lib/librte_ipsec

A NATIVE DPDK IPSEC LIBRARY UPDATE 2018/12

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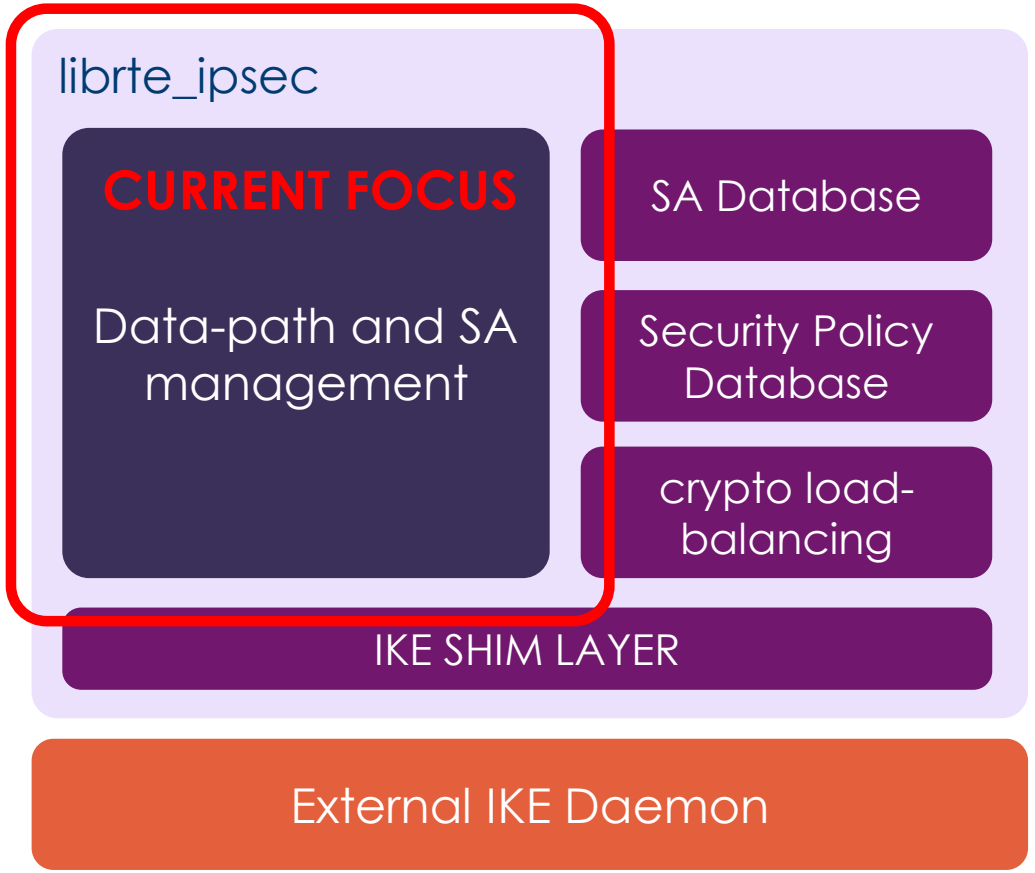
/intro

- Create a DPDK native high performance library for IPsec processing.
- Develop a modular library built around a core functionality of data-path processing and SA management.
- Optional modules which implement scalable and performant security association and security policy database, crypto load-balancing (host, lookaside, inline) and integration point for IKE clients.
- Application abstraction from hardware accelerators, library will handle accelerator allocation and resource usage.

/library/components

- Core module:
  - Data-path and SA management (create/destroy/update SA)
- Optional modules:
  - SA database with associated data path functions
  - SP database with associated data path functions
  - Crypto processing load-balancer
  - Shim layer for integration of library to existing external IKE solutions.



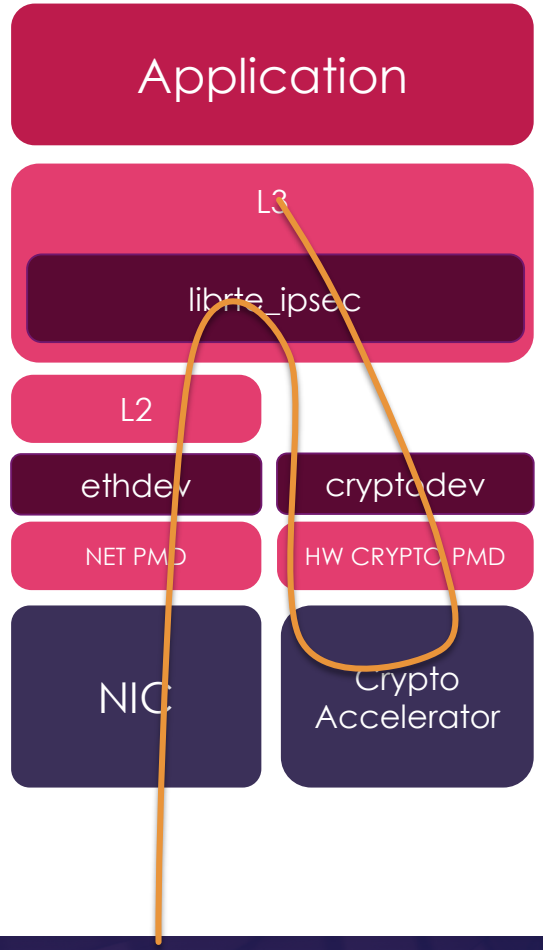
/library/datapath

- Data path API is SA oriented and packet burst based.
- Low-level APIs handle the IPsec protocol processing only with no crypto processing and crypto device management.
- The high-level APIs plan to abstract all IPsec processing including crypto processing and hw acceleration.
- Datapath module can be used independently of the other modules to allow integration with existing applications which may want to use their existing infrastructure.

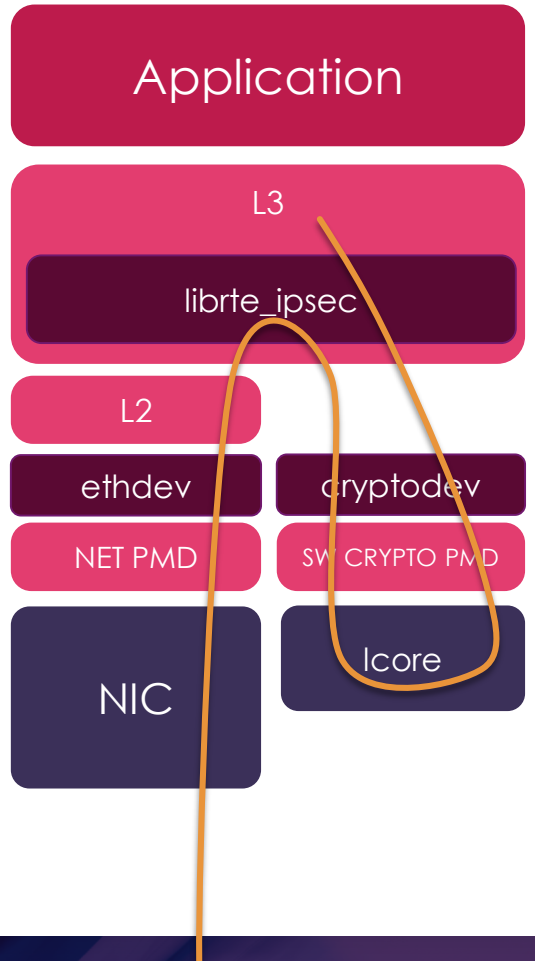
/library/supported_processing_modes

DPDK
DATA PLANE DEVELOPMENT KIT

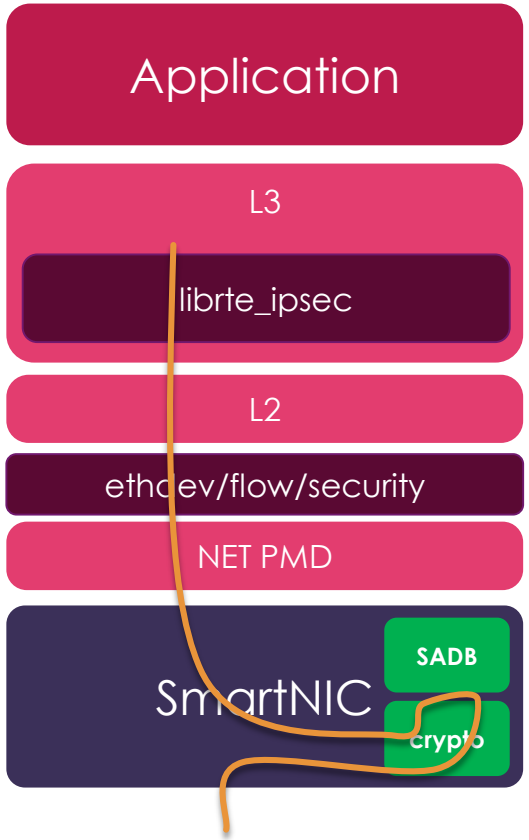
Host based Crypto Processing



Lookaside Hardware Crypto Processing



IO based Inline Crypto Processing



/library/19.02 features

- Transport/Tunnel ESP
- IPv4/(IPv6 partial)
- aes-cbc-128/hmac_sha1, aes-gcm-128, null/null
- rte_cryptodev - CPU/lookaside crypto (aesni_mb, aesni_gcm, qat)
- rte_security - inline crypto (ixgbe)
- ESN and anti-replay
  - Multi-threaded sequence handling capabilities

/sad & /spd

- Standard APIs for SAD and SPD, allow deployment specific implementations to be used to optimize the use case.
- High performance scalable databases implementation built around table libraries (hash, ACL etc.)
- Inbound and outbound data path implementations for the security policy and security association databases.

/crypto-load-balancing

- Optional crypto load-balancer for selecting the best crypto processing option from the available processing models on a per SA basis based on user provided QoS parameters.
- Support migration of SA from one processing model to another, i.e. hardware accelerator crypto processing to host CPU crypto processing in case of an oversubscribed accelerator.

/ike-client-shim

- NETLINK XFRM shim layer to allow external IKE client to integrate with the SA/SP databases.

lib/librte_ipsec

Datapath APIs

/apis/rte_ipsec_sa_*

- SA structure is opaque to the application
- Memory allocation left up to the application.

```
size_t rte_ipsec_sa_size(uint32_t sz);
```

- SA initialization and hardware configuration based on sa_prm provided by user.

```
int rte_ipsec_sa_init(struct rte_ipsec_sa *sa,
        const struct rte_ipsec_sa_prm *prm);
```

- Query SA type, eg. egress tunnel/ESP

```
uint64_t rte_ipsec_sa_type(
        const struct rte_ipsec_sa *sa);
```

- Clear SA parameters, free related resources.

```
void rte_ipsec_sa_fini(struct rte_ipsec_sa *sa);
```

```
/* An opaque structure to repesent Security Association (SA) */
struct rte_ipsec_sa;

/* SA initialisation parameters.*/
struct rte_ipsec_sa_prm {

        uint64_t userdata; /**< provided and interpreted by user */
        uint64_t flags;  /**< see RTE_IPSEC_SAFLAG_* below */

        struct rte_security_ipsec_xform ipsec_xform;
        struct rte_crypto_sym_xform *crypto_xform;
        union {
                struct {
                        uint8_t hdr_len;     /**< tunnel header len */
                        uint8_t hdr_l3_off;  /**< offset for IPv4/IPv6 header */
                        uint8_t next_proto;  /**< next header protocol */
                        const void *hdr;     /**< tunnel header template */
                } tun; /**< tunnel mode repated parameters */
                struct {
                        uint8_t proto;  /**< next header protocol */
                } trs; /**< transport mode repated parameters */
        };

        uint32_t replay_win_sz;
        /**< window size to enable sequence replay attack handling.
         * Replay checking is disabled if the window size is 0.
         */
};
```

/apis/rte_session_prepare

- rte_ipsec_session is an aggregate structure that defines the particular SA on given security/crypto device:
  - pointer to the SA object
  - security session action type
  - pointer to security/crypto session, plus other related data
  - session/device specific functions to prepare/process IPsec packets

```
int rte_ipsec_session_prepare(
        struct rte_ipsec_session *session);
```

```
struct rte_ipsec_session {
        /**
         * SA that session belongs to.
         * Note that multiple sessions can belong to the same SA.
         */
        struct rte_ipsec_sa *sa;
        /** session action type */
        enum rte_security_session_action_type type;
        /** session and related data */
        union {
                struct {
                        struct rte_cryptodev_sym_session *ses;
                } crypto;
                struct {
                        struct rte_security_session *ses;
                        struct rte_security_ctx *ctx;
                        uint32_t ol_flags;
                } security;
        };
        /** functions to prepare/process IPsec packets */
        struct rte_ipsec_sa_pkt_func pkt_func;
} __rte_cache_aligned;
```

/apis/rte_ipsec_pkt_crypto_prepare

- Takes an array of packets with their associated rte_ipsec_session.
- Preforms all IPsec related pre-crypto processing on the packet burst.
- Generates a set of crypto operations for processing on a crypto device for the input packet burst.

```
static inline uint16_t
rte_ipsec_pkt_crypto_prepare(const struct rte_ipsec_session *session,
        struct rte_mbuf *mb[], struct rte_crypto_op *cop[], uint16_t num)
```

apis/rte_ipsec_pkt_crypto_group

- Retrieve IPsec session pointer from crypto_op metadata

```
static inline struct rte_ipsec_session *
        rte_ipsec_ses_from_crypto(const struct rte_crypto_op *cop);
```

- Take as input an input array crypto ops associated with multiple IPsec sessions.
- Extract related mbufs and group them by the rte_ipsec_session that they belong to successfully.

```
static inline uint16_t rte_ipsec_pkt_crypto_group(
        const struct rte_crypto_op *cop[],
        struct rte_mbuf *mb[],
        struct rte_ipsec_group grp[], uint16_t num);
```

- For mbuf which crypto-op wasn't completed a failure flag will be raised in ol_flags

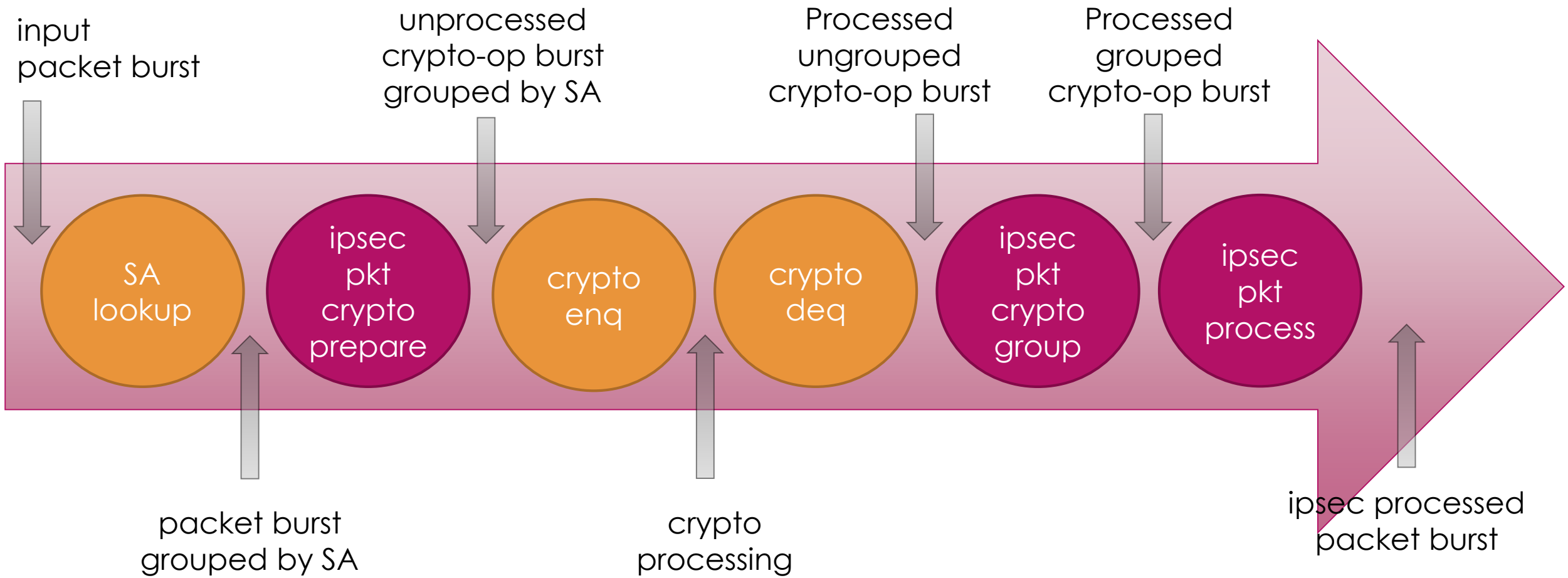
```
struct rte_ipsec_group {
        union {
                uint64_t val;
                void *ptr;
        } id; /**< grouped by value */
        struct rte_mbuf **m;  /**< start of the group */
        uint32_t cnt;         /**< number of entries in the group */
        int32_t rc;           /**< status code associated with the group */
};
```

/apis/rte_ipsec_pkt_process

- Takes a burst of processed crypto operations associated with a single SA session.
- Performs all IPsec related post crypto processing and returns an array of processed mbufs.

```
static inline uint16_t
rte_ipsec_pkt_process(const struct rte_ipsec_session *session,
        struct rte_mbuf *mb[], uint16_t num);
```

/datapath/low-level-pipeline



Examples

IPsec Security GW

/samples/ipsec-secgw

- Introduces new parallel processing path to existing application which uses the new library
- Will maintain existing data path in application until full feature parity
  - -l option used to select new codepath

lib/librte_ipsec

Roadmap

/patches/19.02

- IPsec Library Patches
  - http://patches.dpdk.org/patch/48143/
  - http://patches.dpdk.org/patch/48144/
  - http://patches.dpdk.org/patch/48145/
  - http://patches.dpdk.org/patch/48146/
  - http://patches.dpdk.org/patch/48147/
  - http://patches.dpdk.org/patch/48148/
  - http://patches.dpdk.org/patch/48149/
  - http://patches.dpdk.org/patch/48150/
  - http://patches.dpdk.org/patch/48151/
- IPsec Security GW
  - http://patches.dpdk.org/patch/48276/
  - http://patches.dpdk.org/patch/48277/
  - http://patches.dpdk.org/patch/48278/
  - http://patches.dpdk.org/patch/48279/
  - http://patches.dpdk.org/patch/48280/
  - http://patches.dpdk.org/patch/48281/
  - http://patches.dpdk.org/patch/48282/

/r19.05++

- AH transport/tunnel mode.
- Full IPv6 support.
- Fully migrate examples/ipsec-secgw to use librte_ipsec.
- Data-path scaling, multicore processing of “Fat Flow” SA.
- High Level Data Path APIs.
- SAD APIs and database implementation.
- SPD APIs and database implementation.
- External IKE daemon integration.