

DetNet Configuration YANG Model Update

draft-ietf-detnet-yang-09

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Status

- Ready for WG Last Call
- Will present a summary today
- We have cleaned up items from reviews
- Please Review and Comment

History

- Version 00: accepted as a WG document after IETF 102
- Version 01: *ietf-detnet-topology-yang* is defined independently
- Version 02: updated following the feedback from IETF103
 - Add 'Sequence Number Generation'
 - OAM considerations
 - Add 'DetNet Service Decapsulation'
 - Add 'DetNet Transport Tunnel Decapsulation'
- Version 03: DetNet Configuration Structure Update in IETF104 and IETF105
- Version 04 :
 - Modify the scope of DetNet YANG Model



- Version 05/06:
 - Two YANG Models Discussion -> Comparison
- Version 07
 - Merging Models. Some terminology alignment.
- Version 08
 - Aggregation and Instance Models
- Version 09
 - Terminology and name changing
- Versions 10-11
 - Finalization for last call

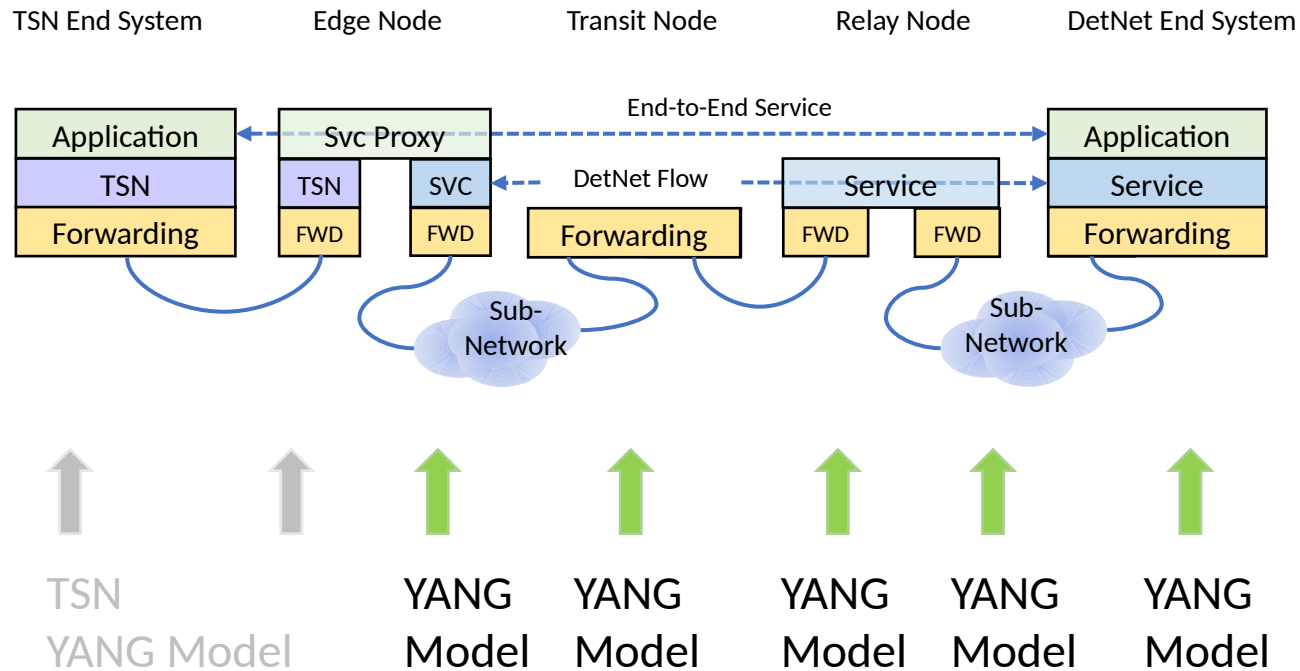
WG Call Meeting Every Week

Detnet Architecture

Architectural Model

Control Planes (Future)

↔
Flow Model
↔
Data Plane Drafts



Flow Model Attributes Supported by YANG

App-flow, DetNet flow and DetNet service

draft-ietf-detnet-flow-information-model

App-flow

Characteristics

- FlowID: unique (manag.) ID
- FlowType: Eth, MPLS, IP
- *DataFlowSpecification*:
src/dst-addr, label, VLAN, etc.
- *TrafficSpecification*:
interval, Packets per interval
max/min payload-size, Min
packets per interval
- FlowEndPoints: Src, Dst(s)
- FlowRank
- FlowStatus

Requirements

- *FlowRequirements*:
MinBW, Max Latency, ML
Variation, Loss tolerance, etc.
- FlowBiDir

UserToNetworkRequirements

DetNet flow

Characteristics

- DnFlowID: unique (manag.) ID
- DnPayloadType: Eth, MPLS, IP
- DnFlowFormat: MPLS, IP
- *DnFlowSpecification*:
Label, 6-tuple
- *DnTrafficSpecification*:
interval, Packets per interval
max/min payload-size,
Min packets per interval
- DnFlowEndPoints: Ingress, Egress(s)
- DnFlowRank
- DnFlowStatus

Requirements

- *DnFlowRequirements*:
MinBW, Max Latency, ML Variation, Loss
tolerance, etc.
- DnFlowBiDir

DN Service

- DnServiceID: unique (manag.) ID
- DnServiceDeliveryType: Eth, MPLS, IP
- DnServiceConnectivity: p2p, p2mp
- DnServiceRank
- *DnServiceDeliveryProfile*:
MinBW, Max Latency, ML Variation, Loss
tolerance, etc.
- DnServiceBiDir
- DnServiceStatus

A DetNet flow contains one or more App-flows (N:1 mapping).

A DetNet service supports one or more DetNet-flows (M:1 mapping).

Observations

DetNet Data plane YANG Model

- Hierarchical aggregation
- Location dependent
 - Endpoint,
 - Transit
 - Relay
- Flow aggregates are flows
- Captures Flow attribute and status
- Built on reusable pieces – IP/MPLS
- Configuration centric
- Includes Operational attributes

DetNet Flow Model

- Functional
- Concerned with the attributes and characteristics of flow.
- Covers Configuration and operational aspects

Methodology

YANG Model

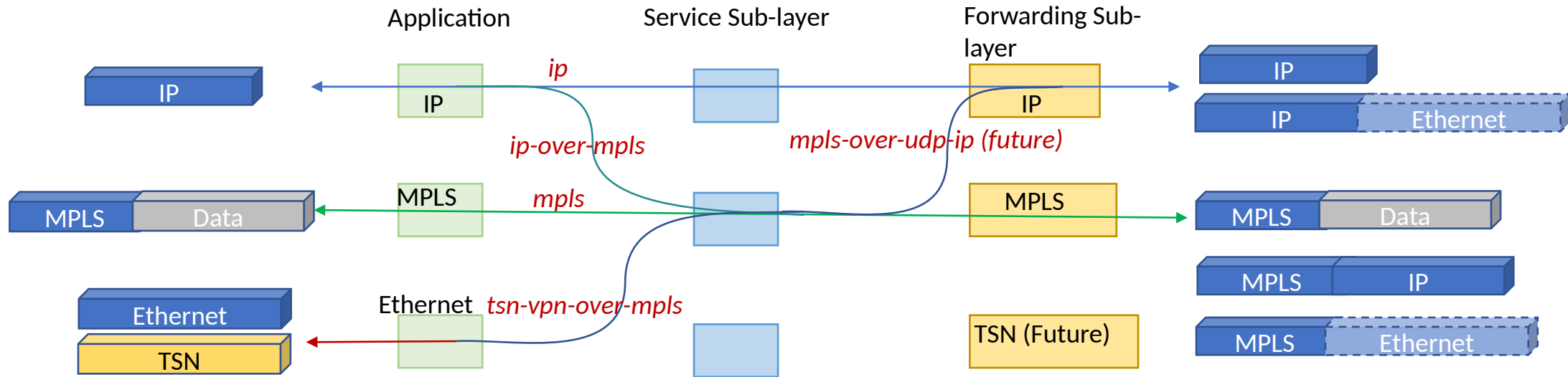
- Large model ~ 1300 lines
- Many permutations
- Hard to validate by simple inspection.
- Needed to enumerate the various cases

What we found worked:

- Consider Configuration Cases with model validation
- Use Yanglint to test and document the cases
- Provide diagrams for the cases
 - Basic single DetNet flow Endpoint Unidirectional/Bidirectional
 - Basic single DetNet flow Transit Node
 - Simple aggregation
 - Aggregation at several places.

Scenarios Covered by DetNet YANG Model

(w/o Aggregation)



- Corresponding Data Plane drafts:*
- RFC8939 (Deterministic Networking (DetNet) Data Plane: IP)*
 - draft-ietf-detnet-ip-over-mpls-06*
 - draft-ietf-detnet-mpls-07*
 - draft-ietf-detnet-mpls-over-udp-ip-06 (Out-of-scope)*
 - draft-ietf-detnet-tsn-vpn-over-mpls-03 (Partial)*
 - draft-ietf-detnet-mpls-over-tsn-03(Not yet)*
 - draft-ietf-detnet-ip-over-tsn-03(Not yet)*

IP-IN-IP (Future)

Not shown Ethernet or other Tunnels as be underlay

DetNet YANG Model Tree

```
module: ietf-detnet
  +-rw detnet
  +-rw traffic-profile* [profile-name]
  +-rw profile-name string
  +-rw traffic-requirements
  +-rw min-bandwidth? uint64
  +-rw max-latency? uint32
  +-rw max-latency-variation? uint32
  +-rw max-loss? uint32
  +-rw max-consecutive-loss-tolerance? uint32
  +-rw max-misordering? uint32
  +-rw flow-spec
  +-rw interval? uint32
  +-rw max-pkts-per-interval? uint32
  +-rw max-payload-size? uint32
  +-rw min-payload-size? uint32
  +-rw min-pkts-per-interval? uint32
  +-ro member-apps* app-flow-ref
  +-ro member-rwd-sublayers* forwarding-sub-layer-ref
  +-rw app-flows
  +-rw app-flow* [name]
  +-rw name string
  +-rw app-flow-bidir-congruent? boolean
  +-ro outgoing-service? service-sub-layer-ref
  +-ro incoming-service? service-sub-layer-ref
  +-rw traffic-profile? traffic-profile-ref
  +-rw ingress
  +-rw name? string
  +-ro app-flow-status? identityref
  +-rw interface? if:interface-ref
  +-rw (data-flow-type)
  +-:(tsn-app-flow)
  +-rw tsn-app-flow
  +-rw source-mac-address? yang:mac-address
  +-rw destination-mac-address? yang:mac-address
  +-rw ethernet-type? ethernet-types:ethertype
  +-rw vlan-id? dot1q-types:vlanid
  +-rw pcid? dot1q-types:priority-type
  +-:(ip-app-flow)
  +-rw ip-app-flow
  +-rw src-ip-prefix? inet:ip-prefix
  +-rw dest-ip-prefix? inet:ip-prefix
  +-rw protocol-next-header? uint8
  +-rw dscp? inet:dscp
  +-rw flow-label? inet:ipv6-flow-label
  +-rw source-port
  +-rw (port-range-or-operator)?
  +-:(range)
  +-rw lower-port inet:port-number
  +-rw upper-port inet:port-number
  +-:(operator)
  +-rw operator? operator
  +-rw port inet:port-number
  +-rw destination-port
  +-rw (port-range-or-operator)?
  +-:(range)
  +-rw lower-port inet:port-number
  +-rw upper-port inet:port-number
  +-:(operator)
  +-rw operator? operator
  +-rw port inet:port-number
  +-rw ipsec-spi? ipsec-spi
```

```
+-:(mpls-app-flow)
  +-rw mpls-app-flow
  +-rw (label-space)?
  +-:(context-label-space)
  +-rw mpls-label-stack
  +-rw entry [id] uint8
  +-rw id uint8
  +-rw label?
  +-rw rt-types:mpls-label
  +-rw ttl? uint8
  +-rw traffic-class? uint8
  +-:(platform-label-space)
  +-rw label?
  +-rw rt-types:mpls-label
  +-rw egress
  +-rw name? string
  +-rw (application-type)?
  +-:(ethernet)
  +-rw ethernet
  +-rw interface? if:interface-ref
  +-:(ip-mpls)
  +-rw ip-mpls
  +-rw (next-hop-options)
  +-:(simple-next-hop)
  +-rw outgoing-interface? if:interface-ref
  +-rw (flow-type)?
  +-:(ip)
  +-rw next-hop-address? inet:ip-address
  +-:(mpls)
  +-rw mpls-label-stack
  +-rw entry* [id] uint8
  +-rw id uint8
  +-rw label?
  +-rw rt-types:mpls-label
  +-rw ttl? uint8
  +-rw traffic-class? uint8
  +-:(next-hop-list)
  +-rw next-hop* [hop-index] uint8
  +-rw hop-index
  +-rw outgoing-interface? if:interface-ref
  +-rw (flow-type)?
  +-:(ip)
  +-rw next-hop-address? inet:ip-address
  +-:(mpls)
  +-rw mpls-label-stack
  +-rw entry* [id] uint8
  +-rw id uint8
  +-rw label?
  +-rw rt-types:mpls-label
  +-rw ttl? uint8
  +-rw traffic-class? uint8
```

DetNet YANG Model Tree (cont)

```
+--rw service-sub-layer
  +--rw service-sub-layer-list* [name]
    +--rw name string
    +--rw service-rank? uint8
    +--rw traffic-profile? traffic-profile-ref
    +--rw service-protection? service-protection-type
    +--rw sequence-number-length? sequence-number-field
    +--rw service-operation-type? service-operation-type
    +--rw incoming-type
      +--rw (incoming-type)
        +--rw (app-flow)
          +--rw app-flow-list* app-flow-ref
          +--rw (service-aggregation)
            +--rw service-aggregation
              +--rw service-sub-layer*
                +--rw service-sub-layer-ref
            +--rw (forwarding-aggregation)
              +--rw forwarding-aggregation
                +--rw forwarding-sub-layer*
                  +--rw forwarding-sub-layer-ref
          +--rw (service-id)
            +--rw service-id
              +--rw (detnet-flow-type)?
                +--rw (ip-detnet-flow)
                  +--rw src-ip-prefix?
                    +--rw inet:ip-prefix
                  +--rw dest-ip-prefix?
                    +--rw inet:ip-prefix
                  +--rw protocol-next-header? uint8
                  +--rw dscp? inet:dscp
                  +--rw flow-label?
                    +--rw inet:ipv6-flow-label
                  +--rw source-port
                    +--rw (port-range-or-operator)?
                      +--rw (range)
                        +--rw lower-port
                          +--rw inet:port-number
                        +--rw upper-port
                          +--rw inet:port-number
                      +--rw (operator)
                        +--rw operator? operator
                        +--rw port
                          +--rw inet:port-number
                    +--rw destination-port
                      +--rw (port-range-or-operator)?
                        +--rw (range)
                          +--rw lower-port
                            +--rw inet:port-number
                          +--rw upper-port
                            +--rw inet:port-number
                        +--rw (operator)
                          +--rw operator? operator
                          +--rw port
                            +--rw inet:port-number
                    +--rw ipsec-spi? ipsec-spi
                +--rw (mpls-detnet-flow)
                  +--rw (label-space)?
                    +--rw (context-label-space)
                      +--rw mpls-label-stack
                        +--rw entry* [id]
                          +--rw id uint8
                          +--rw label?
                            +--rw rt-types:mpls-label
                          +--rw ttl? uint8
                          +--rw traffic-class? uint8
                    +--rw (platform-label-space)
                      +--rw label?
                            +--rw rt-types:mpls-label
```

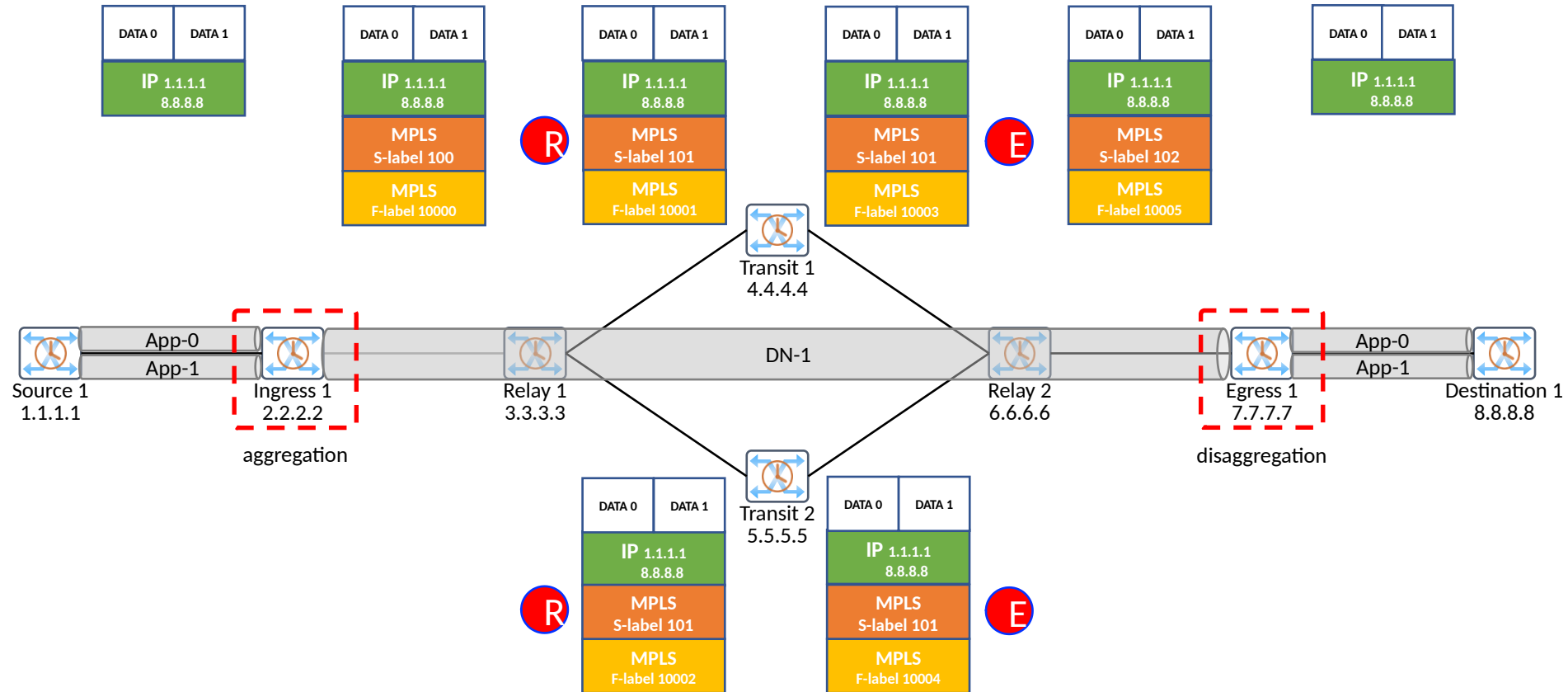
```
+--rw outgoing-type
  +--rw (outgoing-type)
    +--rw (forwarding-sub-layer)
      +--rw forwarding-sub-layer
        +--rw service-outgoing-list*
          +--rw (service-outgoing-index)
            +--rw service-outgoing-index uint8
          +--rw (header-type)?
            +--rw (detnet-mpls-header)
              +--rw mpls-label-stack
                +--rw entry* [id]
                  +--rw id uint8
                  +--rw label?
                    +--rw rt-types:mpls-label
                  +--rw ttl? uint8
                  +--rw traffic-class? uint8
            +--rw (detnet-ip-header)
              +--rw src-ip-address?
                +--rw inet:ip-address
              +--rw dest-ip-address?
                +--rw inet:ip-address
              +--rw protocol-next-header? uint8
              +--rw dscp?
                +--rw inet:dscp
              +--rw flow-label?
                +--rw inet:ipv6-flow-label
              +--rw source-port?
                +--rw inet:port-number
              +--rw destination-port?
                +--rw inet:port-number
            +--rw forwarding-sub-layer-ref
          +--rw (service-sub-layer)
            +--rw service-sub-layer
              +--rw aggregation-service-sub-layer?
                +--rw service-sub-layer-ref
              +--rw service-label
                +--rw mpls-label-stack
                  +--rw entry* [id]
                    +--rw id uint8
                    +--rw label?
                      +--rw rt-types:mpls-label
                    +--rw ttl? uint8
                    +--rw traffic-class? uint8
            +--rw (app-flow)
              +--rw app-flow
                +--rw app-flow-list* app-flow-ref
            +--rw (service-disaggregation)
              +--rw service-disaggregation
                +--rw service-sub-layer*
                  +--rw service-sub-layer-ref
            +--rw (forwarding-disaggregation)
              +--rw forwarding-disaggregation
                +--rw forwarding-sub-layer*
```

DetNet YANG Model Tree (cont)

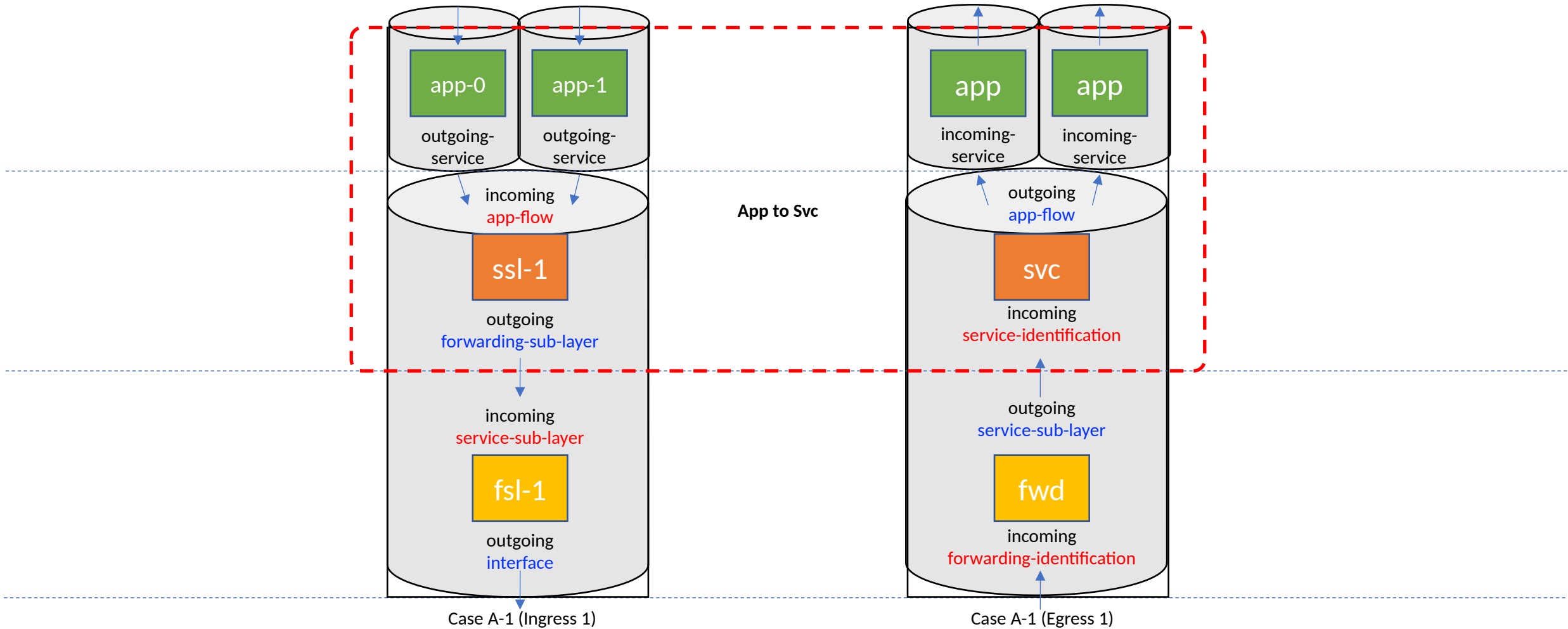
```
forwarding-sub-layer-ref
+--rw forwarding-sub-layer
+--rw forwarding-sub-layer-list* [name]
+--rw name string
+--rw traffic-profile? traffic-profile-ref
+--rw forwarding-operation-type?
+--rw forwarding-operations-type
+--rw incoming-type
+--rw (incoming-type)
+--rw (service-sub-layer)
+--rw service-sub-layer
+--rw service-sub-layer-ref
+--rw forwarding-aggregation
+--rw forwarding-sub-layer*
+--rw forwarding-sub-layer-ref
+--rw forwarding-id
+--rw interface
+--rw if:interface-ref
+--rw (detnet-flow-type)?
+--rw (ip-detnet-flow)
+--rw src-ip-prefix
+--rw dest-ip-prefix
+--rw inet:ip-prefix
+--rw protocol-next-header? uint8
+--rw dscp? inet:dscp
+--rw flow-label
+--rw inet:ipv6-flow-label
+--rw source-port
+--rw (port-range-or-operator)?
+--rw (range)
+--rw lower-port
+--rw inet:port-number
+--rw upper-port
+--rw inet:port-number
+--rw (operator)
+--rw operator? operator
+--rw port
+--rw inet:port-number
+--rw destination-port
+--rw (port-range-or-operator)?
+--rw (range)
+--rw lower-port
+--rw inet:port-number
+--rw upper-port
+--rw inet:port-number
+--rw (operator)
+--rw operator? operator
+--rw port
+--rw inet:port-number
+--rw ipsec-spi? ipsec-spi
+--rw (mpls-label-space)
+--rw (context-label-space)
+--rw mpls-label-stack
+--rw entry* [id]
+--rw id uint8
+--rw label?
+--rw rt-types:mpls-label
+--rw ttl? uint8
+--rw traffic-class? uint8
+--rw (platform-label-space)
+--rw label?
+--rw rt-types:mpls-label
```

```
+--rw outgoing-type
+--rw (outgoing-type)
+--rw interface
+--rw (next-hop-options)
+--rw (simple-next-hop)
+--rw (outgoing-interface)
+--rw (flow-type)
+--rw (ip)
+--rw (operation-type)?
+--rw (ip-forwarding)
+--rw next-hop-address?
+--rw inet:ip-address?
+--rw (mpls-over-ip-encapsulation)
+--rw src-ip-address?
+--rw inet:ip-address?
+--rw dest-ip-address?
+--rw inet:ip-address?
+--rw protocol-next-header?
+--rw inet:protocol-next-header?
+--rw dscp?
+--rw inet:dscp?
+--rw flow-label
+--rw inet:ipv6-flow-label
+--rw source-port?
+--rw inet:port-number?
+--rw destination-port?
+--rw inet:port-number?
+--rw mpls-label-stack
+--rw entry [id]
+--rw id uint8
+--rw label?
+--rw rt-types:mpls-label
+--rw ttl? uint8
+--rw traffic-class? uint8
+--rw (next-hop-list)
+--rw next-hop [hop-index]
+--rw hop-index uint8
+--rw outgoing-interface?
+--rw interface-ref
+--rw (flow-type)
+--rw (ip)
+--rw (operation-type)?
+--rw (ip-forwarding)
+--rw next-hop-address?
+--rw inet:ip-address?
+--rw (mpls-over-ip-encapsulation)
+--rw src-ip-address?
+--rw inet:ip-address?
+--rw dest-ip-address?
+--rw inet:ip-address?
+--rw protocol-next-header?
+--rw inet:protocol-next-header?
+--rw dscp?
+--rw inet:dscp?
+--rw flow-label
+--rw inet:ipv6-flow-label
+--rw source-port?
+--rw inet:port-number?
+--rw destination-port?
+--rw inet:port-number?
+--rw mpls-label-stack
+--rw entry [id]
+--rw id uint8
+--rw label?
+--rw rt-types:mpls-label
+--rw ttl? uint8
+--rw traffic-class? uint8
+--rw (service-aggregation)
+--rw service-aggregation
+--rw aggregation-service-sub-layer?
+--rw service-sub-layer-ref
+--rw optional-forwarding-label
+--rw mpls-label-stack
+--rw entry [id]
+--rw id uint8
+--rw label?
+--rw rt-types:mpls-label
+--rw ttl? uint8
+--rw traffic-class? uint8
+--rw (forwarding-sub-layer)
+--rw forwarding-sub-layer
+--rw aggregation-forwarding-sub-layer?
+--rw forwarding-sub-layer-ref
+--rw forwarding-label
+--rw mpls-label-stack
+--rw entry [id]
+--rw id uint8
+--rw label?
+--rw rt-types:mpls-label
+--rw ttl? uint8
+--rw traffic-class? uint8
+--rw (service-sub-layer)
+--rw service-sub-layer
+--rw service-sub-layer-ref
+--rw forwarding-disaggregation
+--rw forwarding-sub-layer-ref
+--rw forwarding-sub-layer-ref
```

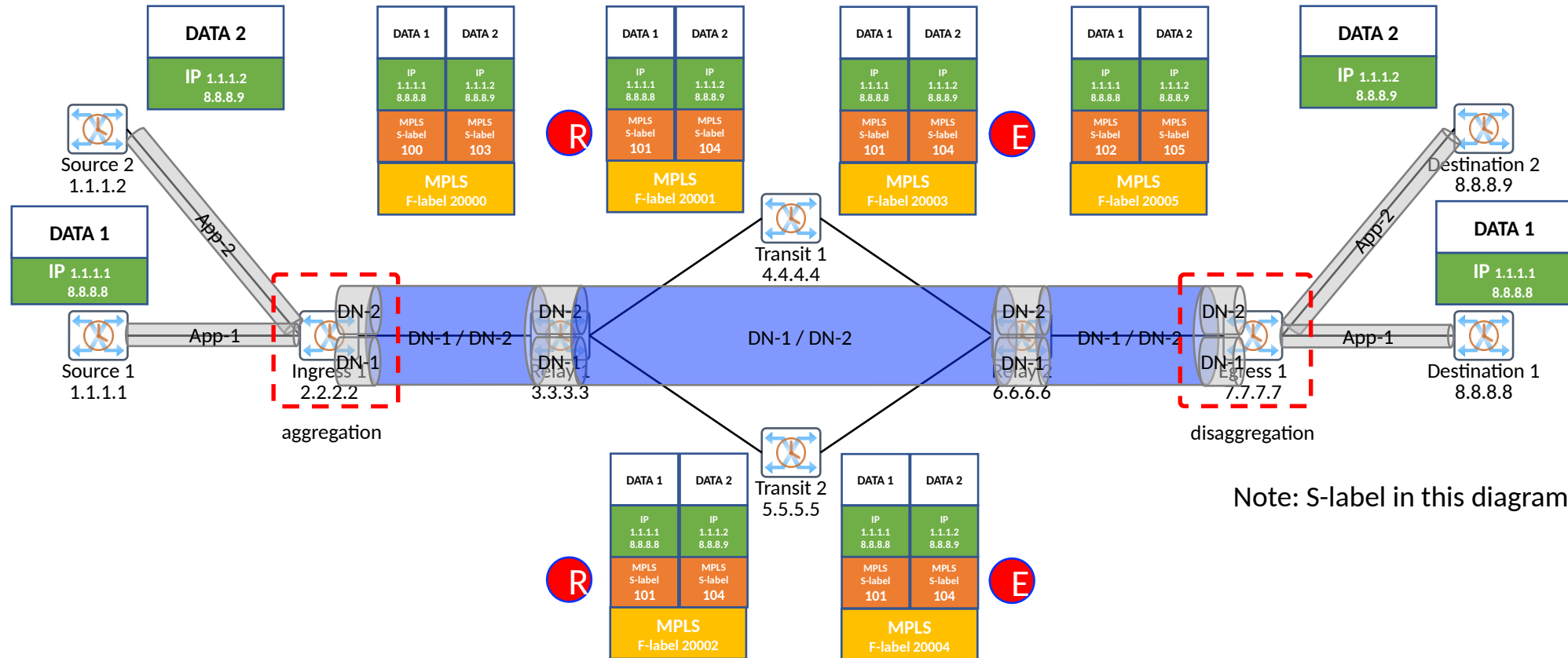
Case A-1: Ingress node 1 aggregates App flows 0 and 1 into a service sub-layer of DetNet flow 1



Case a-1 aggregation & disaggregation

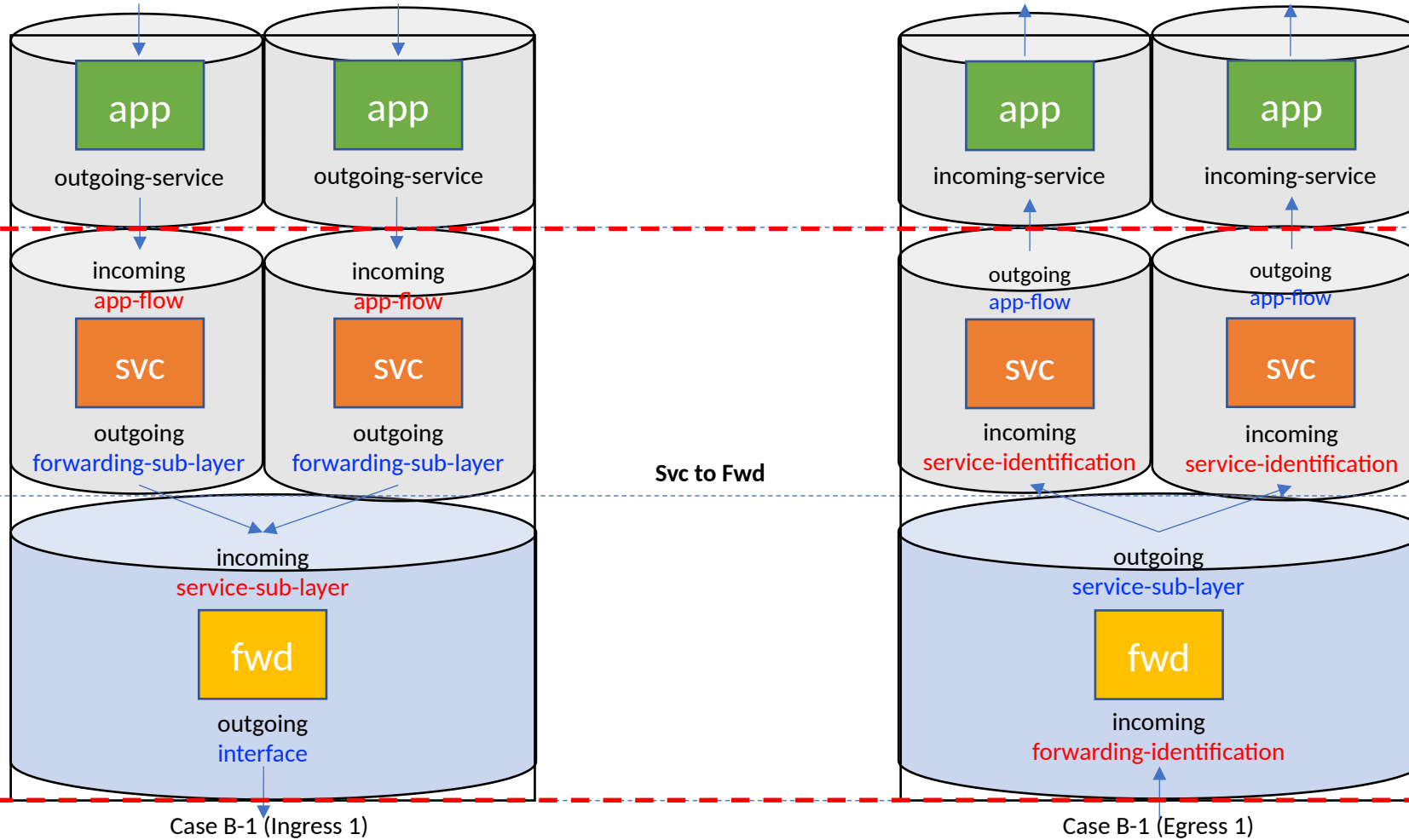


Case B-1: The **service sub-layers** of DetNet flows 1 and 2 are aggregated into a **forwarding sub-layer**

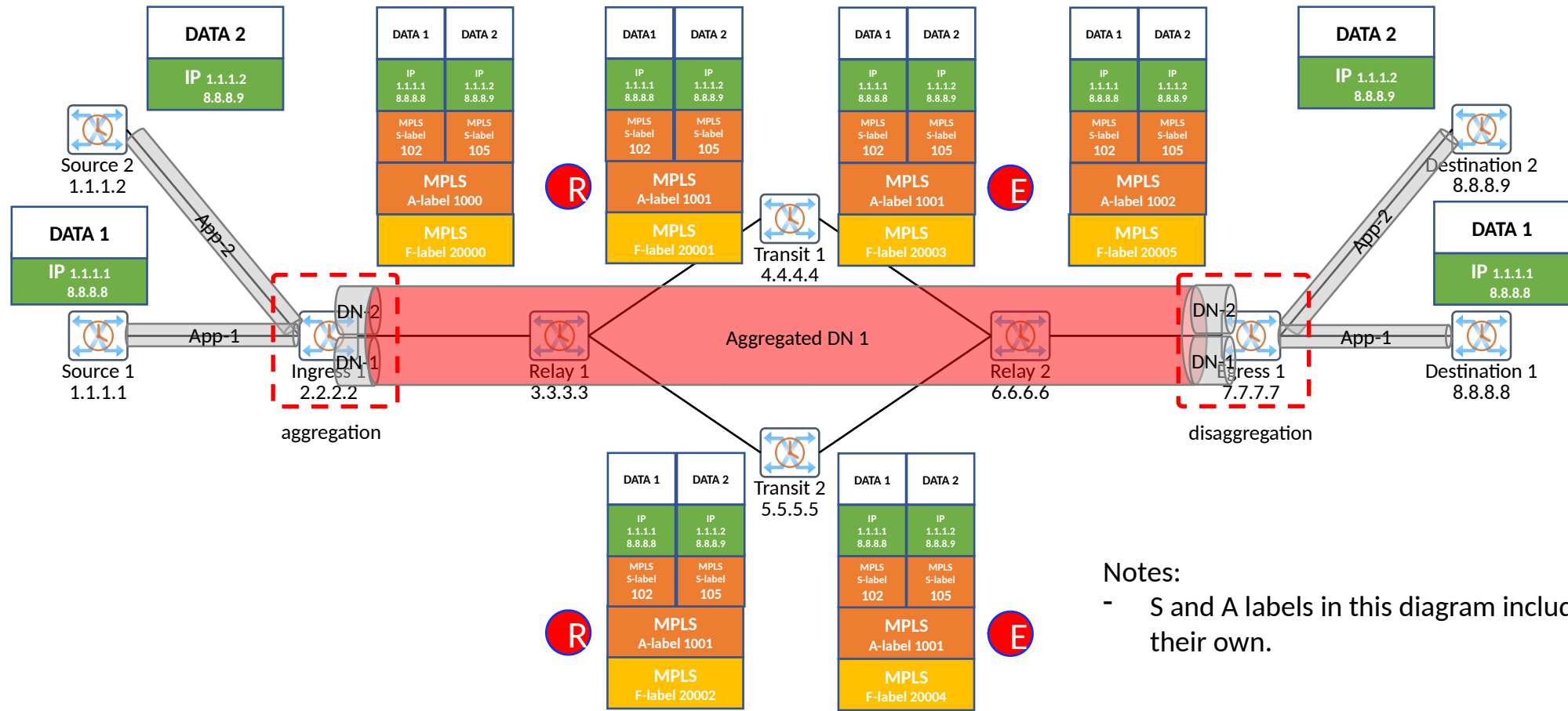


Note: S-label in this diagram includes d-CW.

Case b-1 aggregation & disaggregation

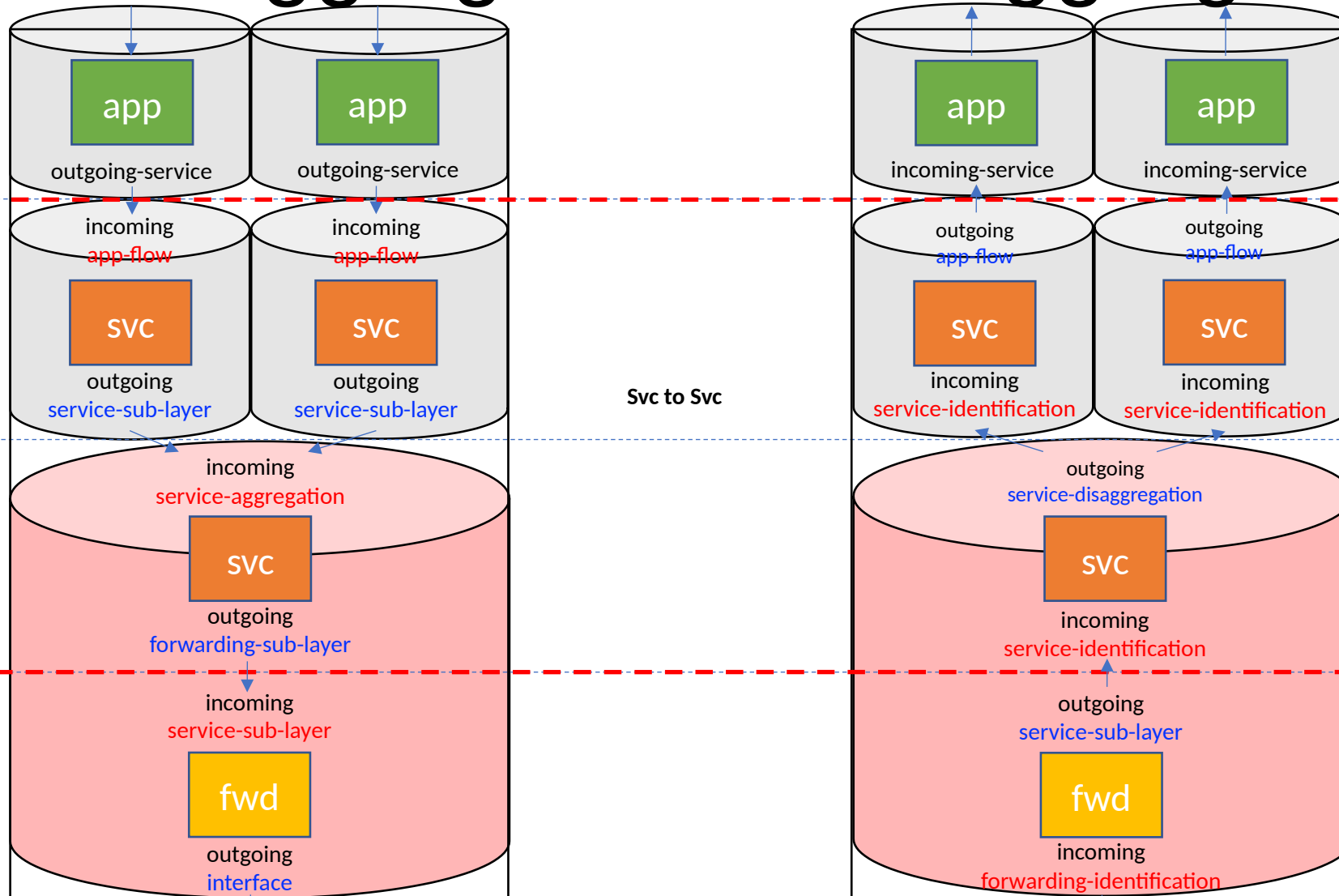


Case B-2: The **service sub-layers** of DetNet flows 1 and 2 are aggregated into a **service sub-layer** of Aggregated DetNet flow 1



Notes:
 - S and A labels in this diagram include d-CWs of their own.

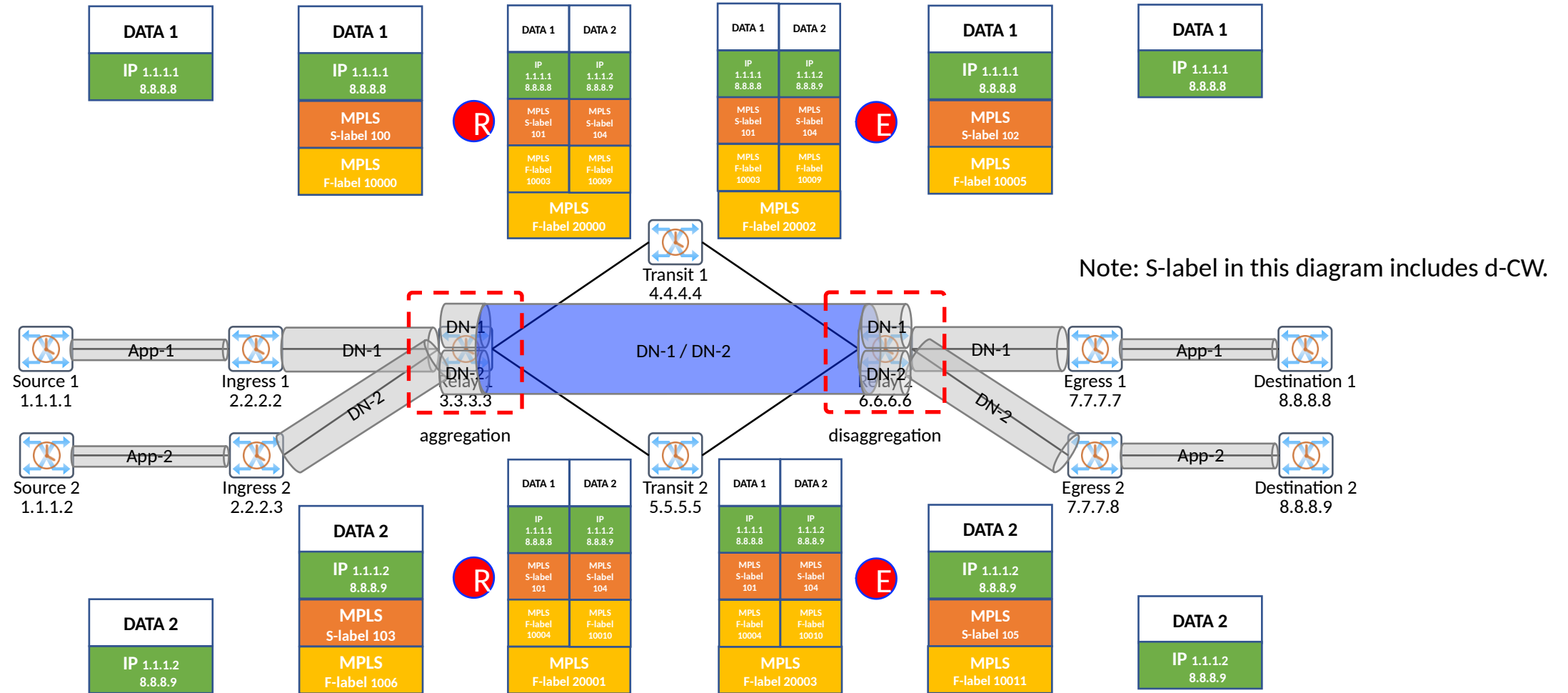
Case b-2 aggregation & disaggregation



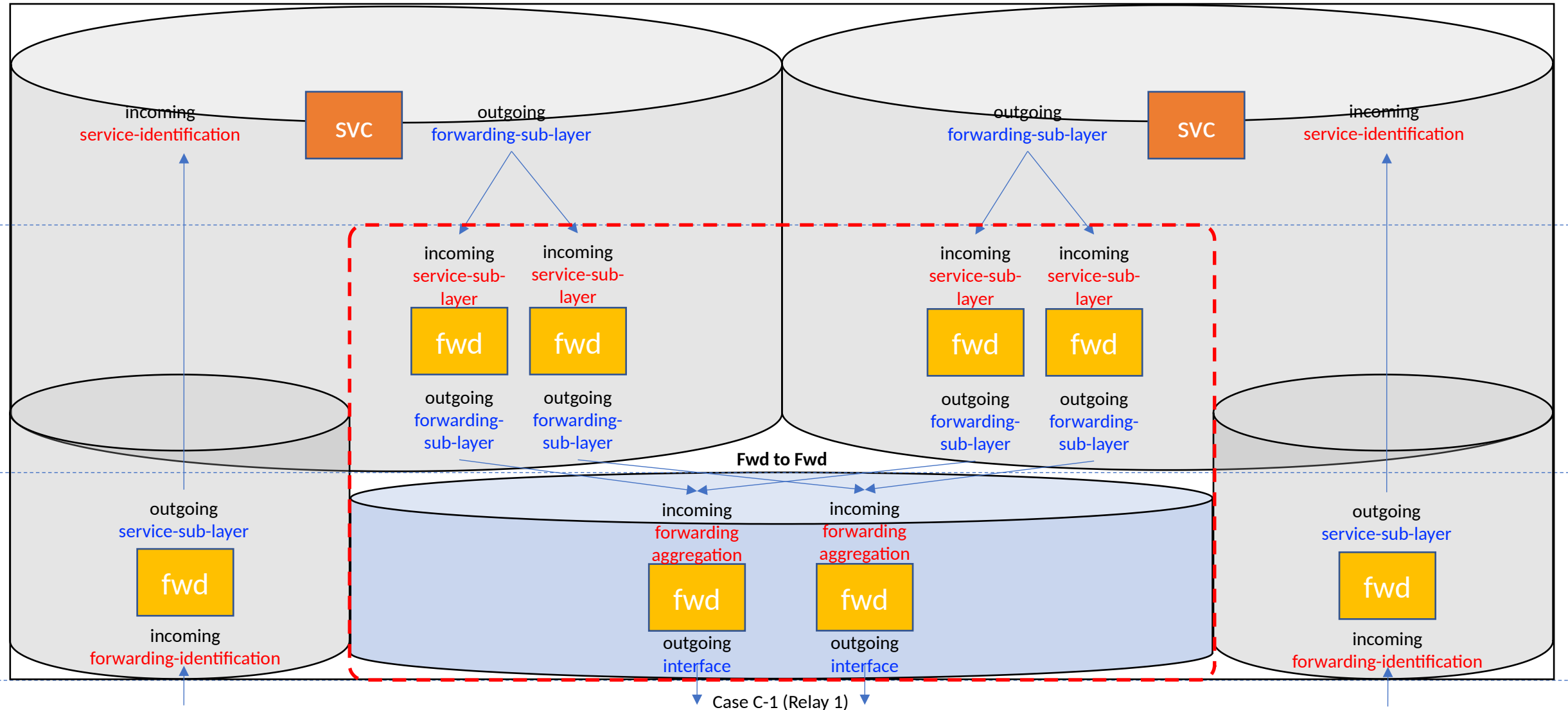
Case B-2 (Ingress 1)

Case B-2 (Egress 1)

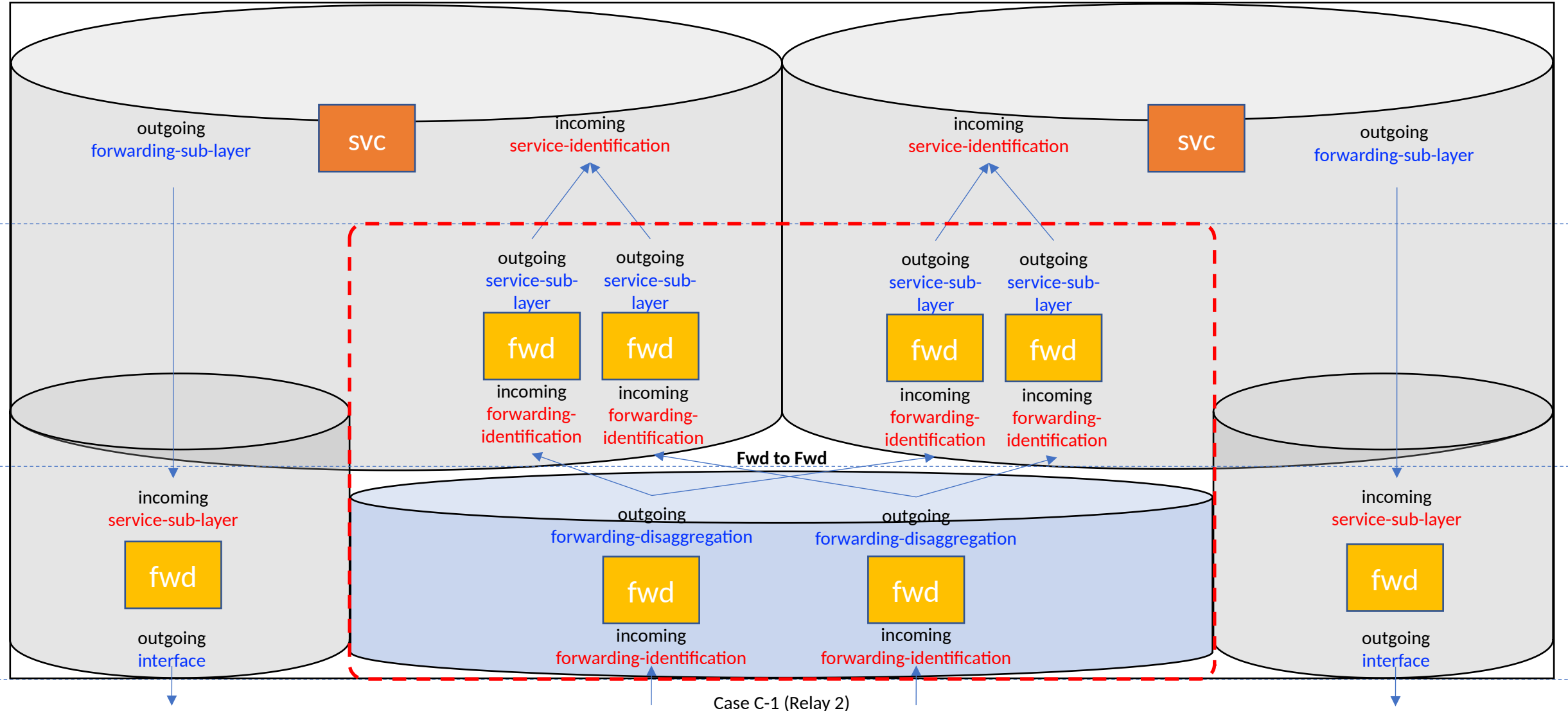
Case C-1: Relay node 1 aggregates the forwarding sub-layers of DetNet flows 1 and 2 into a forwarding sub-layer



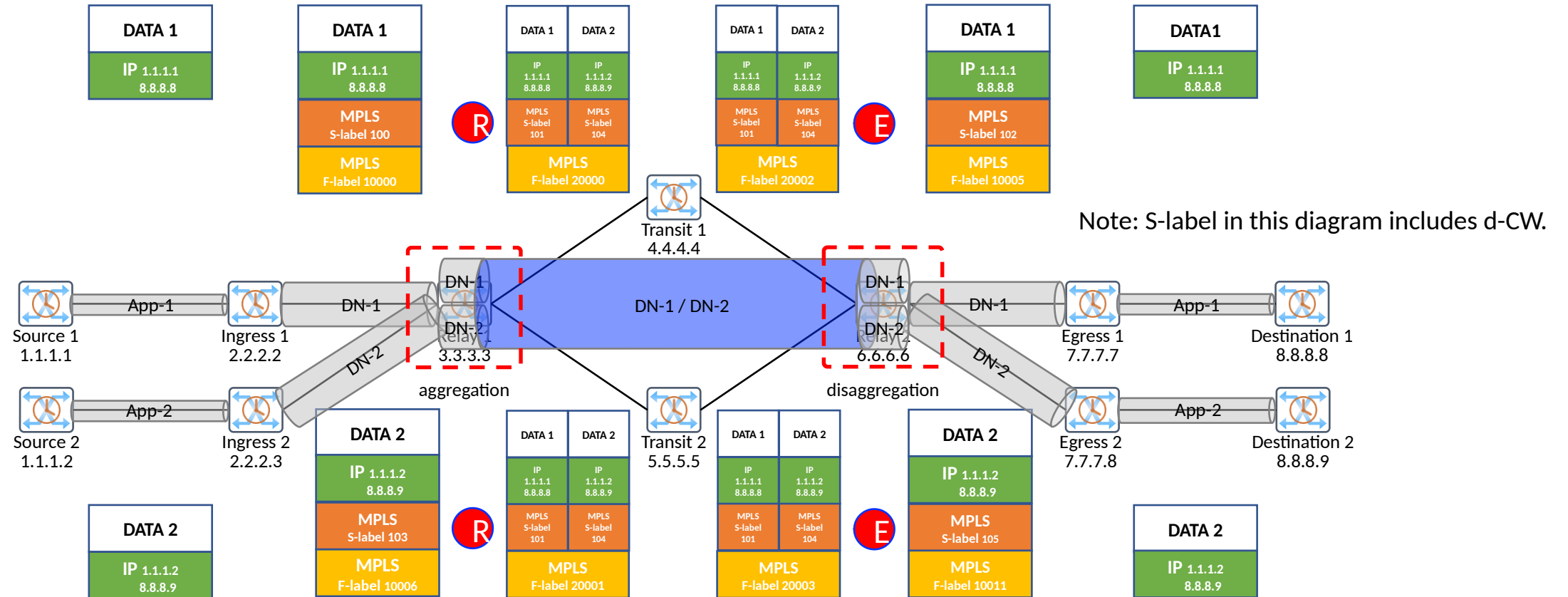
Case c-1 aggregation



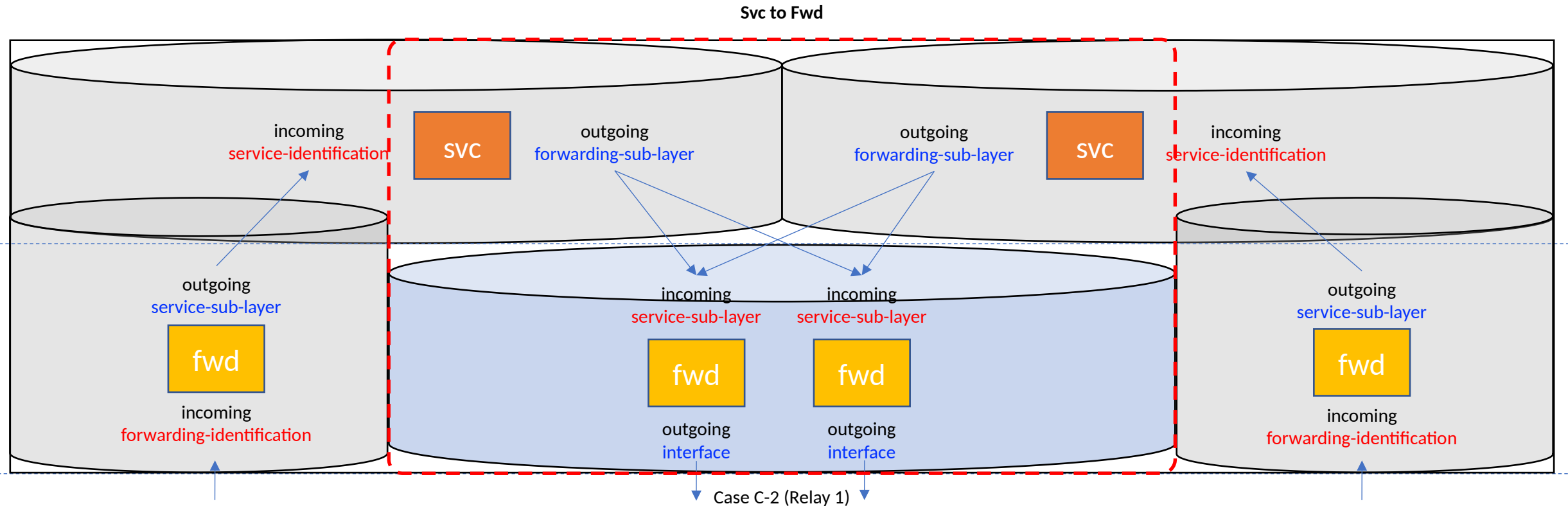
Case c-1 disaggregation



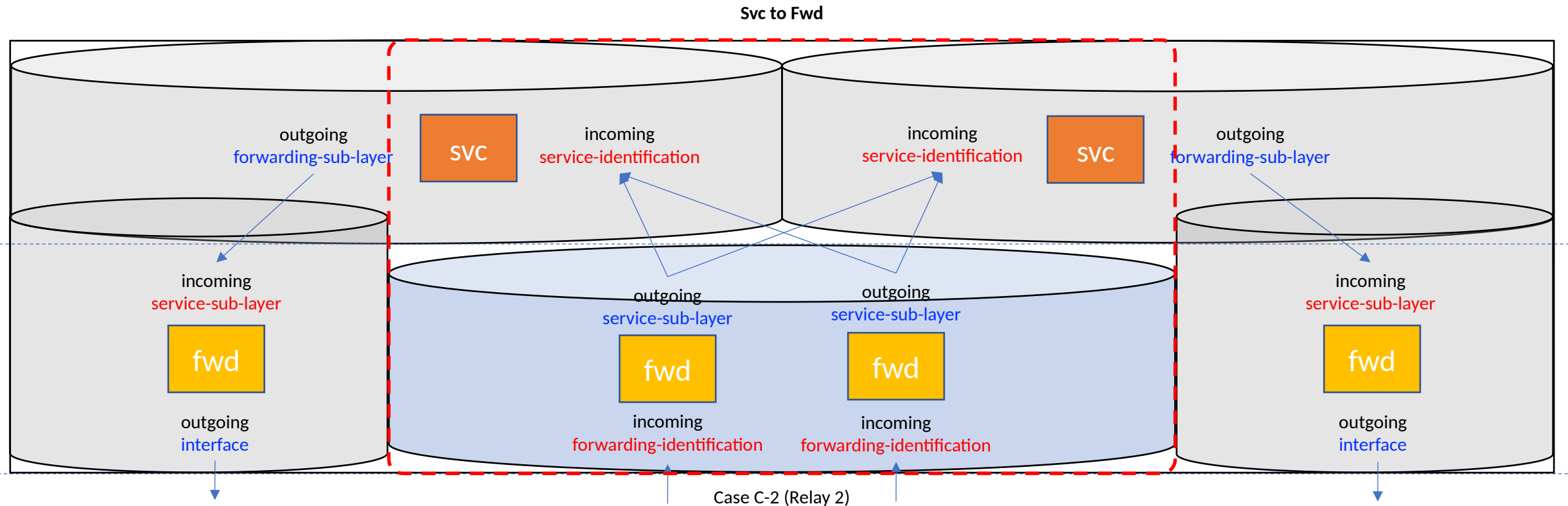
Case C-2: Relay node 1 aggregates the **service sub-layers** of DetNet flows 1 and 2 into **a forwarding sub-layer**



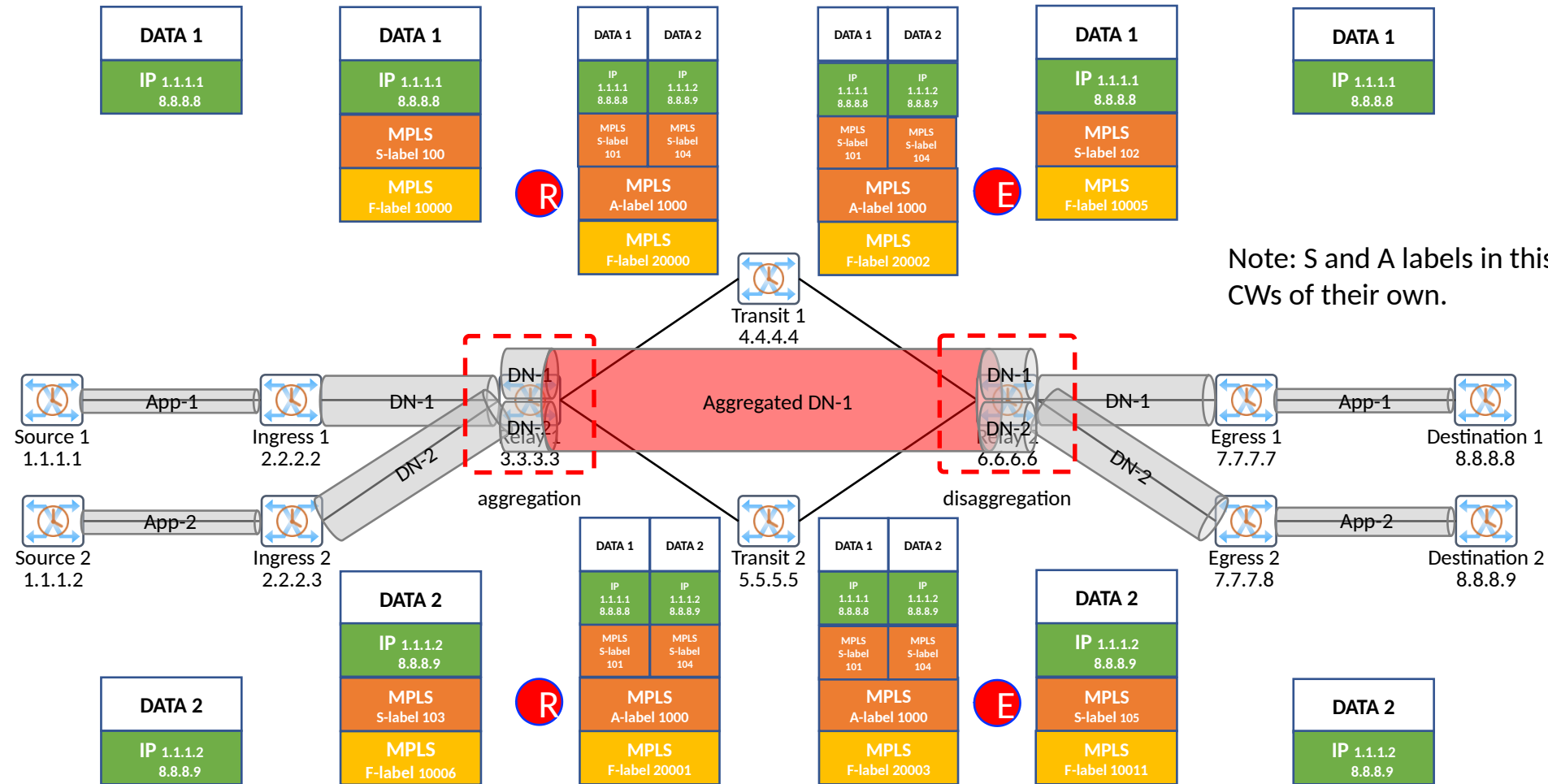
Case c-2 aggregation



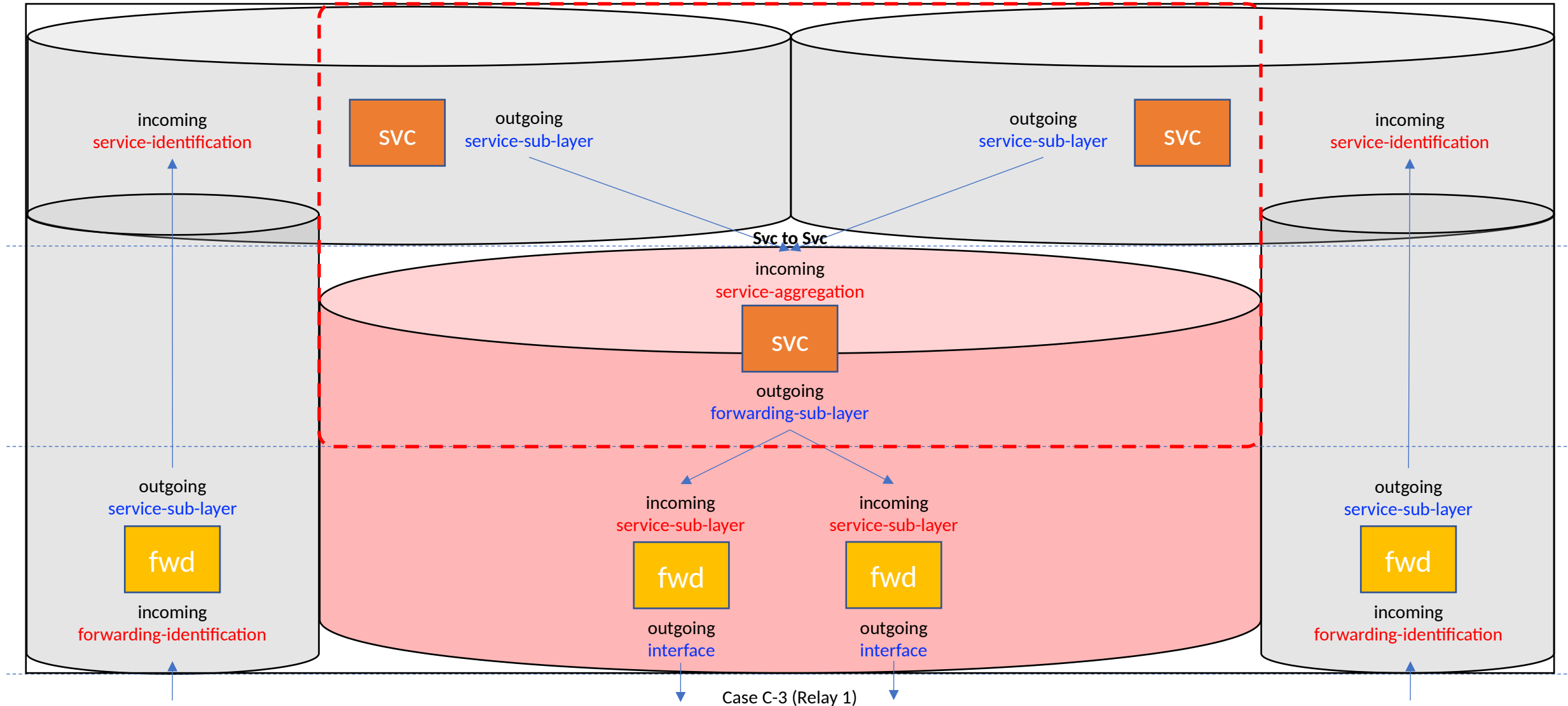
Case c-2 disaggregation



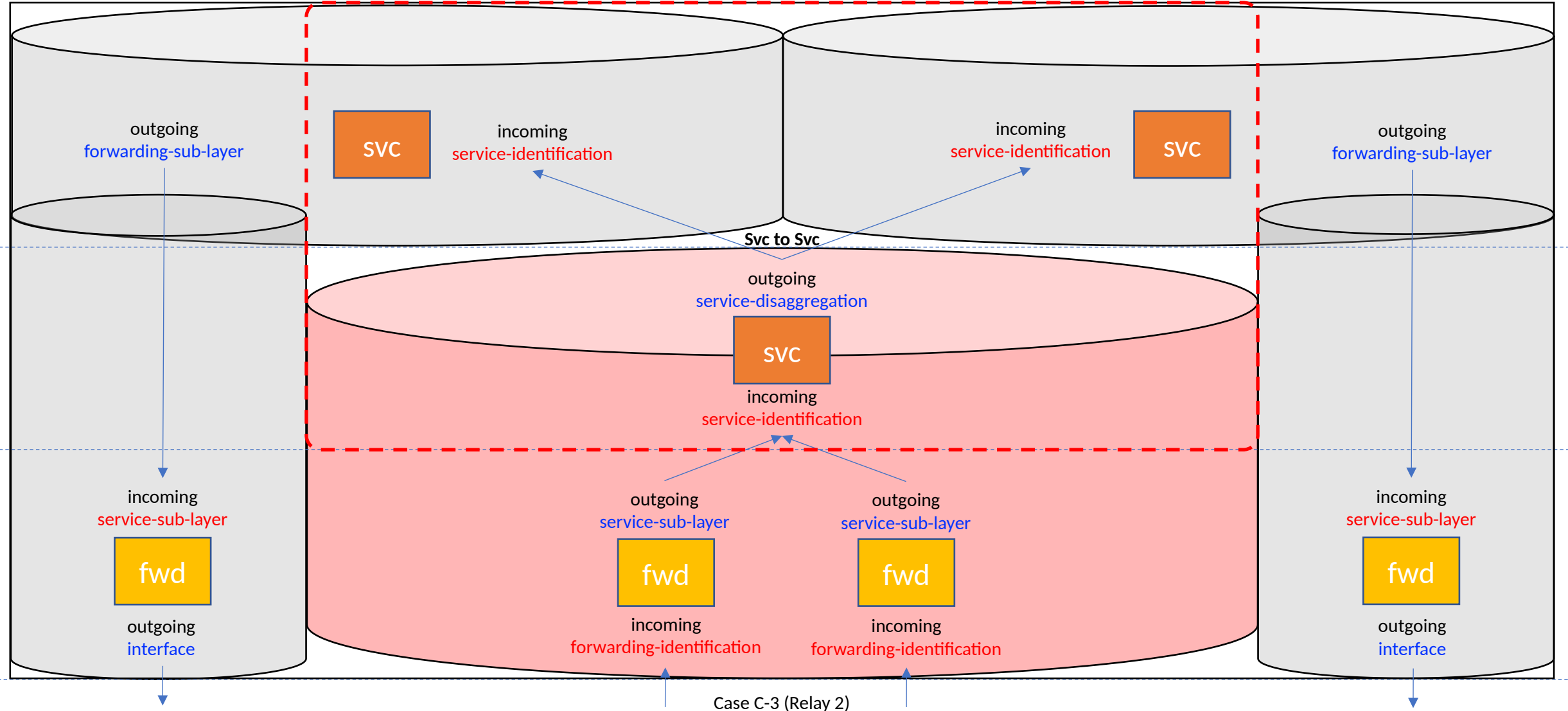
Case C-3: Relay node 1 aggregates the **service sub-layers** of DetNet flows 1 and 2 into **a service sub-layer** of Aggregated DetNet flow 1



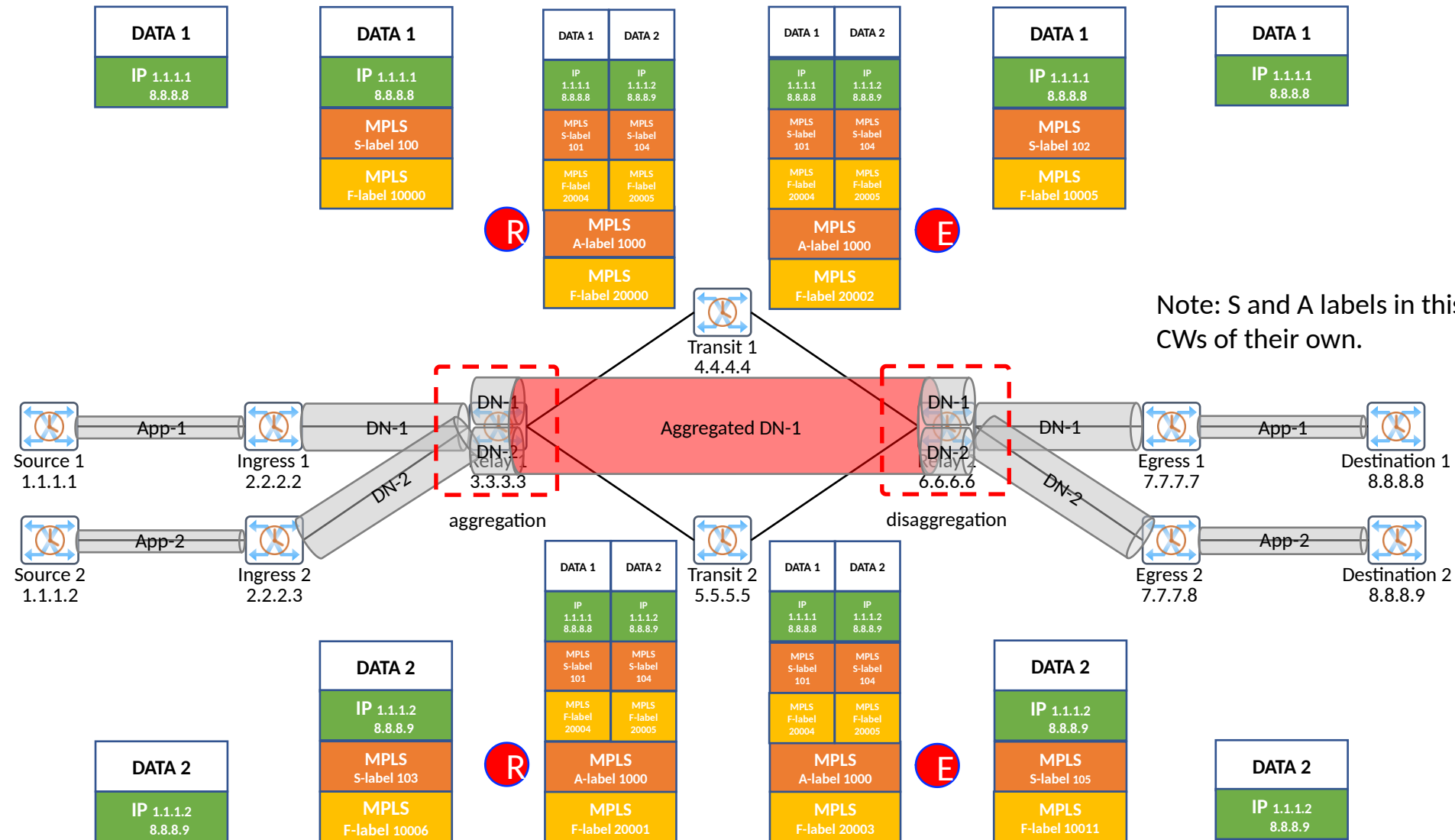
Case c-3 aggregation



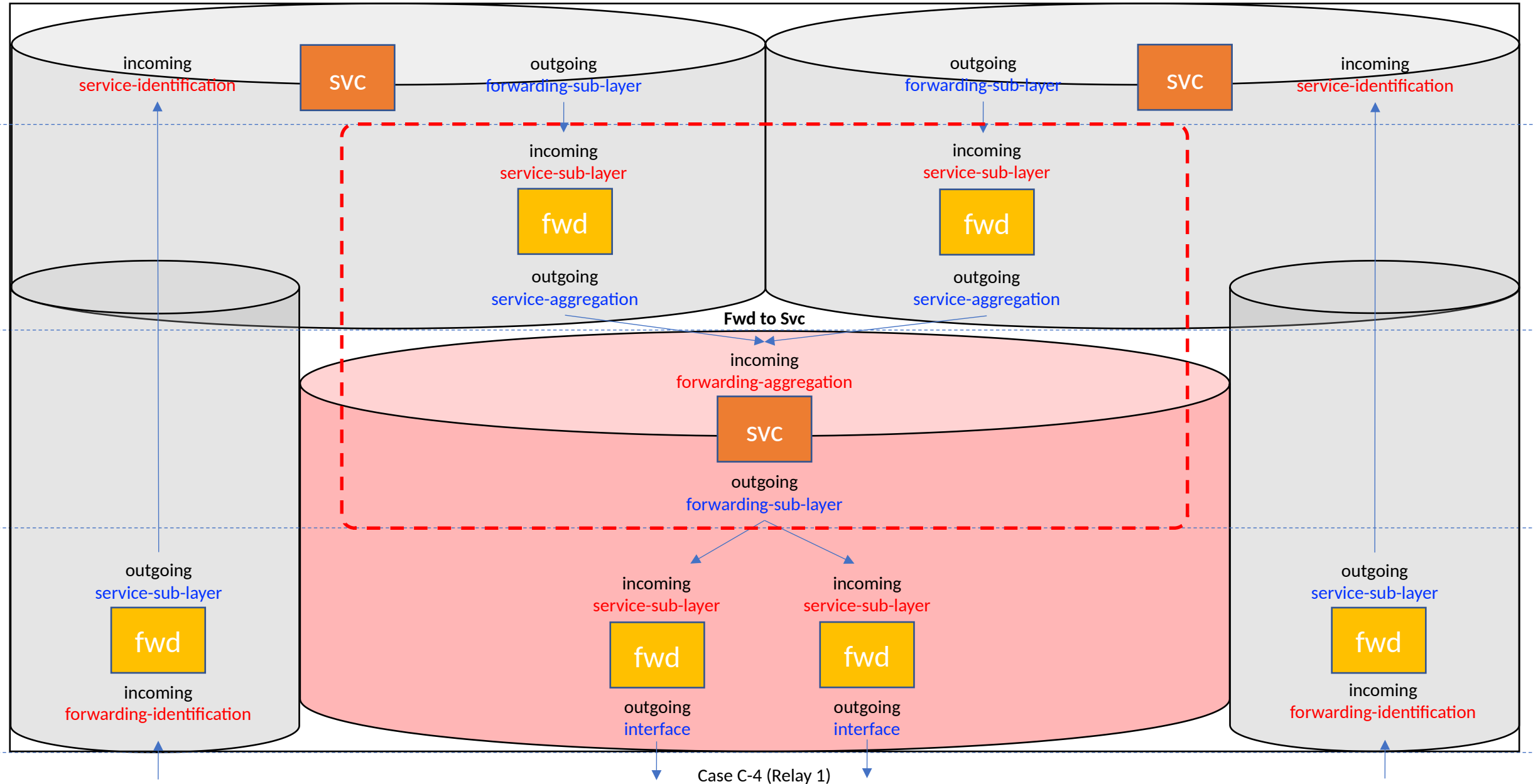
Case c-3 disaggregation



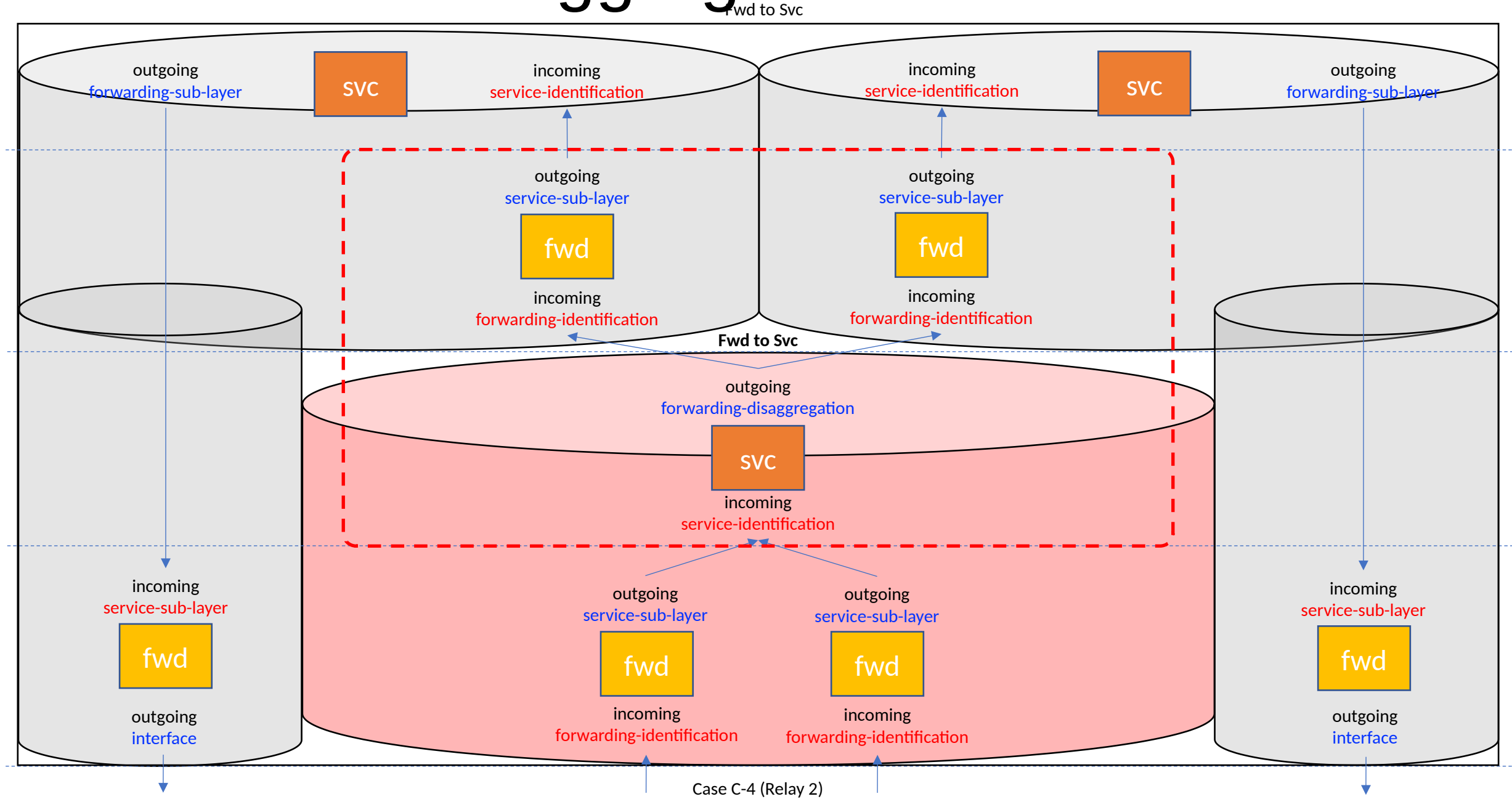
Case C-4: Relay node 1 aggregates the forwarding sub-layers of DetNet flow 1 and 2 into a service sub-layer of Aggregated DetNet flow 1



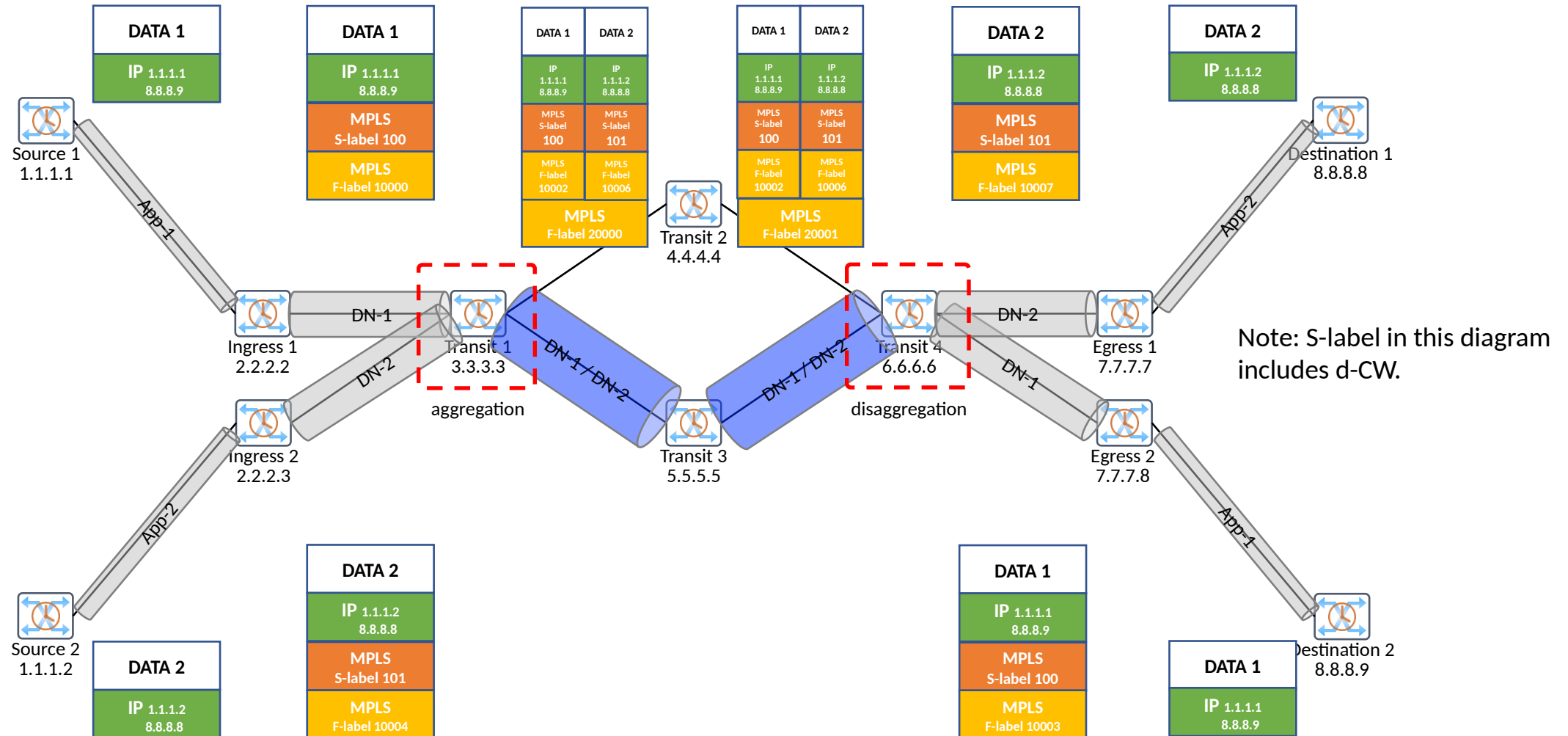
Case c-4 aggregation



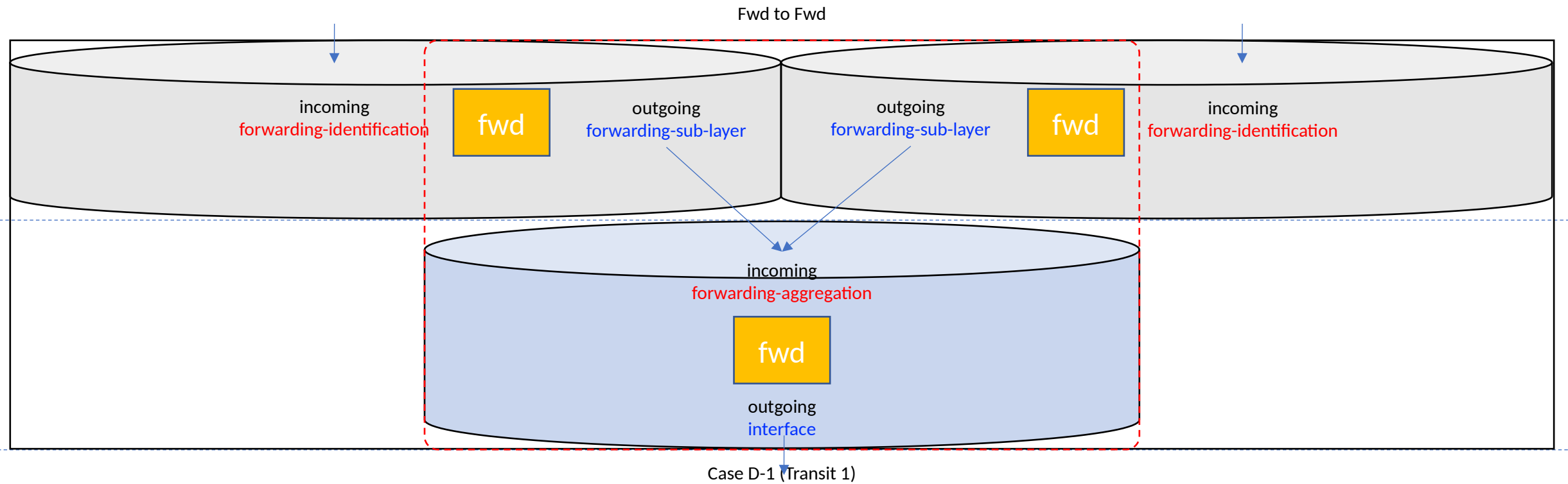
Case C-4 disaggregation



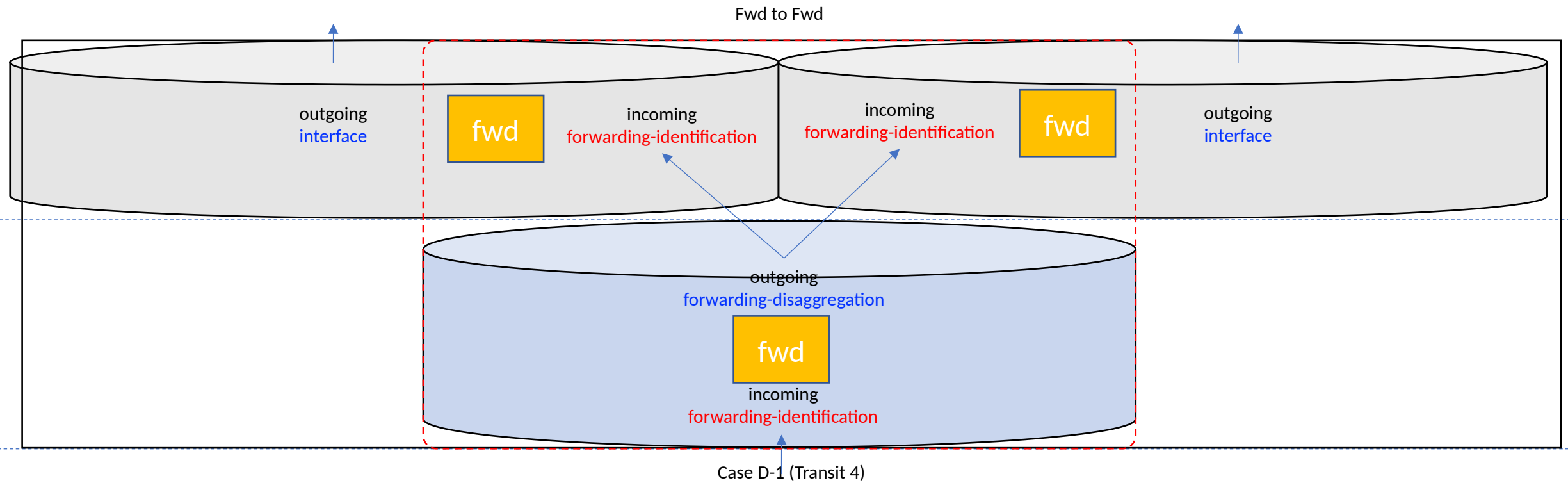
Case D-1: Transit node 1 aggregates the forwarding sub-layers of DetNet flow 1 and 2 into a forwarding sub-layer



Case d-1 aggregation



Case d-1 disaggregation



Thank You