



Supporting Future Internet Services with Extensible In band Processing (EIP)

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

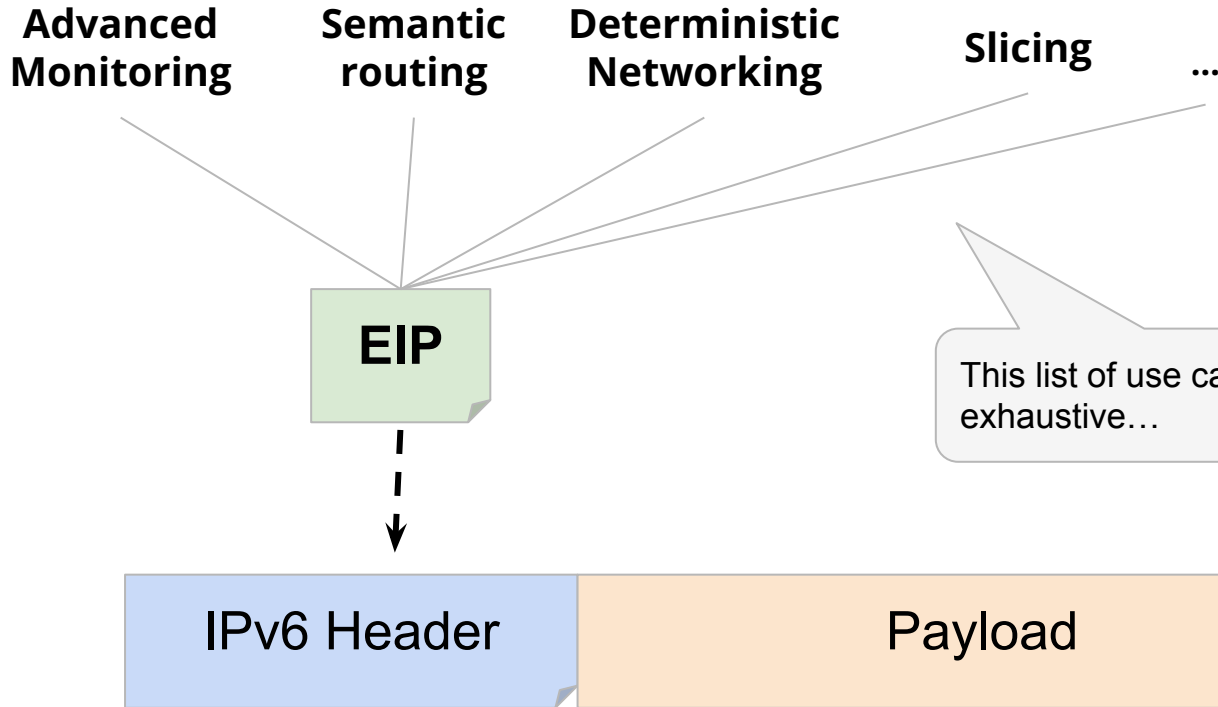
A generic and extensible mechanisms to carry information in IPv6 packets headers.

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.

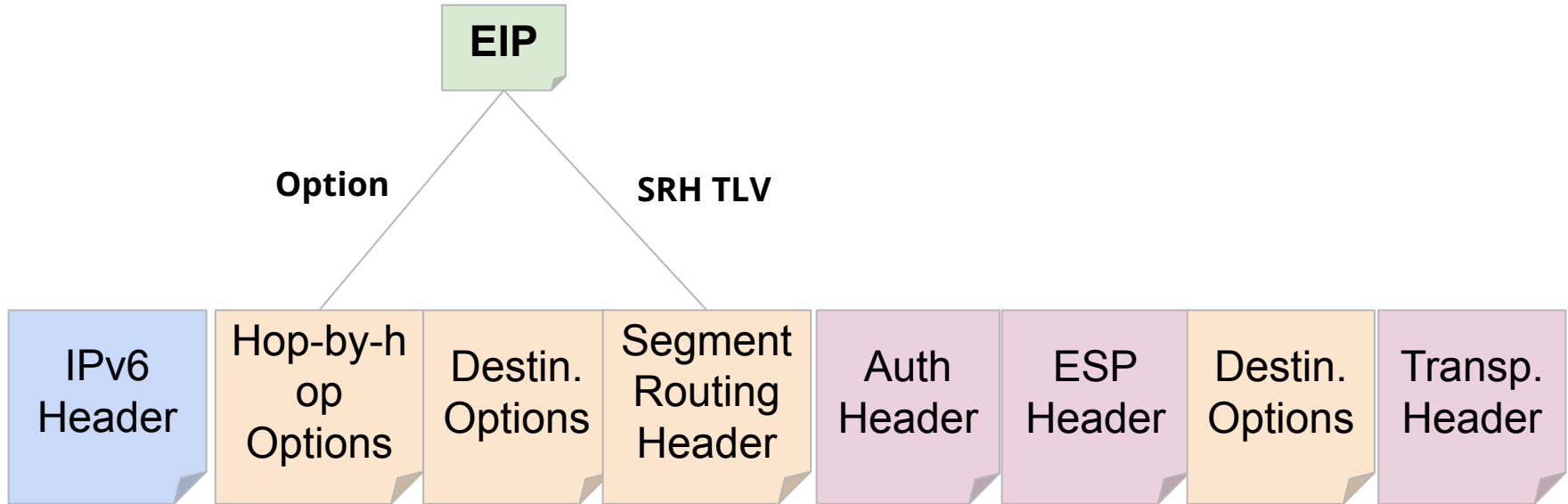
EIP can support **many use cases** that need custom data plane processing features.

<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>

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

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

There are several further ongoing proposals and discussions to allocate Hop-by-hop Options for different use cases.

- In-situ Operations, Administration, and Maintenance (already allocated)
- Minimum Path MTU
- Alternate marking
- Path Tracing
- Application-aware networking
- Path signals for transport protocols
- Virtual Transport Network (VTN) Identifier
- Topology Identifier
- Generic Identifier

Details are provided in <https://datatracker.ietf.org/doc/draft-eip-arch/>

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

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

The EIP IEs can be coded with up to 24 bits => $2^{24} = 16.7 \text{ M}$
(compare with 8 bits for HbH Options)

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

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

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)

We have an open source prototype for EIP in Linux.

Two main components:

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

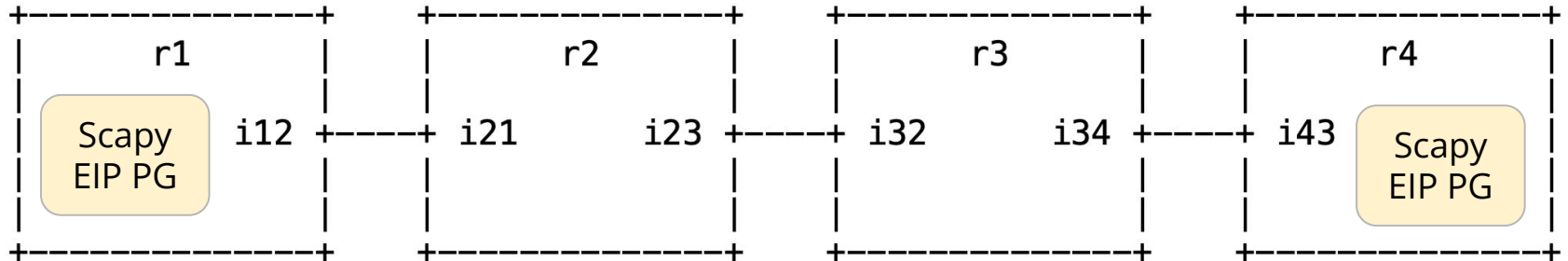
The EIP aware router is based on eBPF/XDP, hence it is very efficient.

We are considering the use cases:

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

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



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
<https://tiny.one/join-eip>

eIP

Extensible In-band Processing

EIP - Extensible In-band Processing

EIP extends the functionality of IPv6 layer to support the requirements of future Internet services / 5G networks.

In a nutshell, IPv6 nodes can read/write EIP information in packet headers to support different use cases (e.g. advanced monitoring, semantic routing, deterministic networking, slicing...).

EIP provides a common solution which can be tailored for the different use cases. Each use case will have its own specific architectural aspects and protocol specifications. The following figure shows potential use cases for EIP.

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graph TD; EIP[EIP] --> AM[Advanced Monitoring]; EIP --> SR[Semantic routing]; EIP --> DN[Deterministic Networking]; EIP --> S[Slicing]; EIP --> P[...]; EIP --> IH[IPv6 Header]; IH --> P2[Payload];
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We think that the evolution of Internet Routing and Addressing requires protocol extensions in the networking layer

EIP is a generic framework that supports the evolution of IPv6 in a “scalable” and “ordered” way

An open source prototype of EIP is available - “running code” !

Join us at <https://eip-home.github.io/eip/>



Thank you for your attention!

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S.Salsano, H.EIBakoury, D.Lopez,
“Extensible In-band Processing (EIP) Architecture and Framework”,
<https://datatracker.ietf.org/doc/draft-eip-arch/>

S.Salsano, G.Sidoretti, C.Scarpitta, H.EIBakoury,
“Extensible In-band Processing (EIP) Headers Definitions”
<https://eip-home.github.io/eip-headers/draft-eip-headers-definitions.html>

S.Salsano, H.EIBakoury, D. Lopez,
“Extensible In-band Processing (EIP) Use Cases”,
<https://eip-home.github.io/use-cases/draft-eip-use-cases.txt>

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.