POS TERMINALS AND NFC

JORDI JOFRE
NFC READERS
NFC EVERYWHERE
05/12/2017
Agenda

• NFC payment market.
• POS and mPOS system architecture.
• NFC and reader ICs portfolio for payments.
• NFC and reader ICs support package.
• POS reader design support package
  – SLN-POS-RDR reference design
  – POS certification support
NFC payment market
The evolution of payments

Form factors have followed the customer needs and available technology

1. Bartering
2. Coinage
3. Bank notes
4. Credit cards
5. Mobile payments

Now → Future
Pay anywhere, anytime using mobile magic
Pay without getting anything out of your pocket

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Coins</th>
<th>Notes</th>
<th>Checks</th>
<th>Cards</th>
<th>Phones</th>
<th>Wearables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptance device</td>
<td>Purse</td>
<td>Register</td>
<td>POS</td>
<td>mPOS, PC/Tablet, Embedded</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Payment terminals: POS and mPOS

TRADITIONAL POS

- Standalone solutions that allow the authorized acceptance of credit cards for financial transactions
- Their own screens and PIN pads to be able to process contact, contactless, and mag-stripe payments, often with a receipt printer included or attached.

MOBILE POS (MPOS)

- Secure accessory to a phone, tablet or PDA.
- Provide a solution for card reading using the connectivity of a handset/tablet to authenticate online
- Cost-efficient, portable and fast to install
- Small merchants, taxis, POS-multiplication
More than 70% of POS / mPOS solutions shipped are integrated with contactless card interface in 2016. By 2020, the percentage will be over 90%.

Global traditional POS market (wo china low end) kept double digital growth of 12% in 2016. PCI 5.0 (release end 2016) will also trigger new market increase.

mPOS total shipment in 2016 has increased by 14% since 2015 and is expected to show 5% CAGR for 2017~2022.

Low end mPOS (China). It moved to contact interface in 2016, with some contact-less penetration in 2017; expected to decrease due to stronger regulation.

Sources: POS, mPOS ABI research Q4 2017, China low end : NXP internal
POS and mPOS system architecture
POS and mPOS architecture
Payment terminal architecture is evolving

- **Legacy Payment**
  - Secure Micro controller/processor
  - PCI Compliant
  - Contact Reader interface
  - Contactless Reader interface
  - Tamper module
  - Fingerprint sensor
  - Camera

- **EMVco Payment**
  - SAMs (Up to x5)
  - USB OTG
  - CTS/RTS

- **Wireless Connectivity**
  - Bluetooth / Wi-Fi
  - GPRS/3G/4G/LTE

- **Standard Connectivity**
  - Wired Interfaces
    - Serial USB
  - SDIO UART / Flex IO

- **Power & Battery Management**
  - PMIC & Int. Battery Charger
  - External Memory
    - Nor, NAND, XIP
    - Memory, DDRx etc.

- **User Interface / Pin Entry**
  - Display (+ LCD Driver if not in the MCU)
  - Buttons (1-9, 0, CLR, C, Enter)
  - LEDs

- **Crypto Engine**
  - CAAM Engine
    - RSA, ECC, 3DES, ECC, SHA, DPA
  - TRNG
  - Etc...

- **Incumbent technology**
- **New technology being integrated**

- **Back-end system**

- **Smartphone / tablet**
Tablet POS, POS/mPOS split architecture – Trending!

- **Image**: Diagram showing the components of a Tablet POS system.
- **Key Components**:
  - **Application processor** running rich OS
  - **Secure Microcontroller** PCI Compliant
  - **Payment co-processor**
  - **QR Code Camera**
  - **Battery**
  - **Buzzer**
  - **Thermal Printer**
  - **External Memory NOR, NAND, DDRx**
  - **Wired Interfaces**
    - USB OTG
    - SDIO UART / Flex IO
    - SDRAM / QSPI
  - **Wireless Connectivity**
    - Bluetooth 2.1 / Bluetooth 4.2 / Wi-Fi
    - GPRS/Cellular
  - **Wired Interfaces**
    - USB OTG
    - SDIO UART / Flex IO
    - SDRAM / QSPI
  - **Display Controller**
  - **LED driver**
  - **EMEG Schottky Diode**
  - **Backlight DC/DC**
  - **Display**
  - **User Interface / Pin Entry**
  - **Sensor (for tamper resistance)**
  - **RTC**
  - **Contact Reader**
  - **Contactless Reader**
  - **SAMs (Up to x5)**
  - **Optional Magstripe Card Reader**
  - **Display Controller**
  - **Host interface**
  - **Crypto Engine** (RSA, ECC, 3DES, ECC, SHA, DPA)
  - **TRNG**
  - **FAC**
  - **SPI / UART**
  - **ADC**
  - **Security TV Tamper Pins**
  - **Sensors**
  - **Display**
  - **User Interface**
  - **Payment processor**

- **Standard Connectivity**
- **GPRS/Cellular**
- **USB OTG**
- **SDIO UART / Flex IO**
- **SDRAM / QSPI**
- **I2S Timer / PWM**

- **Wireless Connectivity**
- **Bluetooth 2.1 / Bluetooth 4.2 / Wi-Fi**
- **GPRS/Cellular**

- **Payment co-processor**
  - **2 x EMVSIM**
  - **ISO 7816-3**
  - **SDIO UART / Flex IO**
  - **EMVSIM**
  - **RTC**
  - **Contact Reader**
  - **Contactless Reader**
  - **SAMs (Up to x5)**
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- **Thermal Printer**
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- **Security TV Tamper Pins**
- **Sensors**
- **Display**
- **User Interface**
- **Payment processor**

- **Training Mobile Knowledge**

- **NXp**
NFC and reader ICs for payment: Product details
CLRC663 plus – push your design further

Best performance at lowest power consumption

- Full RF standard compliance
- High performance and more flexible antenna design
- EMVCo 2.6 ready (analog & digital compliance)
- Longer battery life: Power-saving modes and extended LPCD options.
- Industrial / Automotive temperature range (-40 °C – 105° C)
- Multiple interfaces and support for high-security reader implementations
- Compact package (HVQFN32 with wettable flanks)
Maximum operating transmitter current increases by 40% for CLRC663 plus with 2x the limiting value of the CLRC663

CLRC663 plus has new configuration options(2) enabling up-to 2.5x the detection range in LPCD(1) mode

CLRC663 plus has an automotive or industrial operating temperature range: -40 to +105°C

CLRC663 plus enables better support for battery powered systems

1. Low Power Card Detection
2. New LPCD configuration options are Charge Pump (enabled/disabled) and LPCD Filter (enabled/disabled)
PN5180 – The Best full NFC frontend in the market

- Multi-protocol and high RF performance
  - Full NFC Forum and EMVCo compliant frontend
  - Flexible low power card detection
- Efficient, robust and reliable operation even in harsh conditions
- Maximum interoperability for next generation of NFC phones
- Onboard Dynamic Power Control (DPC) for optimized RF performance
- Fast SPI host interface with optimized commands for use with 32-bit host controllers
- Small, industry-standard packages with BGA form factor for PCI compliance.
PN5180 – DPC in more detail

Dynamic Power Control enables up to 30% increase of the nominal driver current at same max driver spec

EMVCo analog compliancy - too high power in close distance (clipping)
EMVCo analog compliancy - high power required in far distance to reach minimum levels (comm distance)

PN5180… without DPC
PN5180… with DPC theoretical optimum - getting the best long range power and avoiding close coupling power impacts
PN5180… with DPC typical example - reaching long range requirements and optimising current consumption

Dynamic Regulation of...
- Transmitter current for detuning compensation
- H-Field within the operating volume
- Modulation index and rise/fall times

Dynamic Power Control enables up to 30% increase of the nominal driver current at same max driver spec
PN7462 – NFC and contact interfaces, MCU, and SW one chip

The first all-in-one NFC solution

- Integrated Cortex-M0 microcontroller with customizable memory
- State of the art RF interface with EMVCo and NFC Forum compliance for easy certification
- DPC for optimized antenna performance
- Contact interface compliant with ISO/IEC 7816-2 to 4
- One configurable host interface: I2C, SPI, USB, HSUART
- Two master interfaces: I2C and SPI and 12 to 21 GPIOs
- Advanced power management
- HVQFN64 package (9x9 mm)
PN7462 as a payment co-processor for a POS system

EMVCo compliant contactless and contact interfaces

SAMs

27.12MHz

Contactless IF

ISO/IEC7816

PC

AUX I/O

SPI

USB

TDA8026

PN7462

PN7462 as EMVCo L1 co-processor

PCI compliant CPU

Using an LCD
NFC and reader ICs for payment: Product comparison
NXP offers a complete CL/NFC portfolio for POS/mPOS

<table>
<thead>
<tr>
<th>Reader / writer</th>
<th>ISO/IEC 18092 Target</th>
<th>ISO/IEC 18092 Initiator</th>
<th>Output power (TX current)</th>
<th>EMVCo RF</th>
<th>Dynamic Power Control</th>
<th>SW stack</th>
<th>Integrated CPU</th>
<th>Integrated contact interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLRC663+</td>
<td>ISO/IEC14443 FeliCa</td>
<td>Passive</td>
<td>5V (350mA up to 500mA peak)</td>
<td>EMVCo L1 without booster</td>
<td>No</td>
<td>EMVCo L1 NFC Reader</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>PN5180</td>
<td>ISO/IEC14443 FeliCa</td>
<td>Active &amp; Passive</td>
<td>5V (250mA)</td>
<td>EMVCo L1 without booster</td>
<td>Yes</td>
<td>EMVCo L1 NFC Forum</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>PN7462</td>
<td>ISO/IEC14443 FeliCa</td>
<td>Active &amp; Passive</td>
<td>5V (250mA)</td>
<td>EMVCo L1 without booster</td>
<td>Yes</td>
<td>EMVCo L1 CL EMVCo L1 CT NFC Forum</td>
<td>Cortex M0</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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**CLRC663+**
- ISO/IEC14443 FeliCa
- ISO/IEC15693
- Passive
- 5V (350mA up to 500mA peak)
- EMVCo L1 without booster
- No
- EMVCo L1 NFC Reader
- No
- No

**PN5180**
- ISO/IEC14443 FeliCa
- ISO/IEC15693
- Active & Passive
- 5V (250mA)
- EMVCo L1 without booster
- Yes
- EMVCo L1 NFC Forum
- No
- No

**PN7462**
- ISO/IEC14443 FeliCa
- ISO/IEC15693
- Active & Passive
- 5V (250mA)
- EMVCo L1 without booster
- Yes
- EMVCo L1 CL
- EMVCo L1 CT NFC Forum
- Cortex M0
- Yes

**Reader & Writer**
- Peer-to-Peer
## NXP offers a complete CT reader portfolio for POS & mPOS

<table>
<thead>
<tr>
<th>Card class support</th>
<th>EMVCo L1</th>
<th>Number of card slots</th>
<th>ESD protection</th>
<th>Card management</th>
<th>Package</th>
<th>SW stack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class A,B,C</td>
<td>Compliant</td>
<td>1</td>
<td>8 kV</td>
<td>Sync &amp; Async</td>
<td>HVQFN24</td>
<td>EMVCo L1</td>
</tr>
<tr>
<td>TDA8034</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Class A,B,C</td>
<td>Compliant</td>
<td>1</td>
<td>10 kV</td>
<td>Sync &amp; Async</td>
<td>HVQFN32</td>
<td>EMVCo L1</td>
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<tr>
<td>TDA8035</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class A,B,C</td>
<td>Compliant</td>
<td>5</td>
<td>7 kV</td>
<td>Sync &amp; Async</td>
<td>TFBGA64</td>
<td>EMVCo L1</td>
</tr>
<tr>
<td>TDA8026</td>
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</tbody>
</table>
NFC and reader ICs for payment:
Support package
CLRC663 plus, PN5180 and PN7462 development kits

- Straightforward antenna design with NFC Cockpit tool
- Different antenna PCBs for easy antenna matching
- Easy application development with NFC Reader Library
NFC Reader Library support for multiple products and platforms

**Supported products:**
- CLRC663 plus
- PN5180
- PN7462AU

**Supported dev boards:**
- CLEV6630B
- PNEV5180B
- PNEV7462B

**Supported platforms:**
- LPC1769, LPC11U68
- FRDM-K82F
- Raspberry Pi Model 3
- … and portable to other MCUs and platforms.


* NFC Reader Library v5.02.00
NFC cockpit

NFC Cockpit features

- Direct access to registers and EEPROM memory.
- Reader for card activation and card communication.
- Low Power Card Detection (LPCD) calibration and configuration.
- Test signal unlocking and routing.
- RX matrix test for receiver settings optimization.

- Helps to speed up the design, allows quick and easy configuration of registers (USB interface connection to PC) using the development board.
- Get familiar with the IC (on line information of register bits), a fast antenna tuning, a quick DPC parameter setting and to perform some tests with NFC devices (cards or mobile phones).
POS reader design support package
SLN-POS-RDR reference design
SLN-POS-RDR reference design

**HW**
- Reference design
- Secure Touch PIN Pad, CT/CL

**SW**
- Professional Grade EMV L1/L2
- Full Transaction Simulation

**Support**
- Application Expertise
- Detailed software documentation

**Certification**
- PCI 4.1 PED Certification
- EMV L1/L2 CT/CL pre-certification

**Benefits:**
- Reduced Time to Market
- Reduced Risk
- Reduced Development Cost

NXP Point of Sale (POS) Reader Solution
SLN-POS-RDR
Point of Sale (POS) Reader Solution Architecture SLN_POS_RDR

- **Legacy Payment**
- **Secure Microcontroller**
  - **PCI Compliant**
  - **Kinetis: K81**
  - **Crypto Engine**
    - LTC Engine
      - (RSA, ECC, 3DES, ECDSA, SHA, DPA)
    - TRNG
    - FAC
    - 2 x EMV SIM
    - SPI / Flex IO
  - **SDRAM / SPI**
  - **ADC**
  - **I2S**
  - **Timer / PWM**
- **External Memory**
  - NOR XIP
- **RTC**
- **Real Time Clock**
- **Wi-Fi b/g/n**
- **BT / BLE**
- **GPRS / Cellular**
  - 4Mbit/s
- **SDIO UART / Flex IO**
- **GPRS / Cellular**
- **4 x EMV SIM**
  - Timer / PWM
  - FAC
  - TRNG
  - LTC Engine
    - (RSA, ECC, 3DES, ECDSA, SHA, DPA)
  - Crypto Engine
- **User Interface / Pin Entry**
- **Display**
  - (+ LED Driver if not in the MCU)
- **LEDs**
- **Sensors**
  - (for tamper resistance)
- **NXP / FSL**
- **3rd Party**
- **Not Included**

**Wired Interfaces**
- **Serial**
- **USB**

**Wireless Connectivity**
- **Serial**
- **USB OTG**
- **SDIO UART / Flex IO**

**Optional Magstripe Card Reader**
- Legacy Payment

**Contact Reader**
- TDA8035

**Contactless Reader**
- PN5180

**EMVco Payment**
- Card Reader

**NXP Solutions**
- Battery
- PMU (Discrete)
- Buzzer
- Thermal Printer
- RTC Real Time Clock
- External Memory NOR XIP
- ADC
- Display
- LED
- User Interface / Pin Entry

**Not Included**
- Secure Touch AFE
- LEDs
- Display (+ LED Driver if not in the MCU)
- Secure Touch AFE
- User Interface / Pin Entry
POS reader design support package
Certification support
<table>
<thead>
<tr>
<th>Certification</th>
<th>NXP support</th>
<th>End customer</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMVCo L1 contact analog</td>
<td>Application notes; demo board; Report from test house&lt;br&gt;Customer schematic validation</td>
<td>Final device need to be tested at a certified lab</td>
</tr>
<tr>
<td>EMVCo L1 contact digital</td>
<td>Application note; source code; ICS example; internal test report&lt;br&gt;Support on NXP stack integration&lt;br&gt;Support on EMV test suite errors</td>
<td>Final device need to be tested at a certified lab</td>
</tr>
<tr>
<td>EMVCo L2 contact</td>
<td>Link to partners for stack ; Pre integration support if NXP L1 stack is used</td>
<td>Final device need to be tested at a certified lab</td>
</tr>
<tr>
<td>EMVCo L1 contactless analog</td>
<td>Antenna design guide, loop back example; internal test report; demo board&lt;br&gt;Antenna design support &amp; RF support from CAS team</td>
<td>Final device need to be tested at a certified lab</td>
</tr>
<tr>
<td>EMVCo L1 contactless digital</td>
<td>Source code; application note ICS example; internal test report&lt;br&gt;Support on NXP stack integration&lt;br&gt;Support on EMV test suite errors</td>
<td>Final device need to be tested at a certified lab</td>
</tr>
<tr>
<td>EMVCo L2 contactless</td>
<td>Link to partners for stack ; Pre integration support if NXP L1 stack is used</td>
<td>Final device need to be tested at a certified lab</td>
</tr>
<tr>
<td>Certification</td>
<td>NXP support</td>
<td>End customer</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>PCI PTS 4.0 (security certification of the terminal)</td>
<td>Link to PCI test lab or external consultant</td>
<td>Certification</td>
</tr>
<tr>
<td>Country specific security certifications (UKCC, SEPA,…)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEM Regulatory certification</td>
<td>Guidelines for contact-less</td>
<td>Certification</td>
</tr>
<tr>
<td>ROHS</td>
<td>Provides ROHS compliance report of NXP components</td>
<td>Request document from manufacturing entity</td>
</tr>
<tr>
<td>Card acceptance scheme validation (Mastercard PayPass, VISA PayWave,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amex ExpressPay, DiscoverZip for contactless)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To be checked with EMVL2 supplier.
Payment ecosystem is going cashless

• By 2020, almost 100% of new point of sales terminals (POS) deployed are expected to support contactless technology.

• NXP offers a complete contact and contactless reader IC portfolio for POS terminals.

• NXP SLN-POS-RDR platform is providing a solid base for POS or mPOS development
  - Security controller or processor with PCI pre-evaluation
  - Strong expertise in contact and contact-less readers
  - Fully qualified EMV L1 software stack
  - Partners for EMV L2
Software development in Android and iOS
Embedded software for MCUs
JCOP, Java Card operating Systems
Hardware design and development
Digital, analog, sensor acquisition, power management
Wireless communications WiFi, ZigBee, Bluetooth, BLE
Contactless antenna RF design, evaluation and testing

MIFARE® product-based applications
End-to-end systems, readers and card-related designs
EMVco applications
Readers, cards, design for test compliancy (including PCI)
Secure Element management
GlobalPlatform compliant backend solutions
Secure services provisioning OTA, TSM services

We help companies leverage the mobile and contactless revolution

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(Spain)

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