance of a wine bottle that embeds an NFC tag in its cork, the NFC reader **can verify the origin of the tag** and detect if the bottle has been opened, thereby **ensuring the product's integrity**.

How does NFC works? (7/7)

- **Dual-interface NFC chip**
  - Also called an NFC Dynamic Tag
  - Coupled with a microcontroller through a wired interface, thereby offering a second communication interface in addition to the NFC wireless link
  - Enables two-way, wireless communication between two electronic systems, even when no power is supplied to the object carrying the NFC Dynamic Tag

For example, an NFC-enabled smartphone can read the information embedded in the NFC tag of a washing machine, such as the details concerning the condition of the appliance, including fault diagnostics

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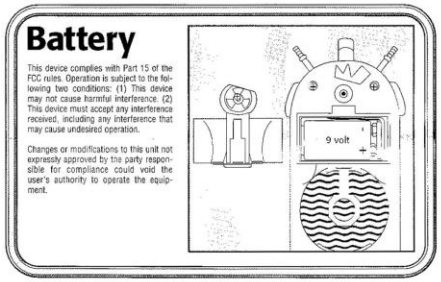
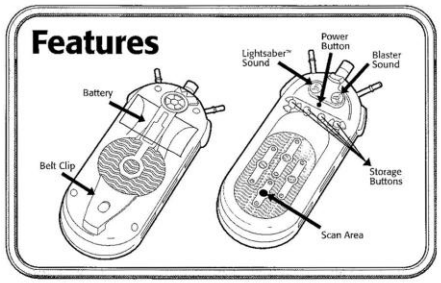
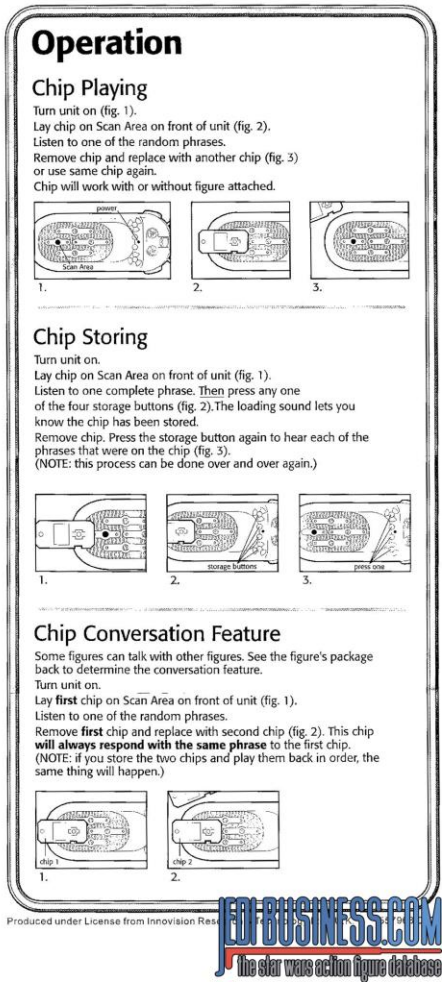
Applications (1/9)

- **Star Wars CommTech**







Applications (2/9)

- **NFC in Cars**
  - Car Door Handle
  - NFC Forum **CR13** (ensure that carmakers offer interoperable key systems using NFC)
  - 2020 NFC Innovation Contest 1st place: An interactive smart holder for cars (using ST's X-CUBE-NFC4 and X-NUCLEO-NFC04A1)
  - **ST25R3920** for Smart Car Key

Applications (3/9)

- **ST NFC/RFID Product**
  - Product line:
    - Electronic Tag
    - Dynamic Tag
    - Reader
  - Contactless interface protocol:
    - ISO 14443 for short distance transmission
    - ISO 15693 for long distance transmission

Applications (4/9)

- Apple Wallet

Applications (5/9)

- Apple Wallet

Applications (6/9)

- Apple Wallet

Applications (7/9)

- **Why Easy Card is not supported?**

卡片規格	採用卡片
FeliCa	Suica (Japan) Octopus (Hong Kong)
MIFARE Classic	90% Easy Card
MIFARE Plus/DESfire	iPASS iCash
CPU Card	Co-branded cards functioned as Electronic Ticket SuperCard

- Apple Pay do not support MIFARE Classic due to security issues.

Applications (8/9)

Tag Type	Use Case	Chip Examples	User Memory (bytes)*	UID Length (bytes)
Forum Type 1	Specialized	Innovision Topaz	90 - 454	4
Forum Type 2	Most common, low cost, single application like smart poster, personal label etc.	NXP MIFARE UL, MIFARE UL-C, NTAG 203, 210, 212, 213, 216 etc.	46 – 142	7
Forum Type 3	Specialized, Asian markets	Sony FeliCa (Lite)	224 – 3984	8
Forum Type 4	High memory applications, high security (in non NFC mode)	NXP MIFARE DESFire EV1 or EV2, Inside Secure VaultIC 151/161, HID Trusted Tag™, NTAG 413 / 424 DNA	1536 - 7678	7
Forum Type 5 (NFC-V / ISO 15693)	Typically industrial rugged tags in various form factors	NXP ICODE SLIx family, EM4233, Fujitsu FRAM MB89R118C, MB89R112, HID Vigo™	32 – 32KB (112 for ICODE SLIx)	8
MIFARE Classic/EV1	Very common, high memory – **not** an NFC Forum standard tag type!	NXP MIFARE Classic EV1 1K, 4K	716 - 3356	4 or 7

Applications (9/9)

NFC/RFID tag ICs: Types and applications

ST25TV Series

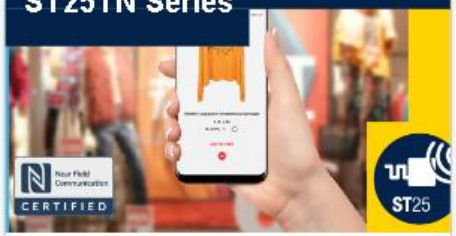
ISO/IEC 15693
NFC Forum Type 5

Applications:

- luxury
- healthcare & wellness
- wine & spirits
- pharmaceutical
- consumer packaged goods
- clothing & footwear
- gaming
- sports

View products →

ST25TN Series



ISO/IEC 14443 Type A
NFC Forum Type 2

Applications:

- luxury
- healthcare & wellness
- wine & spirits
- pharmaceutical
- consumer packaged goods
- clothing & footwear
- sports

View products →

ST25TA Series

ISO/IEC 14443 Type A
NFC Forum Type 4

Applications:

- business card
- smart poster
- Bluetooth/Wi-Fi pairing

View products →

Applications (9/9)

Dynamic NFC Tags			
ST25DV-I²C	ST25DV-PWM	M24LR	M24SR
ISO15693 up to 53kb/s NFC type 5	ISO15693 26kb/s NFC type 5	ISO15693 up to 53kb/s	ISO14443-A 106kb/s NFC type 4
256Bytes buffer EEPROM 4-Kbit to 64-Kbit 40-year, 1Mcycles	EEPROM 2-Kbit 40-year, 100k cycles	EEPROM 4-Kbit to 64-Kbit 40-year, 1Mcycles	EEPROM 2-Kbit to 64-Kbit 200-year, 1Mcycles
Fast Transfer Mode 64-bit password E-harvesting Field detect	64-bit password Up to 15-bit PWM resolution	32-bit password E-harvesting Field detect	128-bit password RF disable Field detect
I²C 1.8V - 5.5V 1MHz	Up to 2 PWM outputs 1.8V - 5.5V 488Hz to 31.25kHz	I²C 1.8V - 5.5V 400kHz	I²C 2.4V - 5.5V 1MHz
Metering, Lightning Healthcare Home automation	Industrial	Metering Lightning Healthcare	Consumer Home appliance Wearable

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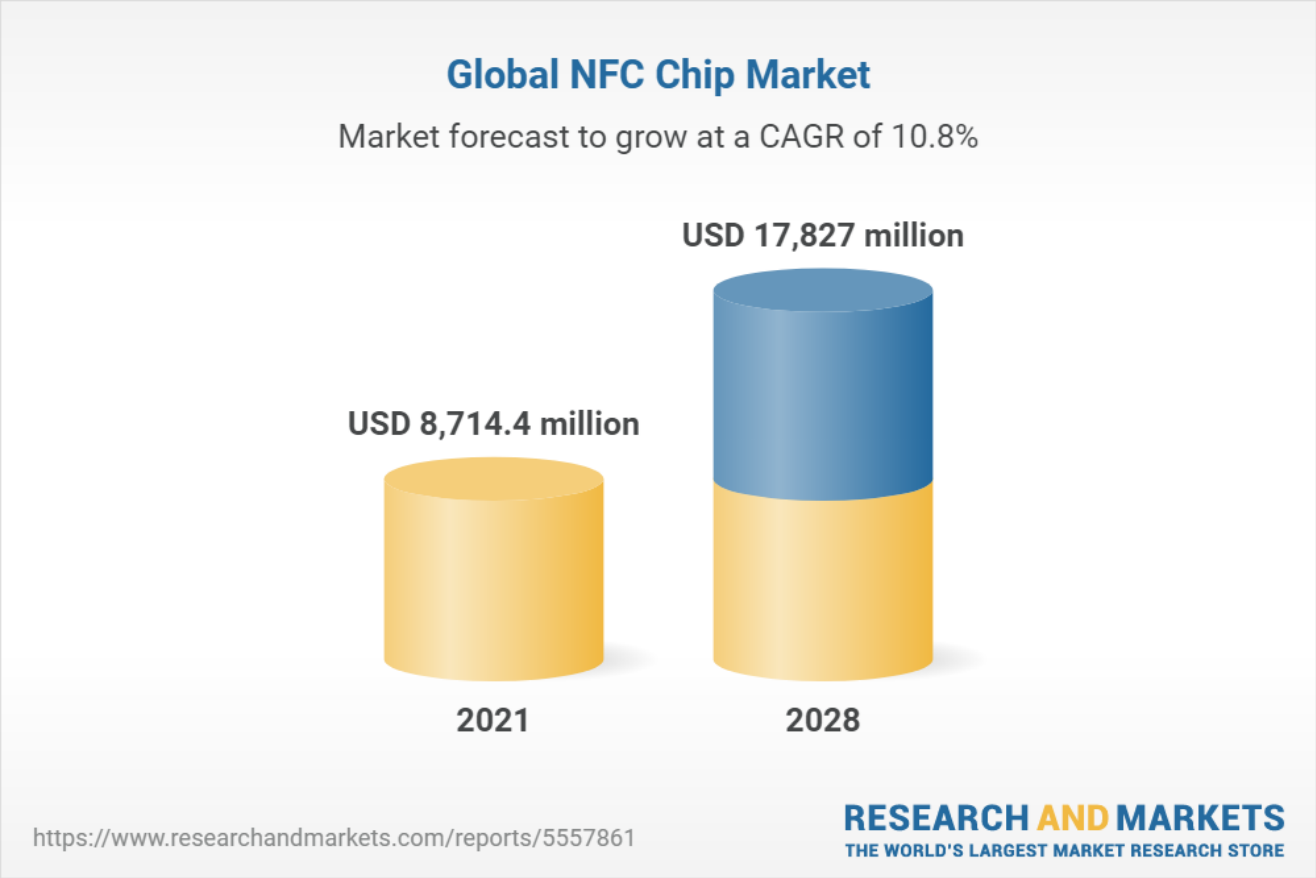
Industry Analysis (1/4)

Specification	NFC	RFID	Bluetooth
Maximum Coverage Range	10cm	3meter	100meter
Frequency of operation	13.56MHz	varies	2.4GHz
Communication	2-way	1-way	2-way
Data rate	106,212,4 24Kbps	varies	22Mbps
Applications	credit card related payments, e-ticket booking	EZ-Pass, tracking items	communication between phone and peripherals

Industry Analysis (2/4)

- **Market Forecast**



Industry Analysis (3/4)

- **Manufacturer**
  - Philips
  - NXP
  - INSIDESecure
  - ST
  - Sony
  - REALTEK
  - MTK

Industry Analysis (4/4)

- **Manufacturer**

行動支付三大廠

廠商	發展重點	主要技術	備註
恩智浦	主攻手機行動支付	SIM卡+嵌入式晶片組	NFC手機晶片全球市占達九成 嵌入式晶片也達七成
Inside Secure	擁大量NFC矽智財主攻晶片金融卡	MicroSD卡+嵌入式晶片組(結合安全元件+NFC晶片)	—
ST(意法半導體)	標籤型產品 安全元件MCU開發	嵌入式晶片+微控制器	—

整理：翁偉捷

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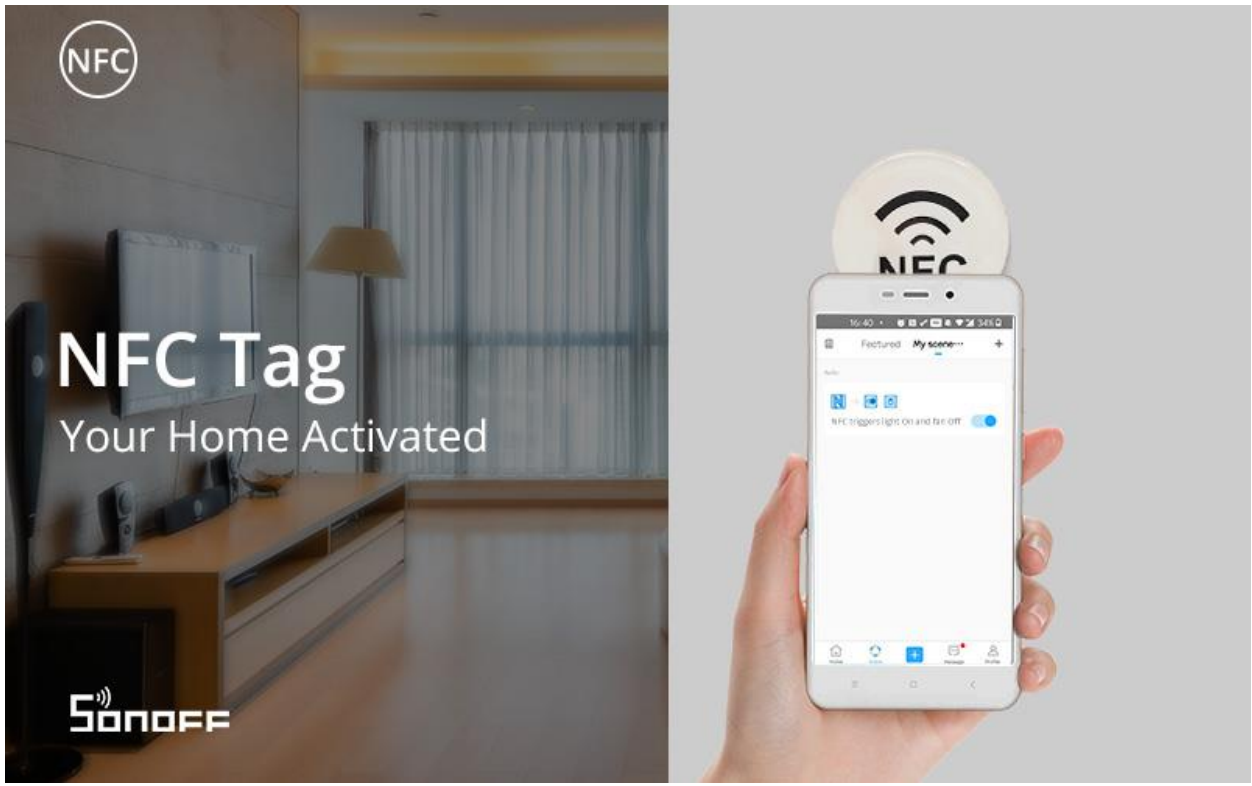
Conclusion

- **SWOT**
  - Strengths
    - Interoperability and multifunctional
    - Fast communication
    - High Security standards
    - Highly promoted by associations such as NFC Forum
  - Weaknesses
    - High investment on POS, SIM and device
    - Need to get a critical mass before to get foot hold in the market
  - Opportunities
    - Many potential application in different fields
    - Development of a new ecosystem
  - Threats
    - A lot of competitor technologies
    - Users resistance to changes

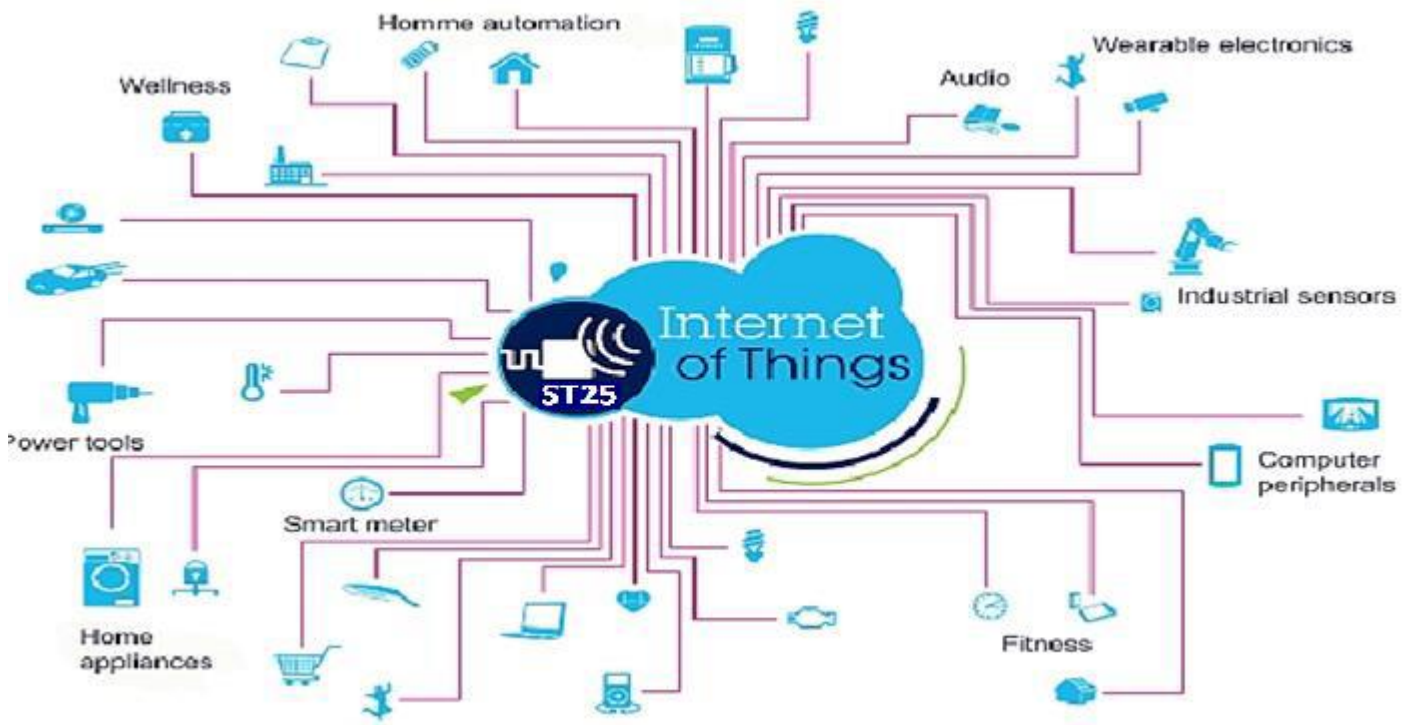
Conclusion

- **Future Scope**
  - Smart Home



Conclusion

- **Future Scope**
  - IoT and 5G



Conclusion

"NFC tags will play an inevitable role in future smart devices for more integrated functions, smart transportation, aviation industry, shipping, and manufacturing industry for automation of particular tasks. Integrating NFC technology with our modern data communication and transaction process ensures convenience, time-saving, energy efficiency, and most importantly improved security."

References

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- https://galacticfigures.com/articles.aspx/6062
- Near Field Communication (NFC) Market 2022 Share, Demand, Overview, Size, Trend and Forecast 2028 | NXP semiconductors, Gentag, Dukosi, Go To Tags (linkedin.com)
- ST25 NFC / RFID Tags & Readers - STMicroelectronics
- ST25 Dynamic NFC Tags - STMicroelectronics
- Apple pay為何不能綁悠遊卡？果粉想拿手機「嗶」進北捷，先克服3大難關 | 產業熱點 | 產業 | 經濟日報 (udn.com)
- 多元應用帶動全新想像 ST展現記憶體智慧風貌 (digitimes.com.tw)