

Alternate Marking Usage for Loss Location in Per-Packet Load Balancing Networks

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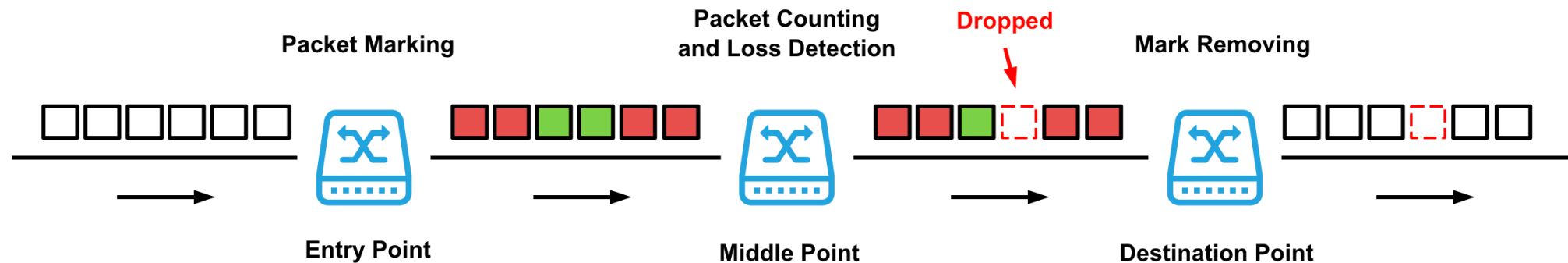
Per-Packet NLB Brings Challenges for Loss Location

- **Many per-packet network load balancing (NLB) schemes have been proposed to achieve near-optimal network performance**
 - Nvidia Adaptive Routing, Broadcom DDC/DLB/GLB, China Mobile GSE...
 - These schemes **spray packets onto parallel paths** to eliminate load imbalance
- **Packet spraying brings challenges for loss location**
 - Packets with the same 5-tuple may traverse different paths
 - **Relaying dropped packets for loss location can result in incorrect conclusions**
- **Packet-spraying networks require real-time loss detection and location on switches**
 - **Traditional switch loss counters cannot capture all packet loss**, such as silent packet loss

Alternate packet marking is an efficient way for switches to precisely locate loss in real time

Alternate Packet Marking Workflow

- Packets are periodically and alternately marked at the traffic entry points, such as source network interface cards (NICs) or top-of-rack (ToR) switches
- In each period, each switch calculates the difference between the ingress and egress packet counts in the previous period, to accurately determine the total packet loss
- Alternate marking ensures that the packet count in the last marking period remains unchanged, allowing for an accurate loss counting
- This method can accurately detect nearly all packet loss in switching, including silent loss



Use Cases in Per-Packet Load Balancing Networks

➤ **Monitor all packet loss on switches**

- **Mark all packets alternately:** Accurately detect all packet loss in switching
- Enable precise switch loss rate monitoring for abnormal switch identification

➤ **Monitor packet loss for loss-sensitive services**

- Some services are highly sensitive to packet loss (e.g., AI training), while others are not
- **Merely marking packets in loss-sensitive services:** Switches can focus on packet loss events in loss-sensitive services

➤ **Locate packet loss in network probing systems**

- Probe path tracking is challenging in per-packet load balancing networks
- **Marking probes alternately:** Accurately locate probe loss and anomalous switches

Thanks