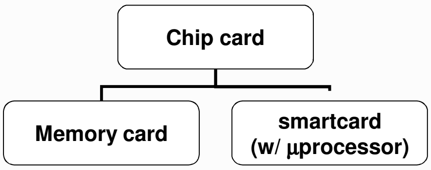
Smartcards

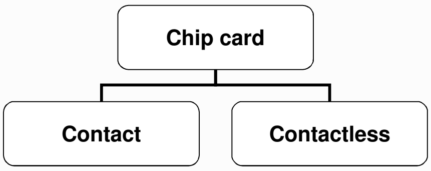
https://pplware.sapo.pt/informacao/saiba-como-renovar-online-o-seu-cartao-de-cidadao/
https://knowtechie.com/security-matters-5-benefits-of-contactless-smart-cards/

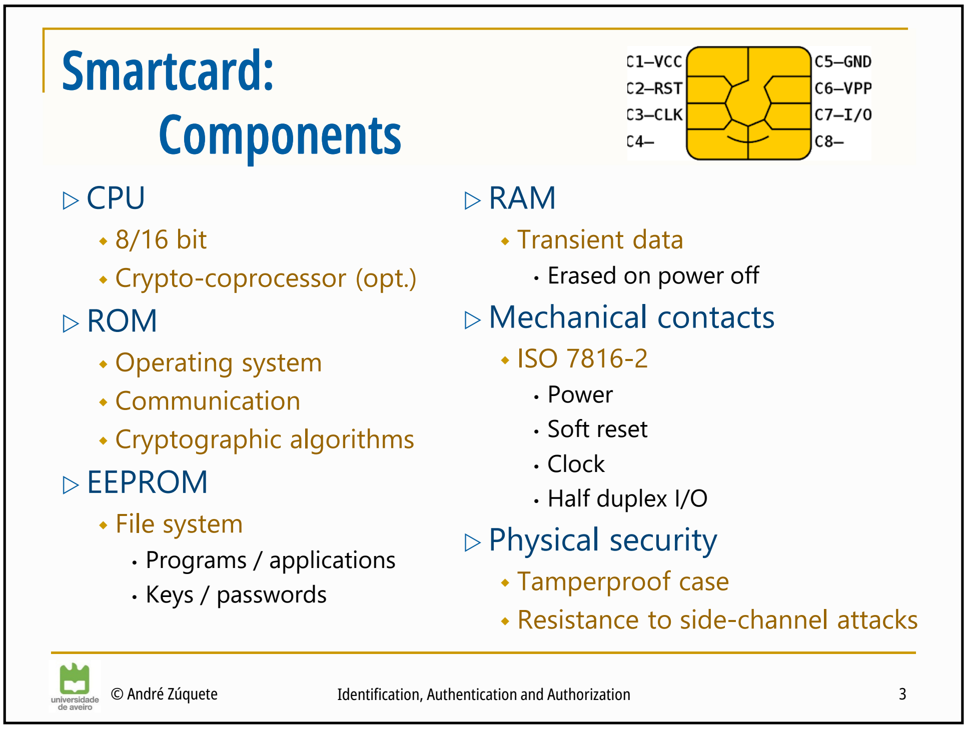
Smartcard: Definition

- ▷ Card with computing processing capabilities
  - CPU
  - ROM
  - EEPROM
  - RAM



- ▷ Interface
  - With contact
  - Contactless

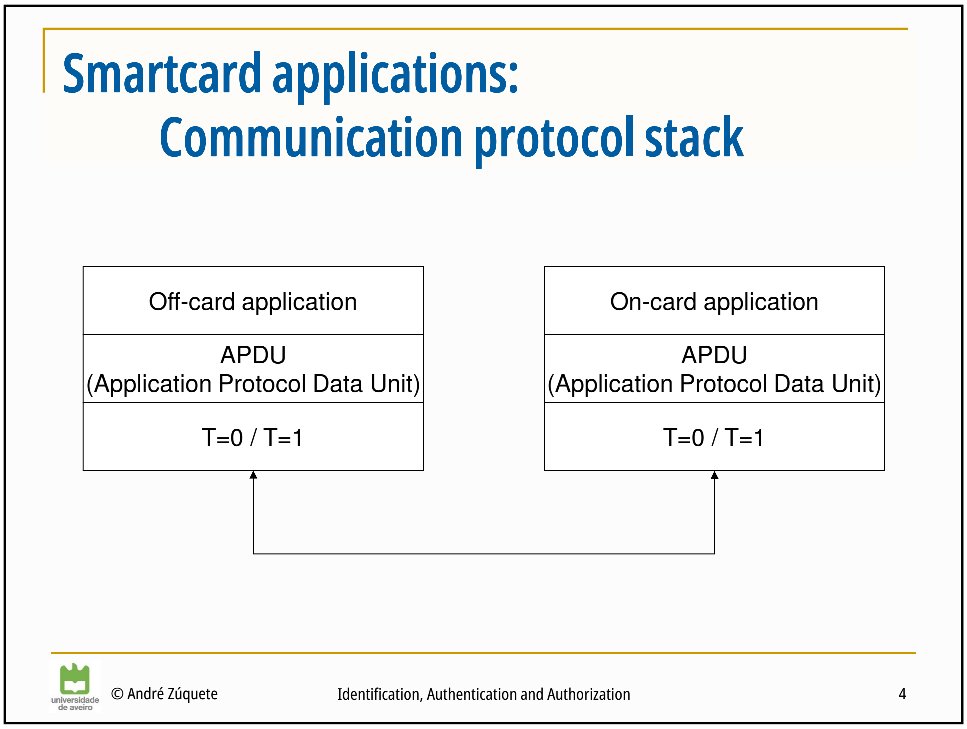




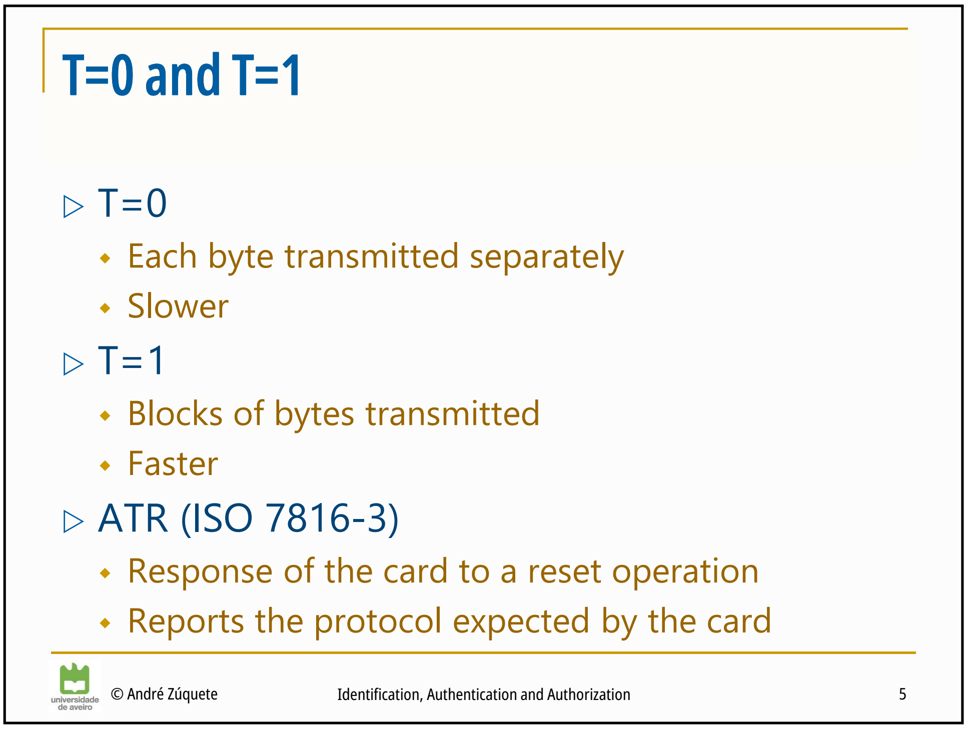
Smartcard: Components

C1–VCC
C2–RST
C3–CLK
C4–
C5–GND
C6–VPP
C7–I/O
C8–

- ▷ CPU
  - 8/16 bit
  - Crypto-coprocessor (opt.)
- ▷ ROM
  - Operating system
  - Communication
  - Cryptographic algorithms
- ▷ EEPROM
  - File system
    - Programs / applications
    - Keys / passwords
- ▷ RAM
  - Transient data
    - Erased on power off
- ▷ Mechanical contacts
  - ISO 7816-2
    - Power
    - Soft reset
    - Clock
    - Half duplex I/O
- ▷ Physical security
  - Tamperproof case
  - Resistance to side-channel attacks

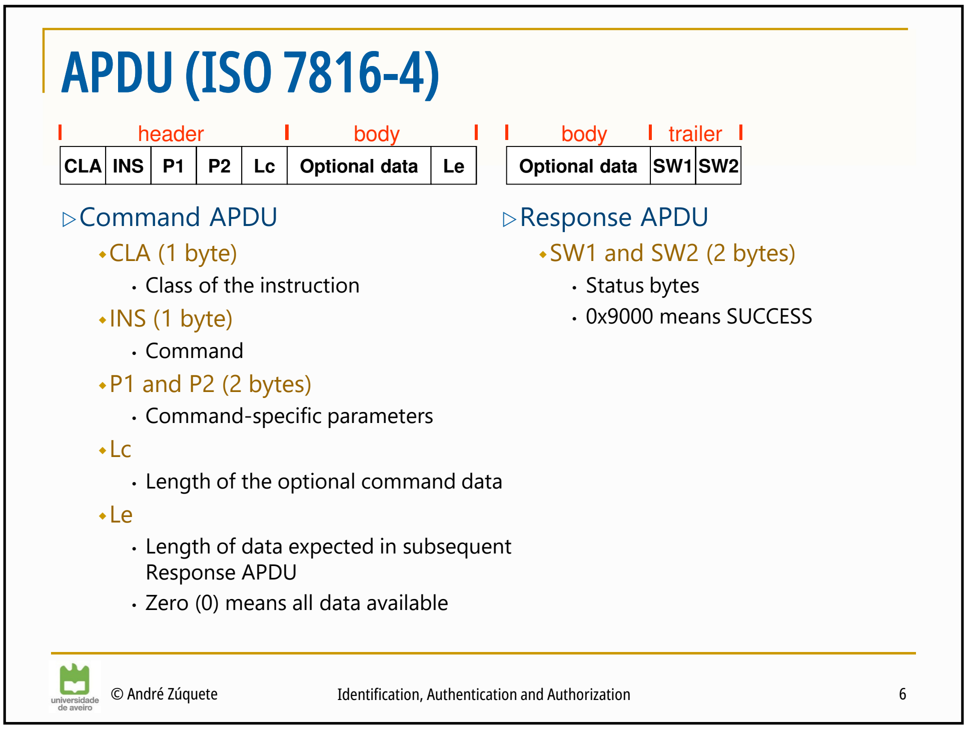


Smartcard applications: Communication protocol stack



T=0 and T=1

- T=0
  - Each byte transmitted separately
  - Slower
- T=1
  - Blocks of bytes transmitted
  - Faster
- ATR (ISO 7816-3)
  - Response of the card to a reset operation
  - Reports the protocol expected by the card



APDU (ISO 7816-4)

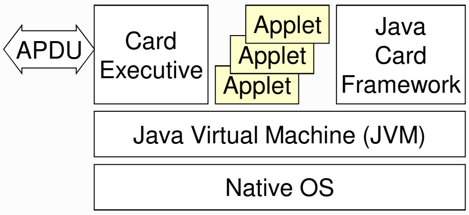
header					body	
CLA	INS	P1	P2	Lc	Optional data	Le

body	trailer	
Optional data	SW1	SW2

- Command APDU
  - CLA (1 byte)
    - Class of the instruction
  - INS (1 byte)
    - Command
  - P1 and P2 (2 bytes)
    - Command-specific parameters
  - Lc
    - Length of the optional command data
  - Le
    - Length of data expected in subsequent Response APDU
    - Zero (0) means all data available
- Response APDU
  - SW1 and SW2 (2 bytes)
    - Status bytes
    - 0x9000 means SUCCESS

Java cards

- ▷ Smartcards that run Java Applets
  - That use the JCRE
  - The JCRE runs on top of a native OS
- ▷ JCRE (Java Card Runtime Environment)
  - Java Virtual Machine
  - Card Executive
    - Card management
    - Communications
  - Java Card Framework
    - Library functions



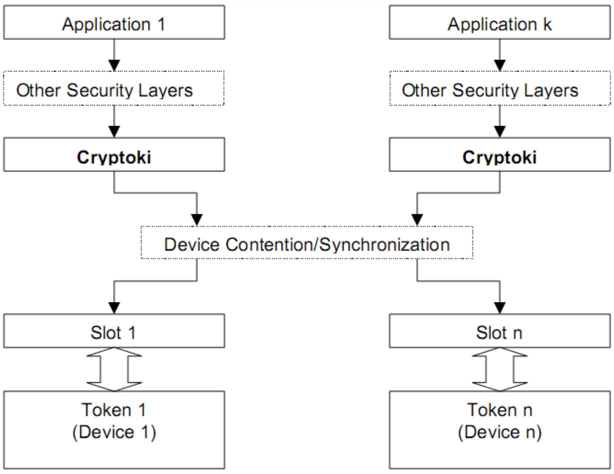
Cryptographic services

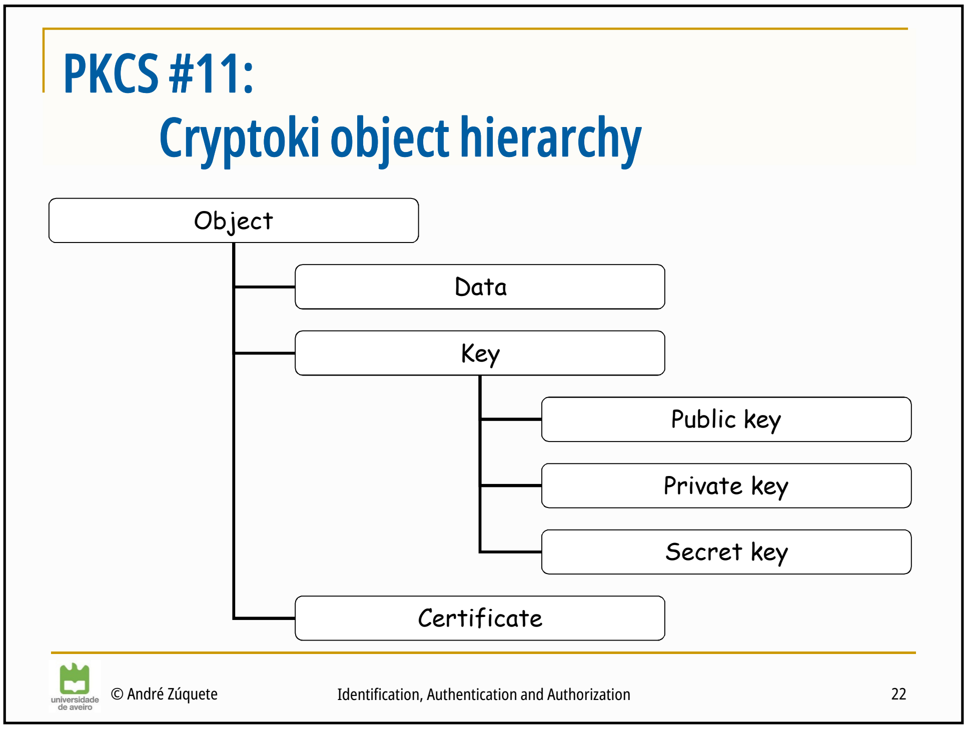
- ▷ Ciphers
- ▷ Digest functions
- ▷ Key generation
- ▷ Key management
  - Key import
  - Key export
- ▷ Digital signatures
  - Generation
  - Verification
- ▷ Management of public key certificates
  - Generation
  - Verification

Cryptographic services: Middleware

- Libraries that bridge the gap between functionalities of smartcards and high-level applications
- Some standard approaches:
  - PKCS #11
    - Cryptographic Token Interface Standard (Cryptoki)
    - Defined by RSA Security Inc.
  - PKCS #15
    - Cryptographic Token Information Format Standard
    - Defined by RSA Security Inc.
  - CAPI CSP
    - CryptoAPI Cryptographic Service Provider
    - Defined by Microsoft for Windows systems
  - PC/SC
    - Personal computer/smartcard
    - Standard framework for smartcard access on Windows systems

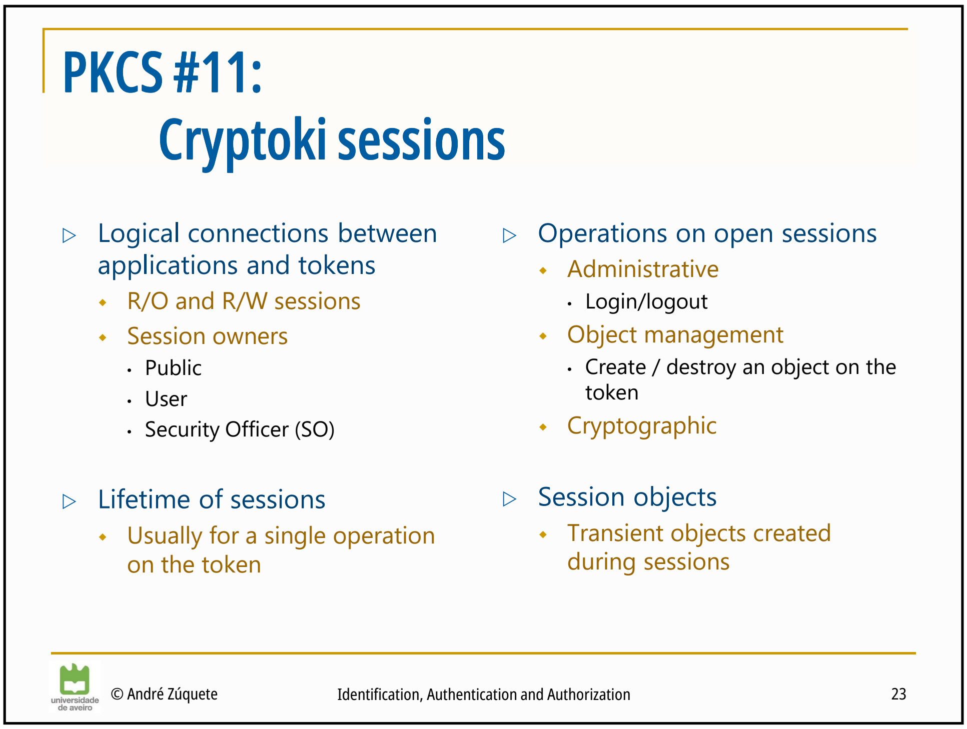
PKCS #11: Cryptoki middleware integration





PKCS #11: Cryptoki object hierarchy

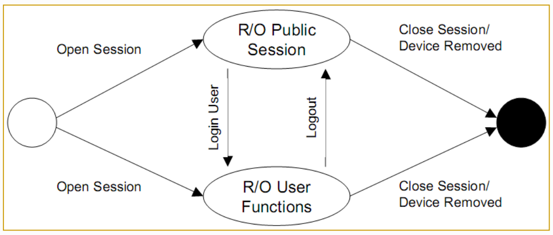
- Object
  - Data
  - Key
    - Public key
    - Private key
    - Secret key
  - Certificate



PKCS #11: Cryptoki sessions

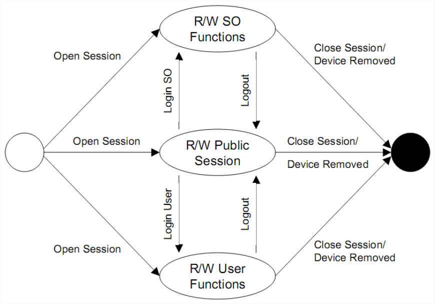
- ▷ Logical connections between applications and tokens
  - R/O and R/W sessions
  - Session owners
    - Public
    - User
    - Security Officer (SO)
- ▷ Lifetime of sessions
  - Usually for a single operation on the token
- ▷ Operations on open sessions
  - Administrative
    - Login/logout
  - Object management
    - Create / destroy an object on the token
  - Cryptographic
- ▷ Session objects
  - Transient objects created during sessions

PKCS #11: Cryptoki R/O sessions login/logout

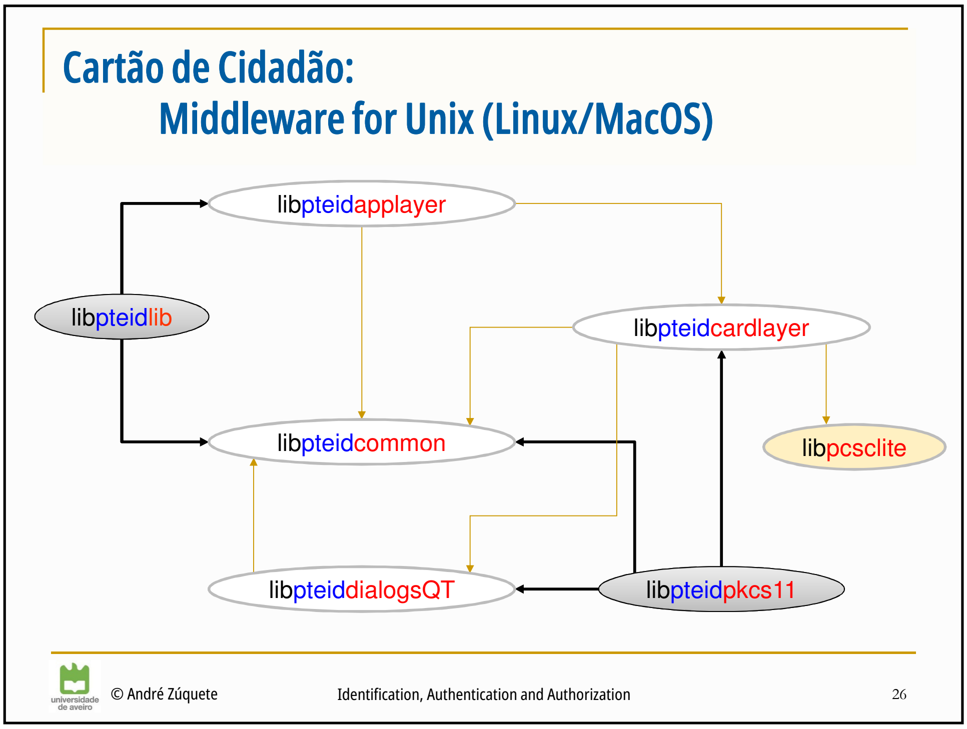


- R/O public session
  - Read-only access to public token objects
  - Read/write access to public session objects
- R/O user functions
  - Read-only access to all token objects (public or private)
  - Read/write access to all session objects (public or private)

PKCS #11: Cryptoki R/W sessions login/logout



- R/W public session
  - Read/write access to all public objects
- R/W SO functions
  - Read/write access only to public objects on the token
    - Not to private objects
  - The SO can set the normal user's PIN
- R/W user functions
  - Read/write access to all objects



Cartão de Cidadão:
Middleware for Unix (Linux/MacOS)

libpteidapplayer

libpteidlib

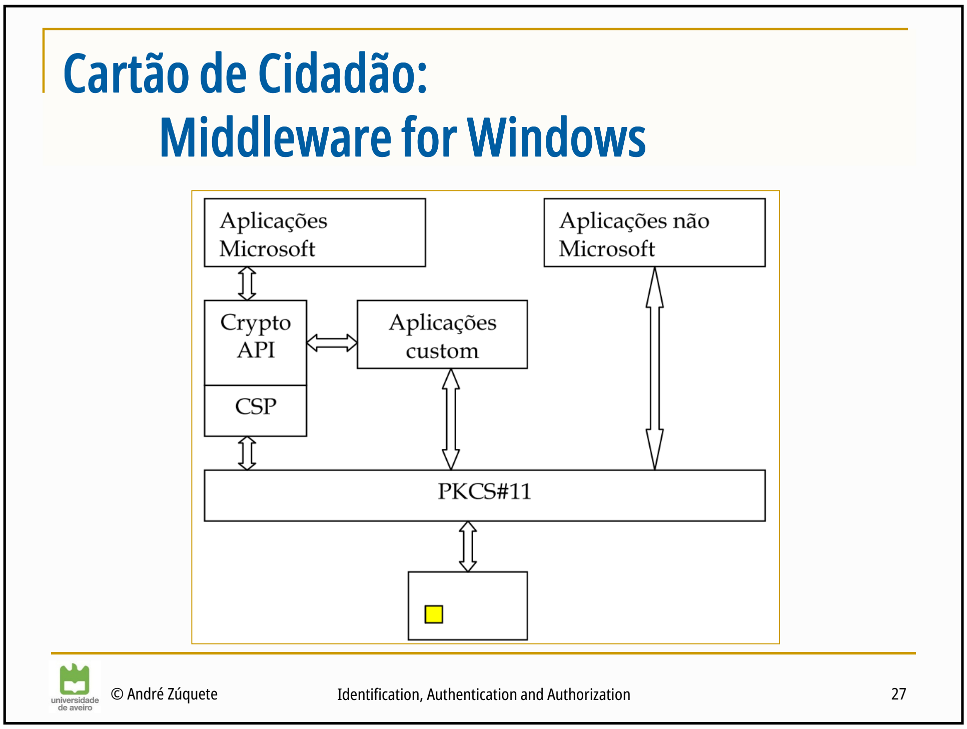
libpteidcardlayer

libpcsclite

libpteidcommon

libpteiddialogsQT

libpteidpkcs11



Cartão de Cidadão:
Middleware for Windows

Aplicações Microsoft

Aplicações não Microsoft

Crypto API

Aplicações custom

CSP

PKCS#11