XFRM Interface Experiences, Dislikes and Suggested Changes

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Motivation

- Frustration with the structuring came as a result of looking at:
  - MIBS, Forces LFB semantics
    - Other Vendors who map nicely to the above but not Linux
- Confusion ...
  - A few things may just have been adapted as is from Kame
- A lot of vomiting ...

New/updates responses/events for Security Associations

Main structure for user->kernel config and kernel->user response and event reports is struct *xfrm_usersa_info*

```
struct xfrm_usersa_info {
        struct xfrm_selector          sel; //relevant on config/report
        struct xfrm_id                id;  // key, must always be present
        xfrm_address_t                saddr; //relevance in config/report
        struct xfrm_lifetime_cfg      lft;  // relevance on config only
        struct xfrm_lifetime_cur      curlft;  // relevant only on report
        struct xfrm_stats             stats;   // relevant only on report
        __u32                         seq; // config/response, valid in some cases (acquire/allocspi)
        __u32                         reqid;  //config/response, valid in some cases
        __u16                         family; // related to IP
        __u8                          mode;  // relevance on tunnel report/config(move to flags)
        __u8                          replay_window; // config/report
        __u8                          flags; // so far valid only on tunnel config
};
// optional TLVs follow, only appear on a need basis:
XFRM_ALG_XXX/XFRM_ENCAP
```

Get/Dump/Delete of SA

Main structure for user->kernel config and kernel->user response and event reports is struct *xfrm_usersa_id*

```
struct xfrm_usersa_id {
        xfrm_address_t              daddr;
        __u32                       spi;
        __u16                       family;
        __u8                        proto;
};
```

- Looks very similar to the *key, xfrm_id,* used in NEW/UPDATE
- combine and come up with the same header for adding/deleting/getting etc
- Nice simple shim header in the classical tradition of other netlink services
- Fix the optionality issue by having TLVs for other elements
  - Much more extensible

- Clearly breaks ABI!
  - Known apps using the API are iproute2 and Pluto

Other xfrm messages

- Expire, Acquire and ALLOCSPI
  - All describe the SA using struct xfrm_usersa_info
    - Meaning same desire of reusing
- Flush is the only odd one out
  - uses struct *xfrm_usersa_flush* which contains protocol to be flushed
    - We could use the same shim header if we keep proto in shim header and just ignore the rest of the messages

Kill *xfrm_address*

- I hate unions for netlink configuration
  - We need to be as close to a wire formatted packet
    - Future work to make netlink distributed
- Introduce XFRM_SRC and XFRM_DST TLVs
  - no different than the ones used to configure FIB
    - XFRM_SRC implies a src address
    - XFRM_DST implies a dst address
    - Length (L in TLV) implicitly declares V4 or V6

Introduce shim header, *xfrm_sa_id*

- Used in add/del/get/dump/expire/allocspi/ and all events
  - Do same for flush and only set proto field
    - Sacrifice a few bits for consistency

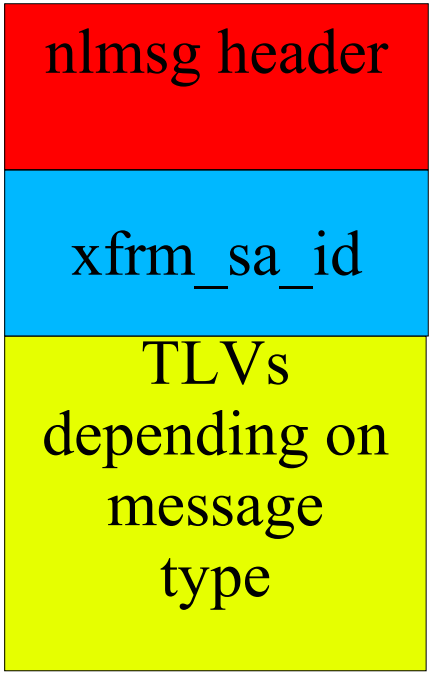
```
struct xfrm_sa_id {
        __u32                   spi;
        __u8                    family;
        __u8                    proto;
        __u16                   flags;
};

flags (16 bits too much?) :
#define XFRM_STATE_NOECN        1
#define XFRM_STATE_DECAP_DSCP   2
#define XFRM_MODE 4 // set implies transport, 1 implies tunnel
#define XFRM_EXPIRE_MODE 8 //set implies hard expire, 1 implies soft
```

Introduce new attribute TLVs

- XFRM_SELECTOR
  - will contain XFRM_DST and XFRM_SRC TLVs
- XFRM_LIFETIME_CFG
- XFRM_LIFETIME_CUR
- XFRMA_STATS
- XFRMA_SEQ
- XFRMA_REQID
- XFRMA_REPLAY_WINDOW
- XFRMA_SPI_RANGE

New SA Message Convention



A NEW/UPD config message, attributes

XFRM_SELECTOR
XFRM_LIFETIME_CFG
XFRMA_SEQ (optionally)
XFRMA_REQID (optionally)
XFRMA_REPLAY_WINDOW
XFRMA_ALG_XXX
XFRMA_ENCAP(optionally)

note the missing attributes for NEW/UPD config

XFRM_LIFETIME_CUR
XFRMA_STATS

New/updates responses/events for Security Policy

Main structure for user->kernel config and kernel->user response and event reports is struct *xfrm_userpolicy_info*

```
struct xfrm_userpolicy_info {
        struct xfrm_selector          sel;  //key
        struct xfrm_lifetime_cfg      lft;    // config/response/event
        struct xfrm_lifetime_cur      curlft;  // response/event
        __u32                         priority;    // config
        __u32                         index; //key
        __u8                          dir; //key
        __u8                          action; //BLOCK if set otherwise allow
        __u8                          flags; //only XFRM_POLICY_LOCALOK defined
        __u8                          share;
};

// optional TLVs follow, only appear on a need basis (good thing):
XFRMA_TMPL
```

Get/Dump/Delete of SP

Main structure for user->kernel config and kernel->user response and event reports is struct *xfrm_userpolicy_id*

```
struct xfrm_userpolicy_id {
        struct xfrm_selector            sel;
        __u32                           index;
        __u8                            dir;
};
```

- Again: Looks very similar to the *keys* used in NEW/UPDATE of policy
  - combine and come up with the shim header like SA
- Fix the optionality issue by having TLVs for other elements
  - Much more extensible

- Again: Clearly breaks ABI!
  - Known apps using the API are iproute2 and Pluto

Other xfrm policy messages

- Expire, Flush
  - Similar treatment as in SA
    - They all eventually deal with xfrm_userpolicy_info

Introduce shim header, *xfrm_sp_id*

- Used in all config/response/event messages

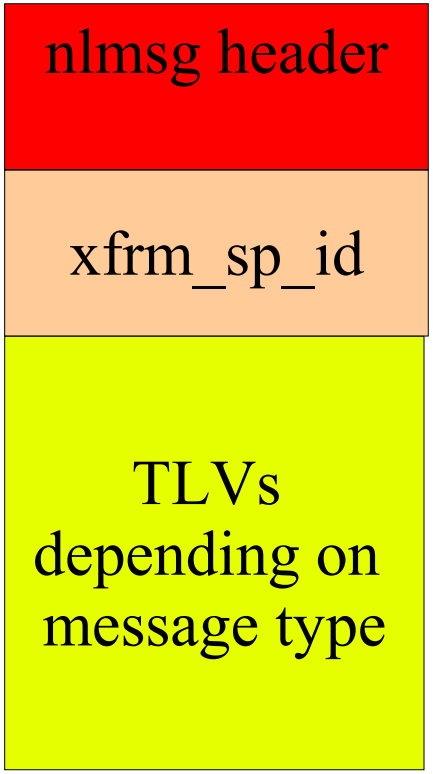
```
struct xfrm_sp_id {
        __u32                    index;
        __u32                   flags;
};


flags (32 bits too much?) :
// reserve two bits for XFRM_POLICY_DIR  IN/OUT/FWD
// 1 bit for XFRM_EXPIRE_MODE
// reserve bits for actions: ALLOW/BLOCK/
// reserve bits for share
// reserve bits for proto (used only in flush messages)
```

Attribute TLVs

- Reuse the same TLVs from SA
  - nice
- Introduce one new TLV XFRMP_PRIORITY
  - It holds the policy priority

New SP Message Convention



A NEW/UPD config message, attributes

XFRM_SELECTOR (always present?)
XFRM_LIFETIME_CFG
XFRMP_PRIORITY
XFRMA_TMPL(optionally)

Usability: Introduce owner field

- We already have this in current FIB
  - We issue numbers to routing daemons and apps
  - Displaying routes shows who inserted them
- Do the same for SADB and SPD
- For SADB we also need to distinguish phase1 vs phase2 Security Associations
  - A few vendors already do this (CISCO comes to mind)

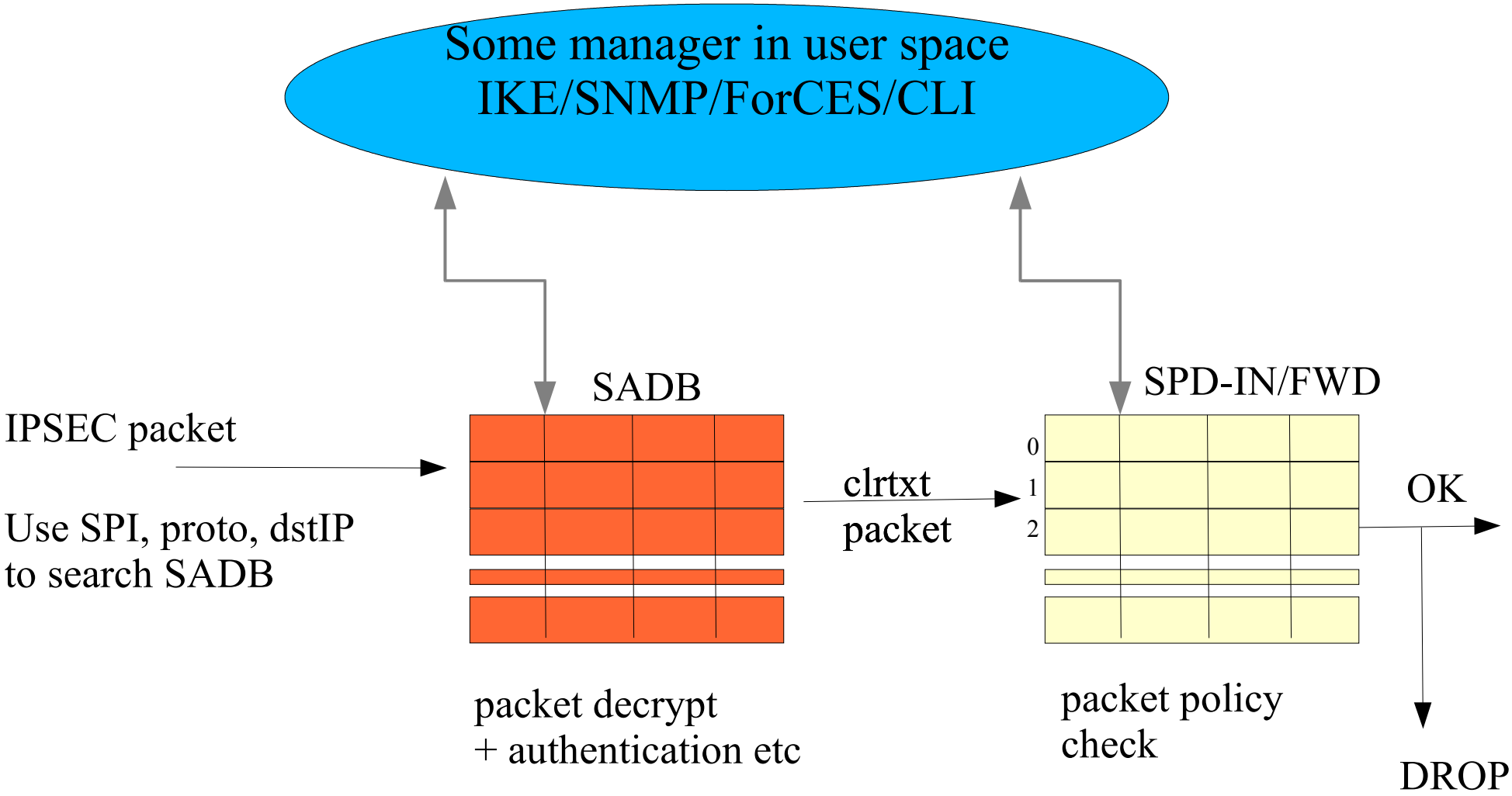
Usability: MISC

- Need better Stats
  - Just reuse Gen stats we already have
  - Need to figure out how many times a SA or SP has been hit pkt/byte count etc
- Delete ranges instead of just flush for both SP/SA
  - Can currently be done if Manager issues multiple messages to delete specific entries
  - Will be made a lot easier if we have indices for all tables

MISC Comments

- We should probably prefix all TLVs as XFRM_xxxx
  - XFRMA_xxxx to SA specific
- Other classifier should be usable for policies instead of standard vanilla flavored SPD
  - In particular makes sense for policy checking
    - Netfilter/iptables
    - I would like to do it from ingress/egress tc level

Modeling IPSEC Inbound



Modeling IPSEC Outbound

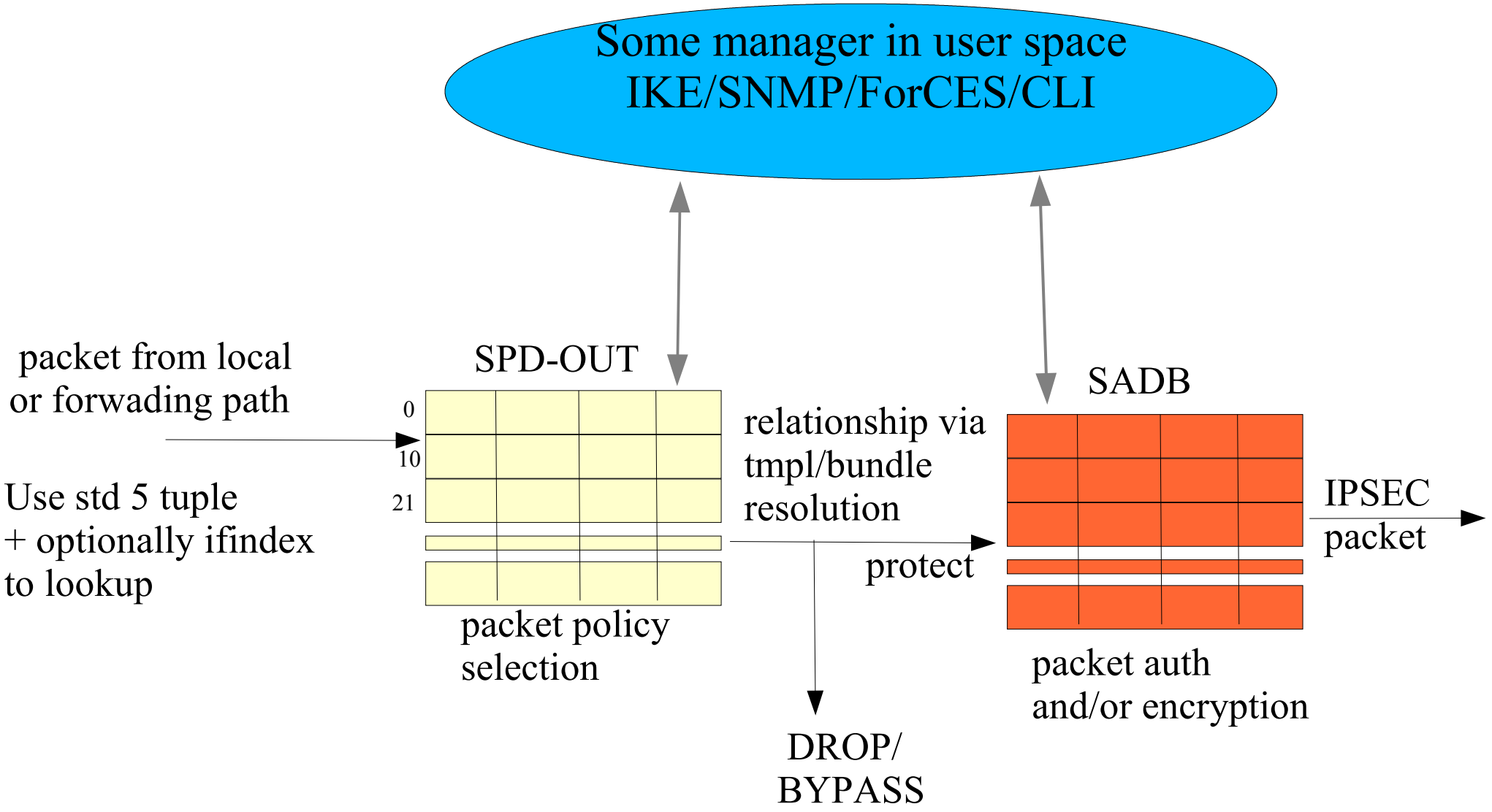


Table Management

- Tables management typically utilizing something unique about the table properties, a *key*
  - There maybe more than one key applicable
    - SPD index vs Selector
    - My employee ID vs phone extension vs LastName
  - In case of multiple keys, some may make more sense than others in given conditions

Table Management

- Indices or some number are preferable by management
  - SNMP OIDs, Forces Ids, easier to map to hardware (CAMs, address locations etc)
  - less bandwith
    - imagine a few thousand of these things being sent
  - Offload extra computation from the forwarding path
    - "*Insert this at index 100*" is easier than "*heres a selector and priority, please figure out where to insert it*"
      - The manager has the intelligence to figure out a given selector and priority should fit at index 100 after sorting etc

And the point is ....

- SPD has selector + dir vs index as keys
- Problem is the index is not controlled by the manager
  - Manager cannot define it
    - Instead the kernel does
      - Other issues with it such as the way it is defined etc (offtopic)
    - This means an intelligent control/datapath separation where you use as little resources as possible is hard to do
- Recommendations
  - SPD index to be defined by manager
    - Default kernel gives you the next available one

What about SADB?

- It too should have indices!
- Makes it easier to map SPD toSADB than the case of using tmpls.
  - Infact a few vendors and organizations like the NPF are defining it this way

MISC: ACQUIREs

- One approach
  - SPD fails to find SA
  - Set a SPD flag to indicate ACQ_IN_PROGRESS
    - Set sequence number to expect back
      - very basic simple larval state
  - Initiate ACQUIRE
    - Queue packet
    - Queue incoming packets up to MAX packets allowed
      - Drop any incoming packets after
  - Acquire resolved
    - protect packets

Potpourri

- CISCO has flags and events for sequence number overflows
- What about PMTU? Flags/display?events?
- What should happen when Links go down?
- Can we have DPD(RFC3706) support in kernel?
  - Would need events to inform km of peer death etc
- GRE/IPSEC config?
- NAT-T for static config?

High Availability/Redundancy

- Clearly static info on SADB/SPD needs syncing
- Dynamic details as well need syncing
  - Keys
  - Lifetime state (bytes/timeouts)
  - Sequence numbers + window state
  - SPI?
  - All the above would need configs like configuring lifetimes, inserting expires etc