Segment Routing v6 (SRv6) Academy Update

Fujitsu Laboratories Ltd.

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Chunghan Lee

A list of research papers

- **Software Resolved Networks: Rethinking Enterprise Networks with IPv6 Segment Routing (ACM SOSR'18)**
  - David Lebrun and Mathieu Jadin (UCLouvain), Francois Clad and Clarence Filsfils (Cisco), Olivier Bonaventure (UCLouvain)
    - https://conferences.sigcomm.org/sosr/2018/program.html

- **eBPF for programmable network functions with IPv6 Segment Routing (ACM CoNext'18)**
  - Mathieu Xhonneux, Fabien Duchêne, Olivier Bonaventure (*Université catholique de Louvain*)
    - https://conferences2.sigcomm.org/co-next/2018/#!/program

  - Additional thesis paper
    - An interface for programmable IPv6 Segment Routingnetwork functions in Linux
      - Mathieu Xhonneux (*Université catholique de Louvain*)

Software Resolved Networks: Rethinking Enterprise Networks with IPv6 Segment Routing
(ACM SOSR’18)

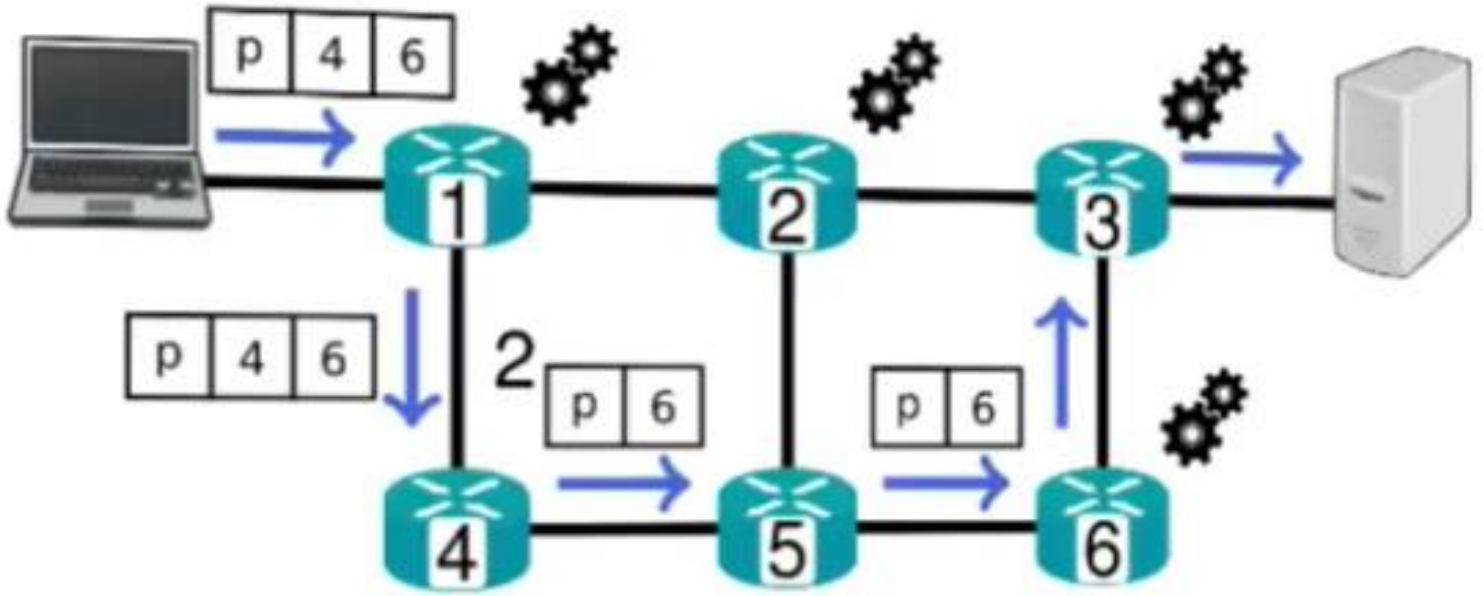
Introduction

- **Enterprise networks**
  - They are smaller than ISP networks
  - They have more endhosts
  - They are controlled by switches, routers, middlebox
  - Business rules favor some applications

- **Business policies of enterprise networks**
  - Quality of Service
    - VOIP and video service require special QoS in particular on low bandwidth wide area links
  - Fine grained access control
    - Restrict access using firewall and routing policies to parts of the network for some classes of users
  - The need to support specific paths for specific applications
  - The large number of middleboxes

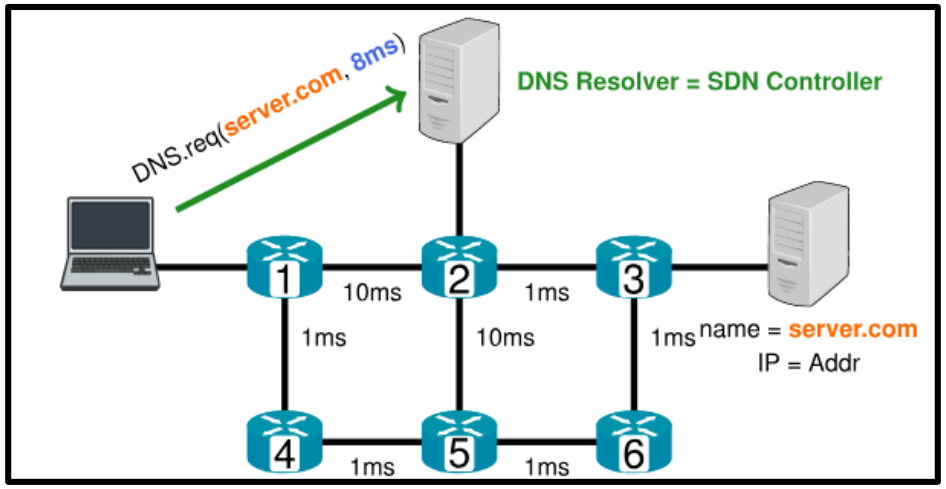
Segment routing v6

- Encode the path in each packet

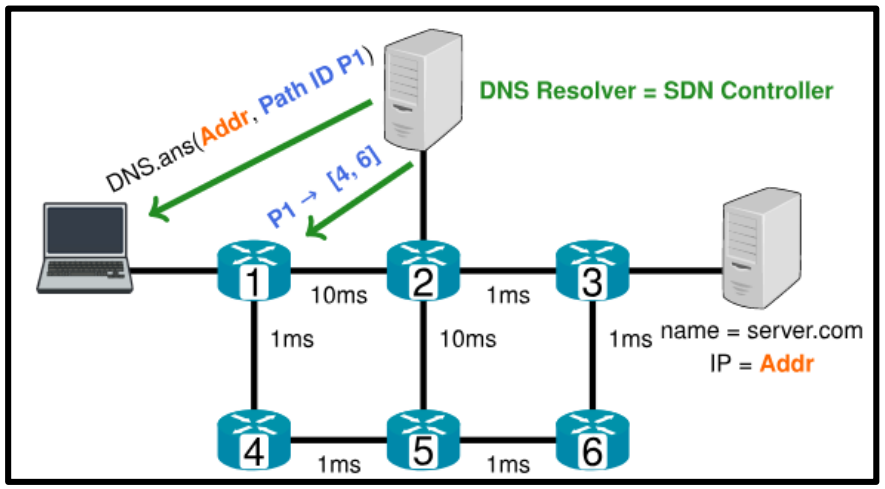


How to learn the path on the endhost?

- Using DNS!
- Send application requirement to DNS server (SDN controller)

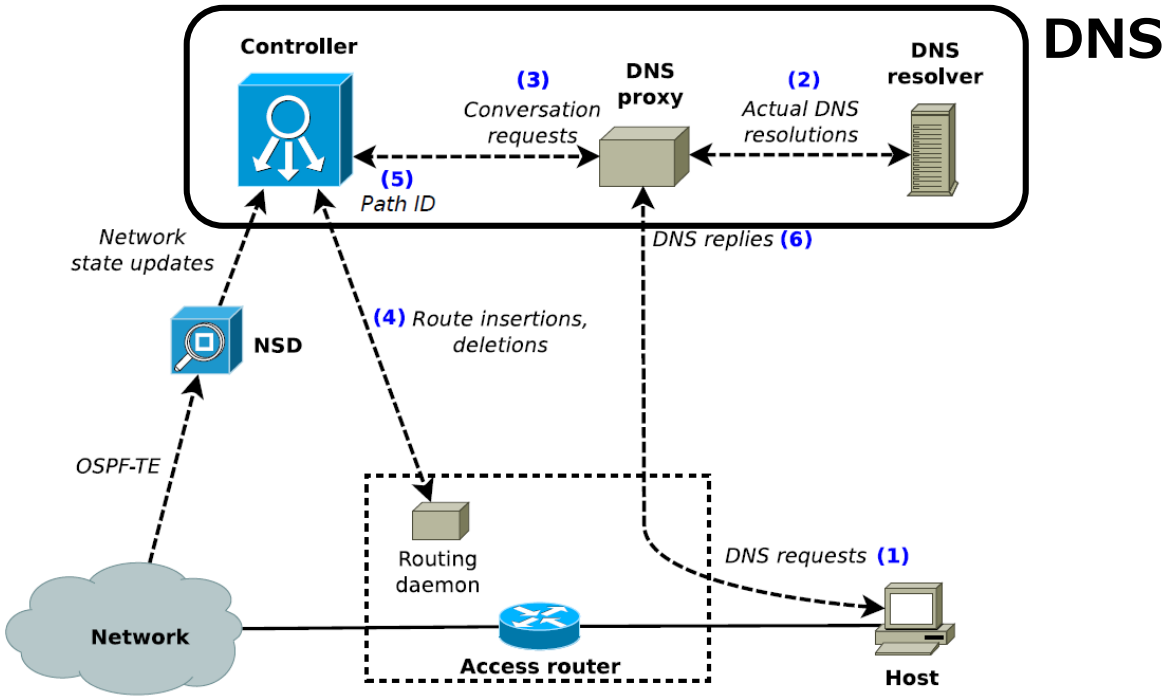


- Send a list of segments to client (user)



Software Resolved Networks (SRN)

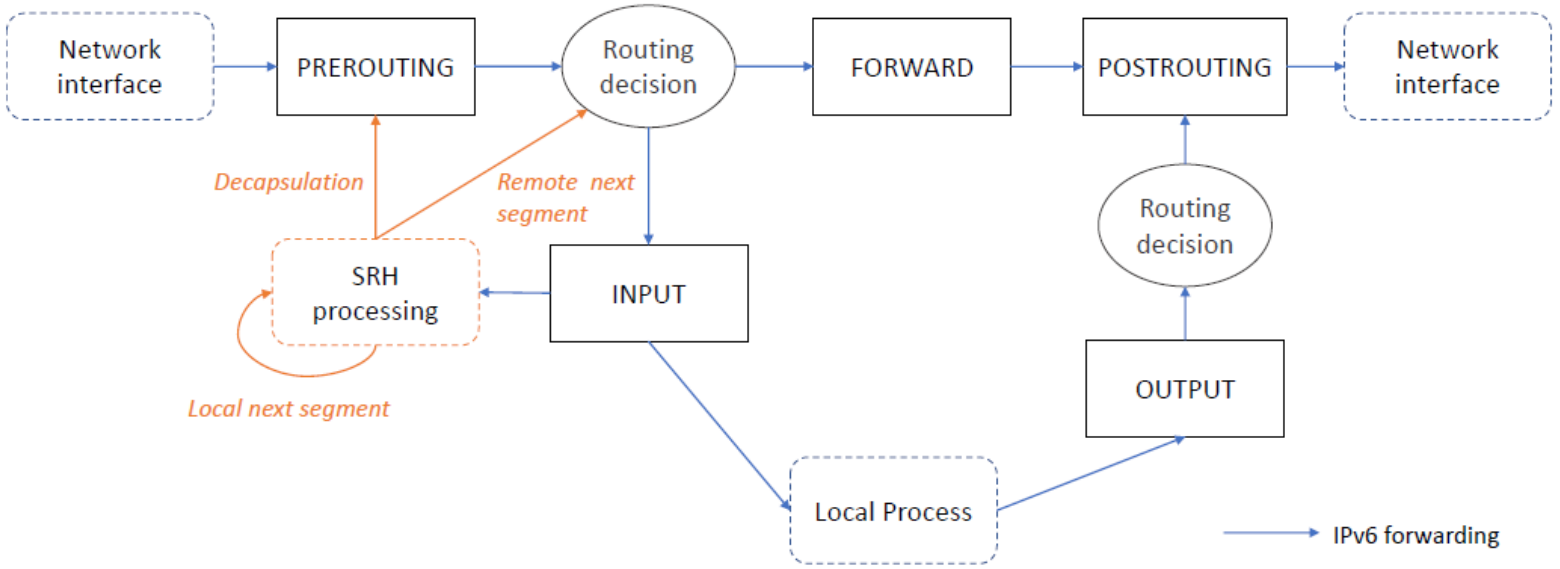
- The state, such as prefixes, link utilization, and latency, are gathered by OSPF-TE
- The controller in the DNS calculate the path for the host
- The codes are available
  - https://github.com/segment-routing/srn



Leveraging eBPF for programmable network functions with IPv6 Segment Routing
(ACM CoNext'18)

Introduction

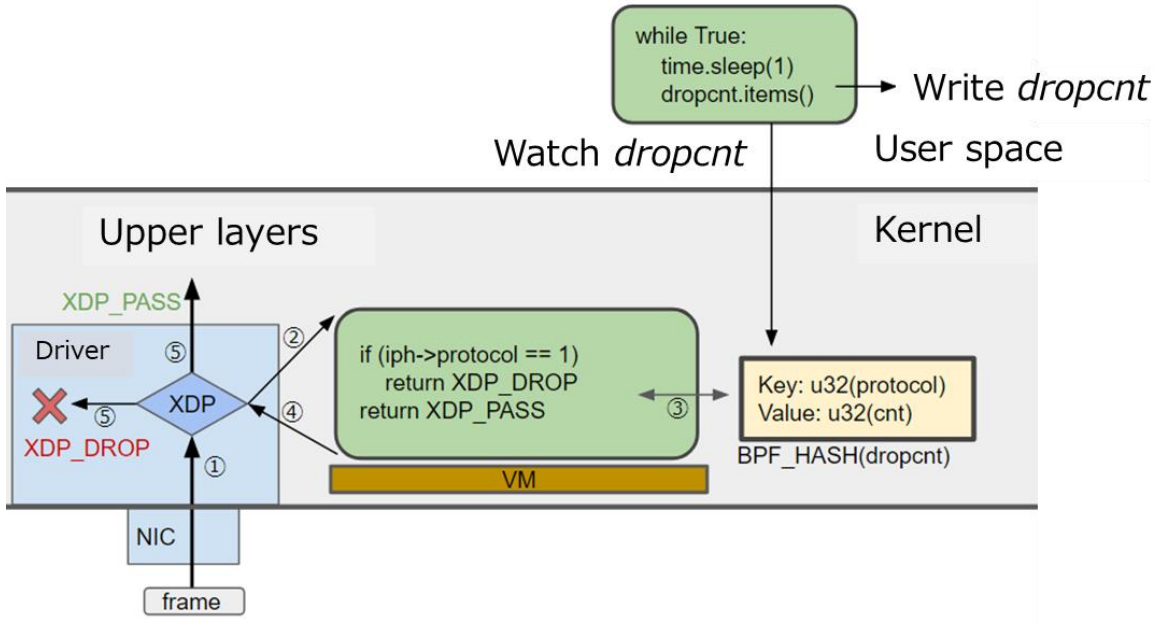
- SRH processing in the IPv6 layer
  - SRH processing is supported in Linux 4.10
  - This processing is only capable of executing the encap./decap. function
    - It is not possible to inject SRHs



Upper layer (UDP,TCP)

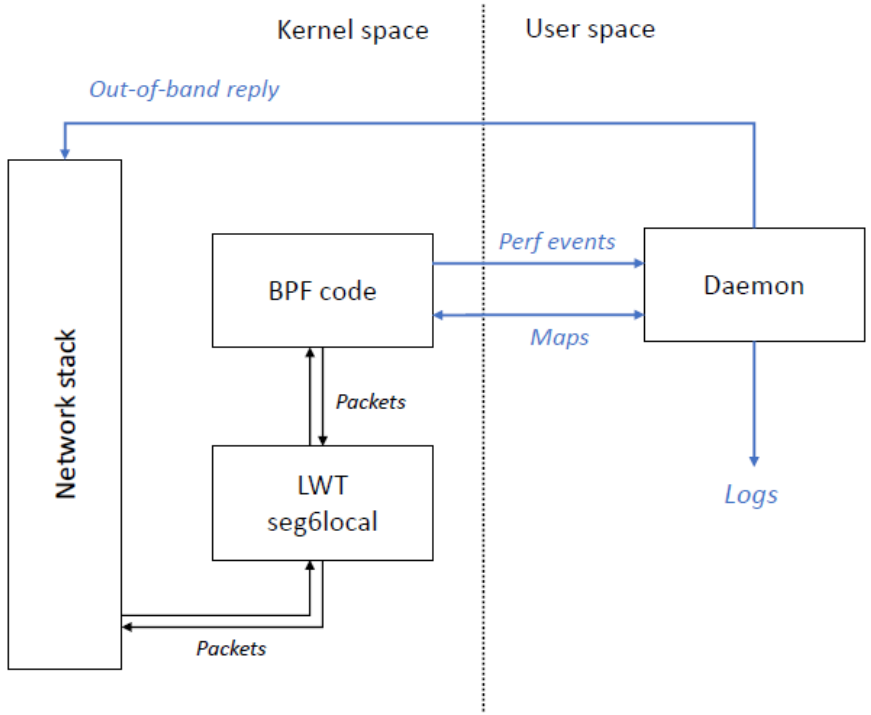
extended Berkeley Packet Filter (eBPF)

- eBPF, a virtual machine inside the kernel
  - eBPF is provides a programmable interface to adapt kernel components at run-time to user-specific behavior
  - The eBPF program is then executed for each packet going through the datapath associated to its hook
  - The program can read and, for some hooks, modify the packet



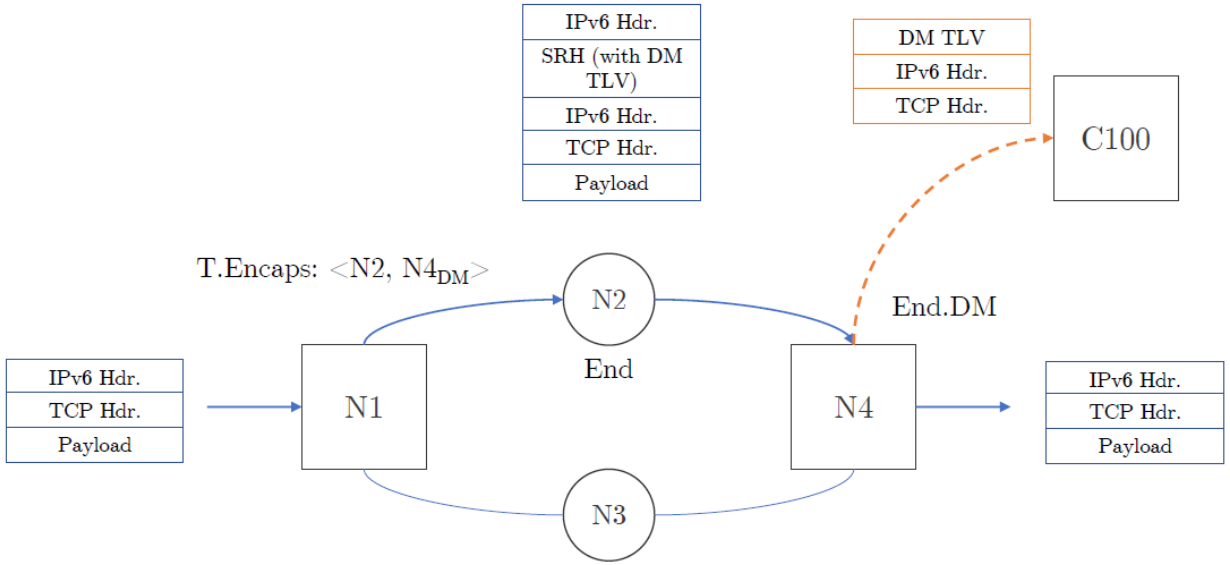
The capabilities of SRv6 through eBPF

- Unleashing the capabilities of SRv6 through eBPF
  - A eBPF interface to implement a broad range of SRv6 actions
  - Only allow write access to fields of the packet which can be modified by SRv6 endpoints



Use case (Telemetry)

- Passive monitoring of network delays
  - eBPF programs encapsulate/decapsulate the incoming regular IPv6 packets with an SRH
  - This SRH contains a Delay Measurement (DM) TLV, with a 64-bit timestamp inserted by the router
  - The daemon continuously listens for perf events (timestamps)



Conclusion

- Software Resolved Networks (SRN)
  - The polices on enterprise networks are different from ISPs and DCNs
  - SRv6 is possible to provide functionality for the polices

- SRv6 with eBPF
  - There is a lack of functionality of SRH processing in the kernel
  - It is possible to unleash the capabilities of SRv6 through eBPF
    - It provides the programmability of network
  - The SRH can measure latency (one-way/round-trip)
    - It is telemetry!