Interface Complexity
Design by Committees

- ISO-7816-4 - Contact cards. Command/response semantics and binary formats (APDUs)
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- ISO-14443 - Contactless cards
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- PC/SC - Application C API

PKCS#11 - Application C API
PKCS#15 - Credential object discovery and storage using path-based tree layout (atop ISO-7816-4)
OpenPGP Smartcard - Simple ISO-7816 profile
FIPS-201 (PIV) - U.S. Federal government technical standard
NIST SP 800-96 - ISO-7816 Profile. PC/SC API. ISO-14443, etc details.
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- ASN.1 DER
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- PKCS#7
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- X.509
- PKCS#7
- OpenPGP - RFC 4408, RFC 6637, etc
Interface Complexity

Binary object formats

- ASN.1 DER
- X.509
- PKCS#7
- OpenPGP - RFC 4408, RFC 6637, etc
- OpenSSH - RFC 4251, RFC 4716, draft-miller-ssh-agent-02, etc
Software Complexity

Projects

- OpenSC - Incredibly comprehensive. Backbone of smartcard support in open source community.
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- Legacy code, including built-in workarounds to card errata, makes it difficult to understand and modify.
- Hardcodes too much knowledge about specific smartcards.
- Emulation modes, number of moving parts create doubt about whether you’re using hardware securely.
- Architecture primarily directed at implementing the standardized interfaces at expense of ability to develop above and below those layers.
Software Complexity

GnuPG

- OpenPGP focused.
Software Complexity

GnuPG

- OpenPGP focused.
- Relies too heavily on scdaemon agent and IPC for interface abstraction.
Applying Lua
Importing and Exporting PKCS#11 and PC/SC Interfaces

- Best scripting language for creating bindings to PKCS#11 and PC/SC C APIs exported by driver modules.
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- Can export PKCS#11 and PC/SC C APIs. Lua “framework” transparently fits into small, dynamically loadable module. Few or no issues related to symbol pollution, dependency pollution, or reentrancy.
- Allows rapid implementation of bridges and adapters so solutions are consumable using standard interfaces.
struct pcsc_dylib
    void *handle;

long (*SCardEstablishContext)(pcsc_dword, const void *, const void *, pcsc_context *);
long (*SCardReleaseContext)(pcsc_context);
long (*SCardListReaders)(pcsc_context, const char *, char *, pcsc_dword *);
long (*SCardGetStatusChange)(pcsc_context, pcsc_dword, struct pcsc_readerstate *, pcsc_dword);
long (*SCardConnect)(pcsc_context, const char *, pcsc_dword, pcsc_dword, pcsc_card *,
    pcsc_dword, pcsc_dword, pcsc_dword, pcsc_dword *);
long (*SCardReconnect)(pcsc_card, pcsc_dword, pcsc_dword, pcsc_dword, pcsc_dword *);
long (*SCardDisconnect)(pcsc_card, pcsc_dword);
long (*SCardStatus)(pcsc_card, char *, pcsc_dword *, pcsc_dword *, pcsc_dword *, unsigned char *, pcsc_dword *);
long (*SCardBeginTransaction)(pcsc_card);
long (*SCardEndTransaction)(pcsc_card, pcsc_dword);
long (*SCardTransmit)(pcsc_card, const struct pcsc_io_request *, const unsigned char *,
    pcsc_dword, struct pcsc_io_request *, unsigned char *, pcsc_dword);
long (*SCardControl)(pcsc_card, pcsc_dword, const unsigned char *, pcsc_dword, unsigned char *,
    pcsc_dword, pcsc_dword, pcsc_dword, pcsc_dword, pcsc_dword *);
Applying Lua

Using PC/SC Module

```lua
local pcsc = require "pcsc"
local driver = assert(pscsc.loadcpath"/System/Library/Frameworks/PCSC.framework/PCSC")
local ctx = assert(driver:establish_context(pscsc.SCOPE_SYSTEM))
local function readers(driver, ctx)
    local blob = driver:list_readers(ctx)
    return coroutine.wrap(function ()
        for rdr in blob:gmatch("[^\000]+") do
            coroutine.yield(rdr)
        end
    end)
end
local function cards(driver, ctx)
    return coroutine.wrap(function ()
        for rdr in readers(driver, ctx) do
            local card, protocol = assert(driver:connect(ctx, rdr, pscsc.SHARE_EXCLUSIVE,
                                                         pscsc.PROTOCOL_T0|pscsc.PROTOCOL_T1))
            coroutine.yield(card, protocol)
        end
    end)
end
for card in cards(driver, ctx) do
    local rdr, state, protocol, atr = driver:status(card)
    print(rdr)
    local token = require"openpgp.card".new(driver, card)
    for keyno=1,3 do
        local key = token:get_pubkey(keyno)
        print("KEYNO ", keyno)
        print("KEYID ", auxlib.tohex(key:keyid()):upper())
        print("KEYGROUP", key:keygrip())
        print(token:exportssh(keyno))
        -- print(token:exportpgp(keyno))
    end
end
```
Applying Lua
Using PC/SC Module

1. Yubico Yubikey NEO OTP+CCID
2. KEYNO 1
3. KEYID A8F94B862EA7457F
4. KEYGROUP 2EA7457F
5. ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAABAQCrrnJpsTd6b6nLC1ApabjYCKk7CI0Mv5rcL2zggp12jiZI7jizr
6. KEYNO 2
7. KEYID A61436808415E31F
8. KEYGROUP 8415E31F
9. ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAABAQCN2Js3UD1NG/WAcqpLxOLiLpEYbrUDNuwt2SFAd7H9Vojr3xgk
10. KEYNO 3
11. KEYID C935C3805CC81644
12. KEYGROUP 5CC81644
13. ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAABAQCUICF3D+U0J++XbceWKMc/23Df7j1IK3SH1Ndx+jN7St5ya16