RFC 3706

A Traffic-Based Method of Detecting Dead Internet Key Exchange (IKE) Peers

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Summery

1. Introduction
2. Keepalives and Heartbeats
3. DPD Protocol
4. Resistance to Replay Attack and False Proof of Liveliness

Situation

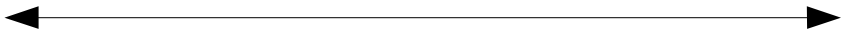
Peer A

Peer B

Internet

IKE

Protected IP traffic



IKE

Problem if connectivity goes down

- No way for IKE and IPSec to identify the loss of peer connectivity
- The SAs can remain until their lifetimes naturally expire

SA = Security Association

"Black Hole" Situation

- Packets are tunneled to oblivion
- It is often desirable to recognize black holes as soon as possible
  - failover to a different peer quickly.
  - recover lost resources.
- Proposals
  - sending periodic HELLO/ACK messages to prove liveliness.

Keepalives and Heartbeats

- Bidirectional "keepalive" message exchange

  - a HELLO followed by an ACK

  only on side is interested in liveliness

- Unidirectional "heartbeat" message exchange

  - a HELLO only

  both sides have to demonstrate liveliness

Scenario 1

Peer A

Peer B

A's 10 sec. timer elapses first

Sends HELLO to B

HELLO

Receives HELLO

Acknowledges A's liveliness

Resets keepalive timer

ACK

Sends ACK

Receives ACK as proof of B's liveliness

Reset keepalive timer

Scenario 2

Peer A

Peer B (dead)

A's 10 sec. timer elapses first

Sends HELLO to B — HELLO → (dead)

Retransmission timer expires

Message could have lost in transit

A increments error counter

Sends another HELLO → (dead)

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Scenario 3

Peer A

Peer B

A's 10 sec. timer elapses first

Sends HELLO to B

HELLO

Receives HELLO as proof of A's liveiness

B's 10 sec. timer elapses

Receives HELLO as proof of B's liveliness

HELLO

Sends HELLO

Scenario 4

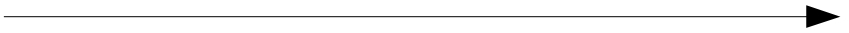
Peer A

Peer B

A's 10 sec. timer elapses first

Sends HELLO to B

HELLO



(dead)

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Assumes B is dead

DPD Protocol

- A peer is free to request proof of liveliness when it needs it.
- asynchronous property allows fewer messages to be sent
- IPSec traffic itself serves as the proof of liveliness.
- Knowledge of the peer's liveliness, is only necessary if there is traffic to be sent.

DPD implementation

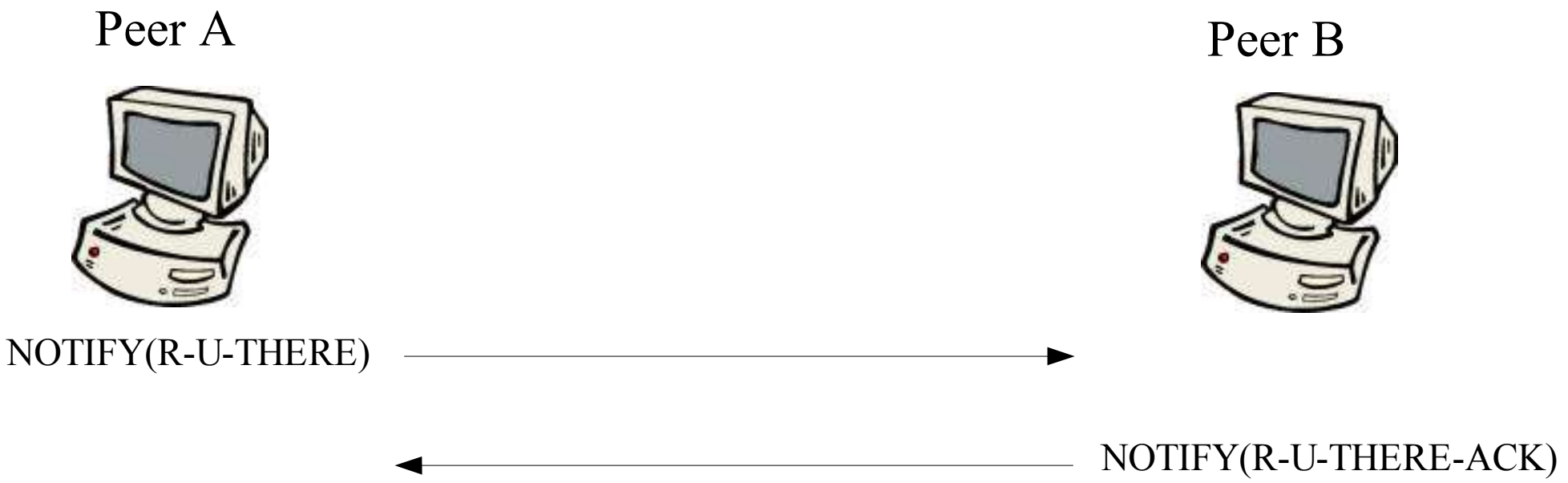
- In DPD, each peer can define its own "worry metric".
- the decision about when to initiate a DPD exchange is implementation specific.
- Each peer's DPD state is largely independent of the other's.

DPD Vendor ID

- Both peers of an IKE session MUST send the DPD vendor ID before DPD exchanges can begin

- MJR and MNR correspond to the current major and minor version of this protocol

Message Exchanges

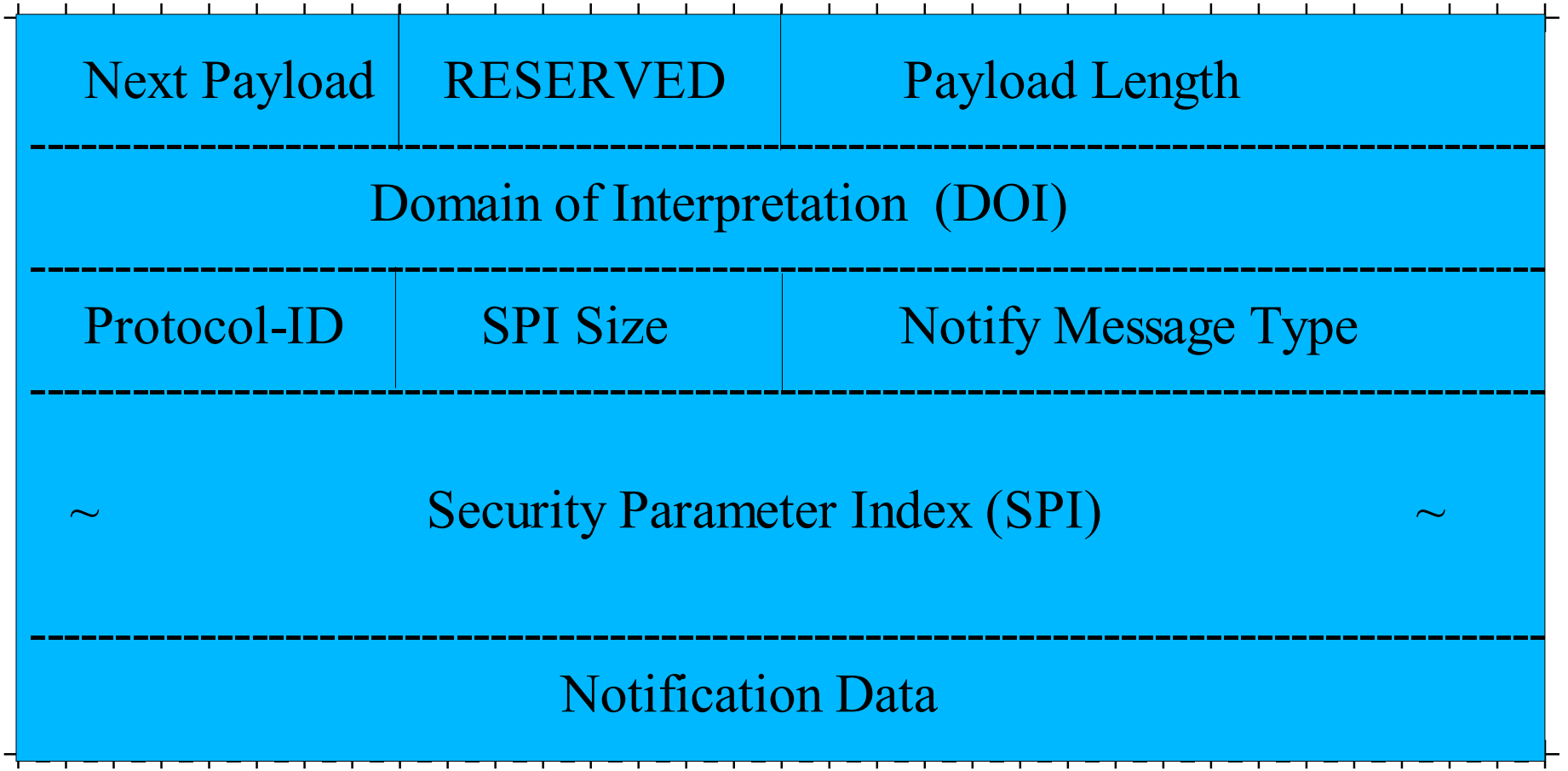


- The DPD exchange is a bidirectional message.
- Both messages are simply ISAKMP Notify payloads
  (Internet Security Association and Key Management Protocol)

Notify	Message Value
R-U-THERE	36136
R-U-THERE-ACK	36137

- A peer MUST keep track of the state of a given DPD exchange.
- Retransmit R-U-THERE queries when it fails to receive an ACK.
- After some number of retransmitted messages delete IPSec and IKE SAs to the peer.

Message Format



- Notify Message Type (2 octets) - MUST be set to R-U-THERE
- Security Parameter Index (16 octets) - SHOULD be set to the cookies of the Initiator and Responder of the IKE SA
- Notification Data (4 octets) - MUST be set to the sequence number corresponding to this message

Implementation Suggestion

- Liveliness of a peer is only questionable when no traffic is exchanged
- A viable implementation might begin by monitoring idleness.
- A peer's liveliness is only important when there is outbound traffic to be sent.
- initiate a DPD exchange if outbound IPSec traffic was sent, but not received any inbound IPSec packets.
- A complete DPD exchange will serve as proof of liveliness until the next idle period.

Comparisons

DPD vs keepalive/heartbeats

- Performance benefit:

  DPD do not need to sent regular messages.

  The number of IKE messages to be sent and processed is reduced.

- Implementation benefit:

  DPD needs only 1 timer

Resistance to Replay Attack and False Proof of Liveliness

Sequence Number in DPD Messages

- A responder to an R-U-THERE message MUST send an R-U-THERE-ACK with the same sequence number.
- The initial sender SHOULD reject the R-U-THERE-ACK if the sequence number fails to match the one sent with the R-U-THERE message.
- both SHOULD check the validity of the Initiator and Responder cookies presented in the SPI field of the payload.

Selection and Maintenance of Sequence Numbers

- both DPD peers can initiate a DPD exchange
- each peer MUST maintain its own sequence number
- The first R-U-THERE message sent in a session MUST be a randomly chosen number
- the high-bit of the sequence number initially SHOULD be set to zero.
- Sequence numbers MAY reset at the expiry of the IKE SA
- Maintain a window of acceptable sequence numbers

Benefit of sequence numbers

- detecting replayed messages

  prevents from needing to build, encrypt, and send ACKs.

- sequence numbers is that it adds an extra assurance of the peer's liveliness.