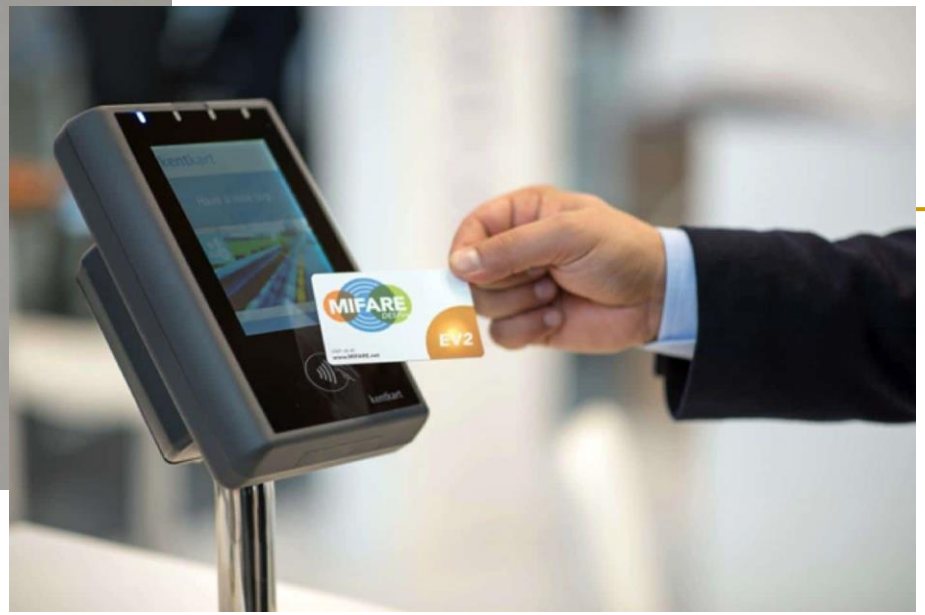
Smartcards



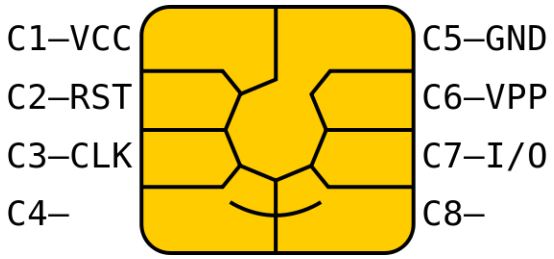
https://pplware.sapo.pt/informacao/saiba-como-renovar-online-o-seu-cartao-de-cidadao/

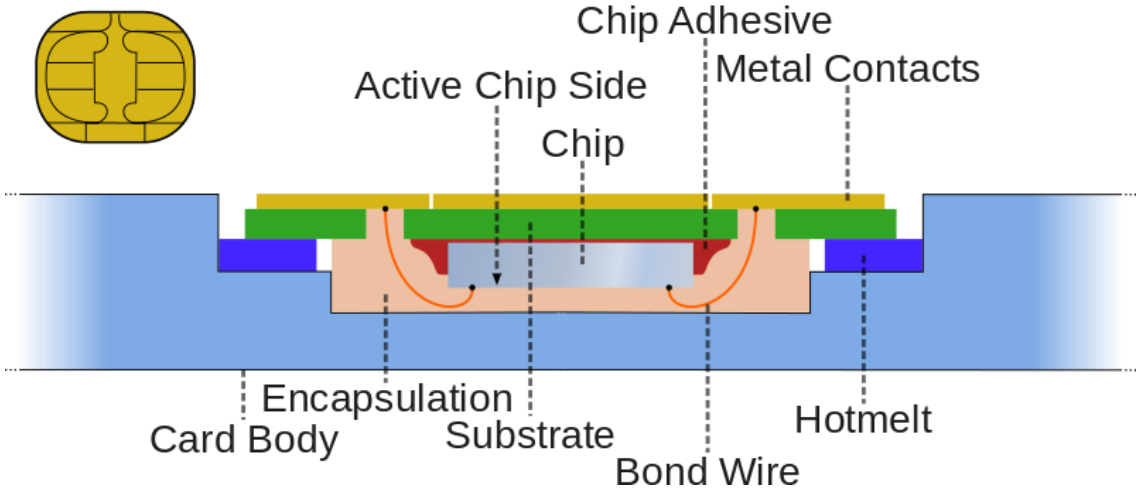
https://knowtechie.com/security-matters-5-benefits-of-contactless-smart-cards/

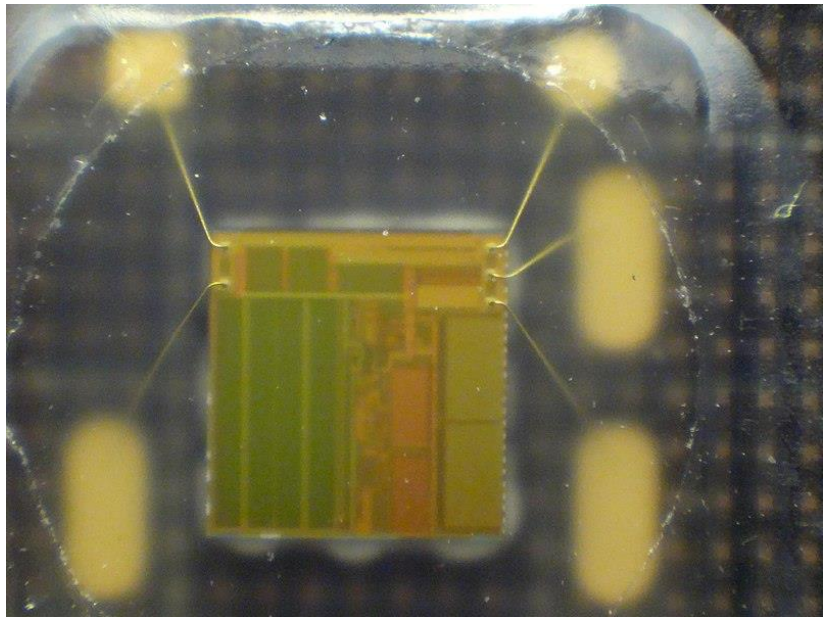

União Europeia
Portugal
Passaporte


Visa Classic
4000 1234 5678 9010
4000
GOOD THRU 12/20
EISHA KHANNA
VISA


navegante


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


Chip Adhesive
Metal Contacts
Active Chip Side
Chip
Encapsulation
Card Body
Substrate
Bond Wire
Hotmelt



Why smartcards

- Interoperability
  - Stack, interfaces and infrastructures are shared over many industries
- Multi-application support
- Secure transactions
- User acceptance
- Acessibility

Smartcard: Definition

- Card with computing processing capabilities
  - CPU
  - ROM
  - EEPROM
  - RAM
- Interface
  - With contact
  - Contactless

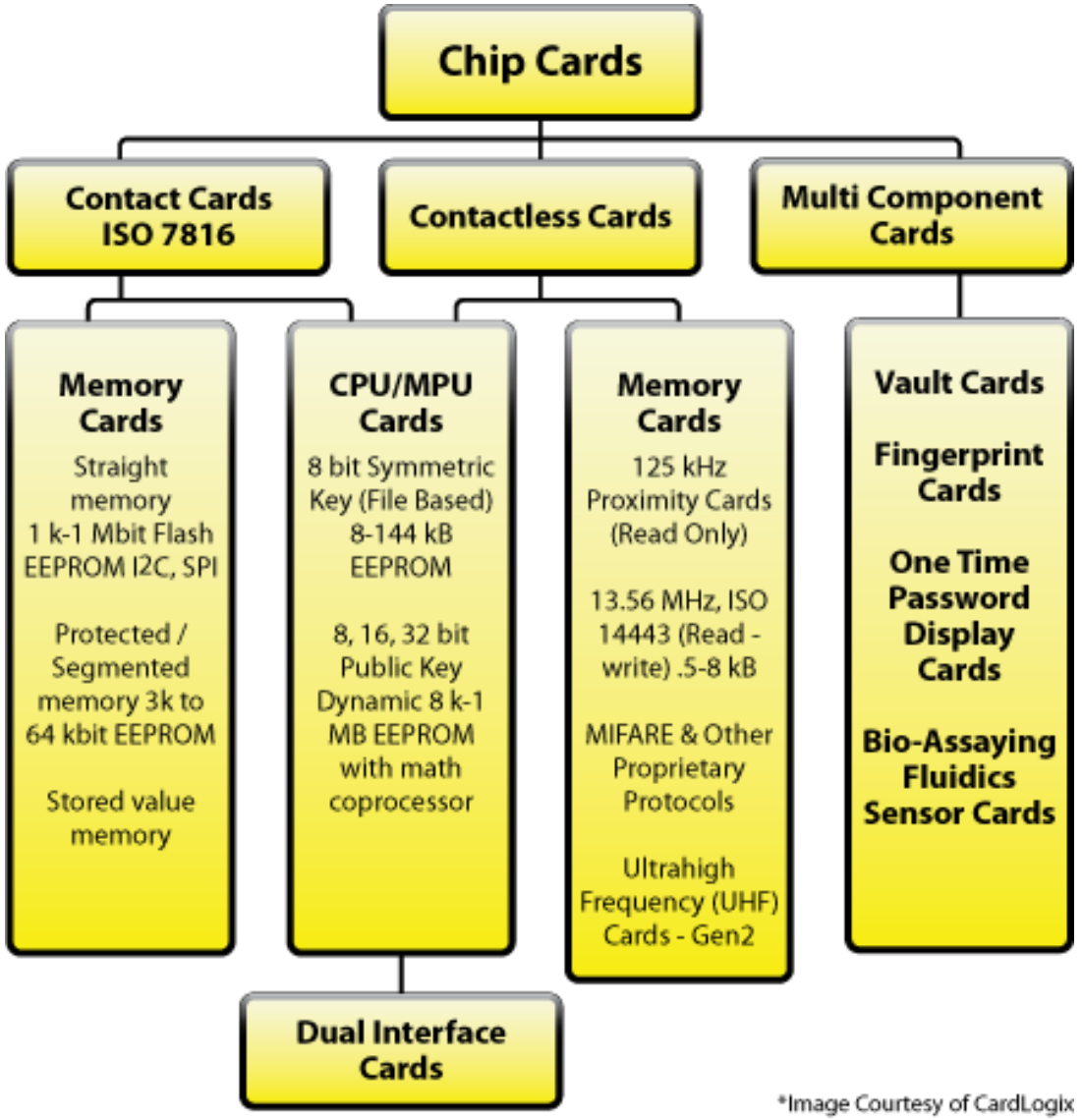
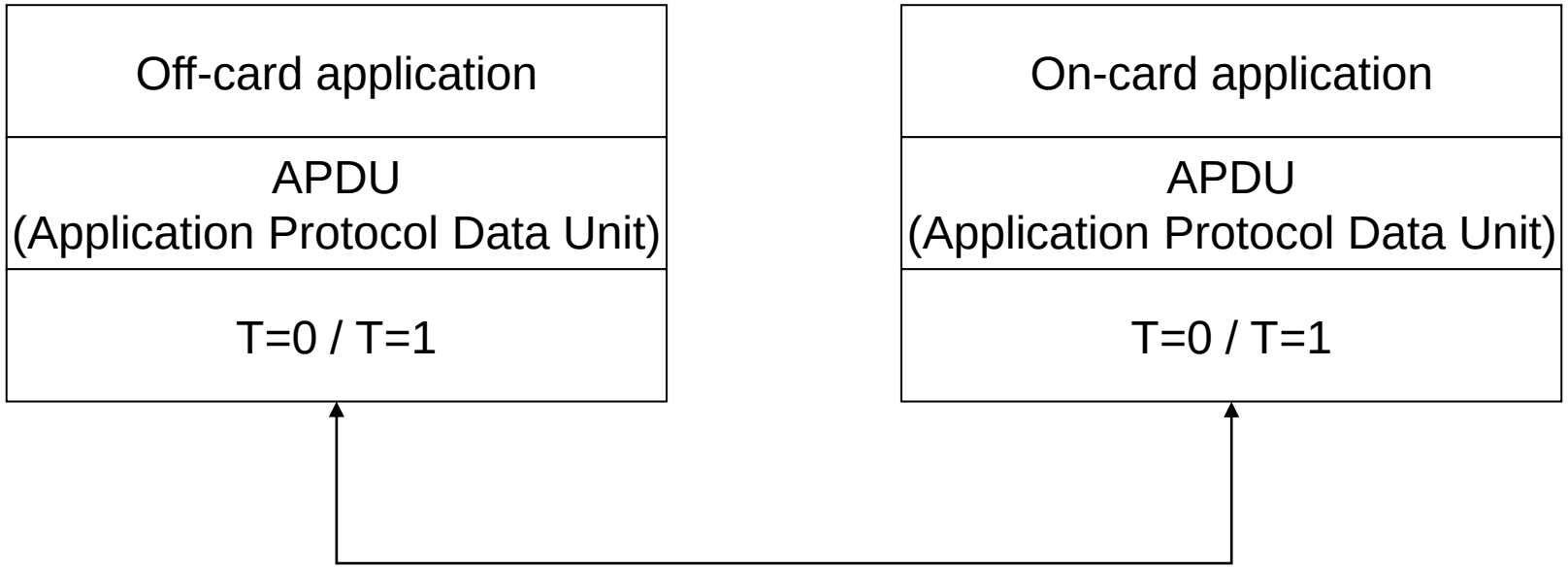


*Image Courtesy of CardLogix

Smartcard applications: Communication protocol stack



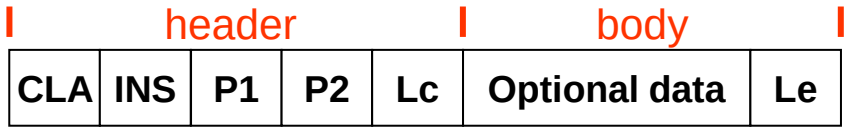
T=0 and T=1

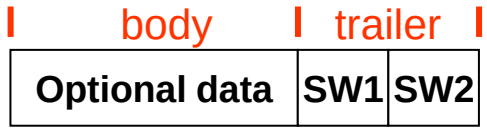
- T=0
  - Each byte transmitted separately
  - Slower
- T=1
  - Blocks of bytes transmitted
  - Faster
- ATR (ISO 7816-3)
  - Response of the card to a reset operation
  - Reports the protocol expected by the card

```
ATR: 3B 7D 95 00 00 80 31 80 65 B0 83 11 00 C8 83 00 90 00
+ TS = 3B --> Direct Convention
+ T0 = 7D, Y(1): 0111, K: 13 (historical bytes)
  TA(1) = 95 --> Fi=512, Di=16, 32 cycles/ETU
    125000 bits/s at 4 MHz, fMax for Fi = 5 MHz => 156250 bits/s
  TB(1) = 00 --> VPP is not electrically connected
  TC(1) = 00 --> Extra guard time: 0
+ Historical bytes: 80 31 80 65 B0 83 11 00 C8 83 00 90 00
  Category indicator byte: 80 (compact TLV data object)
    Tag: 3, len: 1 (card service data byte)
      Card service data byte: 80
        - Application selection: by full DF name
        - EF.DIR and EF.ATR access services: by GET RECORD(s) command
        - Card with MF
    Tag: 6, len: 5 (pre-issuing data)
      Data: B0 83 11 00 C8
    Tag: 8, len: 3 (status indicator)
      LCS (life card cycle): 00 (No information given)
      SW: 9000 (Normal processing.)

Possibly identified card (using /usr/share/pcsc/smartcard_list.txt):
3B 7D 95 00 00 80 31 80 65 B0 83 11 00 C8 83 00 90 00
3B 7D 95 00 00 80 31 80 65 B0 83 11 .. .. 83 00 90 00
        Portuguese ID Card (eID)
        http://www.cartaodecidadao.pt/
```

APDU (ISO 7816-4)





▷Command APDU

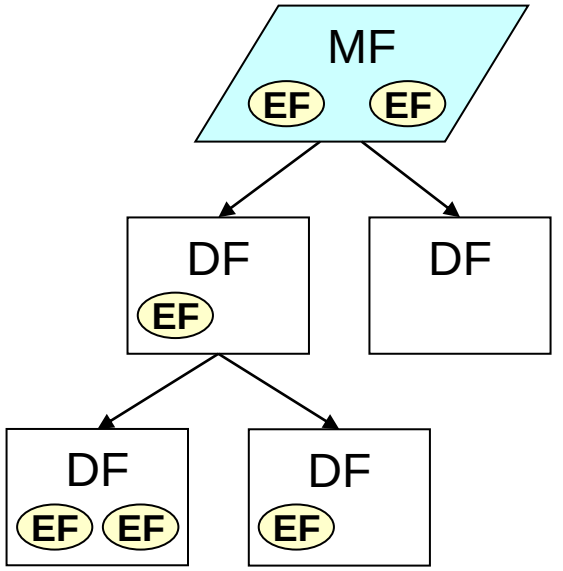
- ◆CLA (1 byte)
  - Class of the instruction
- ◆INS (1 byte)
  - Command
- ◆P1 and P2 (2 bytes)
  - Command-specific parameters
- ◆Lc
  - Length of the optional command data
- ◆Le
  - Length of data expected in subsequent Response APDU
  - Zero (0) means all data available

▷Response APDU

- ◆SW1 and SW2 (2 bytes)
  - Status bytes
  - 0x9000 means SUCCESS

Smartcard: File system

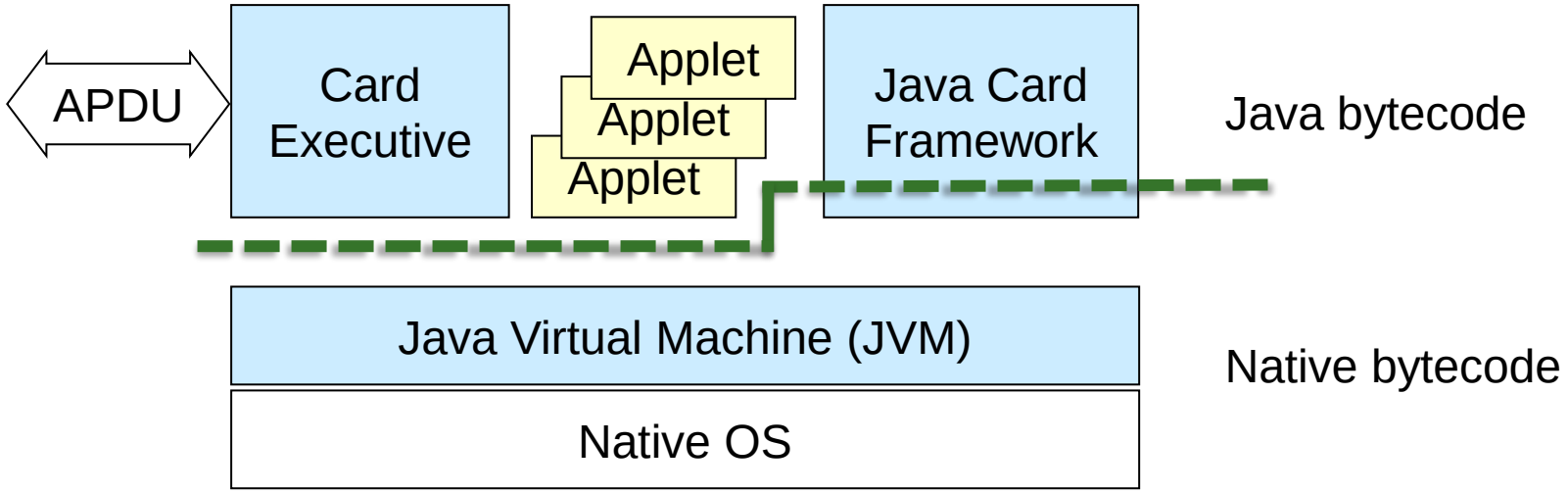
- File identification
  - Name or number
- File types
  - Master File (MF)
    - File system root, ID 0x3F00
  - Dedicated File (DF)
    - Similar to a directory
    - Can contain other EFs or DF
  - Elementary File (EF)
    - Ordinary data file
    - File size fixed and determined when created



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

Java cards


APDU
Card Executive
Applet
Applet
Applet
Java Card Framework
Java bytecode
Java Virtual Machine (JVM)
Native bytecode
Native OS

Cryptographic services

- Ciphers
- Digest functions

- Key generation
- Key management
  - Key import
  - Key export

- Digital signatures
  - Generation
  - Verification

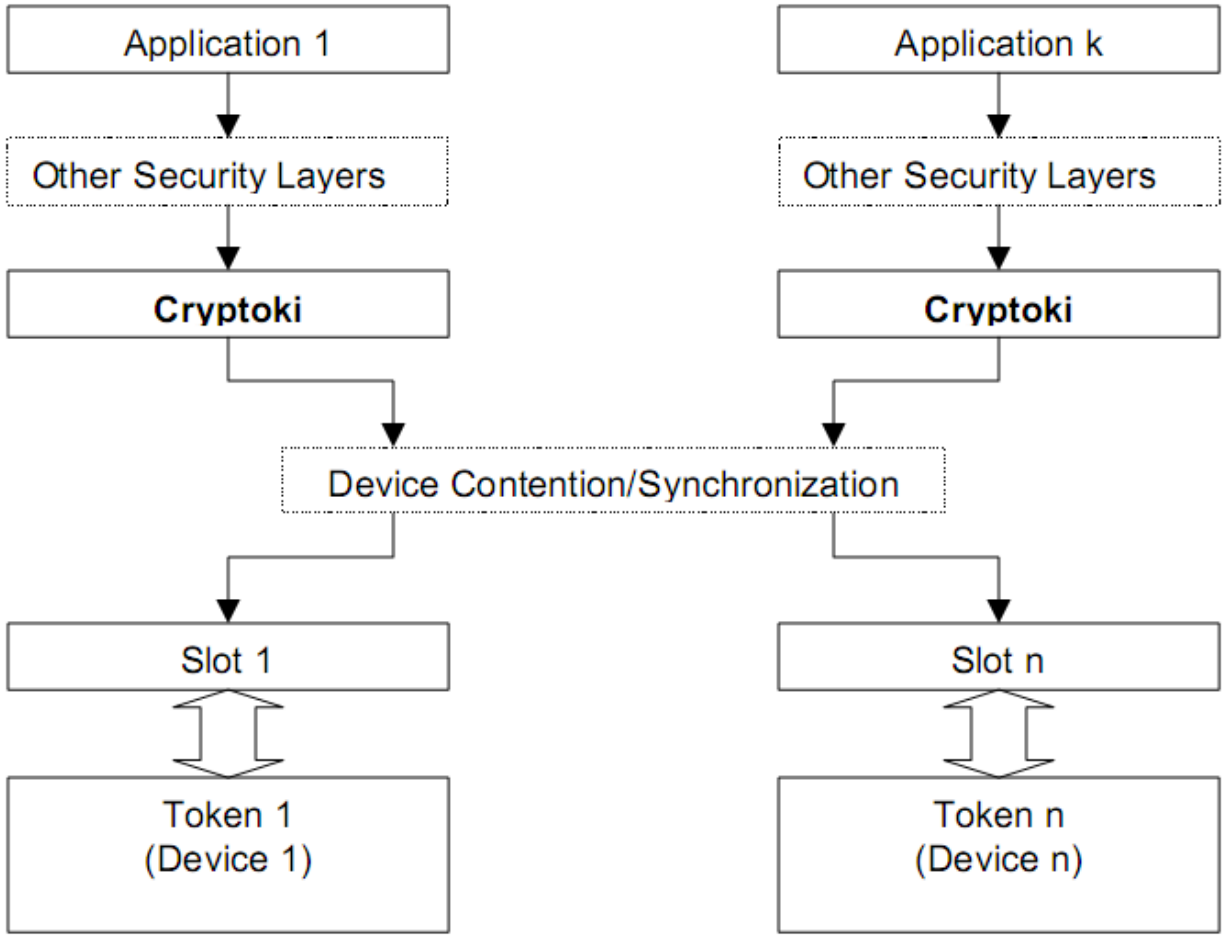
- Management of public key certificates
  - Generation
  - Verification

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

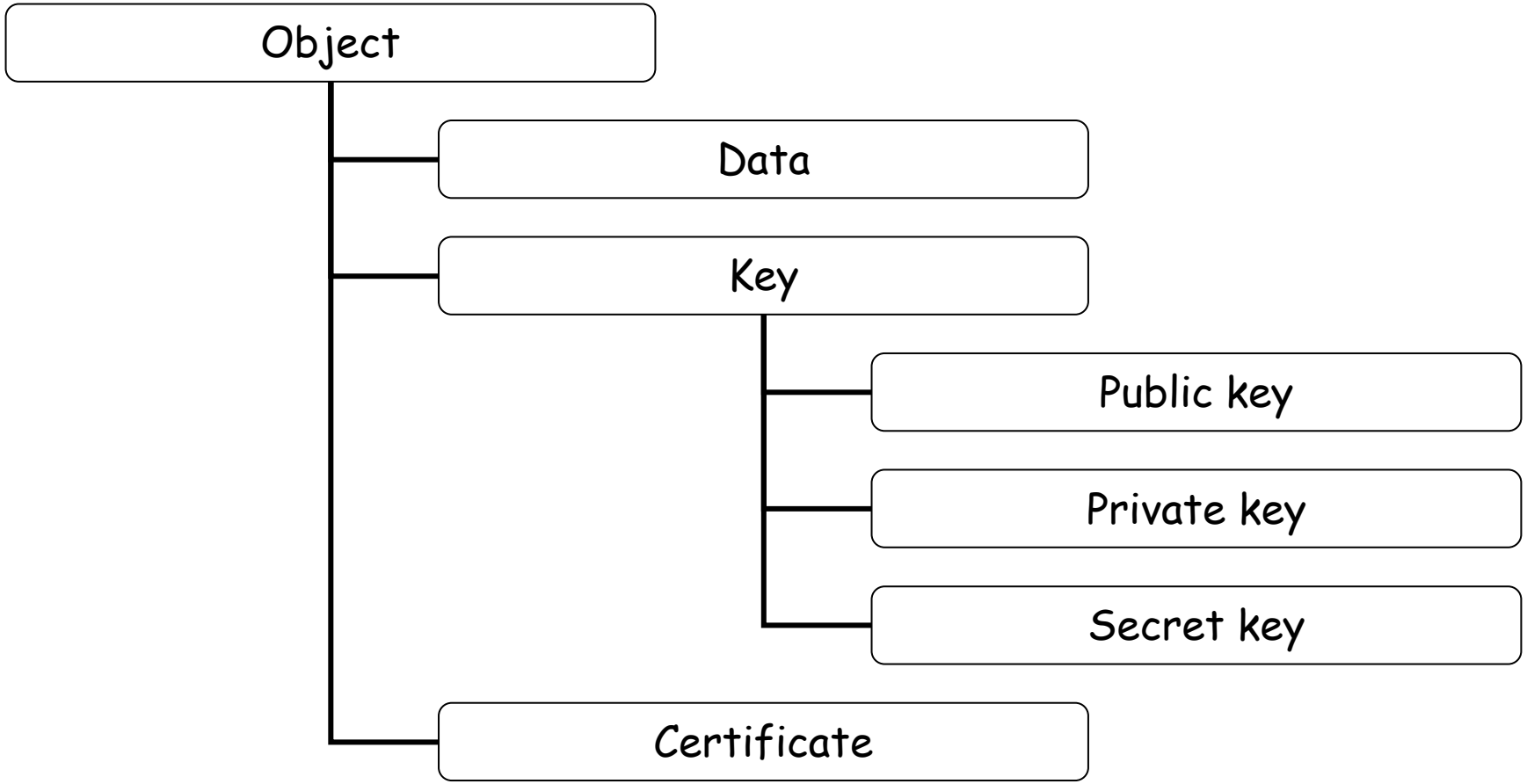
PKCS #11:

Cryptoki middleware integration



PKCS #11:

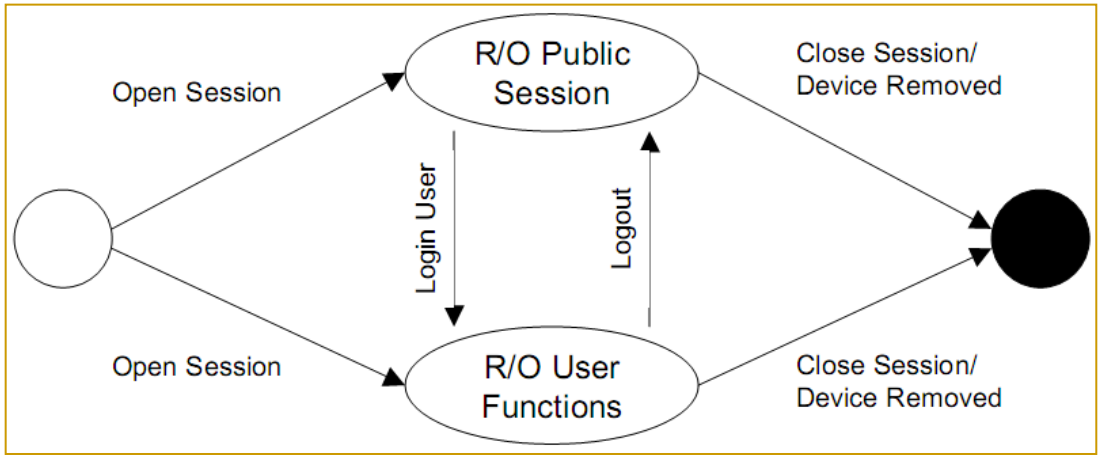
Cryptoki object hierarchy



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

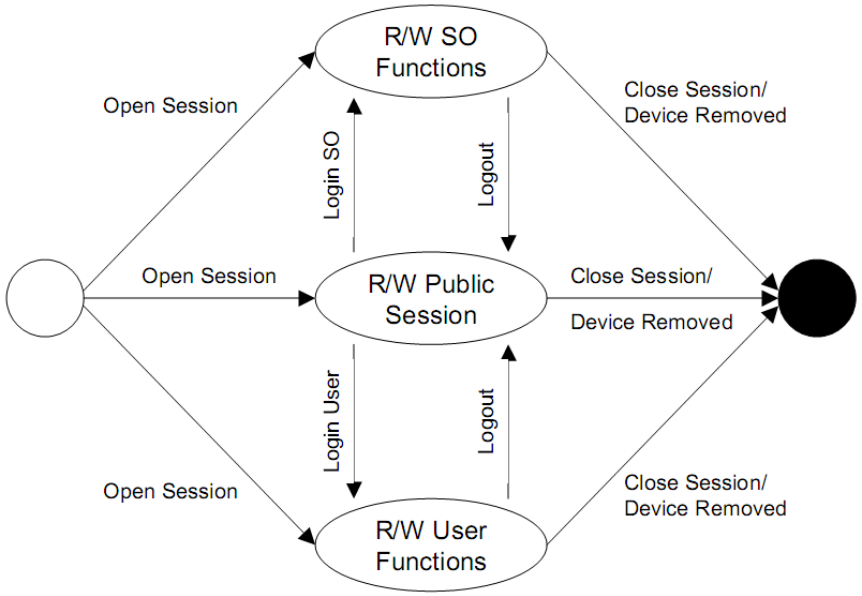
PKCS #11:
Cryptoki R/O sessions login/logout



- 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)

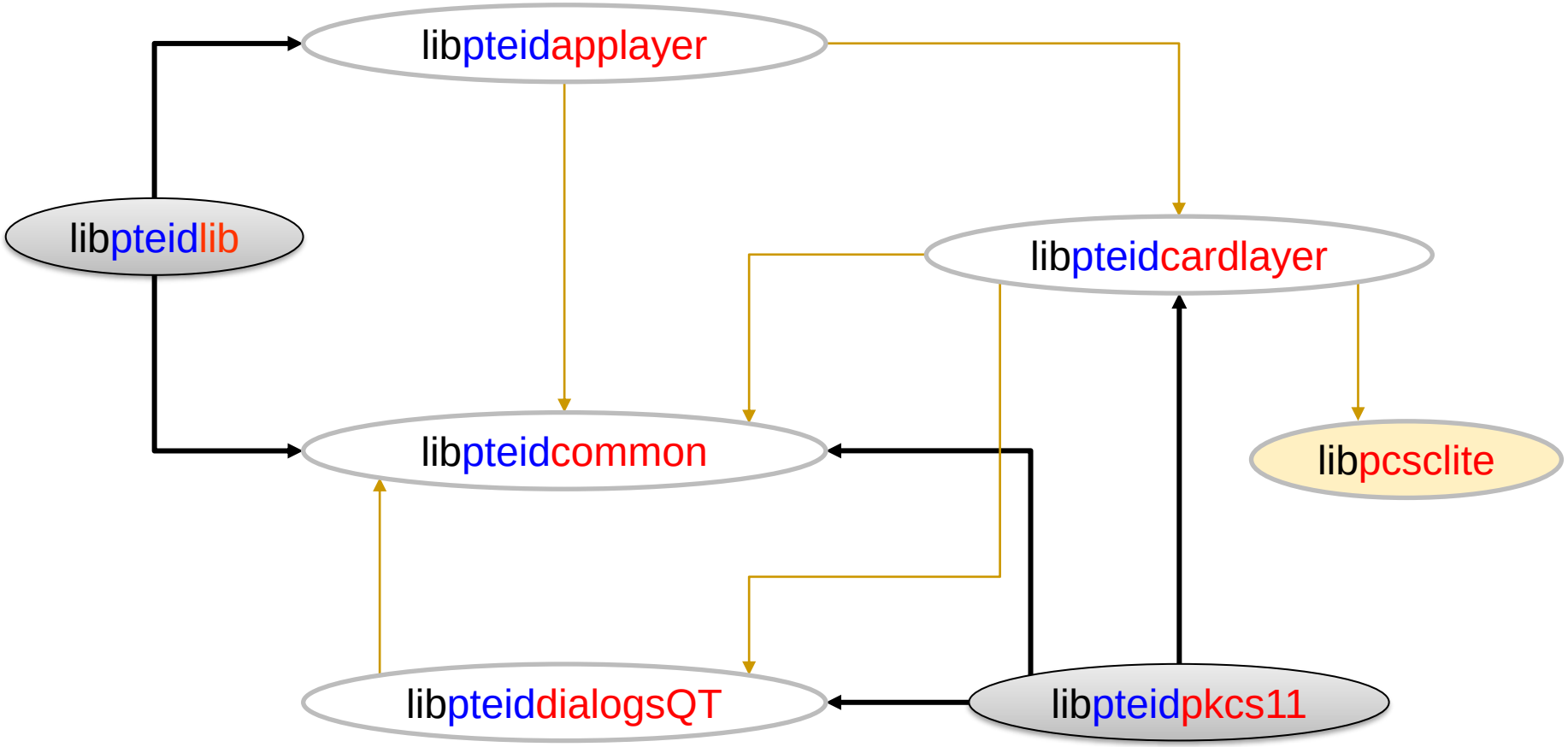
PKCS #11:

Cryptoki R/W sessions login/logout

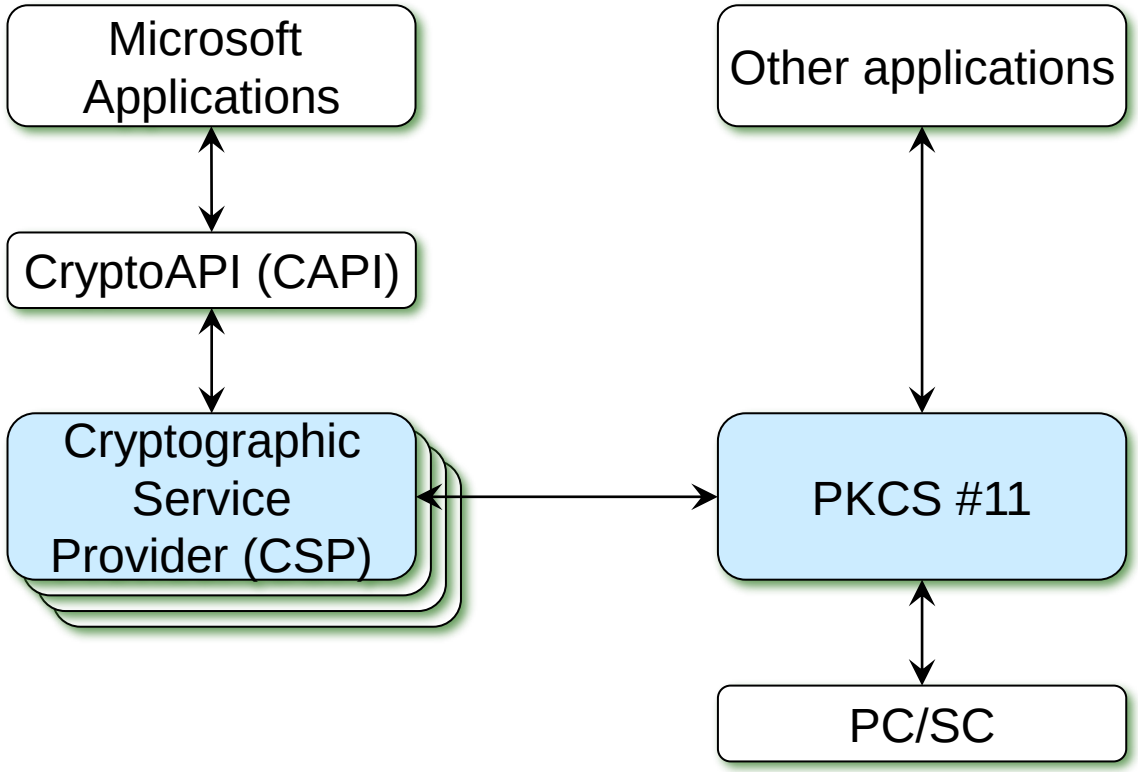


- R/W public session
  - Read/write access to all public objects
- R/W SO functions
  - Read/write access only to public objects on the token
    - Not to private objects
  - The SO can set the normal user's PIN
- R/W user functions
  - Read/write access to all objects

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



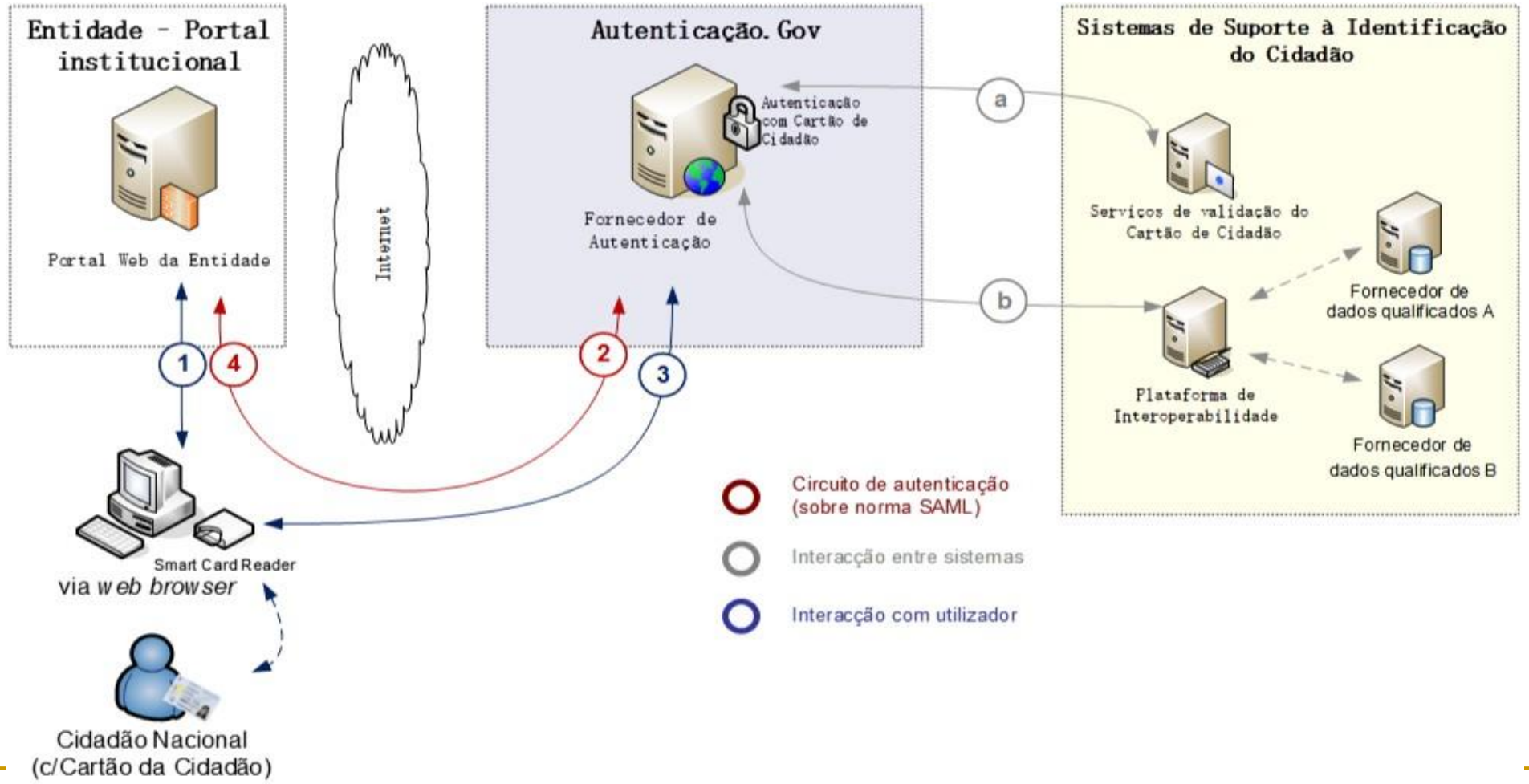
Cartão de Cidadão: Middleware for Windows

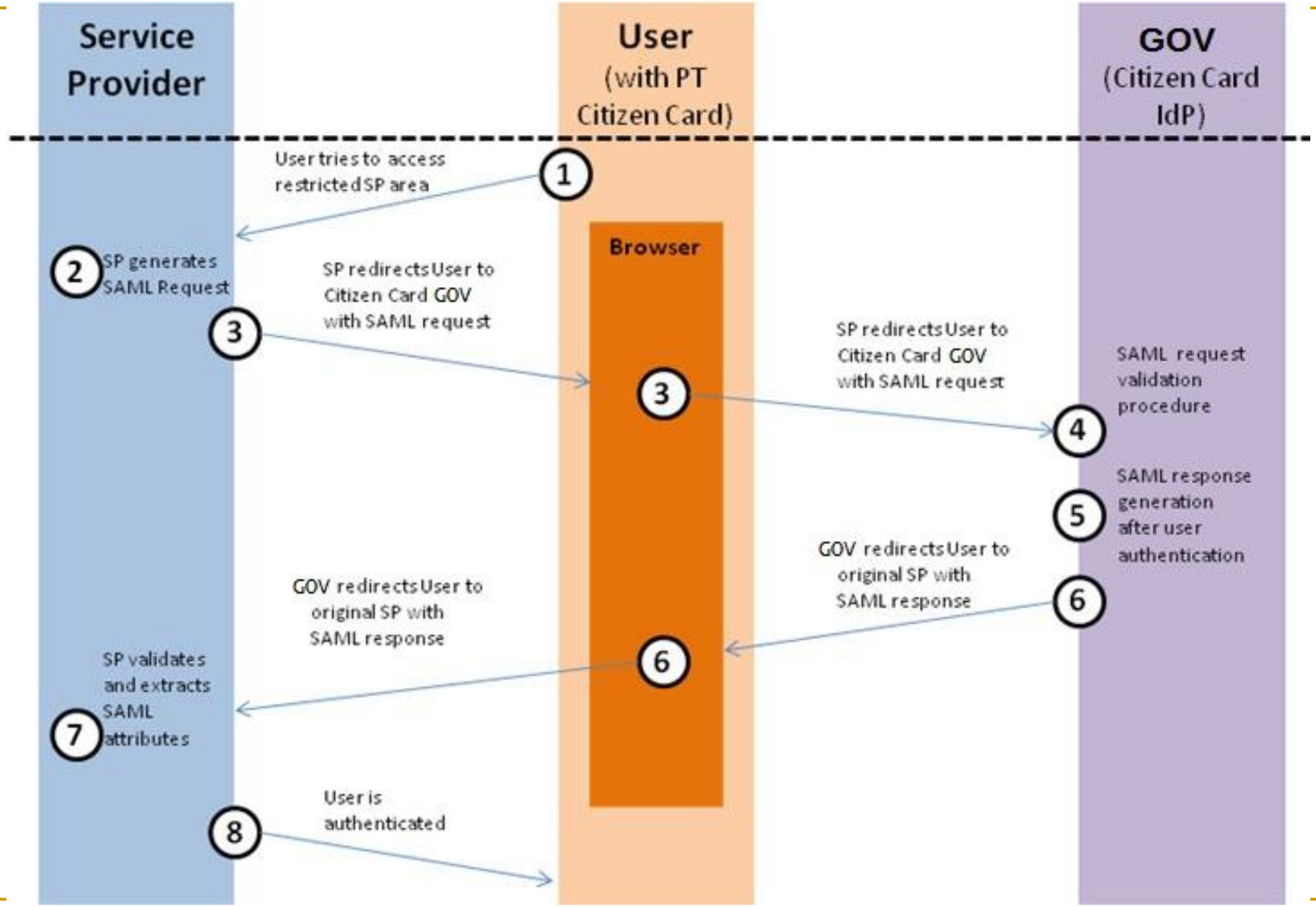


Authentication with the PTEID

- Authenticator sends NONCE to the CC to be signed with the private key
- Issue: Browser do not have direct access to the CC
  - Possible to configure libpteidpkcs11.so, limited to the PKCS#11 API
  - Possible to use a java applet (obsolete)
- Solution: Use a plugin installed in the user computer
  - Exposes a web server to the localhost
  - Allows access to the card through the web server
    - Only to authenticated requests through the CC infrastructure
  - Required the previous approval of each new integration

PT Authentication Plugin




Service Provider
User (with PT Citizen Card)
GOV (Citizen Card IdP)
Browser
1
User tries to access restricted SP area
2
SP generates SAML Request
3
SP redirects User to Citizen Card GOV with SAML request
3
SP redirects User to Citizen Card GOV with SAML request
4
SAML request validation procedure
5
SAML response generation after user authentication
6
GOV redirects User to original SP with SAML response
6
GOV redirects User to original SP with SAML response
7
SP validates and extracts SAML attributes
8
User is authenticated

Mobile Digital Key (CMD)/Virtual Smart Card

- Objective: allow authentication/signature even without the smartcard
  - But with a similar level of security

- Operation principles
  - Requires a smartcard to authenticate the request of a CMD
  - Users can authenticate themselves/sign documents using the CMD
  - Doesn't require any plugin installed
  - Doesn't require the card in future uses
  - Uses 2FA: PIN code in the site + code through another channel
    - E.g: SMS or Twitter