Traffic Class Routing Protocol in Home Networks

draft-xu-homenet-traffic-class-00

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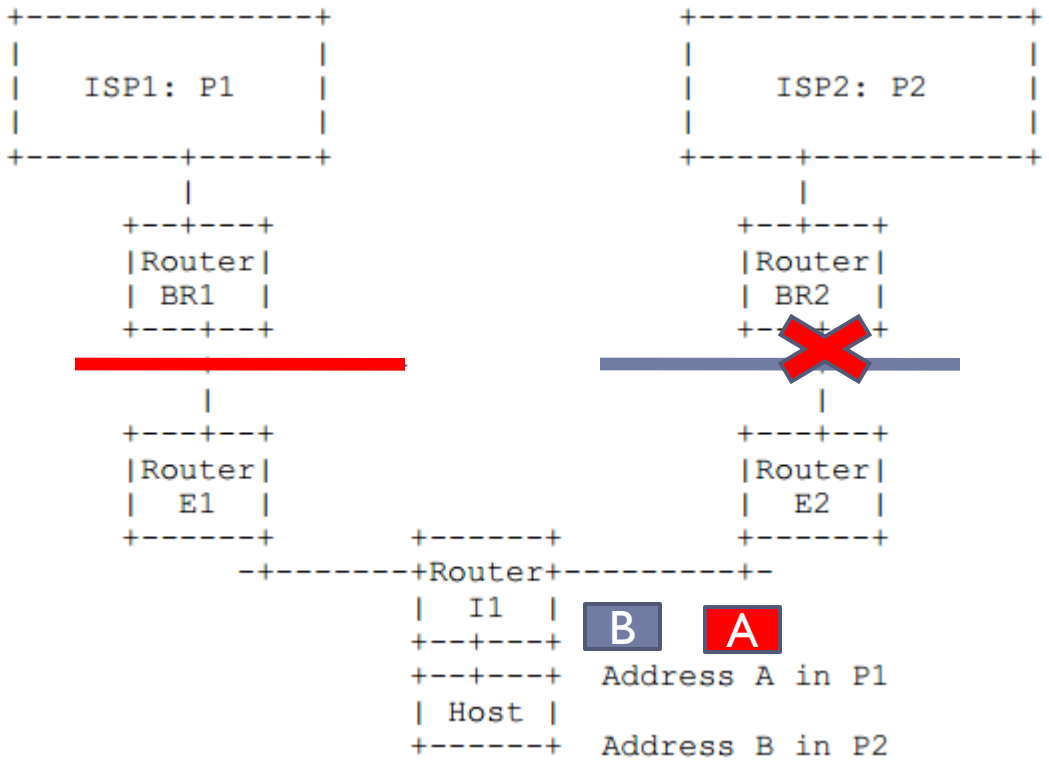
Home Network Configuration

- Home IT staff is generally unfamiliar with network operations
- Home networks are growing in device count and in complexity
  - Contain both wired and wireless components
  - May require placing audio/visual entertainment traffic on one path, office services on another, and wireless LAN on a third
- We need a configuration-free mode of operation
  - Most current solutions require configuration

Multi-homing in Home Networks

- Traditionally, we have simplified networks using a single exit router and a default route
- Today, we might have multiple routers
  - To wired upstream networks
  - To LTE services, smart grid services, or health network services
- However, traditional routing protocols make routing decisions solely based on destination
  - All packets towards the same dst will be delivered to the same next-hop
  - May be dropped if forwarded to the wrong exit router

Ingress Filtering on Upstream



- MTR, PBR and L3-VPN can solve the problem
  - They complex the configuration
- We need a configuration-free solution

Traffic Class Routing

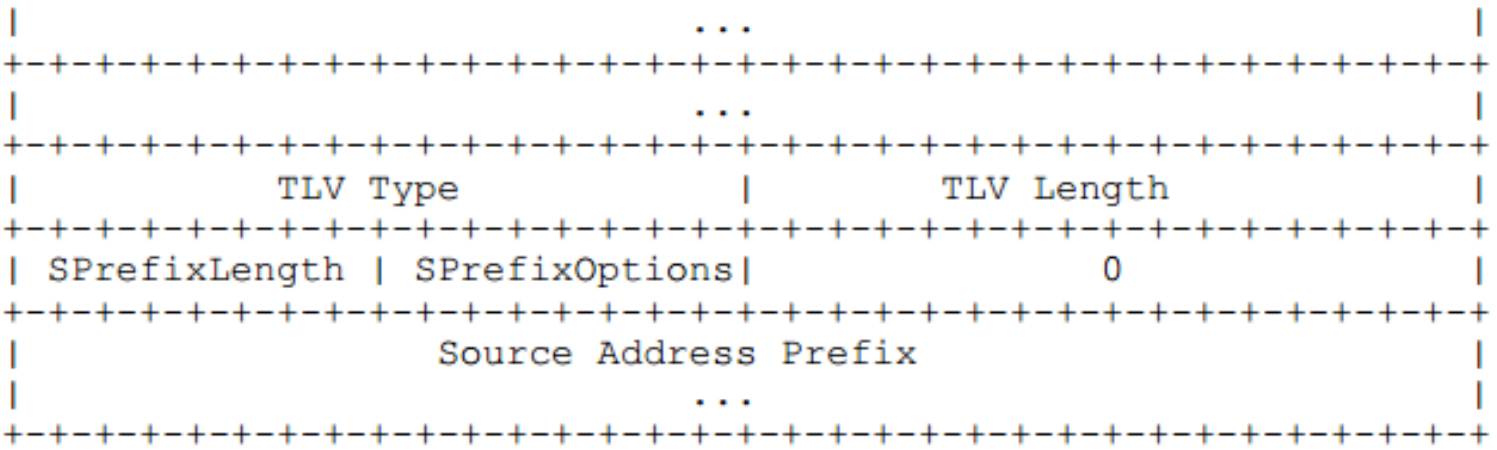
- Traffic Class (TC)
  - Identified by <dst prefix, src prefix>
- TC-Route
  - Defined as <dst prefix, src prefix, cost>
- TC-LSA
  - Advertisement that announce the reachability for a traffic class
- **Basic idea**
  - Traditionally, the object being routed is a dst prefix
  - Here, the object being routed is a traffic class, i.e., a dst prefix given that the packets sports a certain src prefix

Router Behavior

- Egress router behavior
  - Obtaining delegated prefix using DHCPv6 with prefix options
  - Then, originating TC-LSAs (extended LSAs with src prefix appended)
- Interior router behavior
  - Store TC-LSAs into LSDB
  - Flood it to other routers
  - Calculate a path to a traffic class
  - Store the results into extended routing table

TC-LSA Format

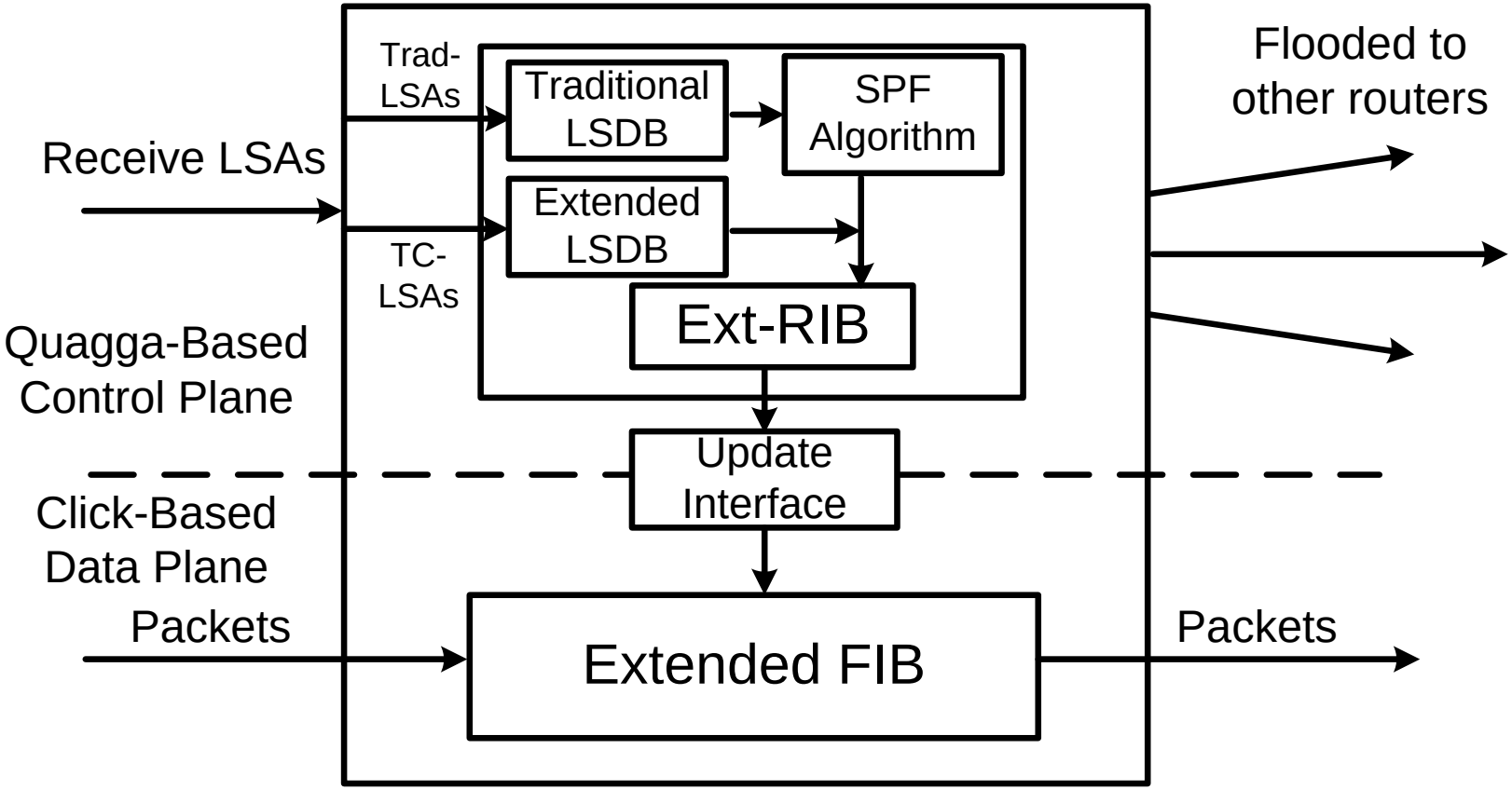
- Modify Intra-Area-Prefix-LSA
  - Ext-Intra-Area-Prefix-LSA
    - Defined in [I-D.acee-ospfv3-lsa-extend-02]
  - Appending a src prefix behind it
    - Defined in [I-D.baker-ipv6-ospf-dst-src-routing]
    - LSA type: 0x2029



Routing Table Calculation

- The fundamental algorithm in OSPFv3 does not change
  - Using SPF approach, compute a shortest path to the routers advertising reachability
  - The first stage of Sec 4.8.1 in [RFC 5340] remains the same
- During the second stage
  - Instead of examing the list of Intra-Area-Prefix-LSA
  - Examing the list of Ext-Intra-Area-Prefix-LSA
  - The cost of a traffic class is
    - The sum of the cost of this advertised cost and the cost to the transit vertex
    - Identified by Ref-LS type, Ref-link state ID, and Ref-Adv router field

Overall Implementation



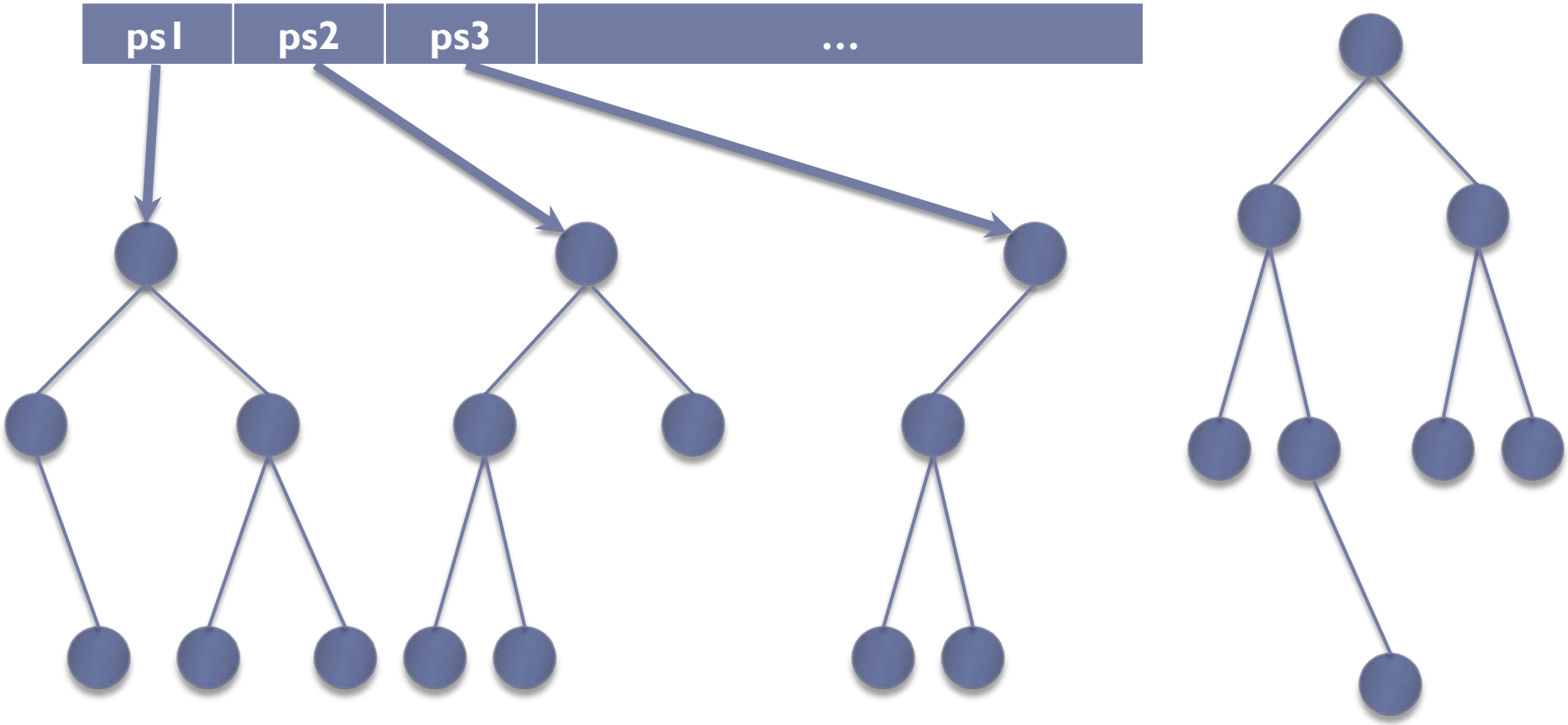
Forwarding Table – Simple Solution

- N+1 FIBs
  - N is the number of source prefixes (or provider)
  - Plus a general one
  - Design based on "IPv6 Source/Destination Routing using OSPFv3" (Section C.1.2)
- FIB Behavior
  - For a given packet
  - Match the src prefix and find the FIB
  - Match the most specific dst prefix in the FIB
- Collision Detection and Resolution
  - If <d1, s1, a1> and <d2, s2, a2> exist, where d1>d2 and s2>s2
  - Then, insert <d1, s2, a1> into the FIB table

Data Structure

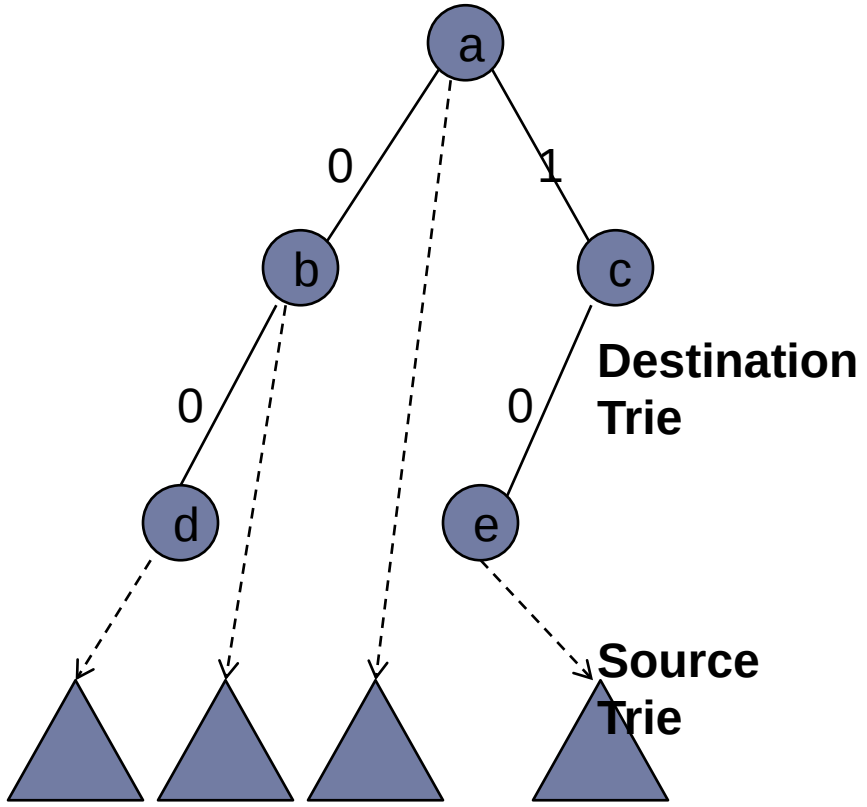
Source Prefix List

General FIB



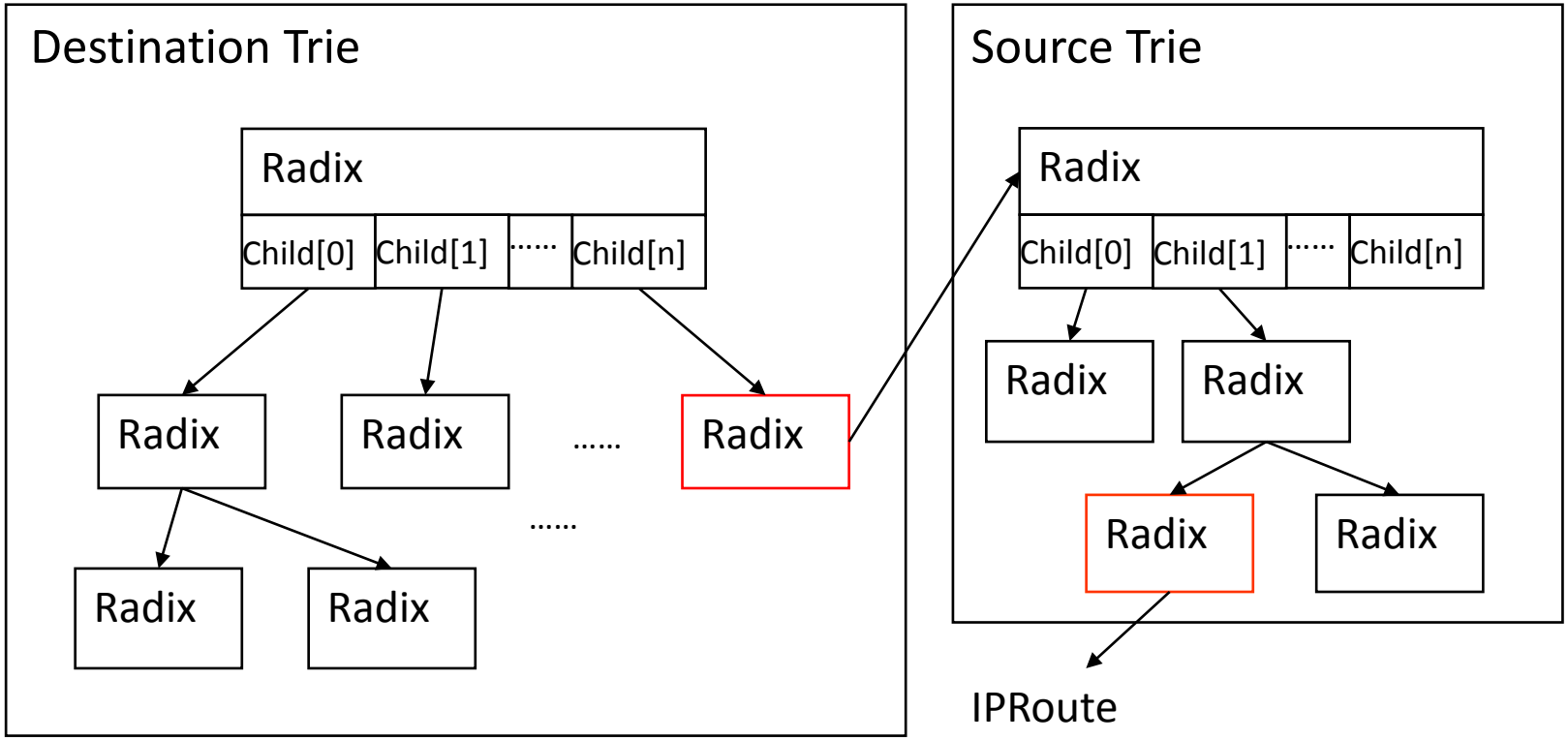
Forwarding Table – Patricia Trie Based

- Two level (dimensional) patricia-trie
- FIB Behavior
  - Match destination prefix in the first dimension using the destination address
  - Then match source prefix in the second dimension



Implementation in Click Router

- Click is a software architecture for building routers
  - Flexible and configurable
  - Assembled from packet processing modules (elements)



Conclusion

- We need a configuration-free mode of operation in homenet
  - Especially in multi-homing scenario
- We are implementing a routing protocol
  - Making routing decision based on both dst and src
  - Based on OSPFv3
  - By modifying Quagga
- The protocol can be applied in other scenarios beyond homenet

Thank You!!!

Related Drafts

- http://tools.ietf.org/html/draft-chroboczek-babel-extension-mechanism
  "Extension Mechanism for the Babel Routing Protocol", Juliusz Chroboczek, 2013-06-30
  http://tools.ietf.org/html/draft-ovsienko-babel-hmac-authentication
  "Babel HMAC Cryptographic Authentication", Denis Ovsienko, 2013-04-18
  http://tools.ietf.org/html/draft-troan-homenet-sadr
  "IPv6 Multihoming with Source Address Dependent Routing (SADR)", Ole Troan, Lorenzo Colitti, 2013-02-18
  http://tools.ietf.org/html/draft-xu-homenet-twod-ip-routing
  "Two Dimensional-IP Routing Protocol in Home Networks", Mingwei Xu, Shu Yang, Jianping Wu, Dan Wang, 2013-02-18
  http://tools.ietf.org/html/draft-baker-ipv6-isis-dst-flowlabel-routing
  "Using IS-IS with Role-Based Access Control", Fred Baker, 2013-02-17
  http://tools.ietf.org/html/draft-baker-ipv6-isis-dst-src-routing
  "IPv6 Source/Destination Routing using IS-IS", Fred Baker, 2013-02-17
  http://tools.ietf.org/html/draft-baker-ipv6-ospf-dst-flowlabel-routing
  "Using OSPFv3 with Role-Based Access Control", Fred Baker, 2013-05-02
  http://tools.ietf.org/html/draft-baker-ipv6-ospf-dst-src-routing
  "IPv6 Source/Destination Routing using OSPFv3", Fred Baker, 2013-05-02
  http://tools.ietf.org/html/draft-baker-rtgwg-src-dst-routing-use-cases
  "Requirements and Use Cases for Source/Destination Routing", Fred Baker, 2013-08-13