LDP & TE| TCP/UDP 646

LDP
- **Hellos UDP** 224.0.0.2 / **Session TCP** (higher RID starts TCP)
- smaller holdtime used (15s for Hello, 30 for Session (10 KA))
- does not generate labels for BGP prefixes (default only Lo)
- **LDP ID** 6 bytes: `192.168.0.1:0`
    - **4**B for LSR (RID)
    - **2**B Label space (0=per-platform(default) else per iface)
- RID should be in RIB (else adj. not formed)

LDP-IGP Synchronization: until LDP session up and labels exchanged, advertise maximum IGP metric.
LDP Hello:
Hello->, Hello<-
LDP Session
Active (highRID) sends **LDP Initialization**
When same received=> **Operational**
LDP Loop prevention based on IGP. NO Split Horizon
LDP can be **tunneled** through RSVP

All packets have bits **U**(known) & **F**(orward) (if **U**=1, **F**ward or not)

LDP Keepalive (Basic Packet):
- Version, Len, LDP ID
- Message Type **0201**, Len, ID

LDP Hello
- Version, Len, LDP ID
- **Message TLV** Type **0100**, Len, ID
- **Hello TLV**
   - Hold Time
   - Flags and reserved:
      - **T**-bit 1=> targeted Hello
      - **R**-bit (if targ. 1=> **r**eply targ)
- **Optional TLV**
      - IPv4 Transport Address (Lo)
      - Sequence Number

LDP Initialization:
- Version, Len, LDP ID
- **Message TLV** Type **0200**, Len, ID
- **Session TLV** (14B)
    - Protocol Version (1)
    - Hold Time (30s)
    - Flags and reserved
       - **A**-bit (0=Downstr. Unsol.)
       - **D**-bit (loop prevention, 0)
    - Path Vector Limit (loop prev.)
    - Maximum PDU Len (negotiate)
    - Receiver LDP ID
- **Fault Tolerant TLV**
- Fault Tolerant Flags
- Fault Tolerant Reconnect Time
- Fault Tolerant Recovery Time

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Graceful Restart TLV (similar RSVP)

LDP Address (& Address Withdraw)
- Version, Len, LDP ID
- **Message TLV** Type **0300/0301**, Len, ID
- **Address TLV**
    - Address Family (IPv4 = 1)
    - Address Values

LDP Label Mapping (& Withdraw)
- Version, Len, LDP ID
- **Message TLV** Type **0400/0402**, Len, ID
- **FEC TLV**
    - FEC Element Type
       - 1- Wildcard (for remove)
       - **2- Prefix (main type)**
       - 3- Host Address
    - Address Family (IPV4 = 1)
    - Prefix Len
    - FEC Prefix (variable)
- **Label TLV**

TE - OSPF uses LSA Type 10 (1TED / area)
   - TE Type: **Router Address RID** or **Link.**
      - Link Type (p2p(1) or bcast(2))
      - Link ID (opposite end)
      - Local IP
      - Remote IP
      - TE Metric for CSPF
      - IF BW
      - Max Reservable BW
      - Unreserved (avail) BW
      - Color
ISIS: Extended IS Reachability TLV (22):
    - Admin. Group (color)
    - IPv4 IF Addr
    - IPv4 neigh
    - BW (3 fields as above)
    - Metric
CSPF - highest prio (0) to lowest prio (7)
- prune link w/o avail BW
- prune links w/o included color
- prune links w/ excluded color
- calculate based on ERO
- for multipaths, least hops
- (random, most-fill, least-fill)
- ERO generated (always strict) -> RSVP
TED Info sent after 10% BW change

Paths: (1) Primary, (2) Secondary (down) or **(3) Sec. Standby** (UP/Ready!)
Retry time: 30s | **Retry limit**: 0 (default, infinite)
Primary preempts when up again:
      Pr DN -> Sec. UP -> wait 2 x timer even if Pr UP to be sure -> Pr UP
      then wait 2 x timer to delete Sec.
To disable preemption, don't use Primarys (only Sec.) or revert-timer=0
Setup priority <= **Holdtime** priority (or else flap)

FRR Node Protection:
Detours built by each router (according to request in **PATH-SessionAttr** bit1). All routers reply with **RRO with FRR bits set**. Routers can merge LSPs.
- Local Repair Node - router creating Detour / Avoid Node ID - RID of prot. router
By default **Detours inherit Admin groups only**! (not BW, etc)
After primary down, search a new primary while using detours (Local Point of Repair swaps labels). Always try to revert to primary or secondary path.

FRR Link Protection:
new LSP Session type Bypass for each link. Label stack used.

TE Adaptive (basically no double-counting used BW on changes)**:**
turns on SharedExplicit style for these 2 cases:
- Secondary Standby to be created withouth reserving double BW
- "Make-before-break": setup secondary path before Tear of old path

TED contains:
- Router ID, BW, Metric, Affinity (color)