OpenPGP:SDK

"PGP is not just for email"

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Overview

- The OpenPGP:SDK
- What PGP does
- History
- Current state of play
- PGP not just for email
- Other applications
- The OpenPGP:SDK

OpenPGP:SDK

- New open source library for OpenPGP
- Developed from scratch
- Apache/BSD licence
- C
- Portable
  - BSD/Linux/Solaris known to work
- http://openpgp.nominet.org.uk

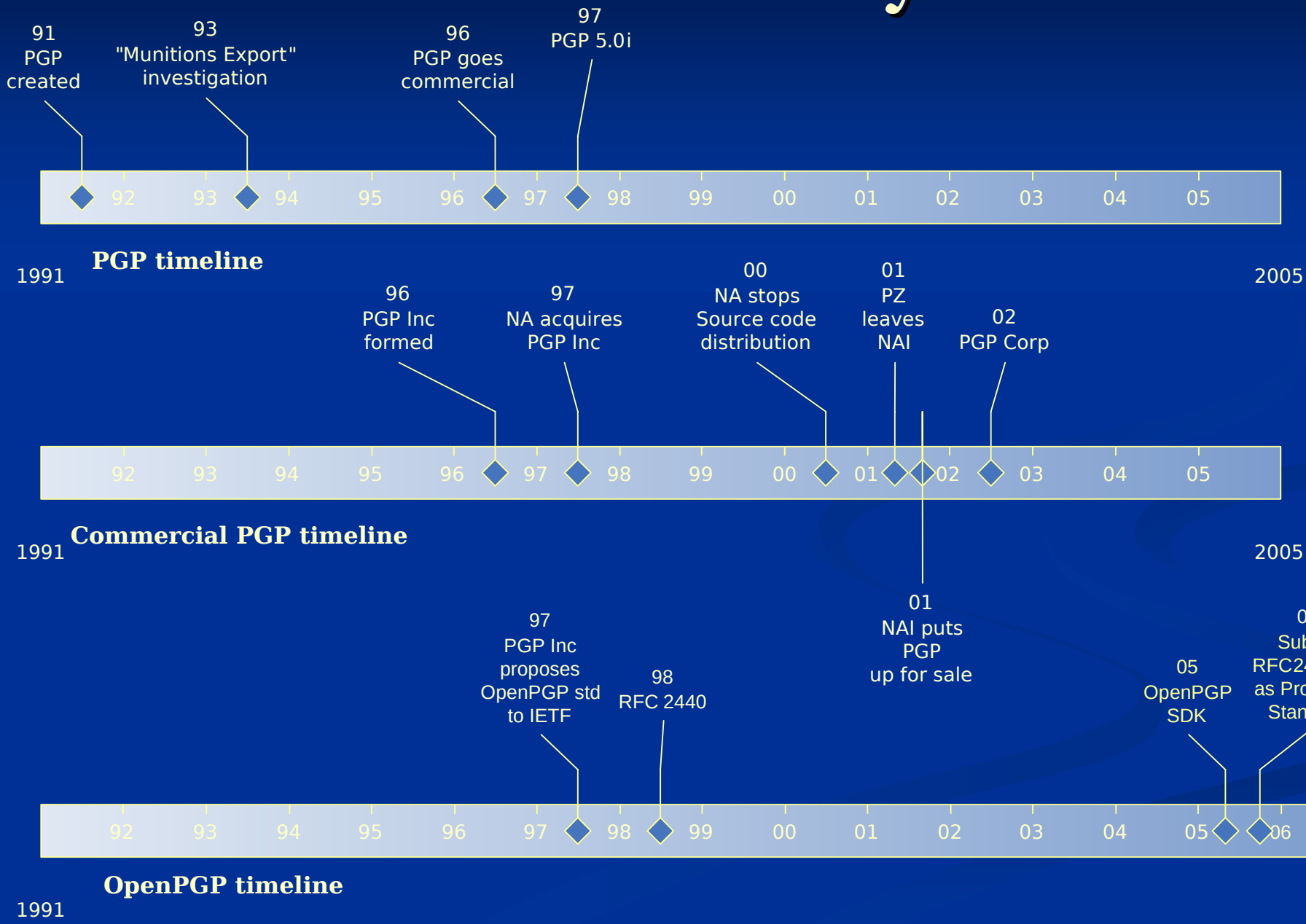
What PGP does

- “OpenPGP software uses a combination of strong public-key and symmetric cryptography to provide security services for electronic communications and data storage”. [Source: RFC 2440]

- Provides:
  - Confidentiality via Encryption
  - Authentication via Digital Signatures
  - Key Management

- Common Usages:
  - Public-key Email Encryption and Signing
  - Secure Disk storage
  - Software Signing

History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PGP
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PGP timeline
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Commercial PGP timeline
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OpenPGP std
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92 93 94 95 96 97 98 99 00 01 02 03 04 05 06
OpenPGP timeline
1991
2006

PGP not just for email

- Main use is email
- Secondary use is secure disk storage
- Software signing

Other Applications

- Authorisation for use of automated services
- X.509 Client certification using PGP
- Notarisation
  - Medical research
  - Copyright

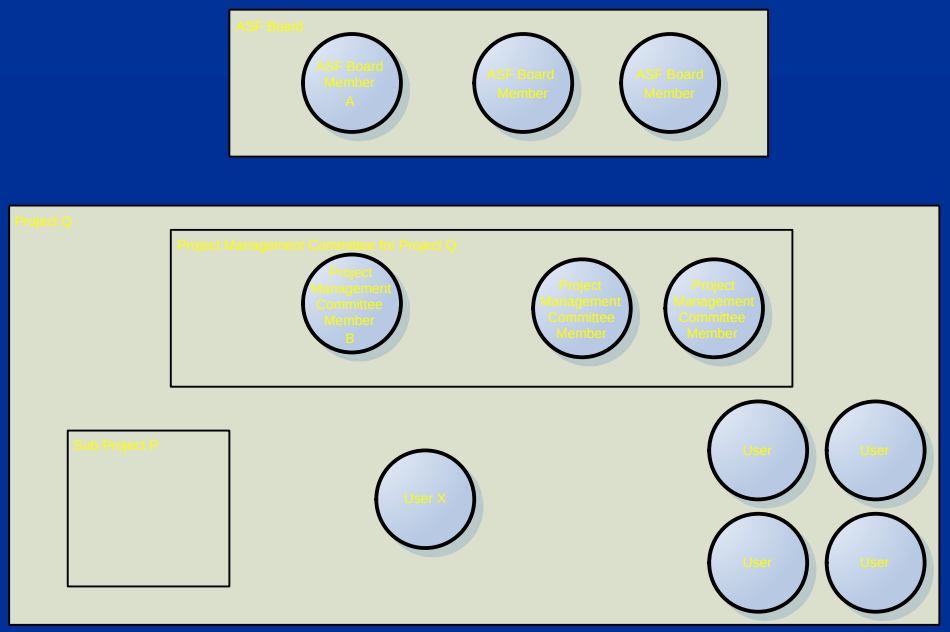
Example: Automated Authenticated Services

- Network Solutions use PGP for authentication of DNS changes
- Also Nominet (who have funded the OpenPGP:SDK) and RIPE
- Apache Software Foundation trialling PGP in their new CA project

DNS

- Network Solutions, Nominet
- Simple system:
  - Domain owner registers key
  - Domain changes sent by PGP-signed email
  - Registrar checks request is signed by registered key

Apache CA



- A signs “B owns project Q”
- B signs “P is subproject of project Q”
- B signs “User X has access to project P”

Validation steps

To check that user X has subversion access to project P:

- Validate that A is ASF board member
  - Build keyring, check signature
- Validate that A has signed B's right to control project Q
  - Build keyring, check signature
- Validate that B has signed project P as subproject of project Q
  - Build keyring, check signature
- Validate that B has signed user X as member of project P
  - Build keyring, check signature

- **8 invocations of command line tool for 1 user validation**

- SDK gives you the ability to do fine-grain operations within a single process

Example: X.509/PGP certificates for online authentication

- What's wrong with X.509 certificates?
  - Hierachical structure
  - Command line tool complicated
  - Long-winded process to get certificate
- What's right with X.509 certificates?
  - Leverage existing browser/server infrastructure
- Solution: combine X.509 with PGP web of trust

X.509/PGP – how it would work

- Server wants access control with Public Key cryptography
- Setup:
  - User sends PGP key to server for signing
  - Utility to create X.509 client cert with PGP public key embedded (New)
  - (X.509 cert can be self-signed, signature is irrelevant)
  - User installs X.509 cert in browser
- Usage:
  - Browser provides cert to server
  - Server ignores X.509 signature and checks PGP key
  - Is PGP key valid and signed by server?
  - If yes, access granted
- Benefit of this approach:
  - Usability: Uses existing browser/server auth mechanism
  - Uses PGP “web of trust”
  - X.509 certificate merely conduit for PGP key exchange

Example: Notarisation

- “Real World” example: copyright protection
- Online equivalent: can do today with existing tools with manual process
- Automated online process would benefit from library
- Applications: copyright, medical research
- Blind Notarisation

The OpenPGP:SDK

- A low-level C API for OpenPGP
- Based around C structures for each OpenPGP data structure
- Can parse OpenPGP packets to produce structures...
- ...or, use structures to construct packets

The Parser

- You provide:
  - A Reader: A function that will read data (e.g. from a file, a socket or some memory)
  - A Callback: which consumes parsed packets
- We provide:
  - Some standard readers (e.g. from file desciptor, from memory)
  - Stackable readers (e.g. read armoured data or compressed packets)
  - A basic parser
  - Stackable parsers (e.g. accumulate a keyring)

The Reader

- Trivial interface – given a buffer and a length, reads as much as it can
- Is not expected to…
  - Buffer
  - Seek
  - Skip data
- Can stack on top of another reader

The Callback

- Called for each parsed packet
  - Handed the structure corresponding to the packet
- Also called for errors
- Indefinite length packets are chunked (e.g. signed cleartext)
- Callbacks can be stacked (e.g. chunked packets could be consolidated in a stacked callback)

Support Library

- Low-level functions
  - Hashes
  - Encryption
  - Signatures
  - Compression
  - Big Number operations
  - Mostly provided by OpenSSL, but pluggable

Support Library

- High-level functions (using OpenPGP:SDK data structures)
  - Check OpenPGP signature
    - On key, subkey, data, cleartext…
  - Generate OpenPGP signature
  - Decrypt encrypted packets
  - Generate encrypted packets
  - Etc…

Packet Construction

- (At least) one API per packet type
- Completely freedom to construct all valid packets in any order
- Packets are constructed from C data structures
- Packets are constructed in memory – then you do what you want with them
- We may provide higher-level APIs to construct standard sequences of packets

Example – Read a Keyring

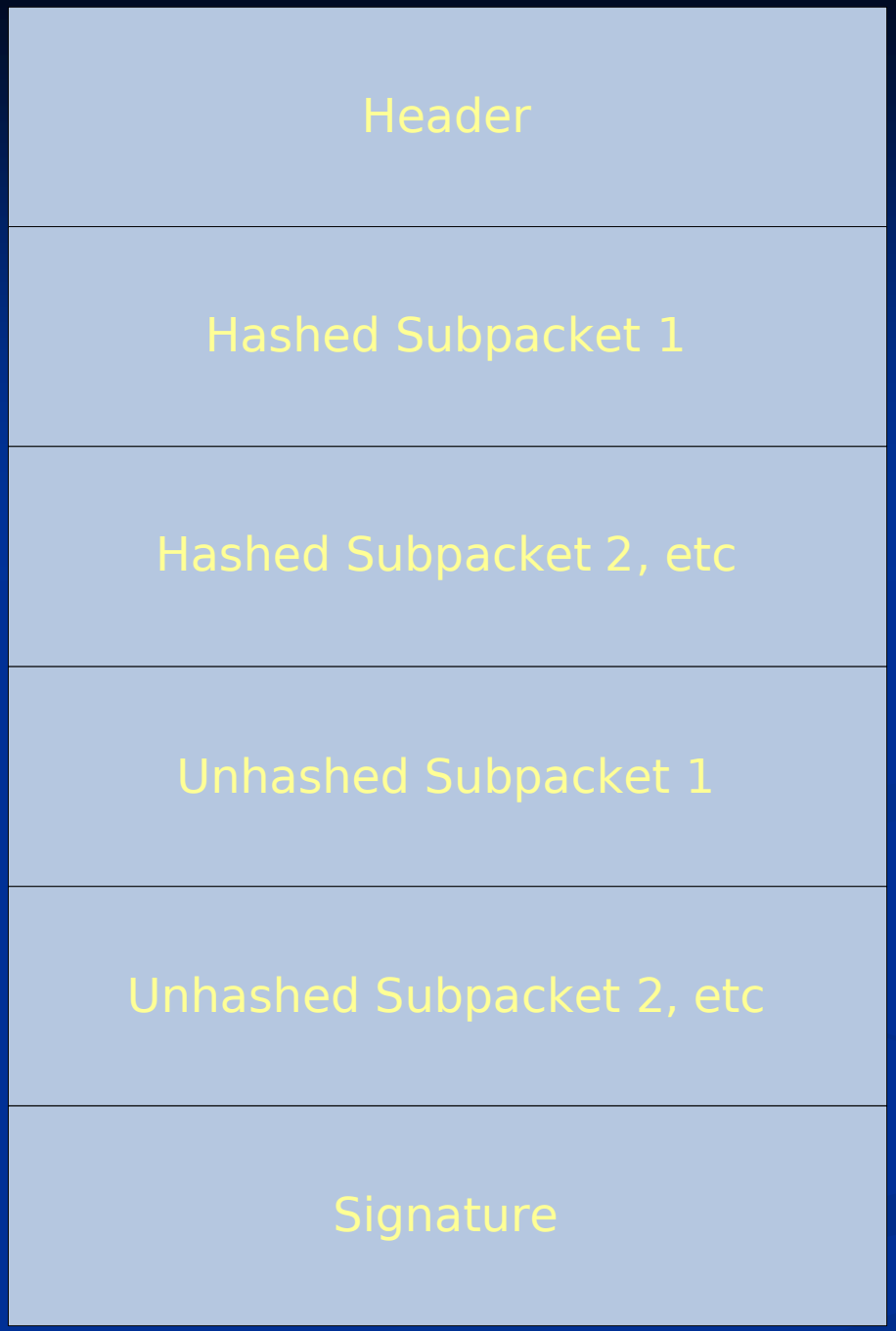
```
memset(&keyring,'\0',sizeof keyring);
ops_parse_options_init(&opt);

arg.fd=open(keyfile,O_RDONLY);
if(arg.fd < 0)
    // Error handling…
opt.reader_arg=&arg;
opt.reader=ops_reader_fd;

ops_parse_and_accumulate(&keyring,&opt);

close(arg.fd);
```

Example – Verify Cleartext Sig I

```
case OPS_PTAG_CT_SIGNED_CLEARTEXT_HEADER:
    free(signed_data);
    signed_data=NULL;
    length=0;
    break;

case OPS_PTAG_CT_SIGNED_CLEARTEXT_BODY:
    signed_data=realloc(signed_data,
                length+content->signed_cleartext_body.length);
    memcpy(signed_data+length,
      content->signed_cleartext_body.data,
      content->signed_cleartext_body.length);
    length+=content->signed_cleartext_body.length;
    break;

case OPS_PTAG_CT_SIGNED_CLEARTEXT_TRAILER:
    signed_hash=content->signed_cleartext_trailer.hash;
    return OPS_KEEP_MEMORY;
```

Example – Verify Cleartext Sig II

```
case OPS_PTAG_CT_SIGNATURE:
    signer=ops_keyring_find_key_by_id(&keyring,
                                      content->signature.signer_id);
    if(!signer)
        {
        fprintf(stderr,"SIGNER UNKNOWN!!!\n");
        exit(2);
        }

    if(ops_check_hash_signature(signed_hash,&content->signature,
                                ops_get_public_key_from_data(signer)))
        {
        puts("Good signature...\n");
        fputs(signed_data,stdout);
        free(signed_data);
        length=0;
        }
    else
        {
        fprintf(stderr,"BAD SIGNATURE!!!\n");
        exit(1);
        }
    break;
```


Header
Hashed Subpacket 1
Hashed Subpacket 2, etc
Unhashed Subpacket 1
Unhashed Subpacket 2, etc
Signature

Example – Write Self-Signed Key

```
ops_write_struct_public_key(&skey.public_key,&opt);

ops_fast_create_user_id(&id,user_id);
ops_write_struct_user_id(&id,&opt);

ops_signature_start(&sig,&skey.public_key,&id,
                    OPS_CERT_POSITIVE);
ops_signature_add_creation_time(&sig,time(NULL));

ops_keyid(keyid,&skey.public_key);
ops_signature_add_issuer_key_id(&sig,keyid);

ops_signature_add_primary_user_id(&sig,ops_true);

ops_signature_hashed_subpackets_end(&sig);

ops_write_signature(&sig,&skey.public_key,&skey,&opt);
```

The OpenPGP:SDK

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