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Extensible In-band Processing (EIP)

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Extensible In-band Processing (EIP) - What is?

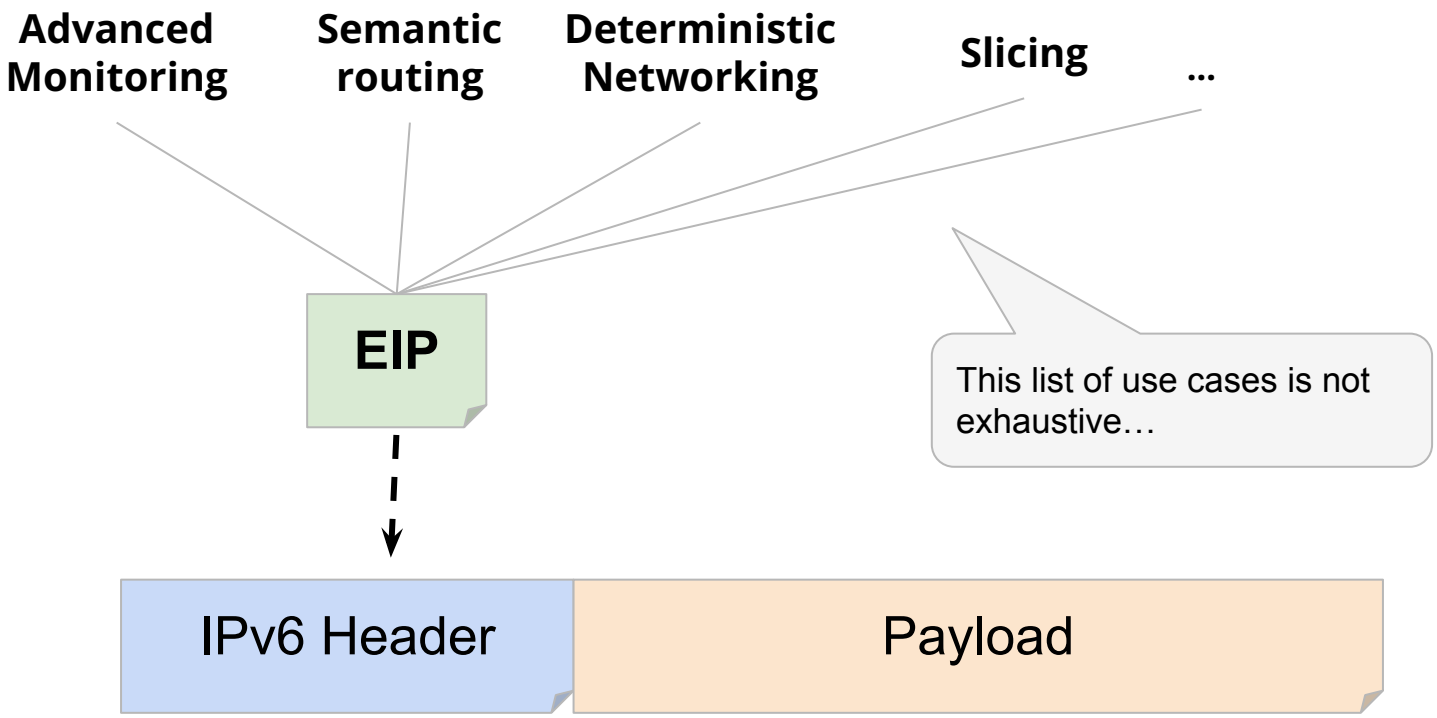
A generic and extensible mechanisms to carry information in IPv6 packets headers.

IPv6 end systems and network nodes can **read and write** this "extensible" EIP information. Nodes can take packet processing decisions depending on the EIP information.

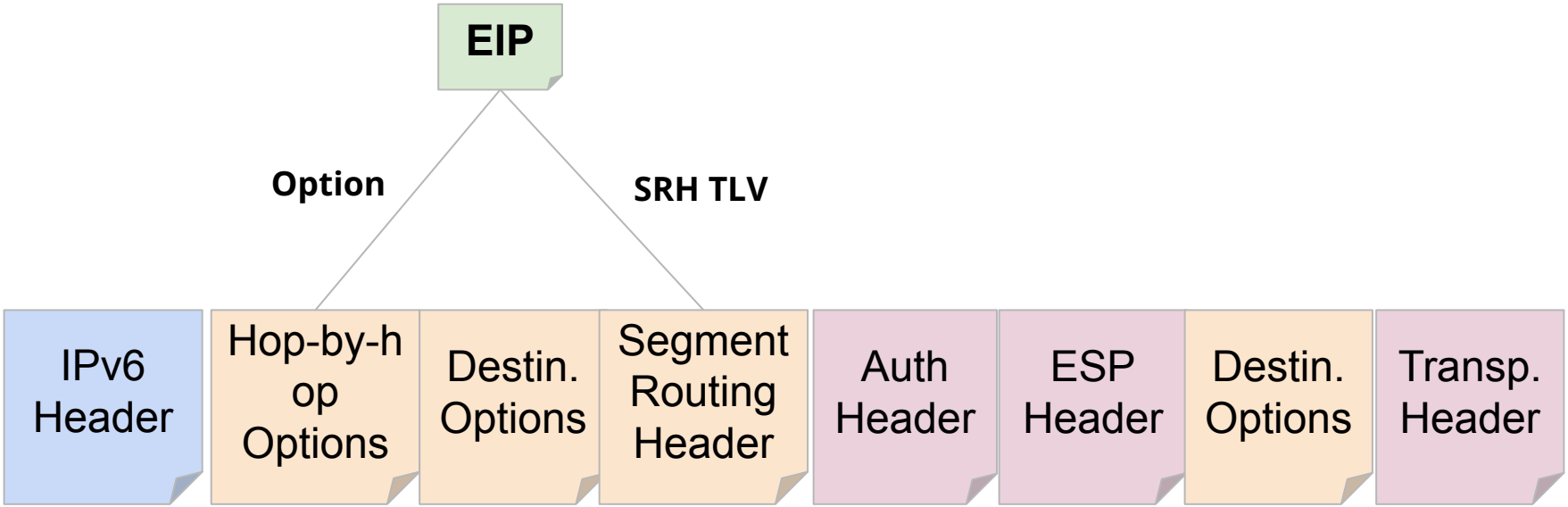
EIP can support **many use cases** that need custom data plane processing features.

https://datatracker.ietf.org/doc/draft-eip-arch/

EIP can support several use cases



Carrying EIP information in IPv6… Where?



See:
https://eip-home.github.io/eip-headers/draft-eip-headers-definitions.html

Extensible In-band Processing (EIP) - Why?

IPv6 header is already "extensible" by definition, with "Extension Headers" and "Options" inside the Extension Headers

Anyway, there are practical barriers in this extension process:

- (1) standardization hurdles
- (2) implementation/experimentation

(1) EIP reduces the “pressure” on the standardization

(2) Open Source prototypes of EIP support the experimentation

Standardization pressure on HbH Options

Some Hop-by-Hop Option code points have been already allocated.

There are several ongoing proposals and discussions to allocate Hop-by-hop Options for different use cases (details in the EIP arch. draft):

- In-situ Operations, Administration, and Maintenance
- Minimum Path MTU
- Alternate marking
- Path Tracing
- Application-aware networking
- Path signals for transport protocols

Benefits of a common EIP header

The EIP header carries different **EIP Information Elements** to support the different use cases

It is useful to define a common EIP header for multiple use cases!

- the number of available Option Types in HBH header is limited (the same for TLVs in the SRH)
- common EIP Information Elements can be re-used across use cases

EIP “Information Elements”

The specific content of the EIP “Information Elements” will be defined considering the requirements of the different use cases.

Some requirements are common to different use cases
e.g. time stamping, authentication (HMAC) => a "library" of common protocol components can be defined

Applicability and scope of EIP

EIP does not need to work end-to-end across Internet

EIP targets "limited domains" (a.k.a. "controlled domains")

Security

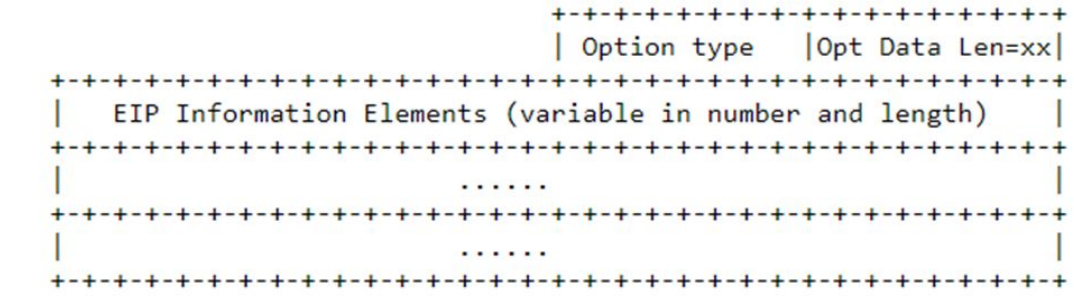
As for security… we added (optional) authentication in the EIP header (i.e. HMAC as done for SRH in SRv6)

In general, our security concerns are aligned with those of SRv6 Network Programming model.

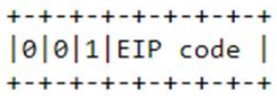
Definition of the EIP header and IEs

https://eip-home.github.io/eip-headers/draft-eip-headers-definitions.html

The EIP header can be carried as an Option in the Hop by Hop Extension Header, as shown in the following figure.



Option type

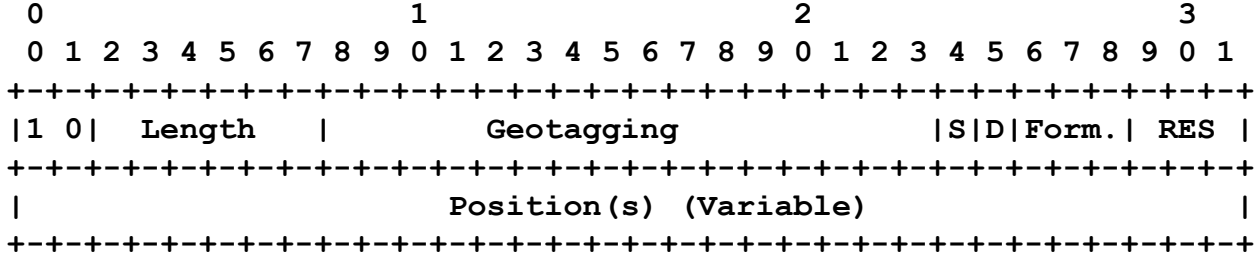


- The EIP header can be carried as an “Option” in the IPv6 Hop-by-Hop Extension Header, or as a TLV in SRH.
- The EIP header carries a set of EIP Information Elements a.k.a. EIP “LTV”s (Length-Type-Value)

EIP for Semantic Routing

We focused on a specific scenario of Semantic Routing, i.e. we considered the use of the geographical positions (“Geotagging”).

We have defined a **Geotagging** Information Element for EIP, that can carry the geographical coordinates of the destination node or of the source node.



https://eip-home.github.io/eip-headers/draft-eip-headers-definitions.html

EIP for Semantic Routing

We support 2 encodings of the coordinates (Quantized and Geohash) with 2 precisions each (64 / 32 bits), corresponding to 4 formats:

Format	Encoding	Precision (error)
0	Quantized Long: Lat. 32 bits, Lon. 32 bits	Lat. ± 2.3 mm, Lon. ± 4.6 mm (max)
1	Quantized Short: Lat. 16 bits, Lon. 16 bits	Lat. ± 153 m, Lon. ± 305 m (max)
2	Geohash Long 60 bits (padded to 64 bits)	Lat. ± 18 mm, Lon. ± 9 mm (max)
3	Geohash Short 30 bits (padded to 32 bits)	Lat. ± 600 m, Lon. ± 300 m (max)

EIP - Prototype / "running code"

We're building an open source prototype for EIP in Linux.

Two main components:

1) Scapy based packet generator / dissector
2) EIP aware router

The EIP aware router is based on eBPF/XDP, hence it is very efficient.

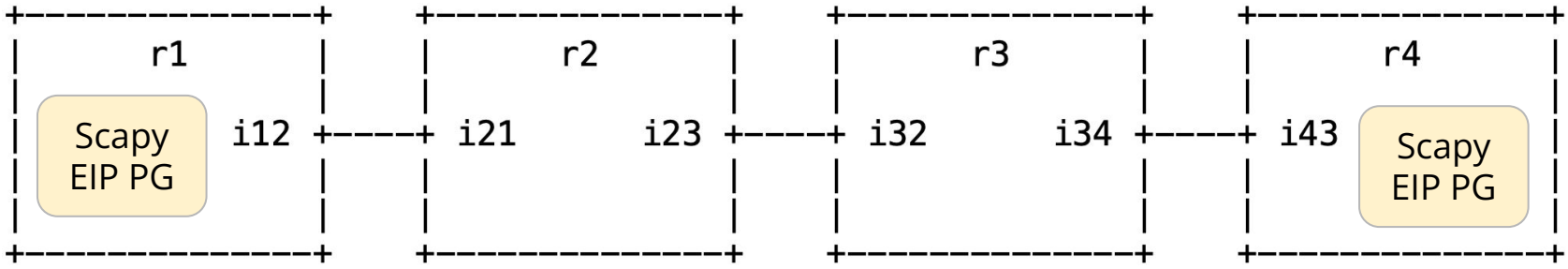
We are considering the use cases:

- Semantic Routing (Geotagging)
- Advanced Monitoring (in-band end-to-end delay monitoring, path tracing)

Basic EIP prototype

The basic EIP prototype is a docker container which includes:

- the development environment for EIP
- a testbed with 4 “namespaces” that implement EIP Packet generator/dissector and EIP aware router



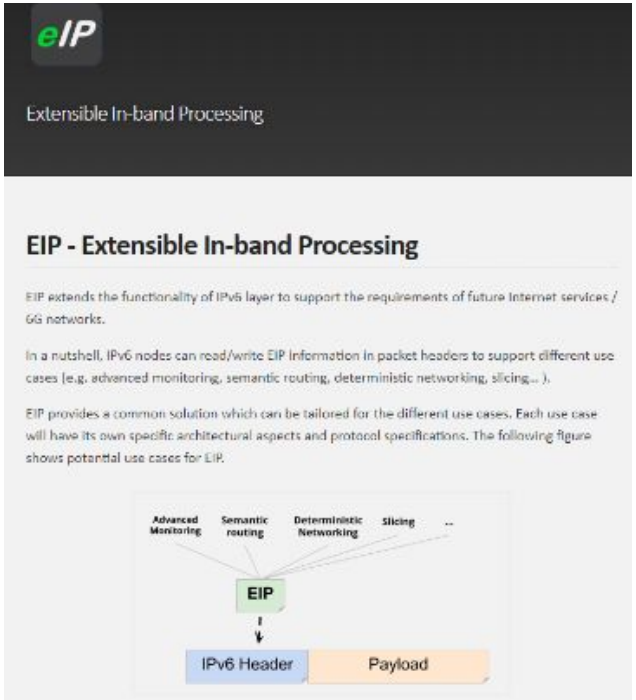
EIP - Interest Group

We've set up an informal Interest Group on Extensible In-band Processing

https://eip-home.github.io/eip/

Mailing list
eip@cnit.it

Join the mailing list
http://postino.cnit.it/cgi-bin/mailman/listinfo/eip



EIP - References

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S.Salsano, H.ElBakoury, D. Lopez,
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https://eip-home.github.io/use-cases/draft-eip-use-cases.txt

Thank you for your attention!

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