ESP Header Compression (EHC)

draft-mglt-ipsecme-diet-esp-07

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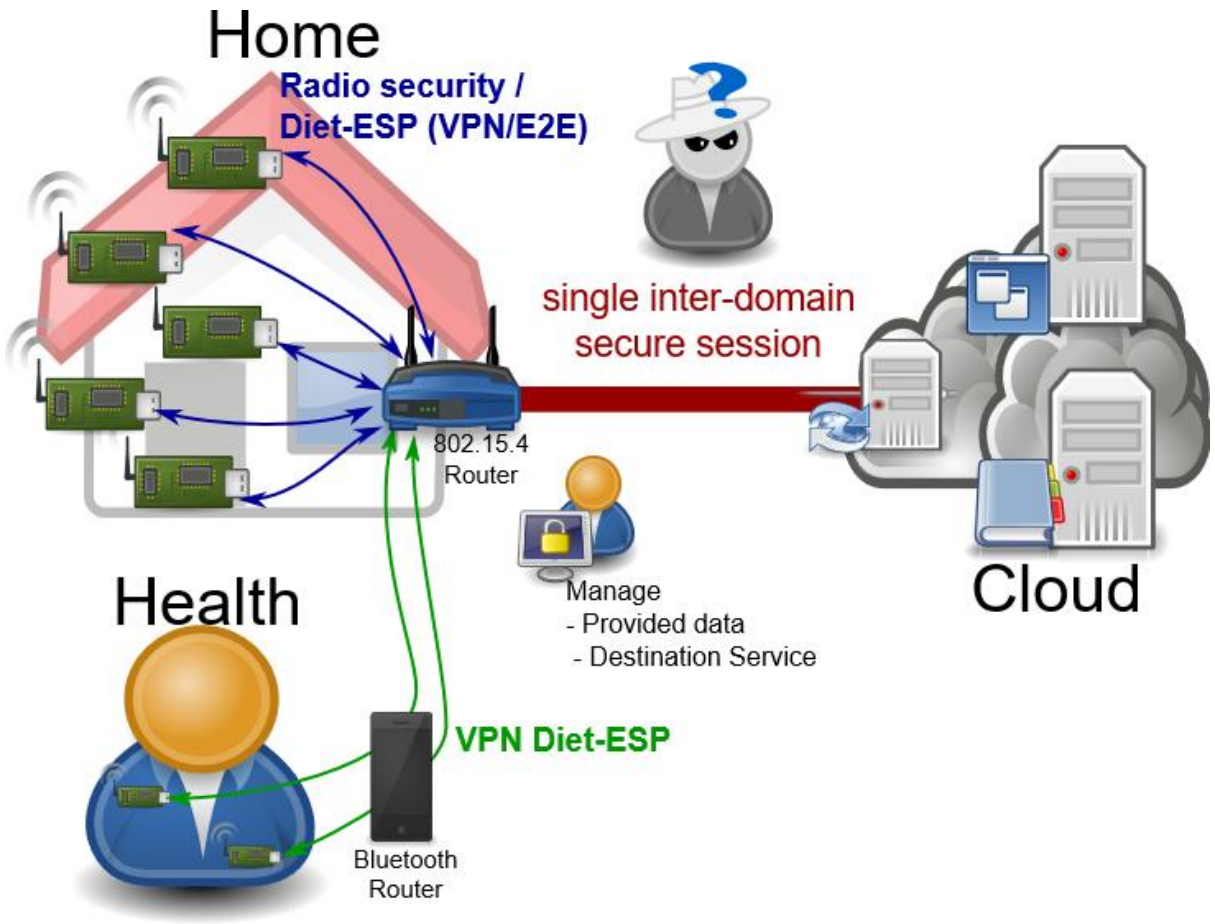
Can you imagine a scenario in IoT, where IPsec/ESP would be useful?

Scenarios for IPsec



- Communication with a server (data center or controler)
- Device to Device (D2D) communication
- Inter-Domain communication (Smart Fabrics/Cities/etc.)
- Multicast / Group Communication
- long term sessionless communications

IPsec‘s Advantage: Flexibility of Key Exchange

- Minimal IKEv2 is already there
- G-IKEv2 works quite well, too
- HIP is standardized for IEEE 802.15.4
- static SAs

So why is IPsec/ESP not widely deployed in IoT?

Problem: Packet Size

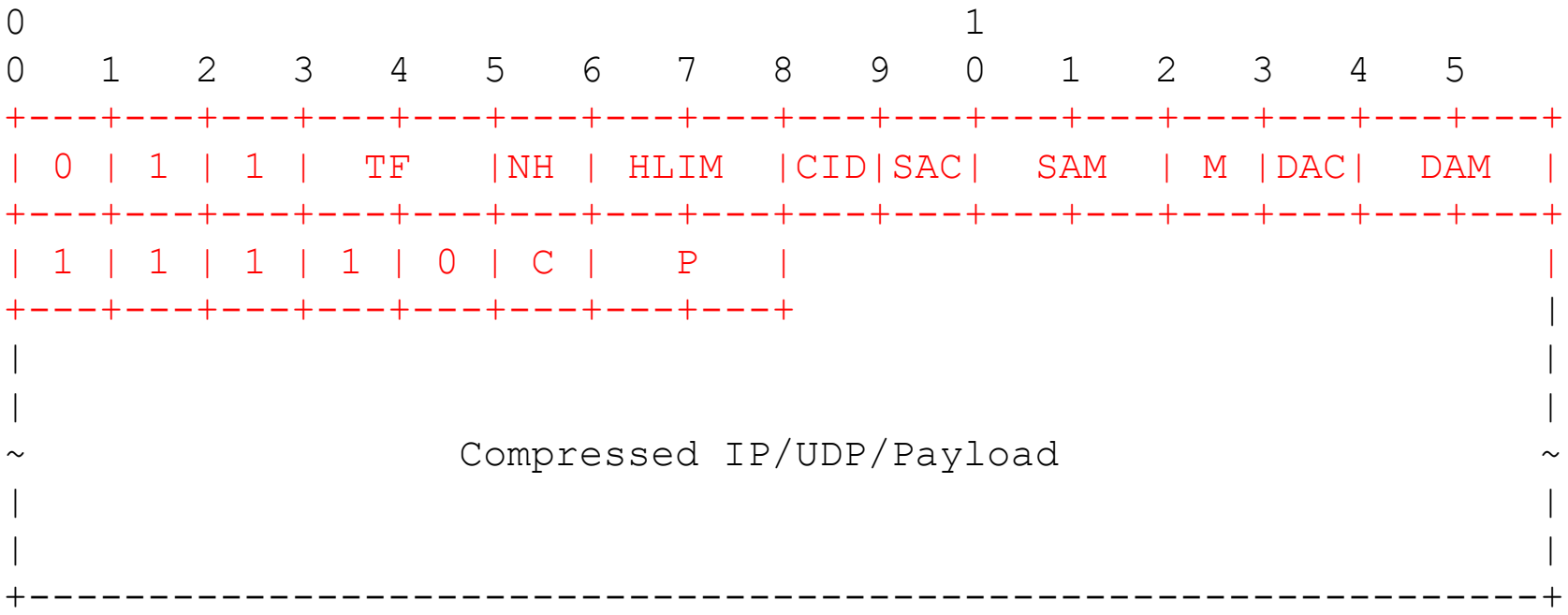
Energy cost of IoT communication:

- Increases with the number of radio frames
- Full / empty radio frames have the same cost
- Security protocol overhead may be larger than a radio frame
- Typical payloads:
  - 802.15.4: 102 Byte
  - LORA: 59 – 230 Byte
  - SigFox: 12 Byte
  - Bluetooth LE: >23 Byte

Solution: Header Compression (1)

Stateless (6LoWPAN)

- Compression Information is sent along with the packet on the wire



Solution: Header Compression (2)

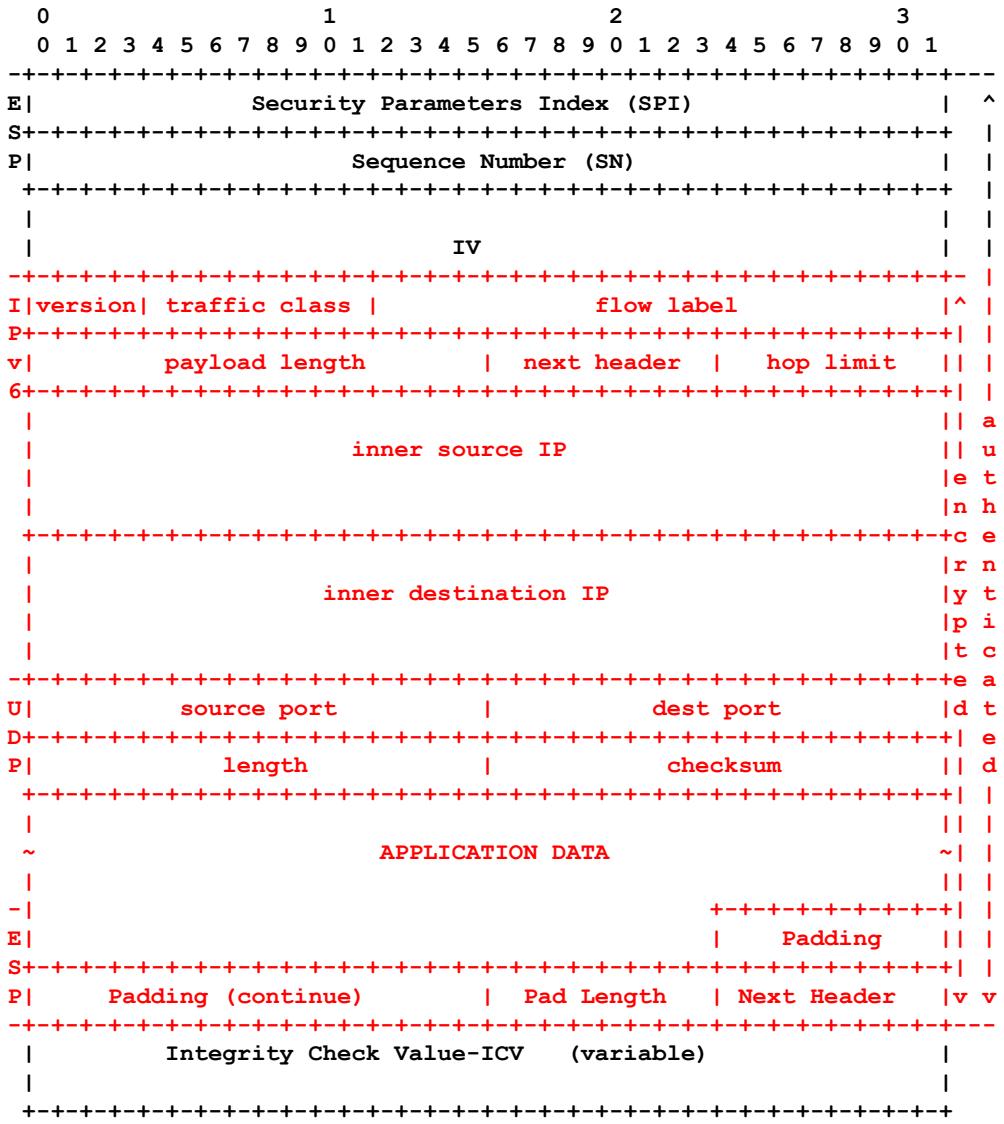
Statefull: RObust HC (ROHC), Static Context HC (SCHC)

- Compression is agreed using a seperate channel
- This can be static (SCHC) or dynamic (ROHC)

Works with functions and context:

- **Functions:** compression technique for a specific field:
  - e.g. „rule 1: delete upd destination port if it is equal to 80“
- **Context:** pre-known knowledge for decompression
  - e.g. „if packet is compressed with rule 1, set the udp destination port to 80“

Problems (with IPsec)



Example of an IP Tunnel

- All shown techniques compress between L2 and L3
- At that time, ESP payload is already encrypted

➔ Only ESP header can be compressed without touching the ESP implementation

Good News: ESP Header Compression (EHC)

- IPsec already has a seperate channel to agree on (and update) a state
  - IKEv2, G-IKEv2, (even HIP could be used)
  - Static
- IPsec already has a **static** state (IPsec SAs)
- The state already holds some context (Traffic Selector)
- We have done this before (ROHCoverIPsec RFC5856)

- We just need to define how to make use of it!
- (Unfortunately) this requires a few specifications

➔ ESP Header Compression (EHC)
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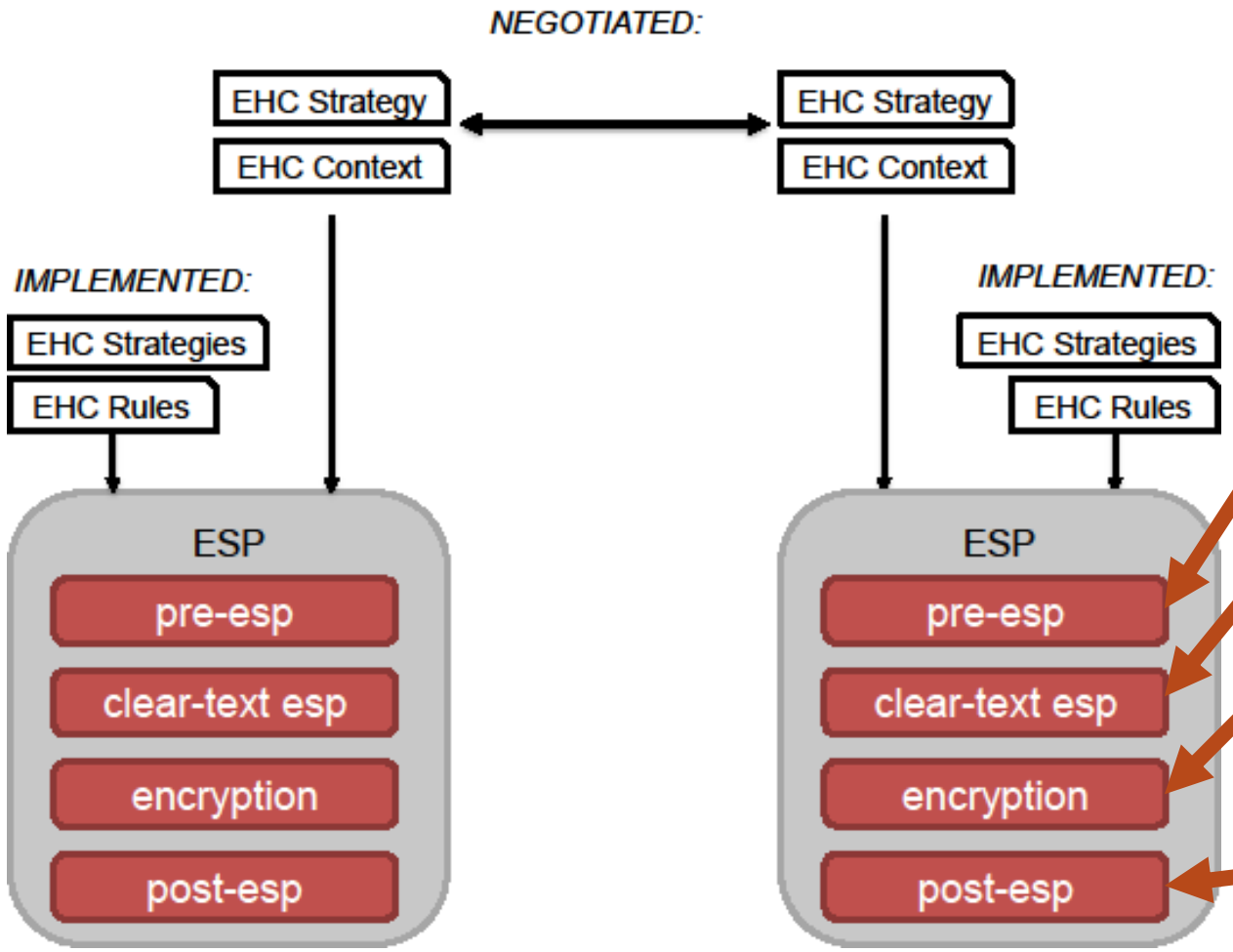
ESP compression Layers



Compression

- ESP payload (IP, UDP, TCP, …)
- ESP Trailer
- Encryption Information (e.g. IV)
  Currently not part of EHC
  ➔ Refer to Implicit IV
- ESP Header
  ICV (currently not part of EHC)

EHC Actions

Function	Compression	Decompression
send-value	No	No
elided	Not send	Get from EHC Context
lsb(_lsb_size)	Sent LSB	Get from EHC Context
lower	Not send	Get from lower layer
checksum	Not send	Compute checksum.
padding(_align)	Compute padding	Get padding

- Define the function, how to compress any field
- Derived from ROHC and SCHC specifications

Some examples:

- send-value: IPv4/TCP Options
- elided: IP address, ports
- lsb: ESP/TCP sequence number
- lower: IP/UDP/TCP length
- Checksum: UDP/TCP checksum
- padding: ESP/TCP padding

EHC Rules (example Inner IPv6)

EHC Rule	Field	Action	Parameters
IP6_OUTER	Version	elided	ip_version
	Traffic Class	lower	
	Flow Label	lower	
IP6_VALUE	Version	elided	ip_version
	Traffic Class	elided	ip6_tc
	Flow Label	elided	ip6_fl
IP6_LENGTH	Payload Length	lower	
IP6_NH	Next Header	elided	l4_proto
IP6_HL_OUTER	Hop Limit	lower	
IP6_HL_VALUE	Hop Limit	elided	ip6_hl
IP6_SRC	Source Address	elided	ip6_src
IP6_DST	Dest. Address	elided	ip6_dst

- Map Actions with the available EHC Context
- Defined for every header we consider compressible
  - ESP
  - IPv6 / IPv4
  - UDP / UDP-Lite
  - TCP
  - Anything else?

EHC Context (example: Inner IPv6)

Attribute	In SA	Possible Values
ip6_tcfl_comp	No	"Outer", "Value", "UnComp"
ip6_tc	No	IPv6 Traffic Class
ip6_fl	No	IPv6 Flow Label
ip6_hl_comp	No	"Outer", "Value", "UnComp"
ip6_hl	No	Hop Limit Value
ip6_src	Yes	IPv6 Source Address
ip6_dst	Yes	IPv6 Destination Address

- Defined for every header we consider compressible
  - ESP
  - IPv6 / IPv4
  - UDP / UDP-Lite
  - TCP
  - Anything else?

EHC Strategy

Problem:

- We still need to exchange (and potentially update) all the context and rules via IKEv2
  - For ESP/IPv6/IPv4/UDP/TCP/UDP-Lite, that‘s 44 header fields (and thus rules/context)
- More difficult than necessary, as most the valuable values are already there

Solution:

- Strategy defines, how to pre-fill context and rules from available SA values (e.g. IP addresses in Traffic Selector)
- Currently one Strategy for IoT (Diet-ESP) defined, but easy to extend

➔Exchanges only max. 9 fields (instead of 44!) to build a compression context


Center alignment
ADOPT
ME
Good
contrast