Export of ECN information in IPFIX

draft-song-opsawg-ipfix-ecn-01

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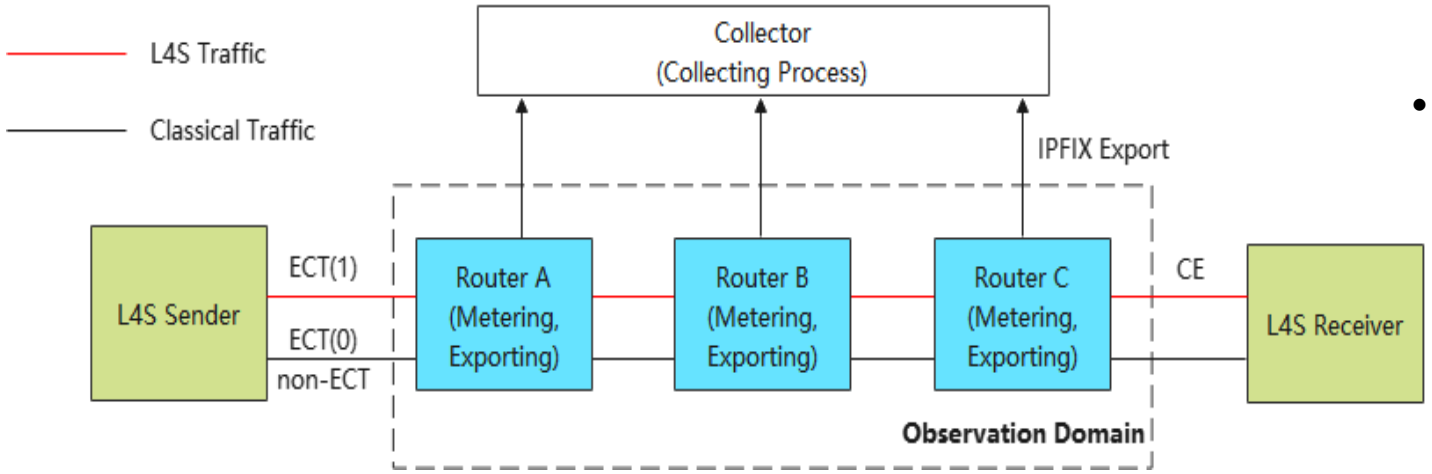
Overview

- **What is IPFIX?**
  - IPFIX = IP Flow Information Export
  - A standards-based protocol (IETF RFC 7011-7015) for exporting flow information from routers, switches, and other network devices.
- **Key Concepts:**
  - Flow: A set of packets sharing common properties (e.g., IP addresses, ports, protocol).
  - Observation Point: Where packets are observed (e.g., an interface).
  - Metering Process: Packet capturing, classification, and flow aggregation.
  - Exporting Process: Sends flow records to a collector using IPFIX messages.
  - Collector: Receives, stores, and analyzes flow data.
- **Why IPFIX for L4S?**
  - IPFIX supports flexible Information Elements (IEs), we can define new IEs to carry L4S-specific ECN counters (ECT(1), CE, etc.) for network service monitoring.

Positioning

- **Features**
  - Defines a set of IPFIX IEs for L4S ECN monitoring.
  - Provides operational considerations for L4S ECN information export.
- **Benefits**
  - Provides network visibility and diagnostics, and quantifies the network congestion status.
  - Monitors the consistency of ECN configuration in IPsec/L2TP tunnels, benefiting diagnostics of ECN propagation issues.
  - Provides IPFIX IEs for L4S ECN marking export and packets statistics to facilitate adjustments of network traffic patterns and supports network planning.
- **Values**
  - Uniform export information helps multi-vendor interoperability.
  - IPFIX monitoring improves the operation and management of L4S service.
- **Gap coverage**
  - Meets the L4S deployment and fills the gap for L4S ECN monitoring using IPFIX.

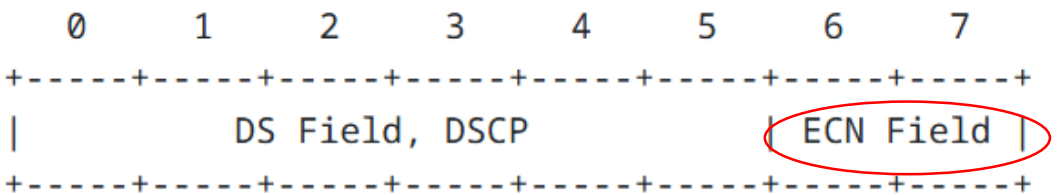
IPFIX for L4S Monitoring



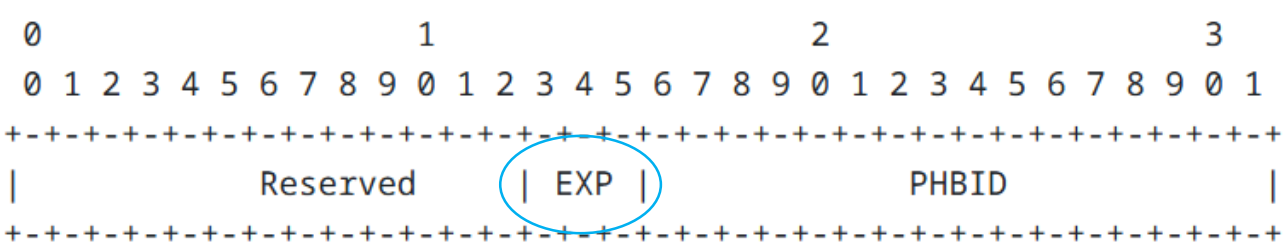
An example for L4S service monitoring using IPFIX

- **L4S Sender/Receiver**
  - Support L4S, send or receive traffic flows with ECN mark (ECT(1) or CE).
- **Router A/B/C, network nodes**
  - IPFIX Observation Point: located in the network (e.g., an interface of router).
  - IPFIX Metering Process: get packets from observation point, parse ECN field, aggregate packets and maintain flow record.
  - IPFIX Exporting Process: encapsulate IPFIX messages and send them to the Collecting Process.
- **IPFIX Collector**
  - Receive IPFIX messages from Exporting Processes, process or store flow records and extract ECN related information and make analysis.

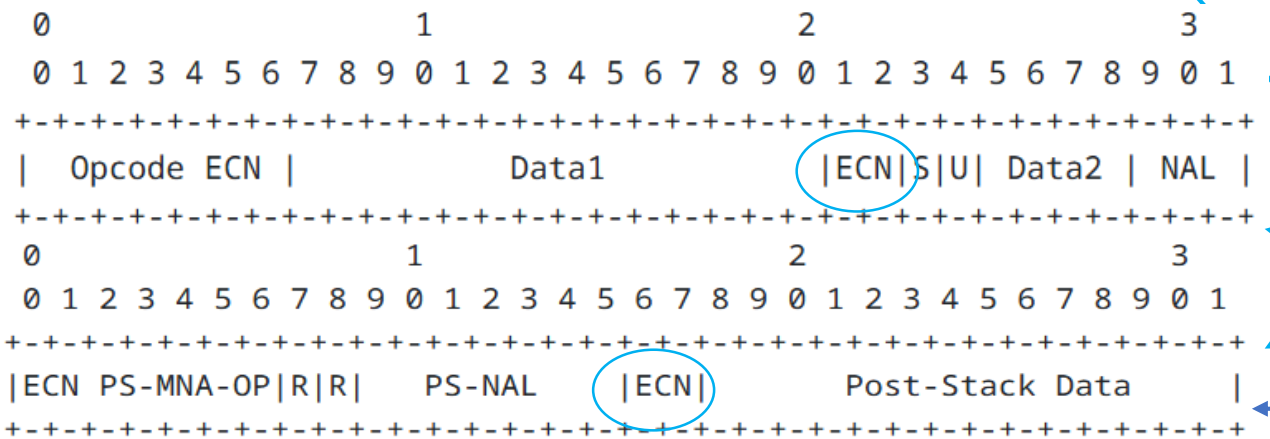
ECN Information Export – data plane



RFC 3168, 9331 ECN field in IP header



RFC5129, 3270 EXP field in MPLS header



Information Elements defined:

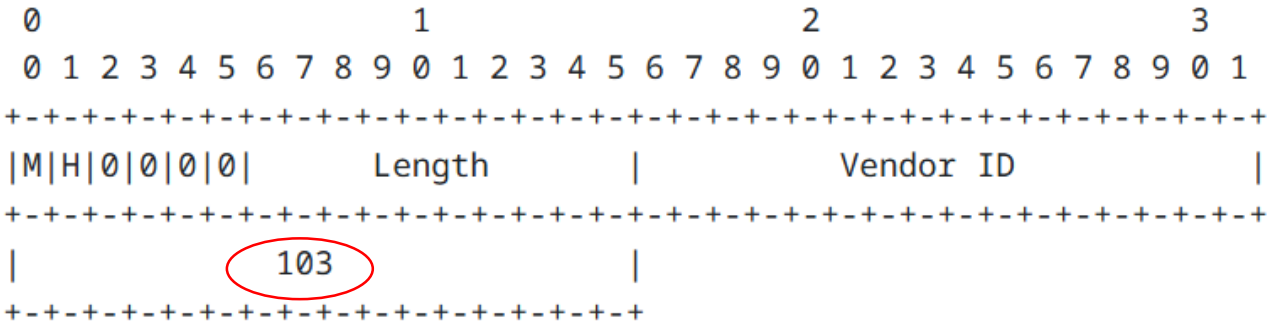
- ipv4HeaderEcn
- ipv6HeaderEcn
- notEctPacketDeltaCount
- notEctPacketTotalCount
- ect0PacketDeltaCount
- ect0PacketTotalCount
- ect1PacketDeltaCount
- ect1PacketTotalCount
- cePacketDeltaCount
- cePacketTotalCount
- mplsHeaderEcn

draft-halmir-mpls-ecn, ECN Field in ISD/PSD MNA

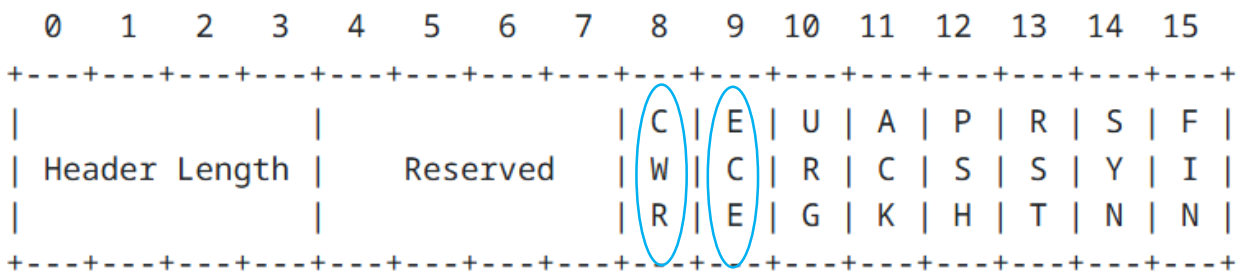
ECN Information Export – control plane

class	value	type
ECN Tunnel	10	Basic

RFC3168 ECN tunnel IPSec SA capability



RFC9601 ECN Capability AVP for L2TP



RFC3168, 9565 ECN field in TCP header (IPFIX Element ID: 6)

For tunnels, we also provide IEs to monitor ECN negotiation status at endpoints, ensuring ECN consistency across the tunnel.

- ipsecSaEcnMode
- l2tpEcnNego

- tcpControlBits (out of scope)

Feedback and Updates

- **1 - Questions for clarification and correction**
- Gregory Mirsky (Target of IPFIX notification and observation location):
  - **Clarification**: The observation point for ECN information can be flexibly positioned depending on the monitoring purpose.
  - **Update Made**:
    - Basic ECN fields (IPv4/IPv6/MPLS headers) can be extracted at any IPFIX-capable node along the path.
    - Tunnel ECN negotiation status IEs are only available at the tunnel endpoints.
    - Cumulative statistics IEs may be prioritized at aggregation or egress nodes.
- Gorry Fairhurst (Reference correction):
  - **Issue:** Noted that RFC 2474 supersedes older definitions of the IPv4 TOS octet and IPv6 Traffic Class octet.
  - **Update Added:** Corrected references throughout (Sections 3.1, 3.2, 4.1, 4.2) to align with the DiffServ Field as defined in RFC 2474.

Feedback and Updates

- **2 - Questions for performance and scalability**
- Joel Halpern (L4S identification and export)
  - **Issue Raised:**
    - How to distinguish L4S traffic from classic ECN/non-ECN traffic?
    - How to avoid the overhead of exporting ECN information for every packet across many flows?
  - **Updates Made (this version):**
    - Addressed overhead concern: Added text recommending the use of sampling methods (RFC5475) to preserve statistical representativeness while reducing export overhead.
  - **Planned Updates (future version):**
    - Will address traffic distinction: Plan to add filtering guidance.
    - Proposed method: Use packet filtering (RFC5475) at the Observation Point to select packets with the ECT(1) codepoint.

Feedback and Updates

- **3 – Questions for IE discussion**
- Sebastian Moeller & Ingemar Johansson S
  - **Issue 1: Probability of CE Marking**
    - Feedback: Noted that whether CE marking is probabilistic or deterministic is a function of the AQM implementation, not the marking law (e.g., DCTCP vs. RFC 3168).
    - Update: Added clarification that in L4S deployments, **CE marking** may be either probabilistic or deterministic, **depending on the AQM**. The defined IEs for statistical counts of CE-marked packets enable quantitative monitoring and management, typically based on flow data acquired via sampling.
  - **Issue 2: Ambiguity of Ratio IEs**
    - Feedback: Pointed out that "l4sCeMarkRatioTotal" and "l4sCeMarkRatioDelta" are useful but could introduce ambiguity. Proposed to calculate these ratios from base metrics instead.
    - Update: Removed the two ratio IEs from the draft. Added text clarifying that calculating derived metrics (e.g., CE marking ratios) from base counters (e.g., ect1PacketTotalCount, cePacketTotalCount) is an implementation issue for the Collector and is out of scope for this draft.

Next Steps

- Refine IEs definitions to align with L4S congestion control semantics.
- Continue to update the draft based on feedback.