Compact Format of IKEv2 Payloads

draft-smyslov-ipsecme-ikev2-compact-00

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Motivation

- Reducing size of IKEv2 messages would decrease power and network bandwidth consumption (important for IoT devices)
- Reducing size of IKE_SA_INIT messages would decrease chances of IP fragmentation

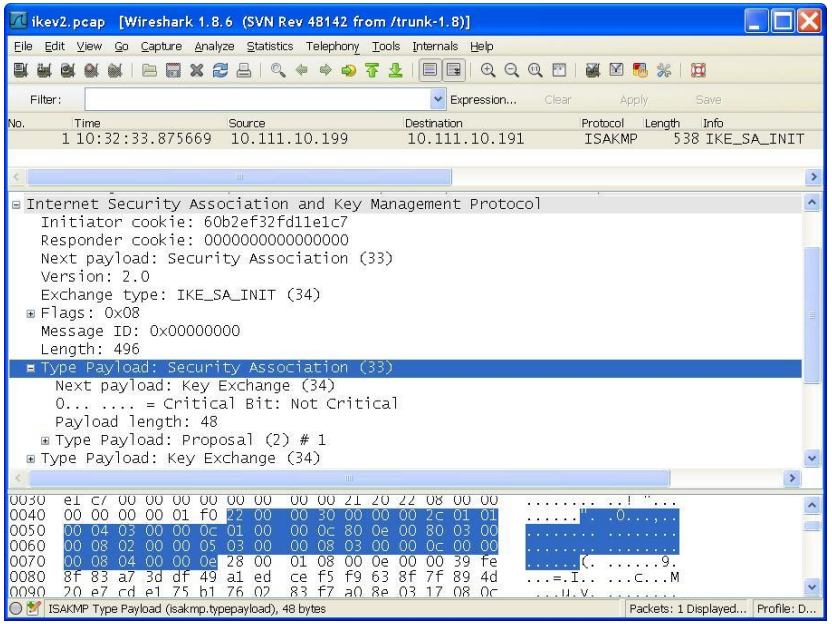
Existing Format Redundancy

- Many payloads contain substantial redundancy
  - Payload Length field occupies 2 bytes, while most payloads are shorter
  - most parameters occupy 2 bytes, while less than 256 values are defined
  - zero-filled RESERVED fields

Example: SA Payload on the right contains one Proposal with four Transforms:

- `ENCR_AES_CBC` (128 bits)
- `PRF_HMAC_SHA2_256`
- `AUTH_HMAC_SHA2_256_128`
- `2048-bit MODP Group`

Payload length is **48** bytes, among which **24** bytes are zeroes.

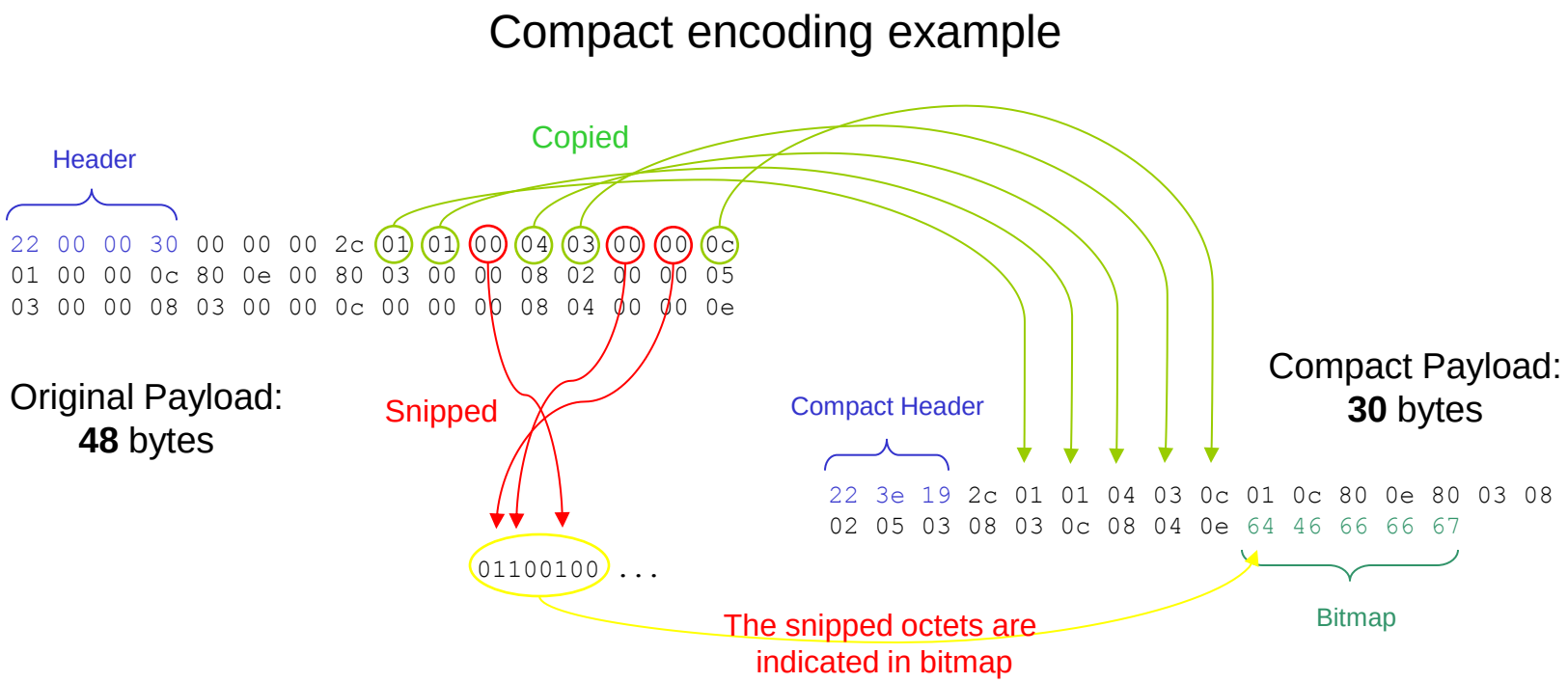


Compact Format Requirements

- The compact format must be generic and must be applicable to any payload, including not yet defined payloads
  - however, some payloads may have special format if it is justified
- The compact format must be easily converted to regular format and visa versa
  - existing parsing/composing code can be reused
- The compact encoding must never increase payload size
- The encoding/decoding algorithms must be simple and consume low resources

Generic Compact Format

Outline: snip zero octets from the payload data and append a bitmap that indicates which octets were snipped



Special Compact Formats

Special compact format is defined for:

- SA Payload
  - SA Payload grows quickly as more and more new transforms are defined and offered by initiators
- Notify Payload with Status Type Notification and no data
  - Exchange of such payloads is a common way to negotiate support for various protocol extensions, so initial IKEv2 messages grow up as more and more extensions are defined

Both payloads contain a lot of redundancy and can be effectively compacted.

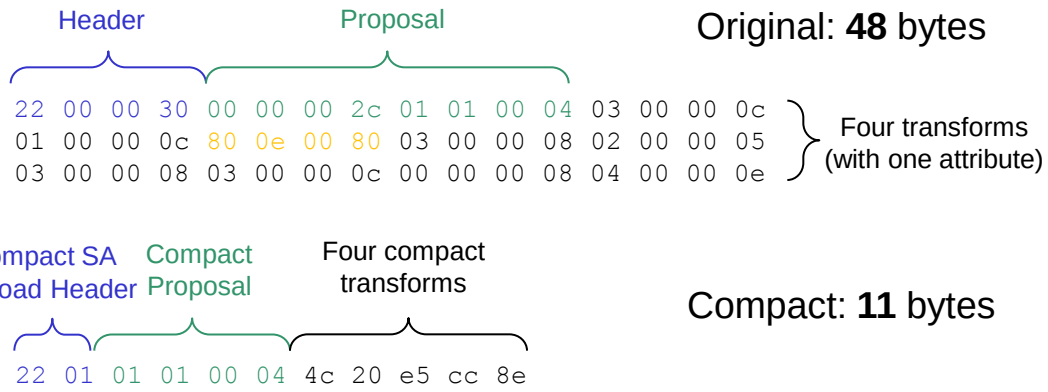
Compact SA Payload

Outline:

- Remove all RESERVED fields
- Remove Length fields in substructures (where they are unnecessary)
- Encode all currently defined transforms w/o attributes in one octet (both Transform Type and Transform ID)
- Encode currently defined Encryption transforms having Key Length attribute in two octets
- Leave possibility to encode arbitrary (even not yet defined) Transform Types and Transform IDs, as with regular format

Example: SA Payload with one Proposal and four Transforms:

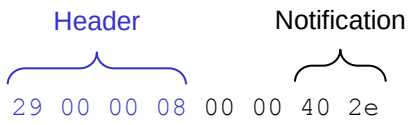
- `ENCR_AES_CBC` (128 bits)
- `PRF_HMAC_SHA2_256`
- `AUTH_HMAC_SHA2_256_128`
- `2048-bit MODP Group`



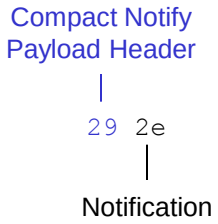
Compact Notify Payload

Outline: encode notification in one octet (limited to first 256 status notifications) and omit all other fields from Notify Payload

Example: Notify Payload with `IKEV2_FRAGMENTATION_SUPPORTED` notification.



Original: **8** bytes



Compact: **2** bytes

Negotiation

Since compact format requires special parsing and is used in an initial IKEv2 exchange, it cannot be negotiated in a usual way – by exchange of Notify Payloads. Instead, a new exchange type `ALT_IKE_SA_INIT` is used in place of `IKE_SA_INIT` (with the same semantics).

- If Responder doesn't supports compact format, then she either replies with `INVALID_SYNTAX` notification or doesn't reply at all
  - Initiator may revert to `IKE_SA_INIT` exchange
- If Responder supports compact format, then she replies with `ALT_IKE_SA_INIT` response, which means that compact format is negotiated

Using

- Once negotiated the compact format can be used in any subsequent exchange
- Messages may contain both compact payloads and regular payloads
  - Generic Compact format is distinguished from regular payloads by non-zero bits in Payload Header's RESERVED field
  - Special Compact formats for SA Payload and Notify Payload have their own Payload Types
- Not all payloads are suitable for compact form
  - some payloads cannot be represented in compact form (e.g. if payload length exceeds 256 bytes)
  - some payloads don't benefit from compact form, because they usually contain random or pseudorandom data (e.g. Encrypted Payload or Nonce Payload)

Integration

Compact format can be easily integrated into existing IKE implementations

- Low complexity: ~200 lines of code in C++ for both encoder and decoder (including special format for SA and Notify payloads)
- Low resource consumption for encoding/decoding
- Can be implemented as pre/post process steps in message parsing/composing code

Thanks

- Comments? Questions?
- More details in the draft
- Please review and send feedback to author