

# **The IPv6 Flow Label and Use of IPv6 Flow Labels with Diffserv**

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`draft-conta-ipv6-flow-label-02.txt`

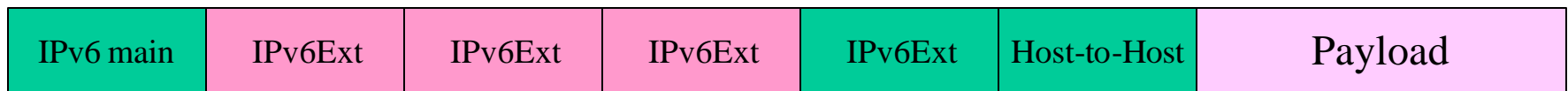
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# Introduction

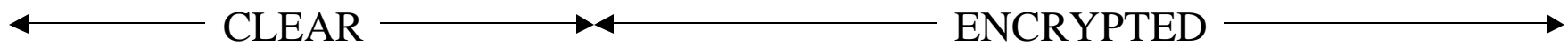
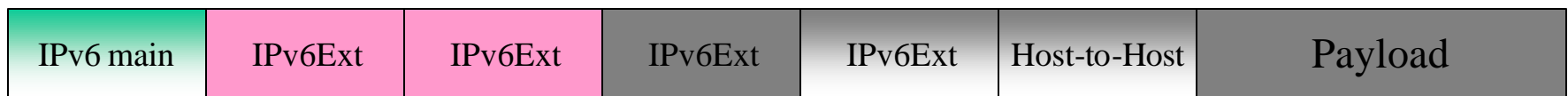
- Updating IPv6 flow label definition (need for)
  - IPv6 Flow Label – defined in RFC 2460 (IPv6 Specifications)
    - During the time it was being written (before 1998), the flow label was, as it is stated in RFC 2460:
      - still experimental
      - subject to change
      - requirements for flow support were evolving
  - Today, based on results of IETF work since 1998
    - IP QoS – Intserv, Diffserv architectures (briefly discussed in draft)
    - Labeling Traffic Flows technologies - MPLS (briefly discussed in draft)
      - more solid and ample perspective,
      - improved framework
        - *for standardization of the flow label*
        - *extend the use of IPv6 Flow Label for QoS*

# Introduction

- Use of IPv6 Flow Label with Diffserv (need for)
  - Type of contractual agreements between users (SOHO) and access network providers
    - Diffserv with M-F classifiers easy, efficient, practical alternative to Intserv and RSVP for individual traffic flows
  - Flow Label Classifier
    - flow label replacing protocol ID, Src. and Dst. Ports
    - resolves efficiency problem with 5, or 6 tuple MF classifiers
      - need to inspect IPv6 extension headers before getting to source and destination ports and protocol identifier



- resolves issue of access to port numbers in IPsec encrypted packets



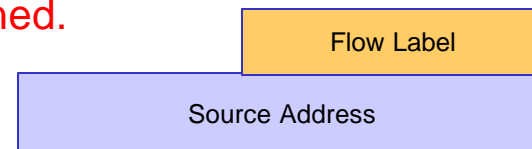
# IPv6 flow label definition and characteristics

## IPv6 Flow Label – current definition

technique of labeling packets belonging to particular traffic "flows" for which the **sender requests** special handling, such as **non-default quality of service** or "**real-time service**" (RFC 2460 – IPv6 Specifications).

The special handling is communicated through a resource reservation protocols...

**Note: NET Management, or Policy Management are not mentioned.**



- a. Flow uniquely identified by **flow label & source address**
- b. Packets with flow label = 0 not part of a flow
- c. Assigned to flow by source of packet
- d. Flow label is assigned as a pseudo-random number (20bits) - 1 to FFFFF
- e. Packets of one flow **MUST** have same source, destination & flow label
- f. Packets of one flow **MUST** have same source, destination & flow label hop-by-hop headers and options
- g. Packets of one flow **MUST** have same source, destination & flow label routing header
- h. Routers may report non-compliance with the above
- i. Flow label state has a time to live,
- j. Flow label **MUST** be consistent across reboots, etc...

## (Other) Definitions of Flows

- **Intserv [RFC1633]**

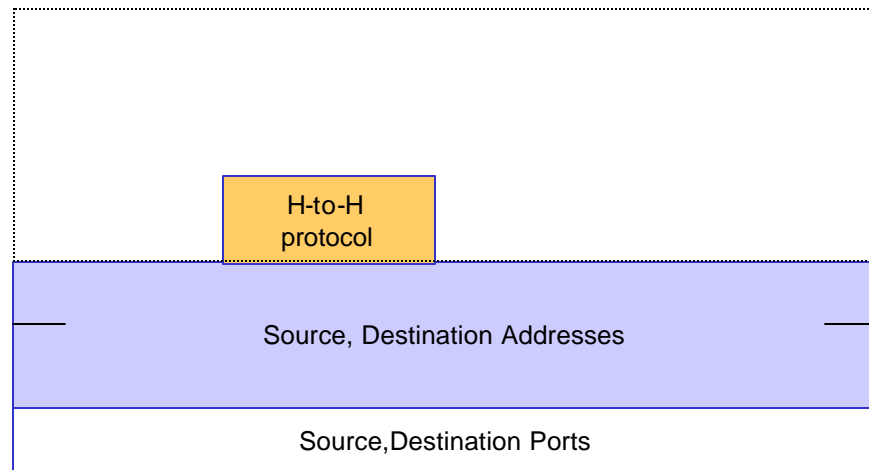
at a given network element a flow may consist of the packets from a **single application session**, or it may be an aggregation comprising the combined data traffic from a number of application sessions

Classifiers – place packets in classes based on certain fields in the header.

Class – abstraction that may be local to a router – routers along the path may classify packets differently

### 5-tuple

- source, destination address pair
- host-to-host-protocol
- source, destination port pair

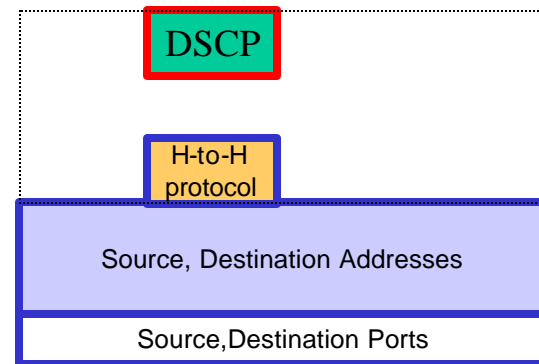


## (Other) Definitions of Flows

- **Diffserv [rfc 2475]**

a single instance of an application-to-application flow of **packets** which is **identified by source address, source port, destination address, destination port and protocol id.**

- Classifier – a mechanism that selects packets based on some portions of the headers
- Two types of classifiers:
  - BA - behavior aggregate
    - DSCP field
  - MF - multi-field classifiers
    - source, destination address
    - source, destination ports
    - protocol id
    - DSCP



# IPv6 Flow Label Discussion

- Integrated Services Flows
  - use of IPv6 flow label recommended in Intserv and RSVP
  - RSVP used to signal flow label values to routers
- Differentiated Services Flows
  - Diffserv provides flexibility in defining MF classifiers
    - “draft-conta-diffserv-fl-classifier-00.txt” defines a IPv6 flow label MF Classifier
  - MF Flow Label Classifier values part of the SLAs, TCAs, SLSs, TCSs
  - Packet header fields values that are part of a Diffserv Classifier MUST be known at the ingress router in the Diffserv Domain prior to traffic.
    - Rule (d) should be relaxed
- Packet Filtering for purposes other than QoS
  - Flow label could be used
    - Rule (d) should be relaxed

# IPv6 flow label proposal

- Improve alignment between IPv6 and Diffserv specifications
- Diffserv specs
  - Add Flow Label Based Classifier to Diffserv (3 tuple ) (model, mib, and pib)
- IPv6 specs
  - Add Diffserv flow label specs to accommodate Diffserv.
    - Signaling - do not mandate control/signaling protocol
    - Configuring - Allow net management, policy control for setting flow label classifiers
    - Flow Label
      - setting – non-random, predefined, or pre-selected value
      - format
        - IANA assigned values
        - Other possibilities
          - *Provide quick access to transport protocol, source and destination ports*
            - can be used with Multi-Field Classifier
          - *Compressed transport protocol type and source and destination ports*
            - can be used with Multi-Field Filter Classifier

# IPv6 flow label proposal

## *RFC 2460 (IPv6 Specs) RULES*

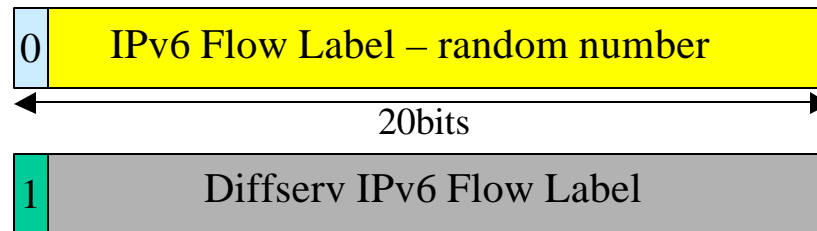
- a. *Flow uniquely identified by **flow label & source address***
  - b. Packets with flow label = 0 not part of a flow
  - c. *Assigned to flow by source of packet*
  - d. *Flow label is assigned as a pseudo-random number (20bits) - 1 to FFFFF*
  - e. *Packets of one flow **MUST** have same source, destination & flow label*
  - f. *Packets of one flow **MUST** have same hop-by-hop headers and options*
  - g. *Packets of one flow **MUST** have same routing header*
  - h. *Flow label state has a time to live,*
  - i. *Flow label must be consistent across reboots, etc...*
  - j. Routers may report non-compliance with the above
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## NEW RULES (Diffserv and Flow Label filtering)

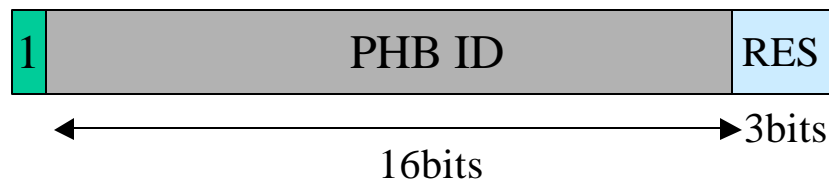
- a. Flow uniquely identified by flow label, source and destination address. Flows can be aggregated by specifying address ranges and/or flow label ranges. Flow label, source address identification can be used.
- b. Packets with flow label = 0 not part of a flow
- c. Assigned to flow by source of packet. It can be changed en-route, as long as significance maintained
- d. Flow label can be assigned
  - as a pseudo-random number (19 bits) - 1 to 7FFFF with Intserv
  - as a number between 8FFFF to FFFFF – with Diffserv
- e. Packets of one flow have same source, destination & flow label
  - Can be trunked – macro-flows
- f. Diffserv flow labels have no time to live rule, However changes in values in the flow label or classifiers **MUST** be synchronized
- g. The consistency of the flow label values across reboots is governed by (f)
- h. Routers may report non-compliance with the above.

# IPv6 flow label format

- IPv6 flow label format for use with Diffserv Multi-Field Classifiers
  - Allow preset values be used as flow labels.
  - Allow use of Flow Label classifier – 3 tuple
    - Eliminate need to examine extension IPv6 headers to get to source, destination ports and protocol ID.
      - Flow Label provide a summary or capture of transport header port and protocol information



- Diffserv flow label - constructed based on the PHB ID value (RFC 3140)
  - it captures the differentiated services treatment intended for the flow
    - Value
      - *Directly derived from DSCP*
      - *Or IANA assigned value.*
  - It piggy backs on the PHB ID value (eliminates additional IANA hassles)



# Diffserv Multi-field Flow Label Classifier

- MF Flow Label Classifier

Flow-label-classifier:

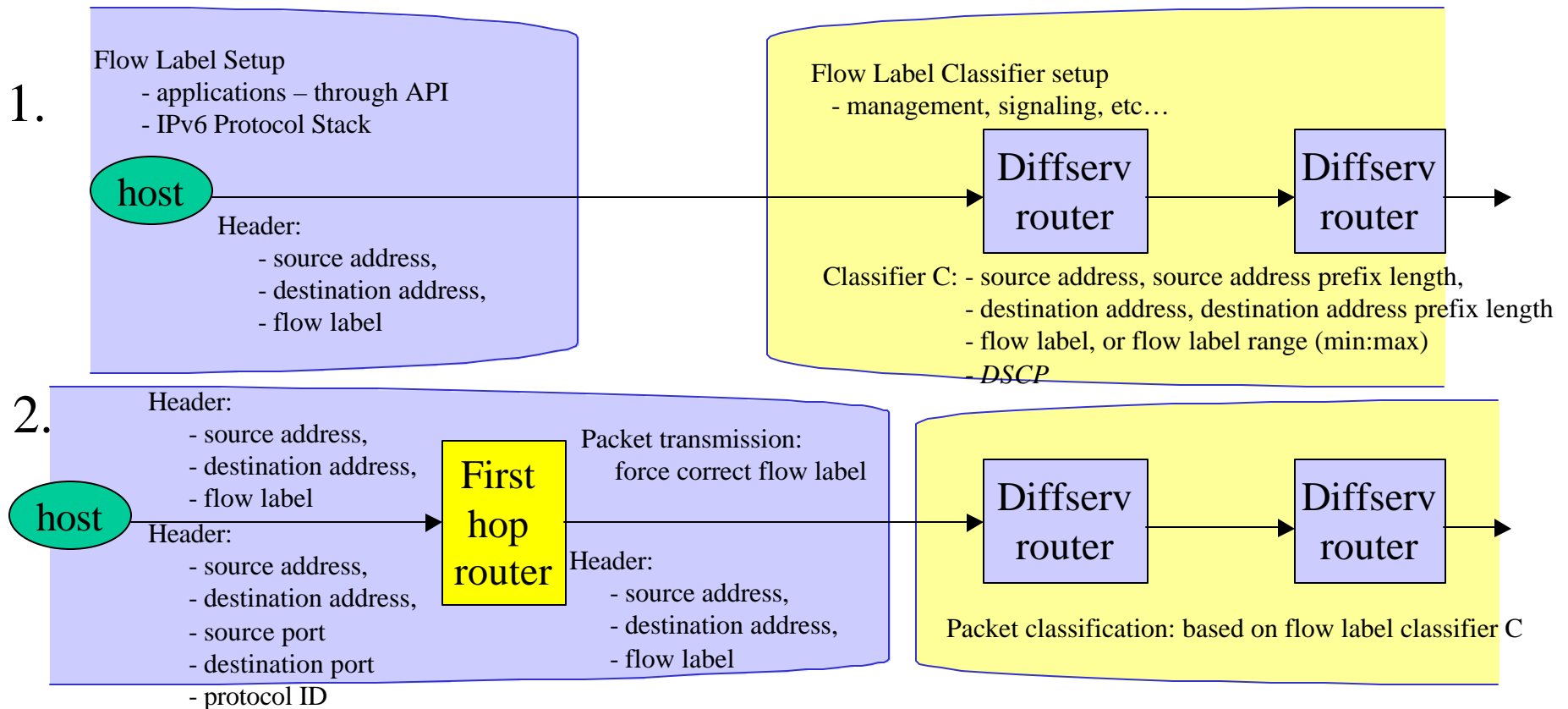
Type: IPv6-3-tuple  
IPv6DestAddrValue: 1:2:3:4:5:6:7:8::1  
IPv6DestPrefixLength: 128  
IPv6SrcAddrValue: 8:7:6:5:4:3:2:1::2  
IPv6SrcPrefixLength: 128  
IPv6FlowLabel: 57 (or flow label range min:max)

Flow-label-classifier:

Type: IPv6-4-tuple  
IPv6DestAddrValue: 1:2:3:4:5:6:7:8::1  
IPv6DestPrefixLength: 128  
IPv6SrcAddrValue: 8:7:6:5:4:3:2:1::2  
IPv6SrcPrefixLength: 128  
IPv6FlowLabel: 57 (or flow label range min:max)  
IPv6DSCP: 28

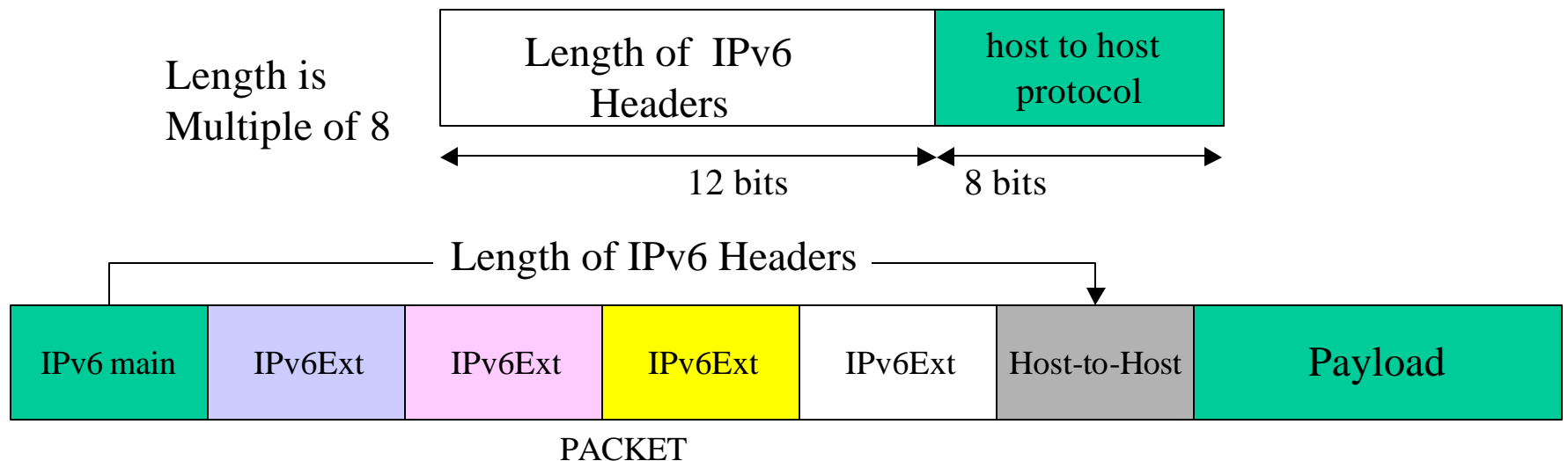
# Conceptual Model for use of IPv6 flow labels with Diffserv

- MF Flow Label Classifiers - defined and known to routers
  - Through configuration or other means )
  - Values of classifier fields setting - classification rules table
    - Local management, Net management, Policy management, etc...
- Flow Label value
  1. known to hosts, or
  2. first hop routers



## Other possible IPv6 flow label formats

- Optimize IPv6 for Diffserv Multi-Field Classifiers
  - Goals:
    - Minimize memory requirements for QoS engines
      - Use 5. Or 6 tuple M-F Classifier
        - Minimize number and types of classification rules, and size of table(s)
    - Optimize classifier operation (classification pipe-lining or parallel processing)
      - Eliminate need to examine all IPv6 headers
        - provide pointer to host-to-host header
          - it can be used also to skip unknown IPv6 headers



## Other possible IPv6 flow label formats

- Optimize IPv6 for Diffserv Multi-Field Classifiers
  - Goals:
    - Minimize memory requirements for QoS engines
      - Use 5 or 6 tuple M-F Classifier
        - Minimize Number and types of classification rules, and size of table(s)
    - Optimize classifier operation (Improve classification speed)
      - Eliminate need to examine IPv6 headers
        - Provide summary of transport header port and protocol information

