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

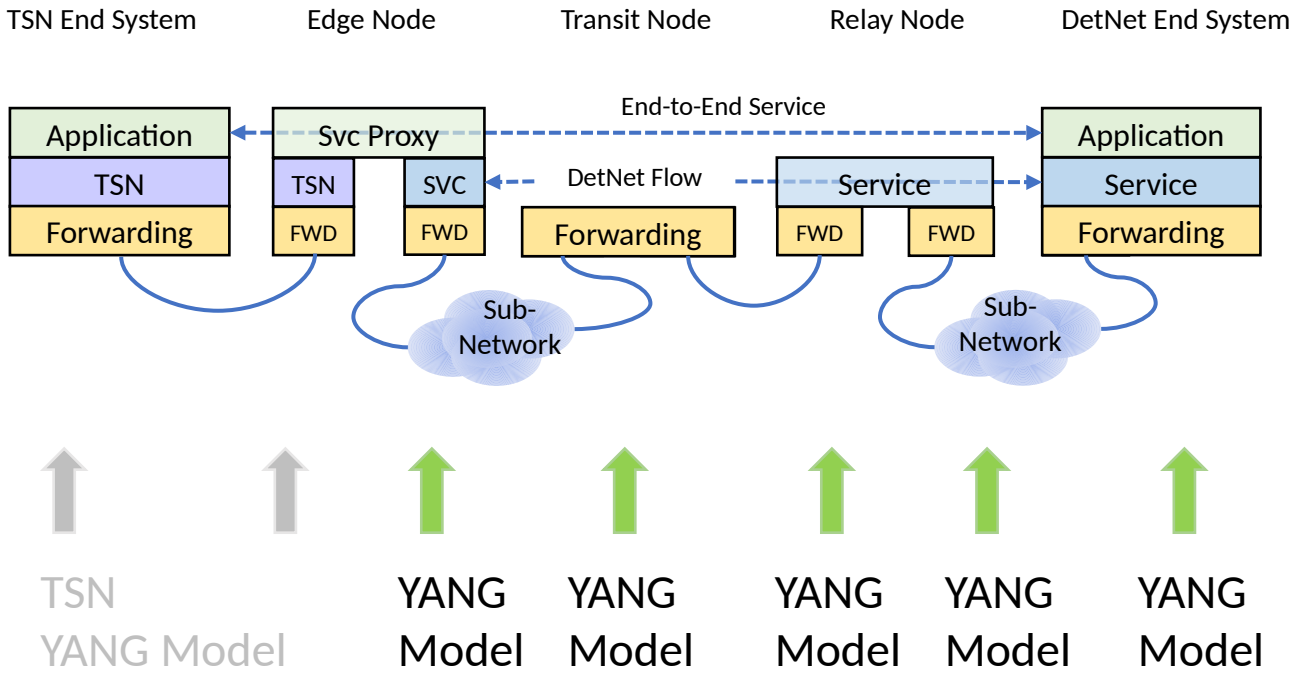
Detnet Architecture

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

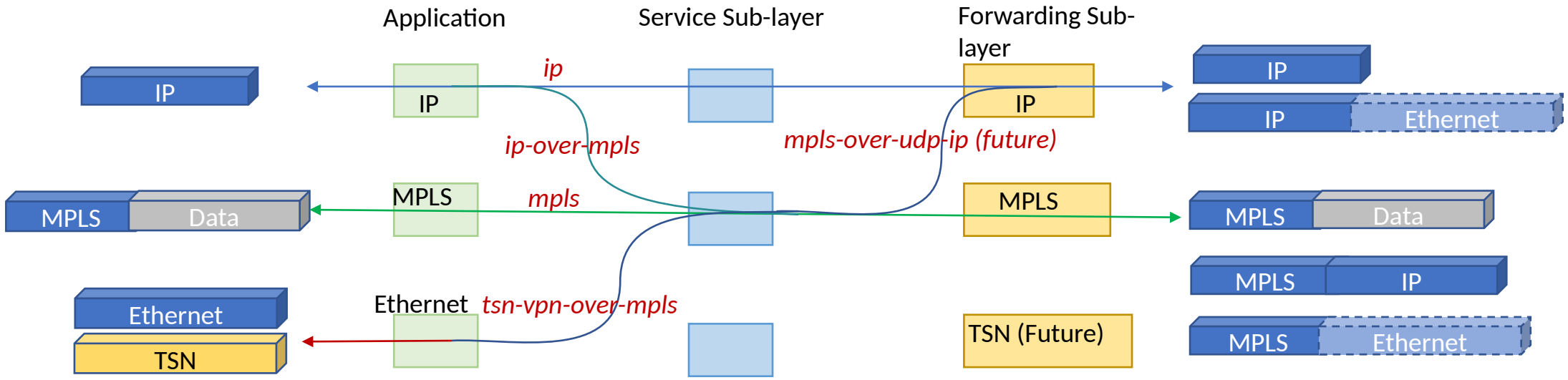
What we found worked:

- 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

Needs updating

(w/o Aggregation)

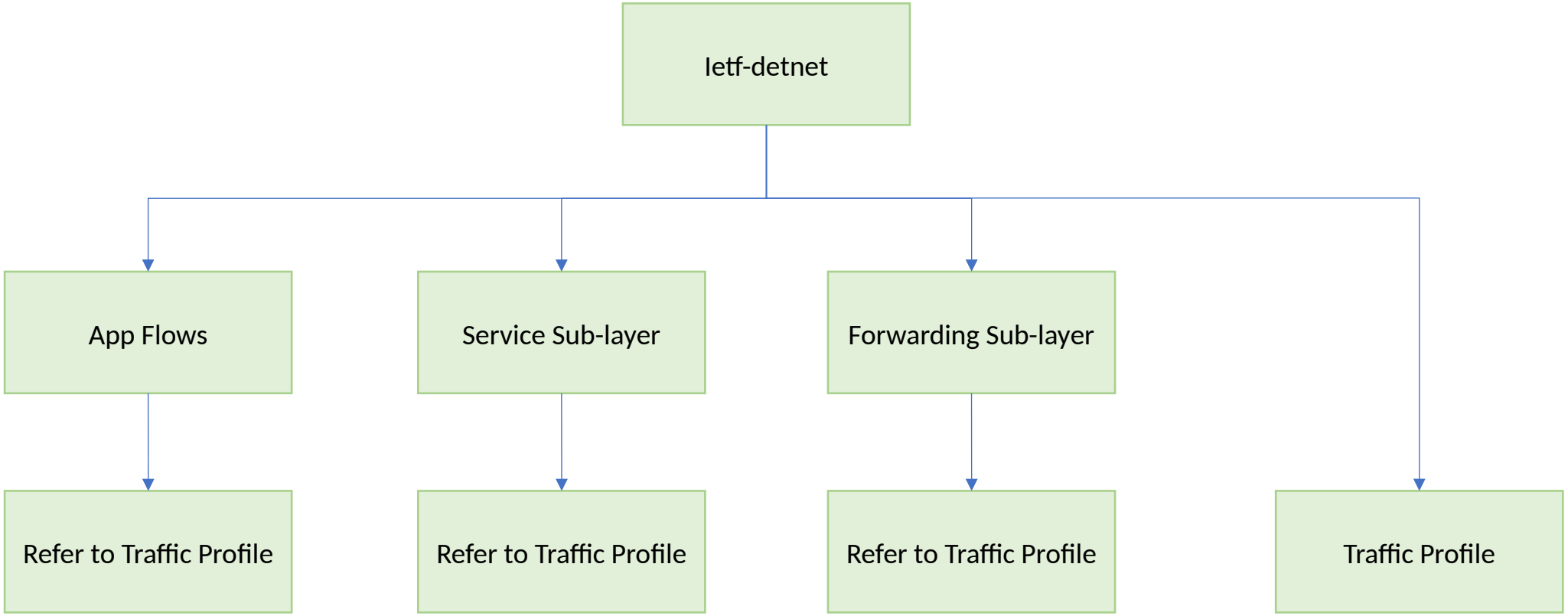


Corresponding Data Plane drafts:
RFC8939 (Deterministic Networking (DetNet) Data Plane: IP)
RFC8964 (Deterministic Networking (DetNet) Data Plane: MPLS)
draft-ietf-detnet-ip-over-mpls-09
draft-ietf-detnet-mpls-over-udp-ip-08 (Out-of-scope)
draft-ietf-detnet-tsn-vpn-over-mpls-07 (Out-of-scope)
draft-ietf-detnet-mpls-over-tsn-07(Out-of-scope)
draft-ietf-detnet-ip-over-tsn-07(Out-of-scope)

IP-IN-IP (Future)

Not shown Ethernet or other Tunnels as be underlay

DetNet YANG Model Structure



DetNet YANG Model Tree

DetNet YANG Model Tree (cont)

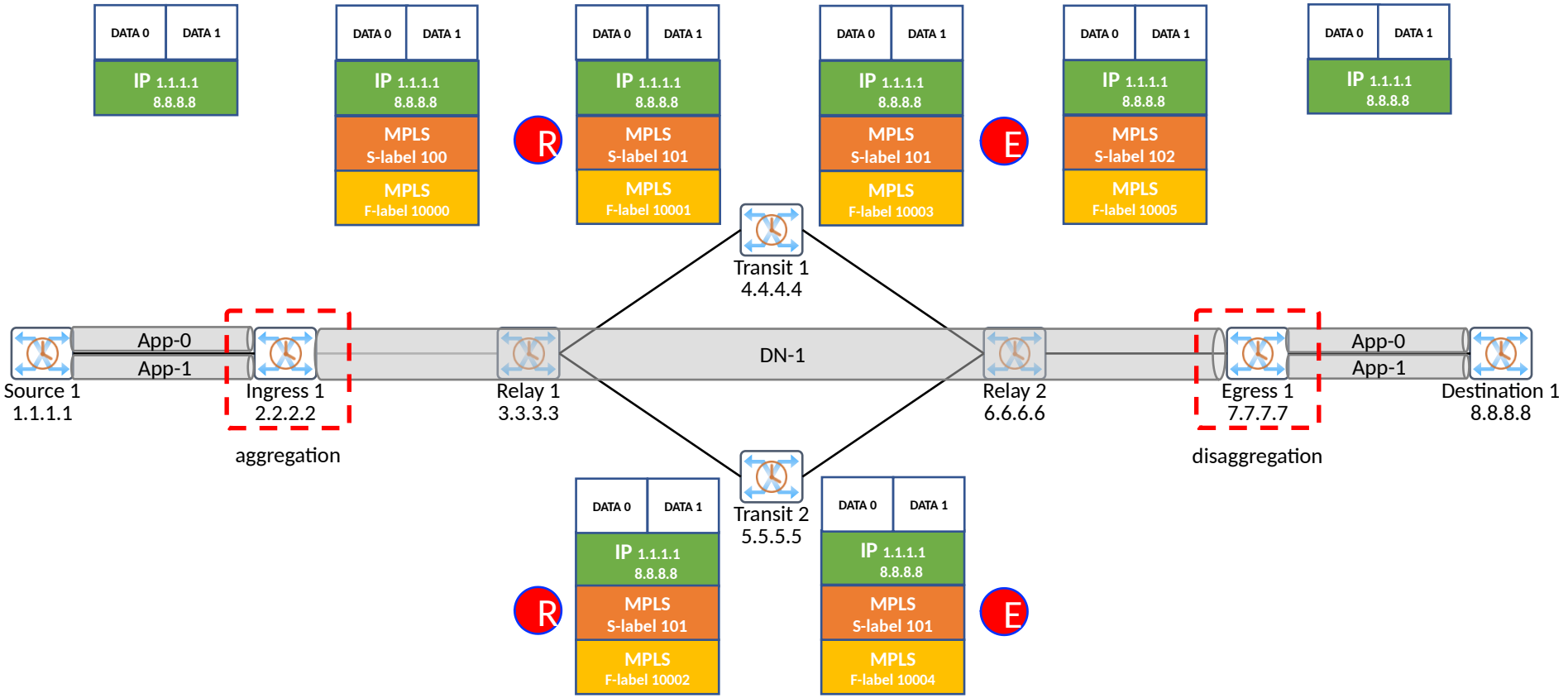
```
+--rw service-sub-layer
|  +--rw service-sub-layer-list* [name]
|     +--rw name                          string
|     +--rw service-rank?                 uint8
|     +--rw traffic-profile?              traffic-profile-ref
|     +--rw service-protection
|     |  +--rw service-protection-type?   service-protection-type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

DetNet YANG Model Tree (cont)

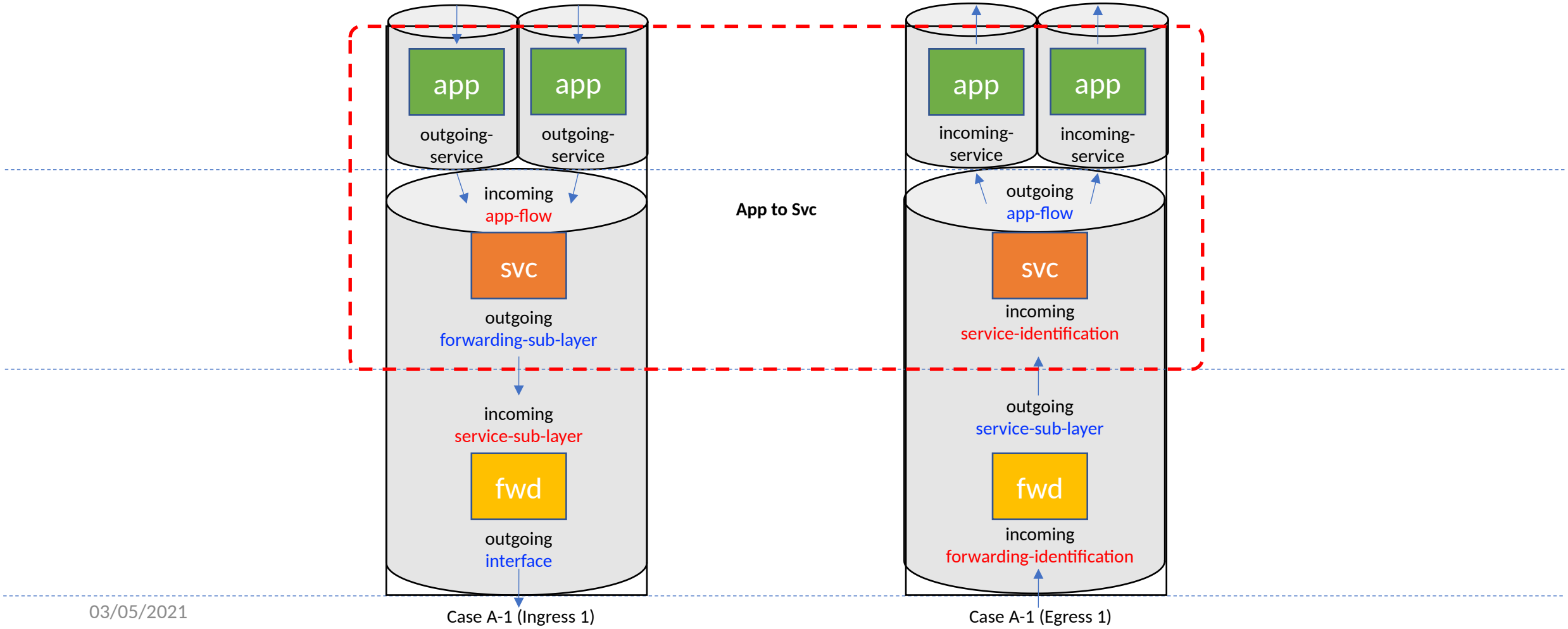
```
+--rw forwarding-sub-layer
   +--rw forwarding-sub-layer-list* [name]
      +--rw name                              string
      +--rw traffic-profile?                  traffic-profile-ref
      +--rw forwarding-operation-type?
      |       forwarding-operations-type
      +--rw incoming-type
      |  +--rw (incoming-type)
      |     +--:(service-sub-layer)
      |     |  +--rw service-sub-layer
      |     |     +--rw service-sub-layer*
      |     |             service-sub-layer-ref
      |     +--:(forwarding-aggregation)
      |     |  +--rw forwarding-aggregation
      |     |     +--rw forwarding-sub-layer*
      |     |             forwarding-sub-layer-ref
      |     +--:(forwarding-id)
      |        +--rw forwarding-id
      |           +--rw interface?
      |           |       if:interface-ref
      |           +--rw (detnet-flow-type)?
      |              +--:(ip-detnet-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-detnet-flow)
      |                    +--rw (label-space)?
      |                       +--:(context-label-space)
      |                       |  +--rw mpls-label-stack
      |                       |     +--rw entry* [id]
      |                       |        +--rw id                uint8
      |                       |        +--rw label?
      |                       |        |       rt-types:mpls-label
      |                       |        +--rw ttl?              uint8
      |                       |        +--rw traffic-class?    uint8
      |                       +--:(platform-label-space)
      |                          +--rw label?
      |                                  rt-types:mpls-label
      |
```

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

Yanglint Validation Case B-1 (Cont.)

Profiles

```
"traffic-profile": [
     {
       "profile-name": "1",
       "traffic-requirements": {
         "min-bandwidth": "100000000",
         "max-latency": 100000000,
         "max-latency-variation": 200000000,
         "max-loss": 2,
         "max-consecutive-loss-tolerance": 5,
         "max-misordering": 0
       },
       "member-apps": [
         "app-1"
         "app-2"
       ]
     },
     {
       "profile-name": "2",
       "traffic-requirements": {
         "min-bandwidth": "100000000",
         "max-latency": 100000000,
         "max-latency-variation": 200000000,
         "max-loss": 2,
         "max-consecutive-loss-tolerance": 5,
         "max-misordering": 0
       },
       "member-services": [
         "ssl-1"
         "ssl-2"
       ]
     },
     {
       "profile-name": "3",
       "flow-spec": {
         "interval": 5,
         "max-pkts-per-interval": 10,
         "max-payload-size": 1500
       },
       "member-fwd-sublayers": [
         "afl-1"
       ]
     }
   ],
```

Service Sub-Layer

```
"service-sub-layer": {
    "service-sub-layer-list": [
      {
        "name": "ssl-1",
        "service-rank": 10,
        "traffic-profile": "2",
        "service-operation-type": "service-initiation",
        "service-protection": {
          "service-protection-type": "none",
          "sequence-number-length": "long-sn"
        },
        "incoming-type": {
          "app-flow": {
            "app-flow-list": [
              "app-1"
            ]
          }
        },
        "outgoing-type": {
          "forwarding-sub-layer": {
            "service-outgoing-list": [
              {
                "service-outgoing-index": 0,
                "mpls-label-stack": {
                  "entry": [
                    {
                      "id": 0,
                      "label": 100
                    }
                  ]
                },
                "forwarding-sub-layer": [
                  "afl-1"
                ]
              }
            ]
          }
        }
      },
```

Yanglint Validation Case B-1

APP

```
{
  "ietf-interfaces:interfaces": {
    "interface": [
      {
        "name": "eth0",
        "type": "iana-if-type:ethernetCsmacd",
        "oper-status": "up",
        "statistics": {
          "discontinuity-time": "2020-12-18T23:59:00Z"
        }
      },
      {
        "name": "eth1",
        "type": "iana-if-type:ethernetCsmacd",
        "oper-status": "up",
        "statistics": {
          "discontinuity-time": "2020-12-18T23:59:00Z"
        }
      },
      {
        "name": "eth2",
        "type": "iana-if-type:ethernetCsmacd",
        "oper-status": "up",
        "statistics": {
          "discontinuity-time": "2020-12-18T23:59:00Z"
        }
      },
      {
        "name": "eth3",
        "type": "iana-if-type:ethernetCsmacd",
        "oper-status": "up",
        "statistics": {
          "discontinuity-time": "2020-12-18T23:59:00Z"
        }
      },
      {
        "name": "eth4",
        "type": "iana-if-type:ethernetCsmacd",
        "oper-status": "up",
        "statistics": {
          "discontinuity-time": "2020-12-18T23:59:00Z"
        }
      }
    ]
  },
```

```
"ietf-detnet:detnet": {
    "app-flows": {
      "app-flow": [
        {
          "name": "app-1",
          "app-flow-bidir-congruent": false,
          "outgoing-service": "ssl-1",
          "traffic-profile": "1",
          "ingress": {
            "app-flow-status": "ready",
            "interface": "eth0",
            "ip-app-flow": {
              "src-ip-prefix": "1.1.1.1/32",
              "dest-ip-prefix": "8.8.8.8/32",
              "dscp": 6
            }
          }
        },
        {
          "name": "app-2",
          "app-flow-bidir-congruent": false,
          "outgoing-service": "ssl-2",
          "traffic-profile": "1",
          "ingress": {
            "app-flow-status": "ready",
            "interface": "eth1",
            "ip-app-flow": {
              "src-ip-prefix": "1.1.1.2/32",
              "dest-ip-prefix": "8.8.8.9/32",
              "dscp": 7
            }
          }
        }
      ]
    },
```

Yanglint Validation Case B-1 (Cont.)

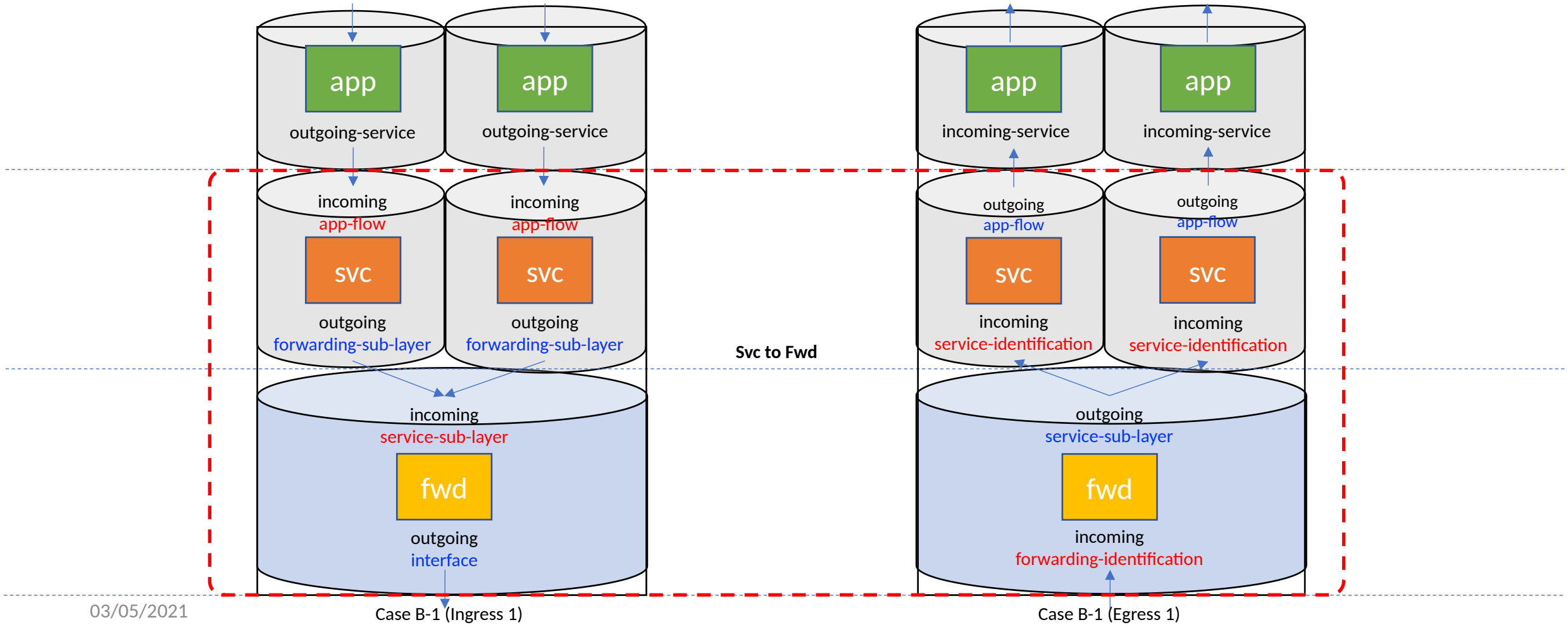
Service Sub-Layer

```
{
   "name": "ssl-2",
   "service-rank": 10,
   "traffic-profile": "2",
   "service-operation-type": "service-initiation",
   "service-protection": {
     "service-protection-type": "none",
     "sequence-number-length": "long-sn"
   },
   "incoming-type": {
     "app-flow": {
       "app-flow-list": [
         "app-2"
       ]
     }
   },
   "outgoing-type": {
     "forwarding-sub-layer": {
       "service-outgoing-list": [
         {
           "service-outgoing-index": 0,
           "mpls-label-stack": {
             "entry": [
               {
                 "id": 0,
                 "label": 103
               }
             ]
           },
           "forwarding-sub-layer": [
             "afl-1"
           ]
         }
       ]
     }
   }
 }
 ]
},
```

Forward Sub-Layer

```
"forwarding-sub-layer": {
      "forwarding-sub-layer-list": [
        {
          "name": "afl-1",
          "traffic-profile": "3",
          "forwarding-operation-type": "impose-and-forward",
          "incoming-type": {
            "service-sub-layer": {
              "service-sub-layer": [
                "ssl-1",
                "ssl-2"
              ]
            }
          },
          "outgoing-type": {
            "interface": {
              "outgoing-interface": "eth2",
              "mpls-label-stack": {
                "entry": [
                  {
                    "id": 0,
                    "label": 10000
                  }
                ]
              }
            }
          }
        }
      ]
    }
  }
}
```

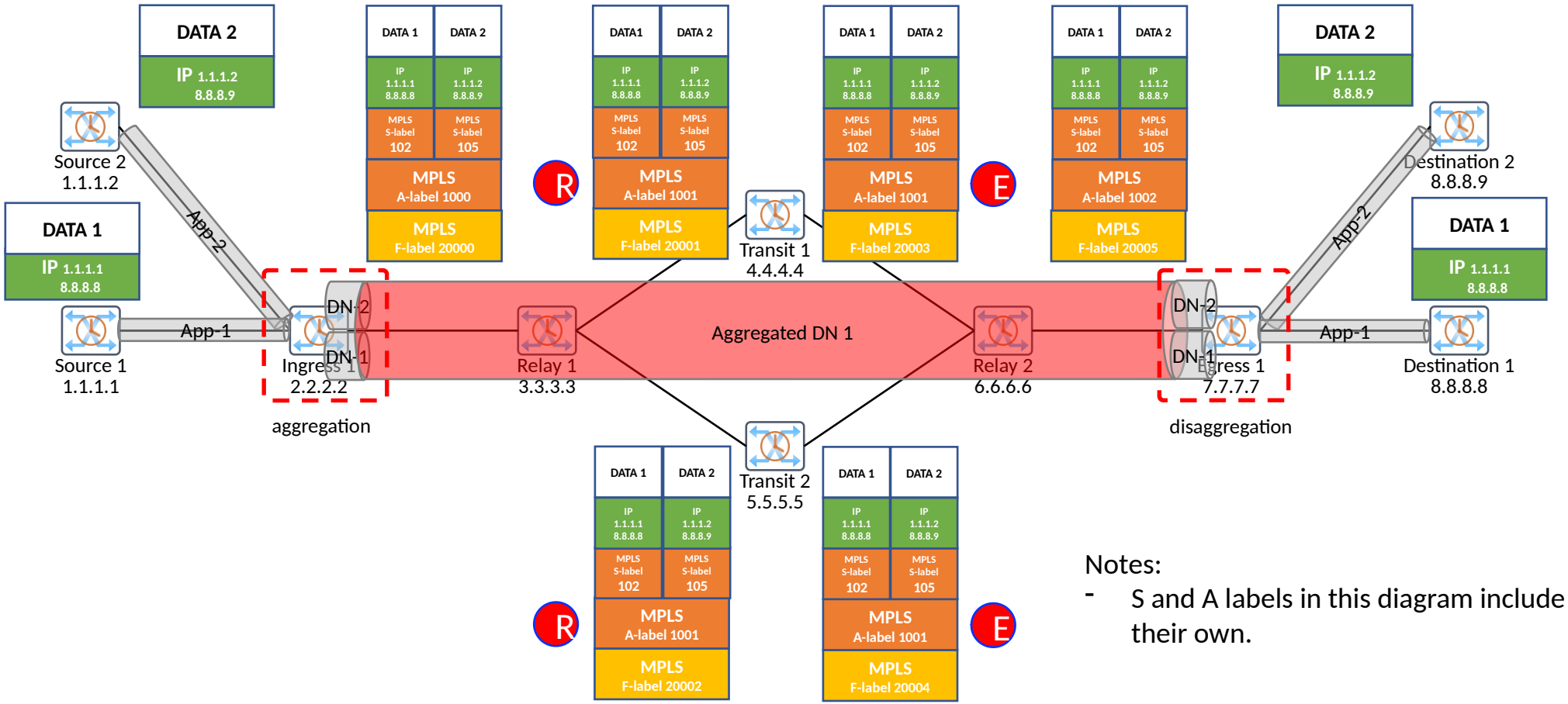
Case b-1 aggregation & disaggregation



Case B-1 (Ingress 1)

Case B-1 (Egress 1)

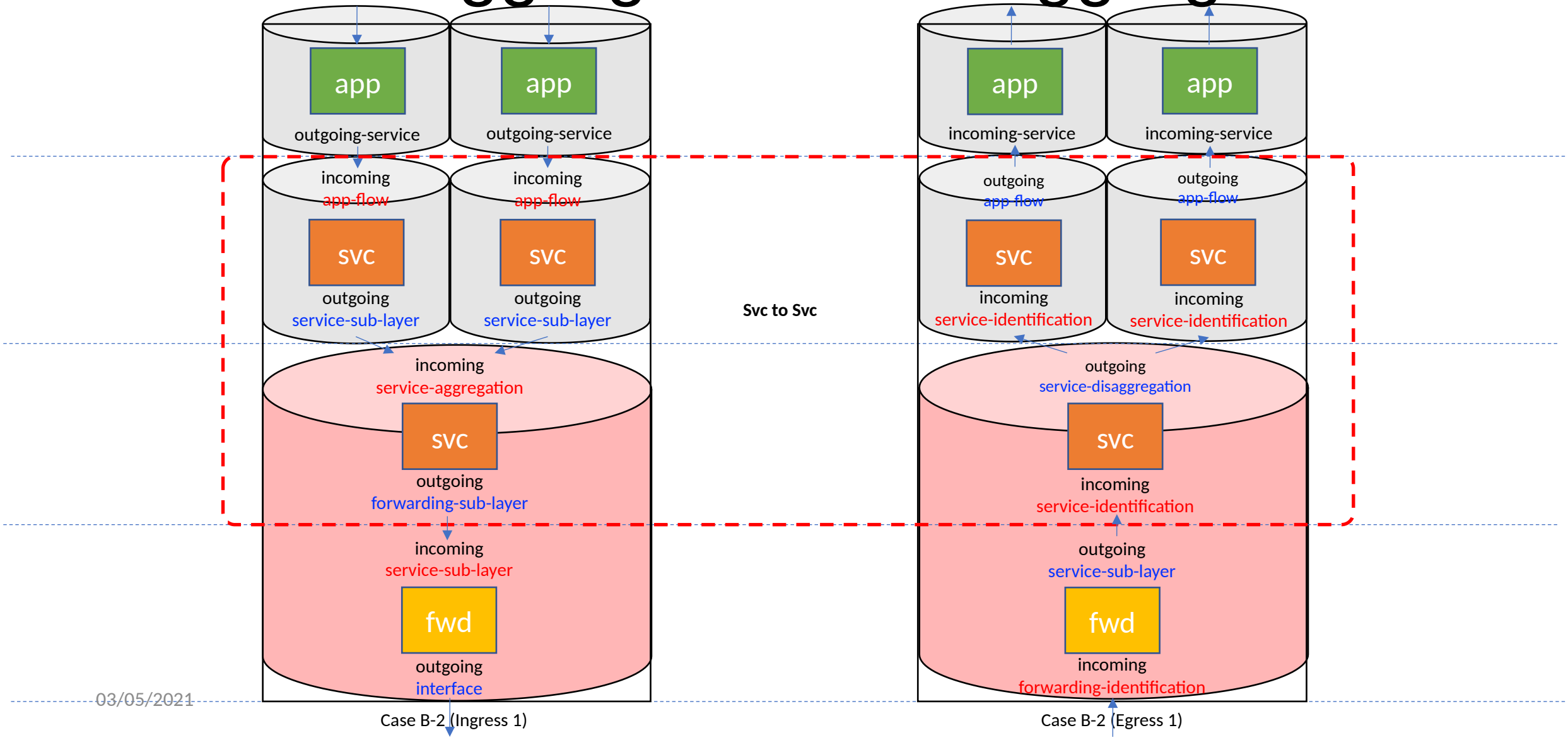
Case B-2: The service sub-layers of DetNet flows 1 and 2 are aggregated into a service sub-layer of Aggregated DetNet flow 1



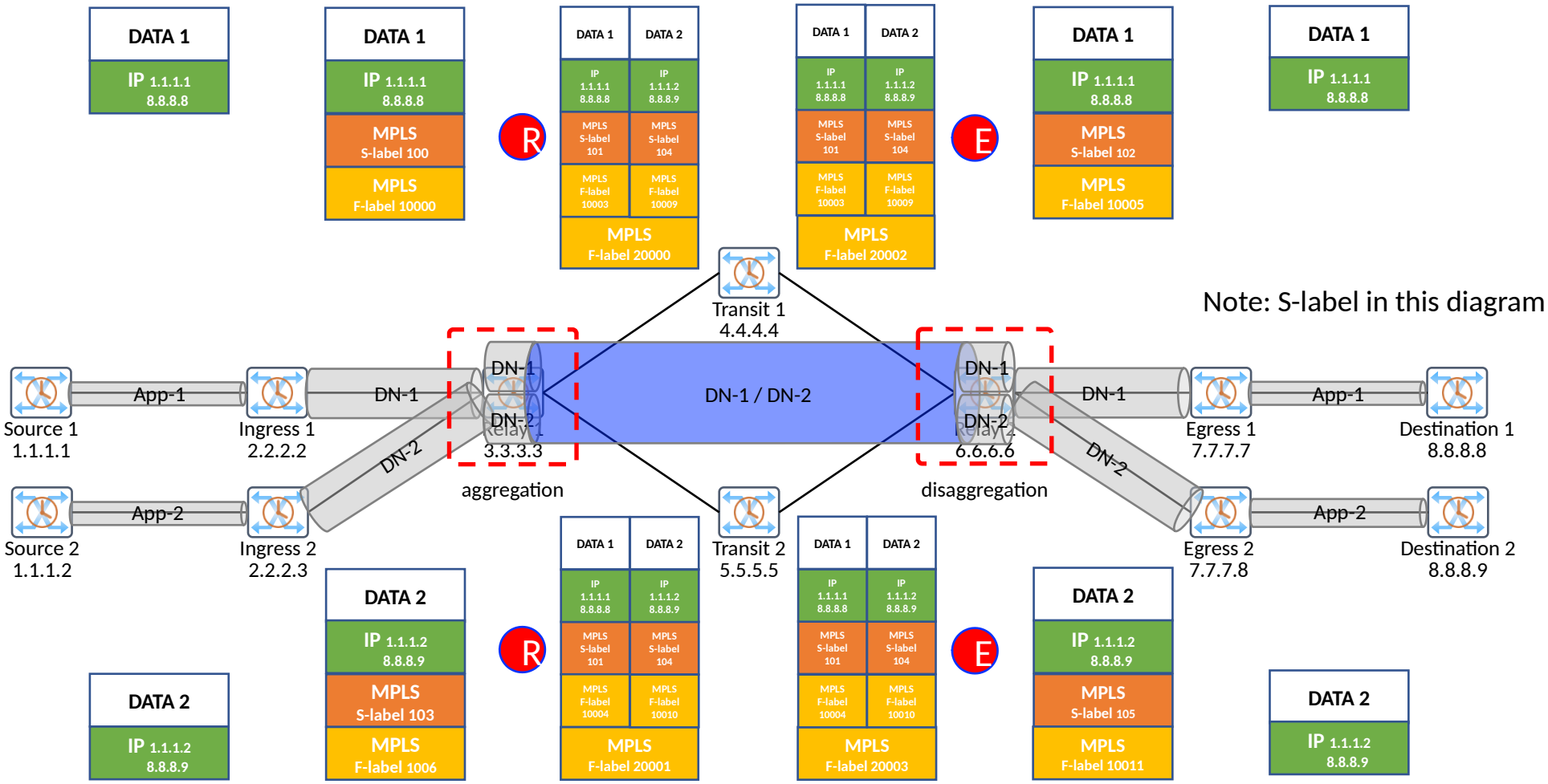
Notes:

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

Case b-2 aggregation & disaggregation

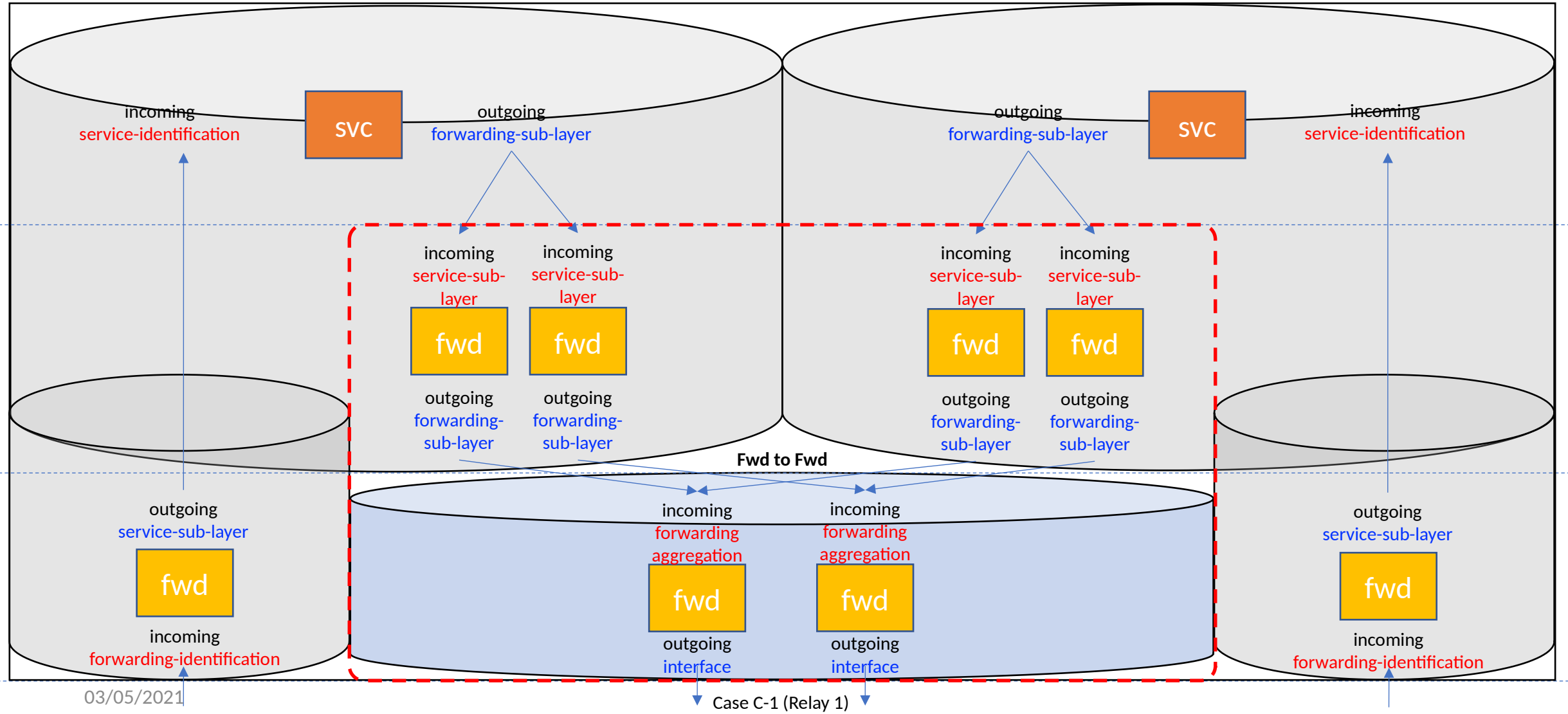


Case C-1: Relay node 1 aggregates the forwarding sub-layers of DetNet flows 1 and 2 into a forwarding sub-layer



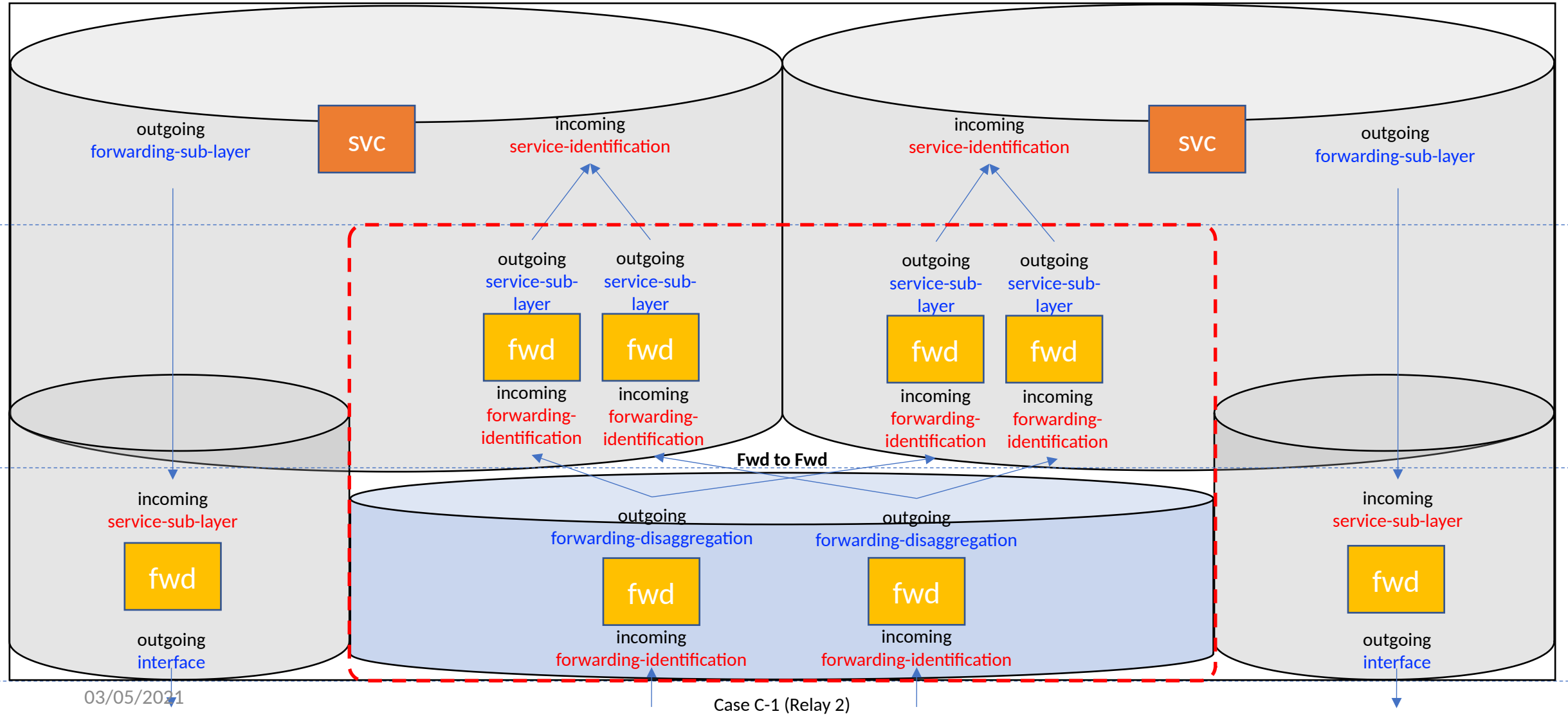
Note: S-label in this diagram includes d-CW.

Case c-1 aggregation



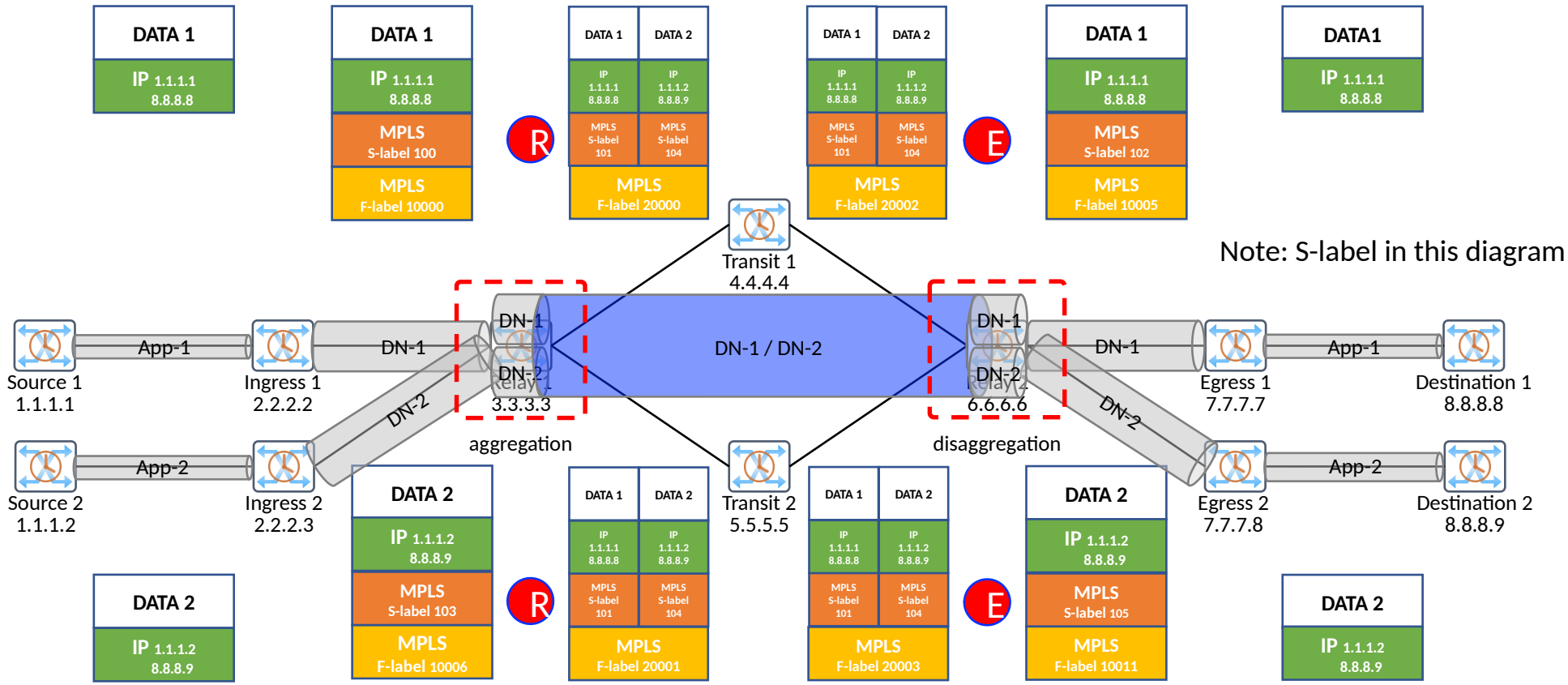
Case C-1 (Relay 1)

Case c-1 disaggregation



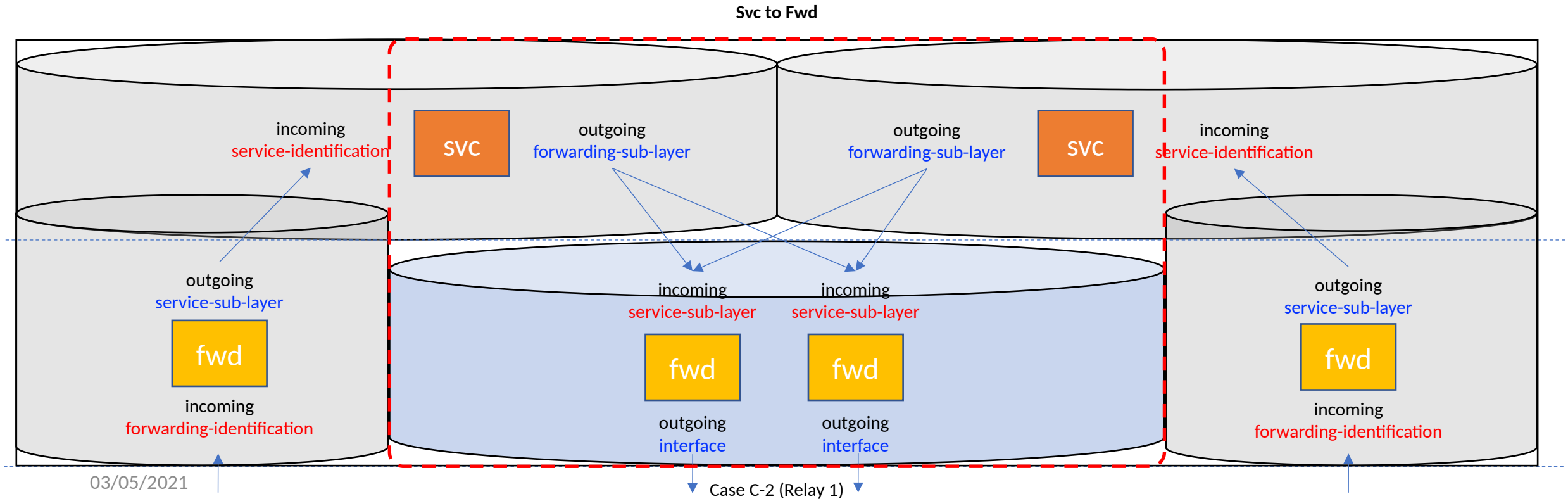
Case C-1 (Relay 2)

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

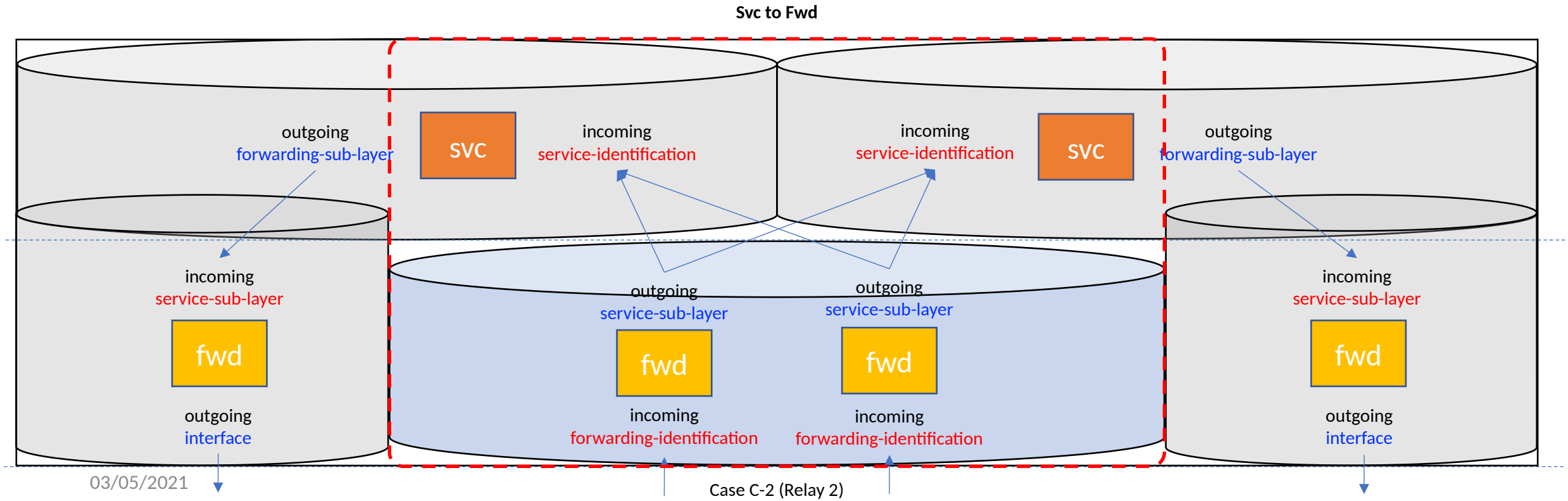


Note: S-label in this diagram includes d-CW.

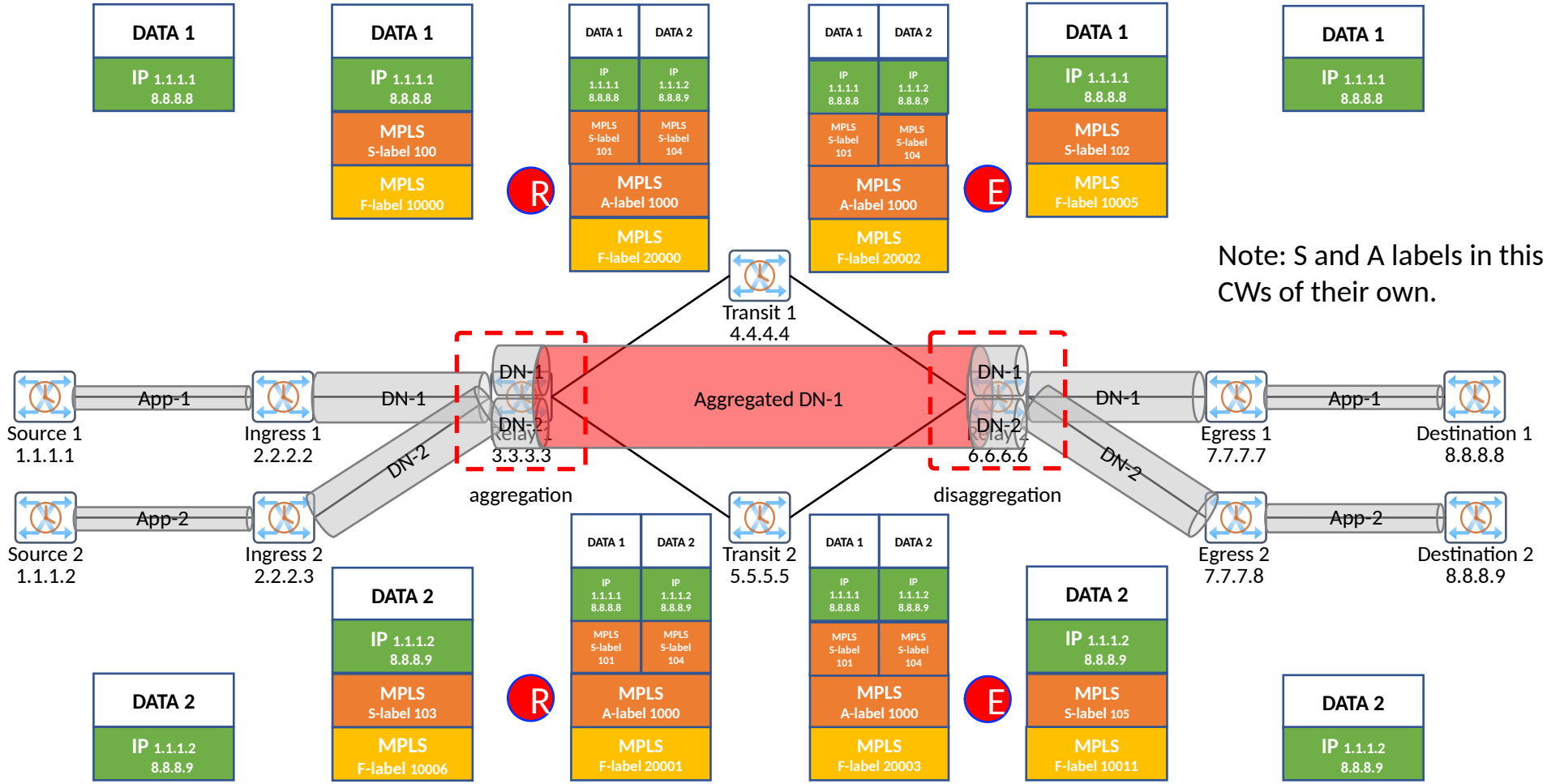
Case c-2 aggregation



Case c-2 disaggregation

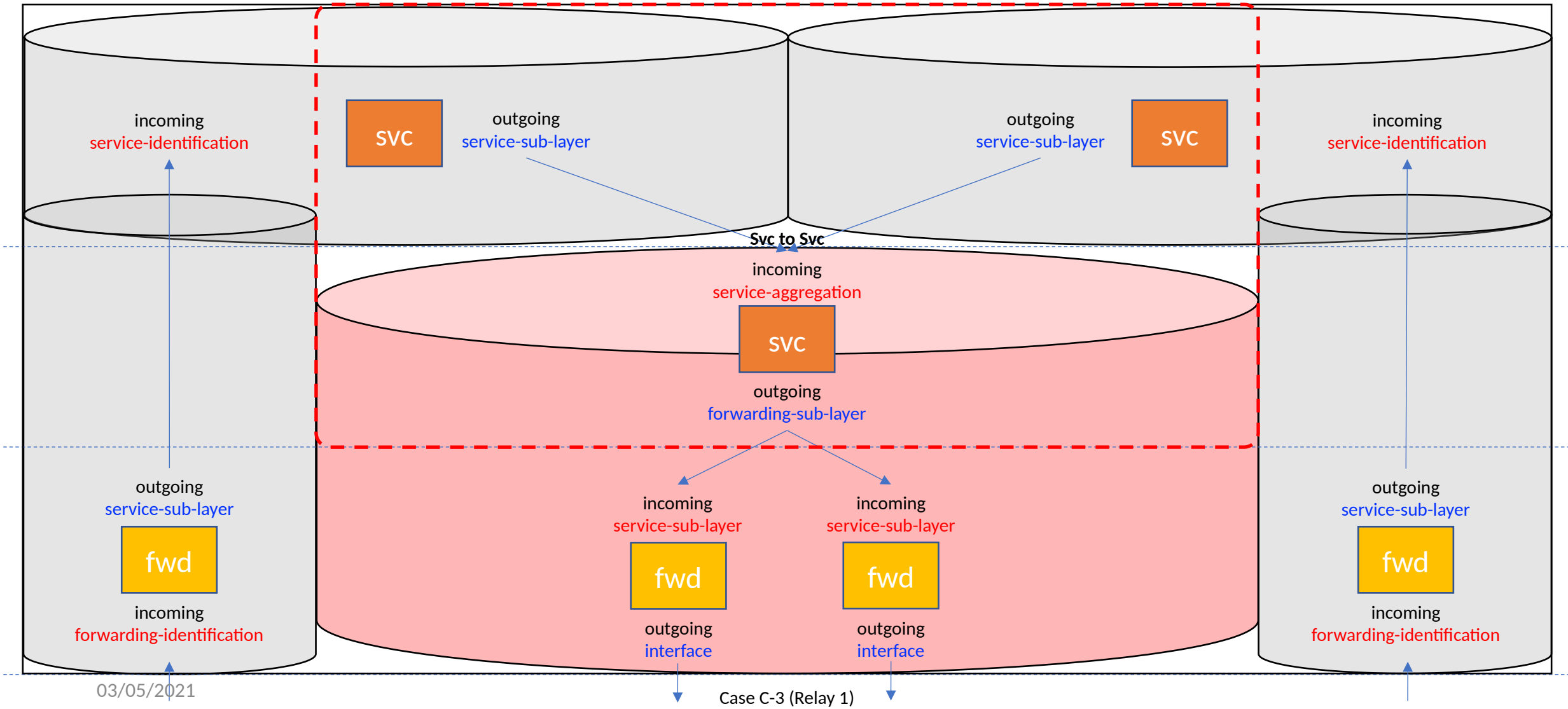


Case C-3: Relay node 1 aggregates the service sub-layers of DetNet flows 1 and 2 into a service sub-layer of Aggregated DetNet flow 1

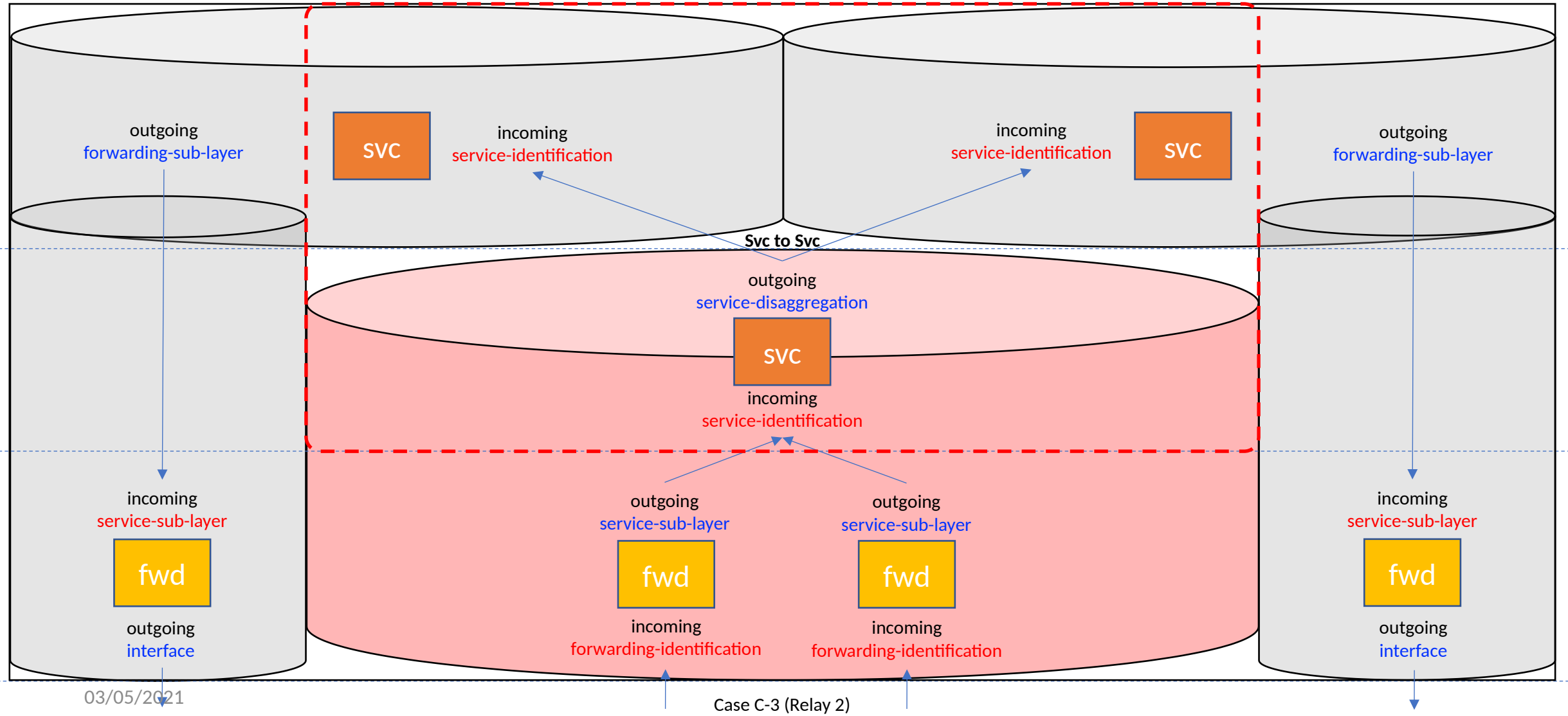


Note: S and A labels in this diagram include d-CWs of their own.

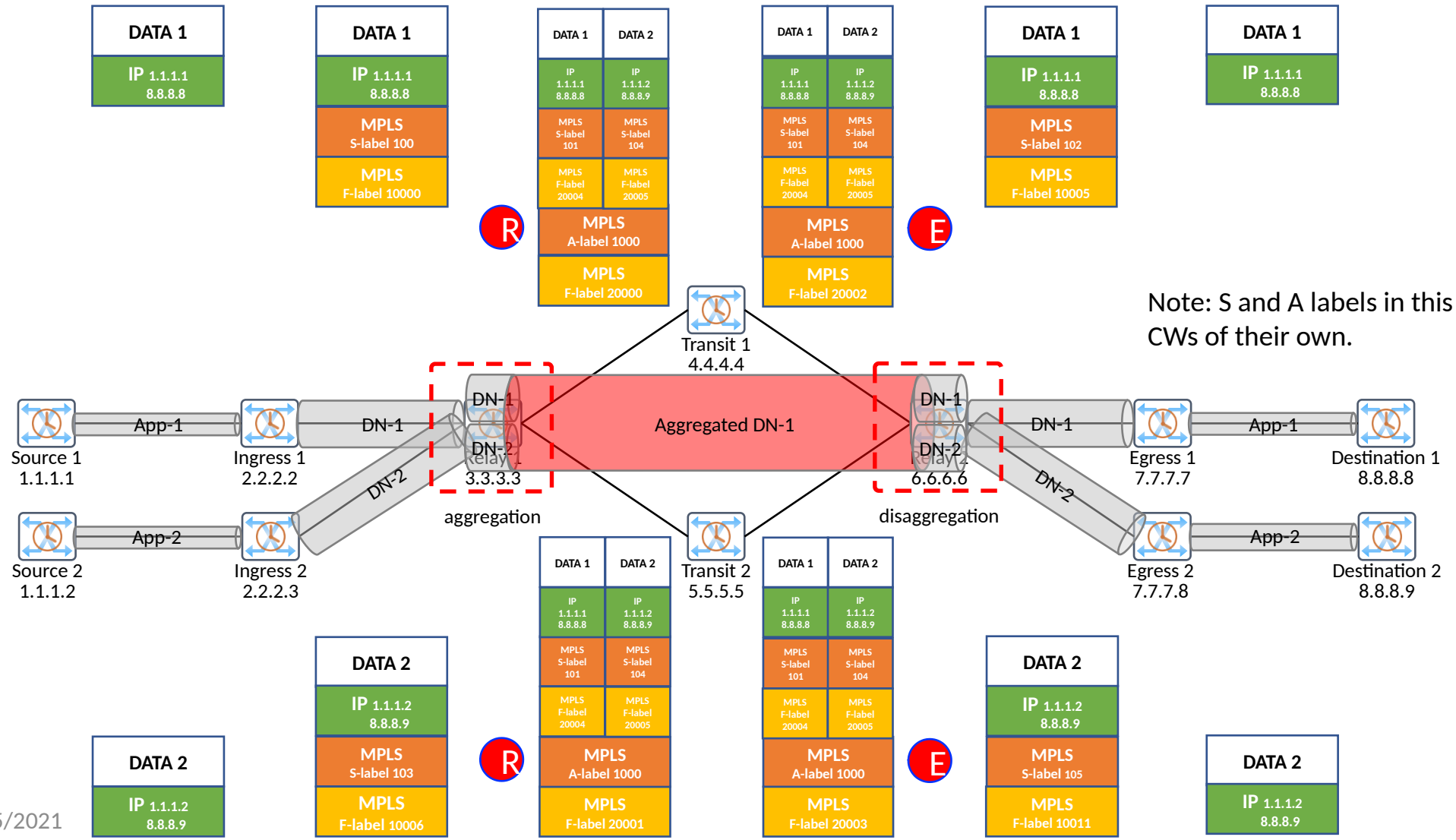
Case c-3 aggregation



Case c-3 disaggregation

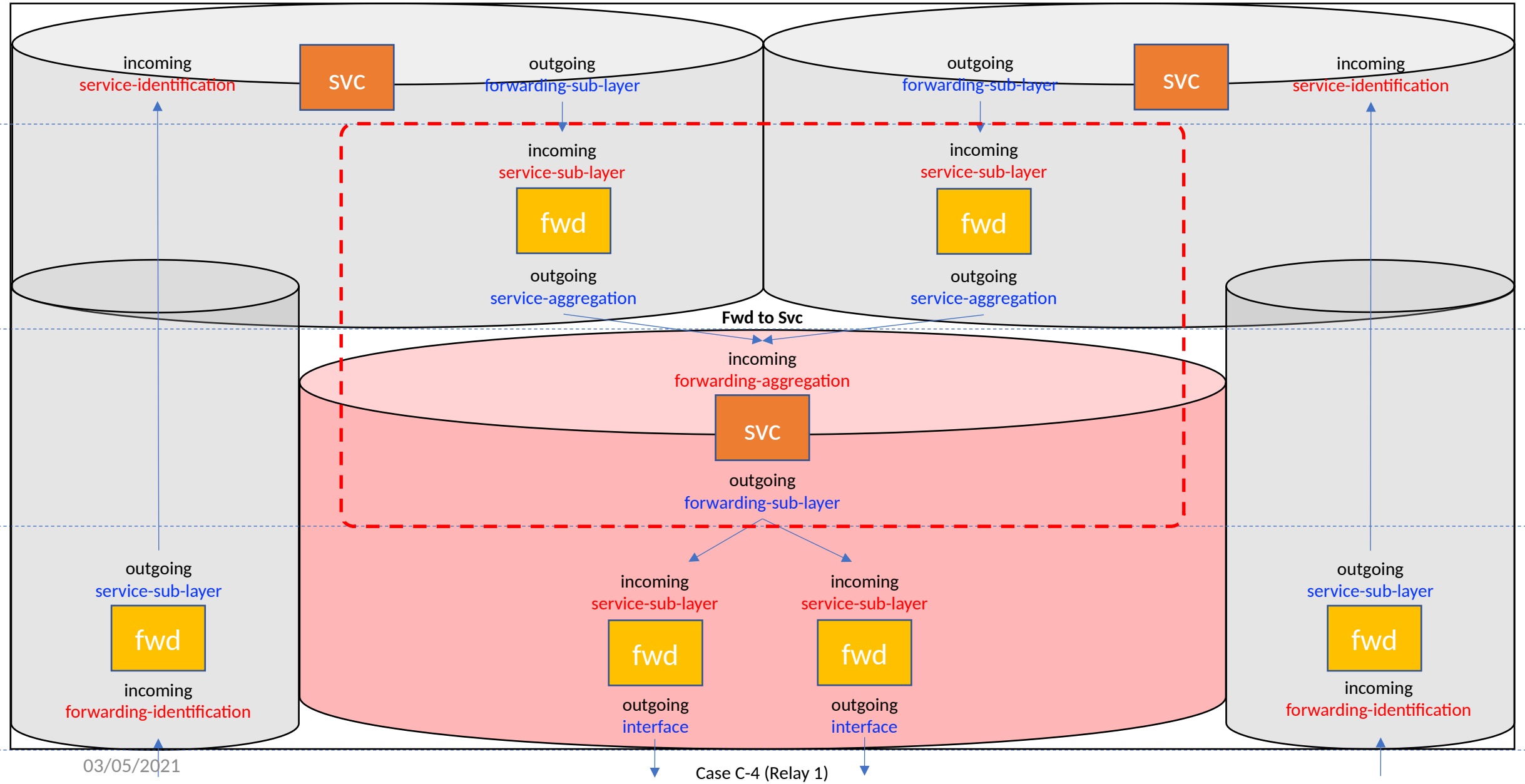


Case C-4: Relay node 1 aggregates the forwarding sub-layers of DetNet flow 1 and 2 into a service sub-layer of Aggregated DetNet flow 1

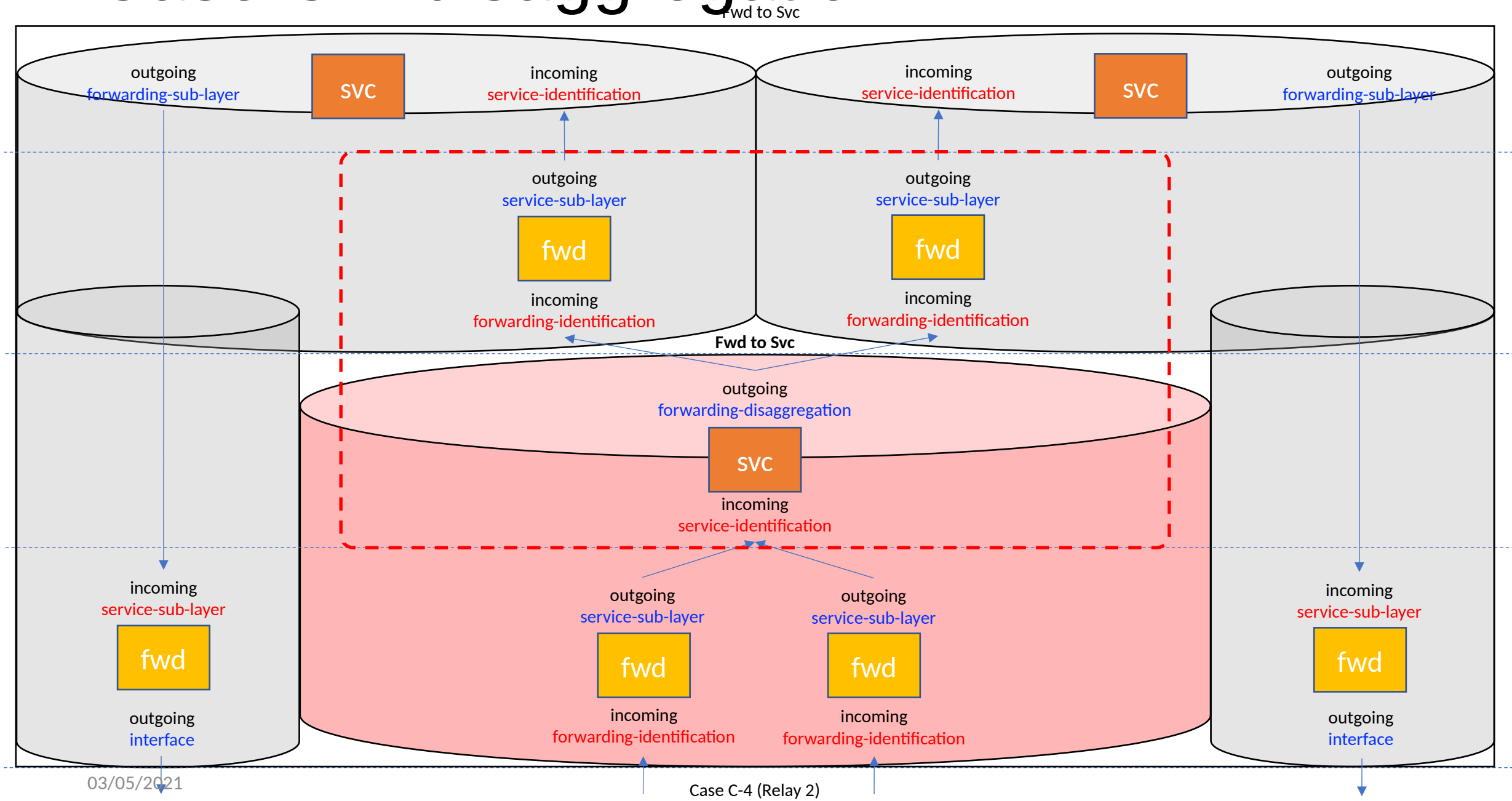


Note: S and A labels in this diagram include d-CWs of their own.

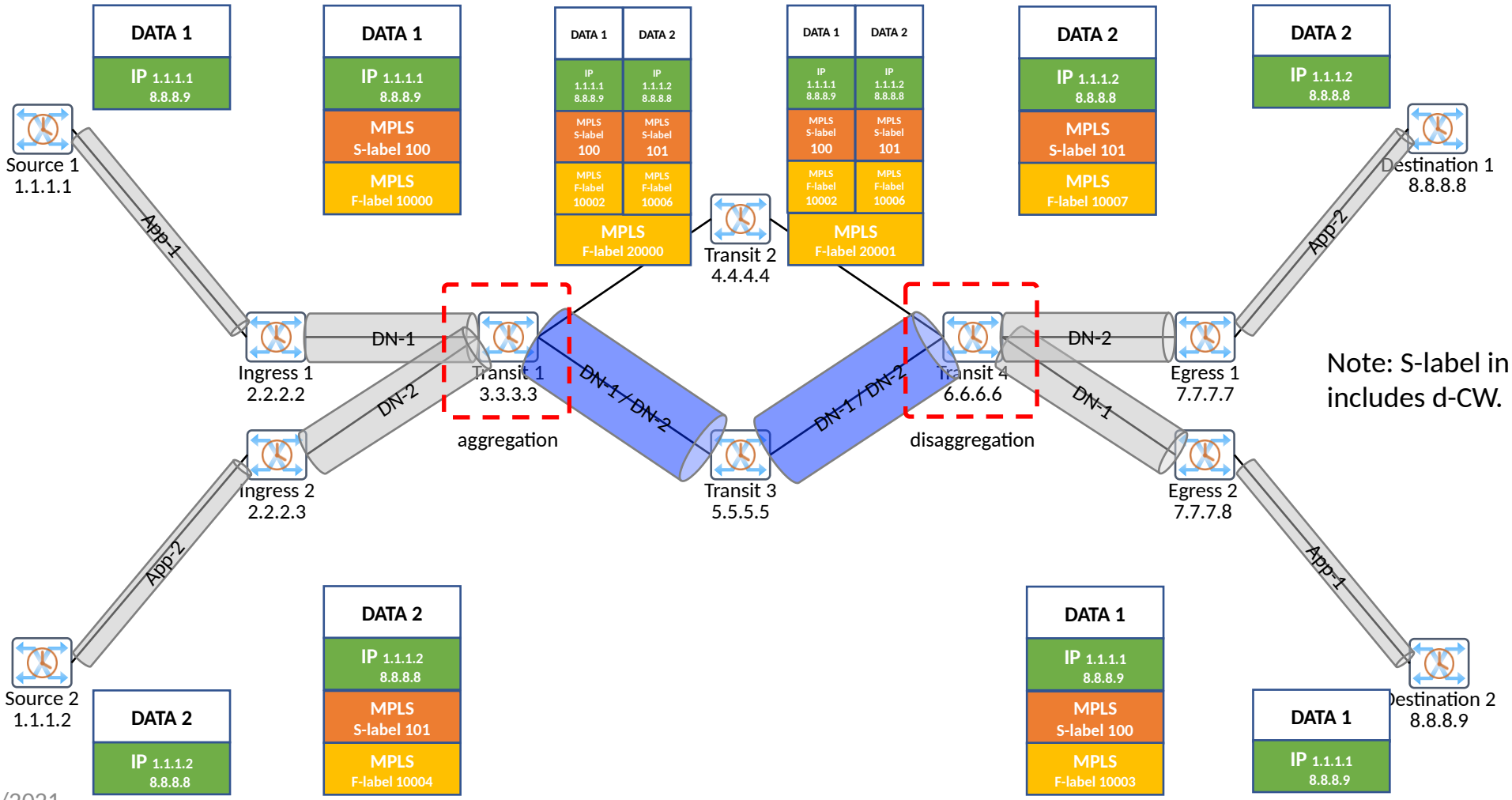
Case c-4 aggregation



Case C-4 disaggregation

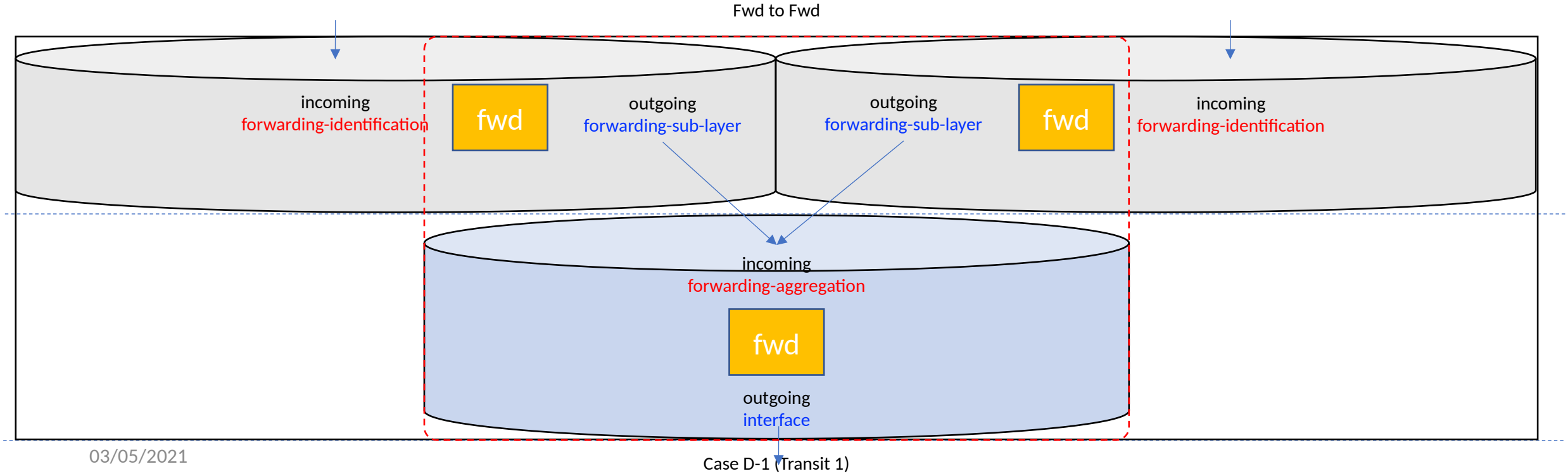


Case D-1: Transit node 1 aggregates the forwarding sub-layers of DetNet flow 1 and 2 into a forwarding sub-layer

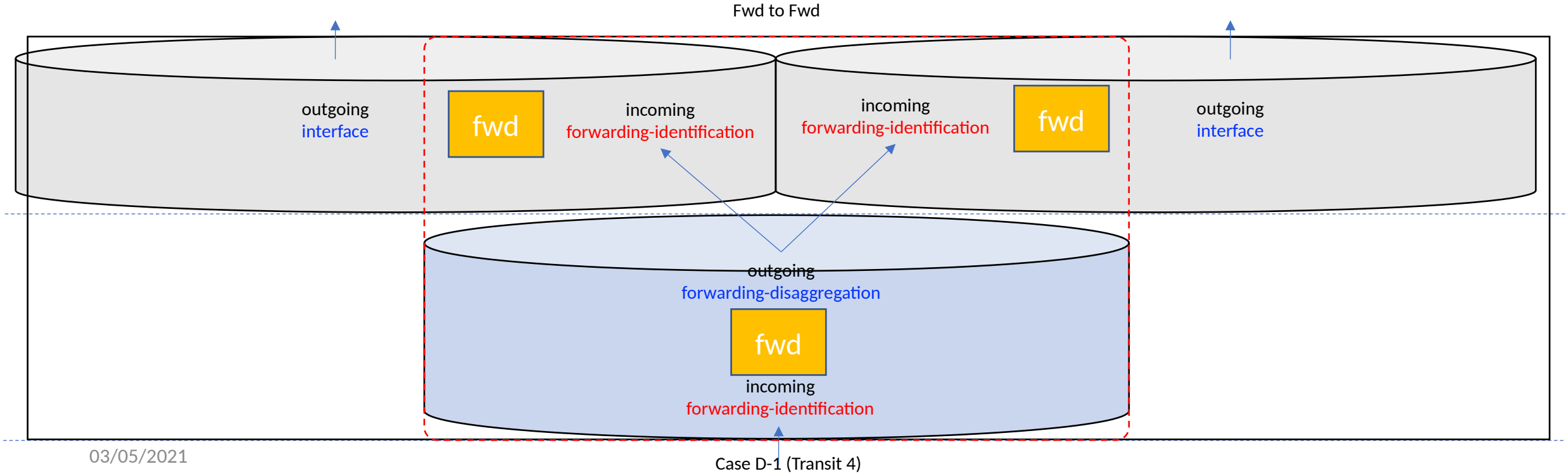


Note: S-label in this diagram includes d-CW.

Case d-1 aggregation



Case d-1 disaggregation



Thank You