



OSPF – LSAs

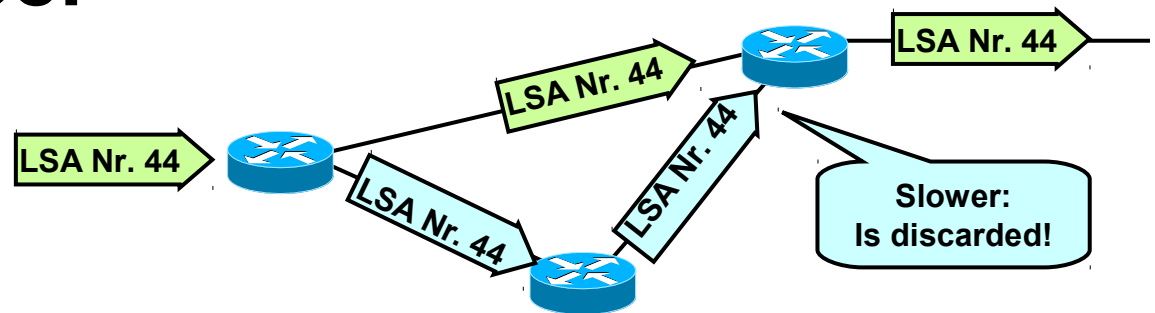
Why there is a dirty dozen of them

Part 3

LSA Sequence Number



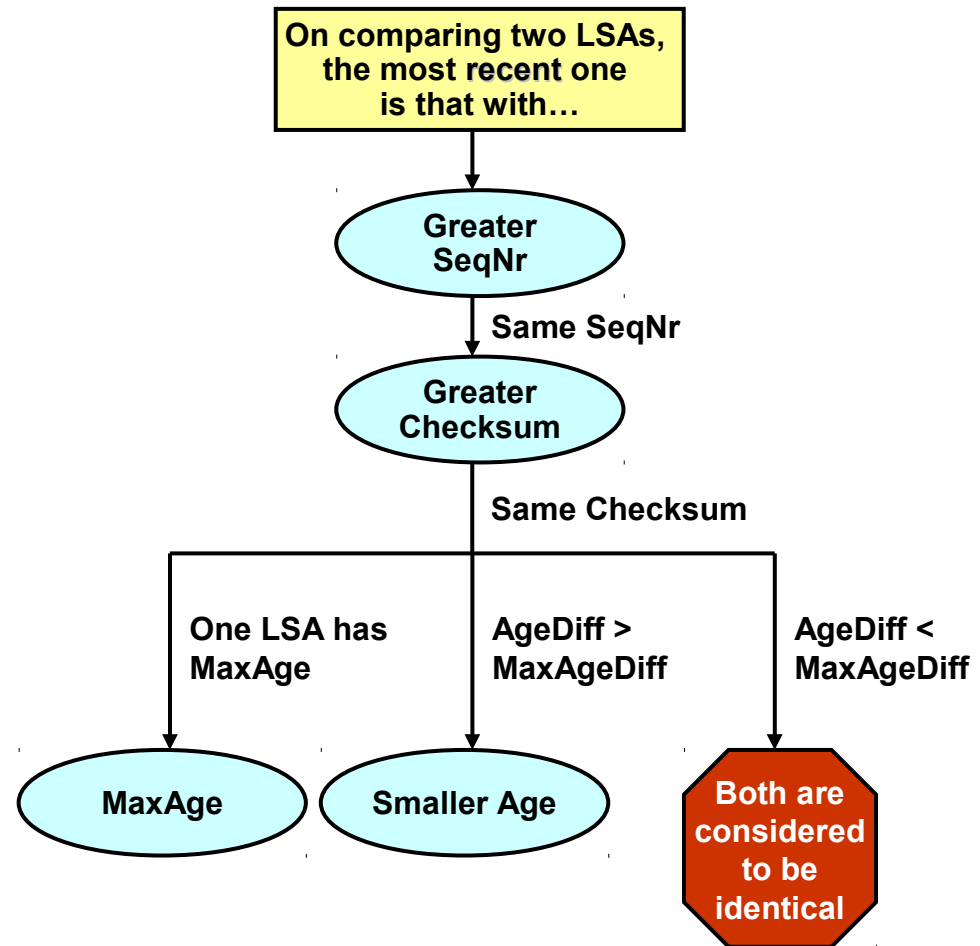
- In order to stop flooding, each LSA carries a sequence number
- Only increased if LSA has changed
 - ◆ So each router can check if a particular LSA had already been forwarded
 - ◆ To avoid LSA storms
- 32 bit number



Detailed Flooding Decisions



- LSA is identified by its
 - ◆ LS type
 - ◆ Link State ID
 - ◆ Advertising Router
- The most recent one of two instances of the same LSA is determined by:
 - ◆ LS sequence number
 - ◆ LS checksum
 - ◆ LS age
- MaxAgeDiff (15 min) as tolerance value





- **Originating router sets LS age = 0 seconds**
- **Increased during flooding by InfTransDelay by every router**
- **Also increased while stored in database**
- **Age is never incremented past MaxAge (60 min)**
- **LSAs having MaxAge:**
 - ◆ **Are not used in routing table calculation anymore**
 - ◆ **Are reflooded immediately**
 - ◆ **Are always considered as most recent**
 - ◆ **Thus quickly flushed from routing domain**
- **Responsible router maintains LSRefreshTime (30 min) to refresh LSAs periodically**

Router LSA – Type 1



- **Router ID (Highest IP address)**
- **Number of Links**
- **Link Descriptions**
 - ◆ **Link type (P2P, Stub, ...)**
 - ◆ **Neighboring router ID**
 - ◆ **Router interface address**
 - ◆ **ToS (typically not supported today)**
 - ◆ **Metrics**

Network LSA – Type 2



- **DR's IP address**
- **One Subnet mask for this broadcast segment**
- **List of Router-IDs of all routers in the broadcast segment**

Network Summary LSA – Type 3



- Originated by **ABRs** only
- Each LSA Type 3 contains a number of
 - ◆ Destination networks + Subnet masks
 - ◆ Metric for each destination network
- This is basically a distance-vector routing information (!)

ASBR Summary LSA – Type 4



- Originated by **ABRs**
- Advertise routes to ASBRs
- Nearly identical to Type 3
 - ◆ Except destination is ASBR not a network
- Each LSA Type 4 contains
 - ◆ Router IDs of ASBRs
 - ◆ Mask 0.0.0.0 (host route)
 - ◆ Metric

AS External LSA – Type 5



- **Originated by ASBRs**
 - ◆ External type 1
 - ◆ External type 2 (default)
- **Advertises**
 - ◆ External routes
 - ◆ Default route
- **Contains**
 - ◆ External Net-ID + Mask
 - ◆ Metric
 - ◆ Next hop (external, not ASBR)

NSSA External LSA – Type 7



- **Originated by ASBRs within NSSAs**
- **Almost identical to Type 5**
 - ◆ **But only flooded within NSSA**
- **RFC 1587**

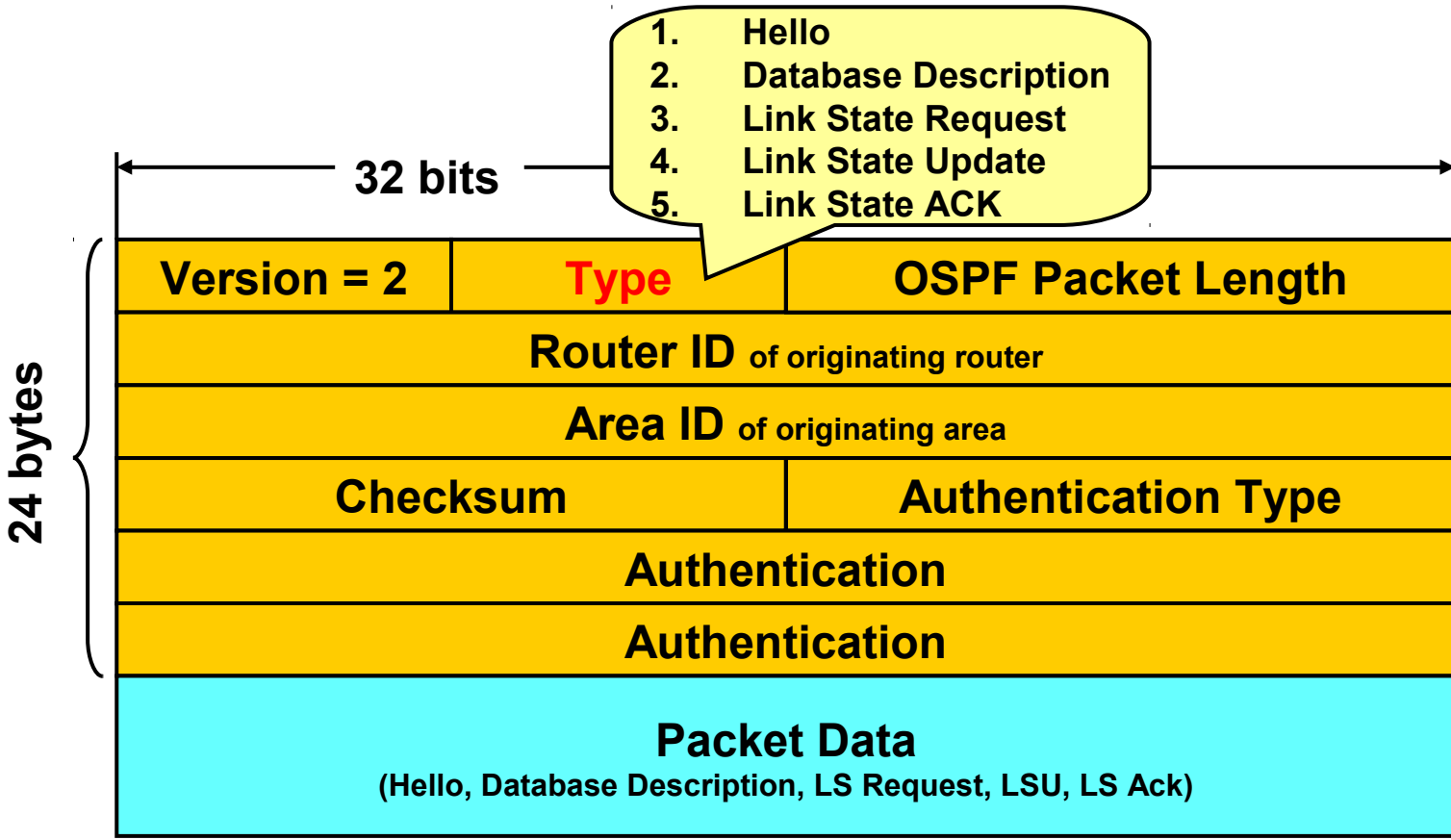


- **Group Membership LSA (6)**
 - ◆ For MOSPF
- **External Attribute LSA (8)**
 - ◆ Alternative to IBGP
 - ◆ Should transport BGP information within an OSPF domain
 - ◆ Not yet implemented, no RFC yet (?)
- **Opaque LSA (9)**
 - ◆ Application specific information
 - ◆ Link local scope



- **Opaque LSA (10)**
 - ◆ **Application specific information**
 - ◆ **Area-local scope**
- **Opaque LSA (11)**
 - ◆ **Application specific information**
 - ◆ **AS scope**

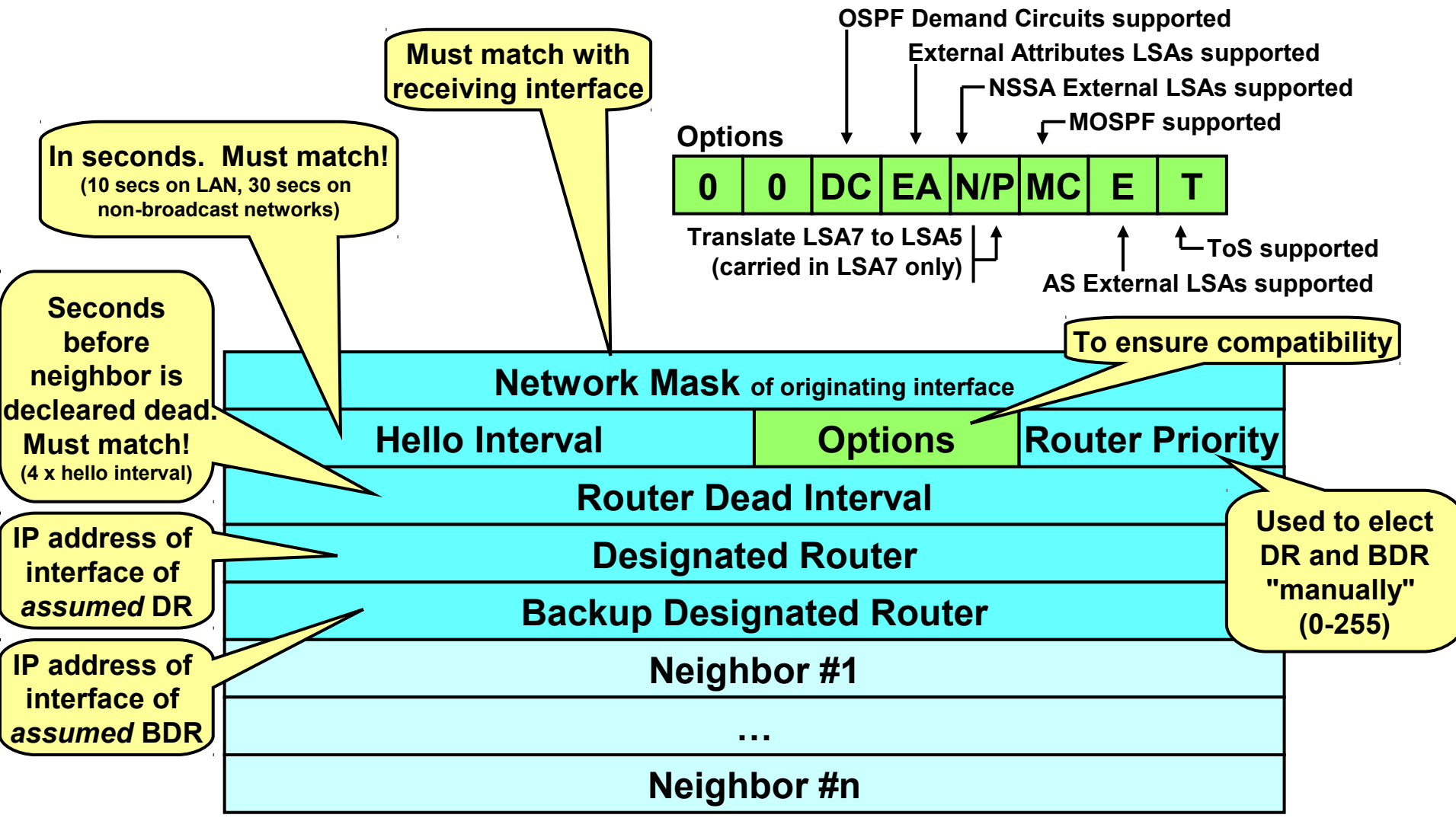
General OSPF Packet Structure



- Carried directly in IP (protocol number 89)
- **All OSPF packets begin with a 24-byte OSPF packet header**

Hello Packet

Type 1



Database Description Packet

Also called "DDP"

Type 2



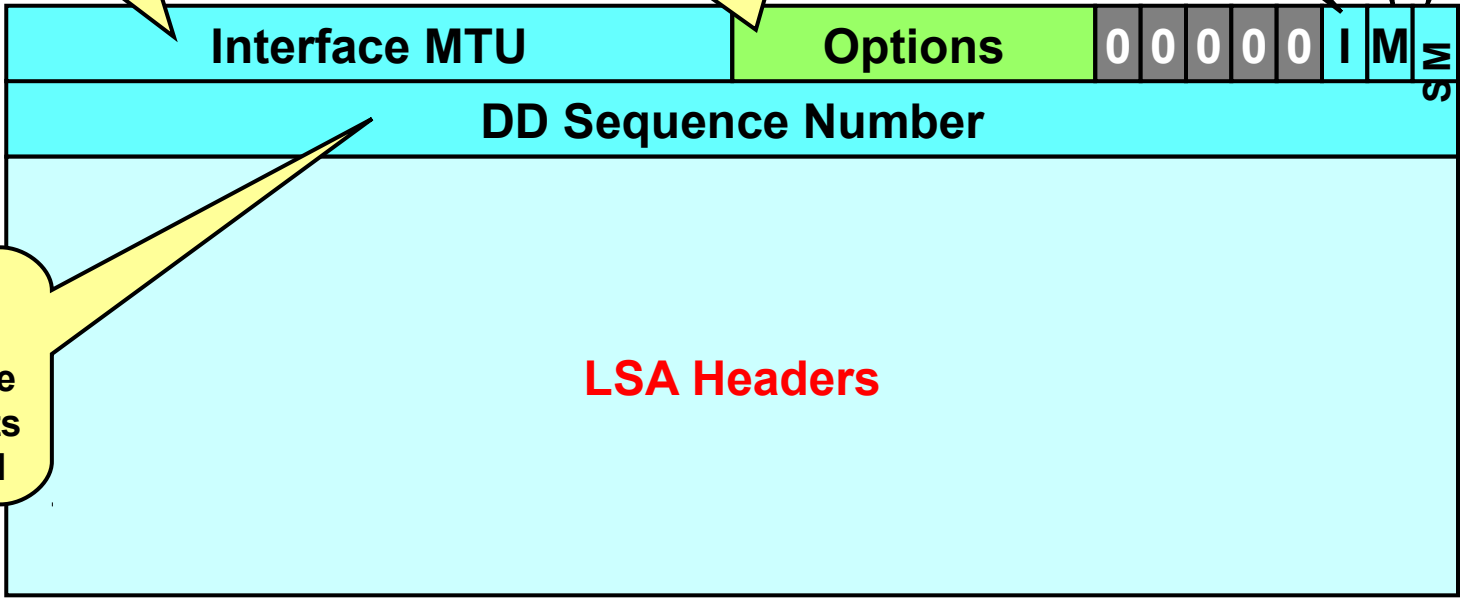
Size of the largest IP packet that can be sent without fragmentation

Marks the initial packet of a series of DD packets

More DD packets will follow

Master=1
Slave=0

Same definition as for the Hello Packet



To ensure that the full sequence of DD packets are received

Link State Request Packet

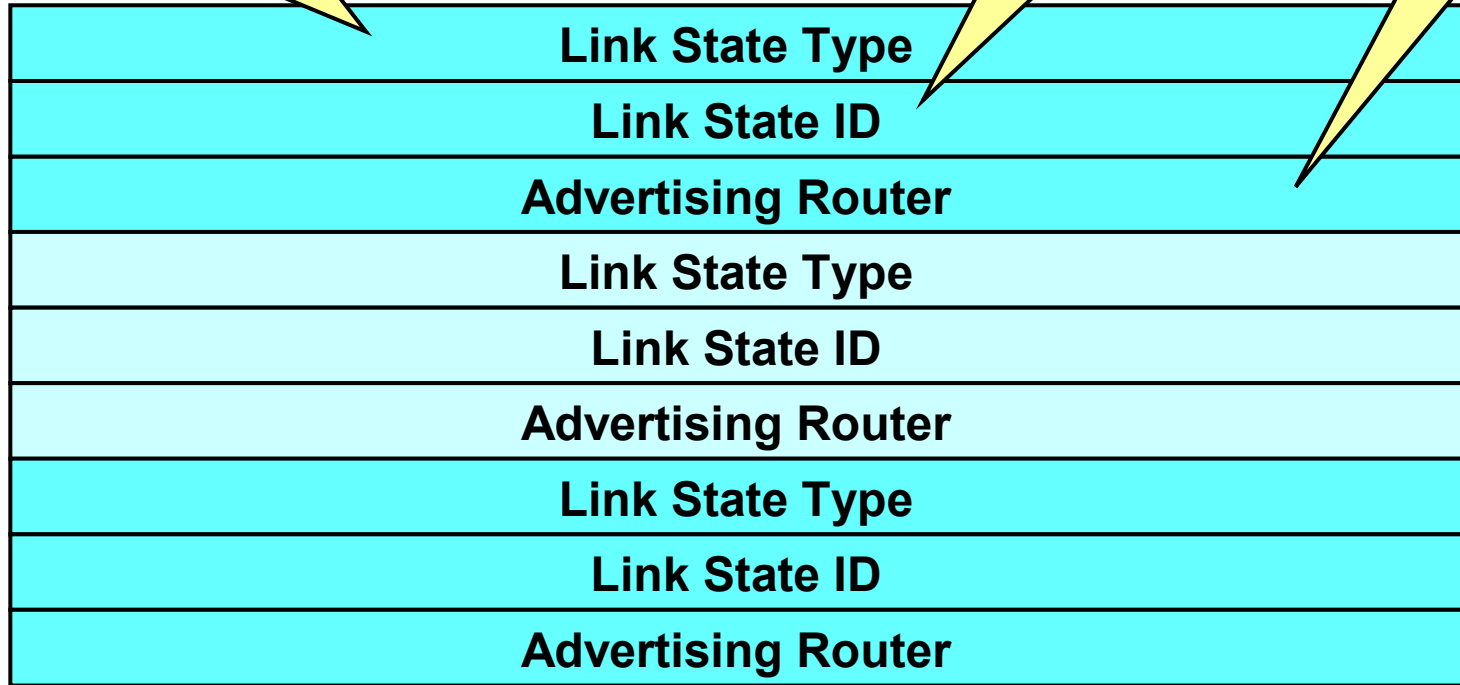
Type 3



Which type of LSA is requested (Router LSA, Network LSA, ...)

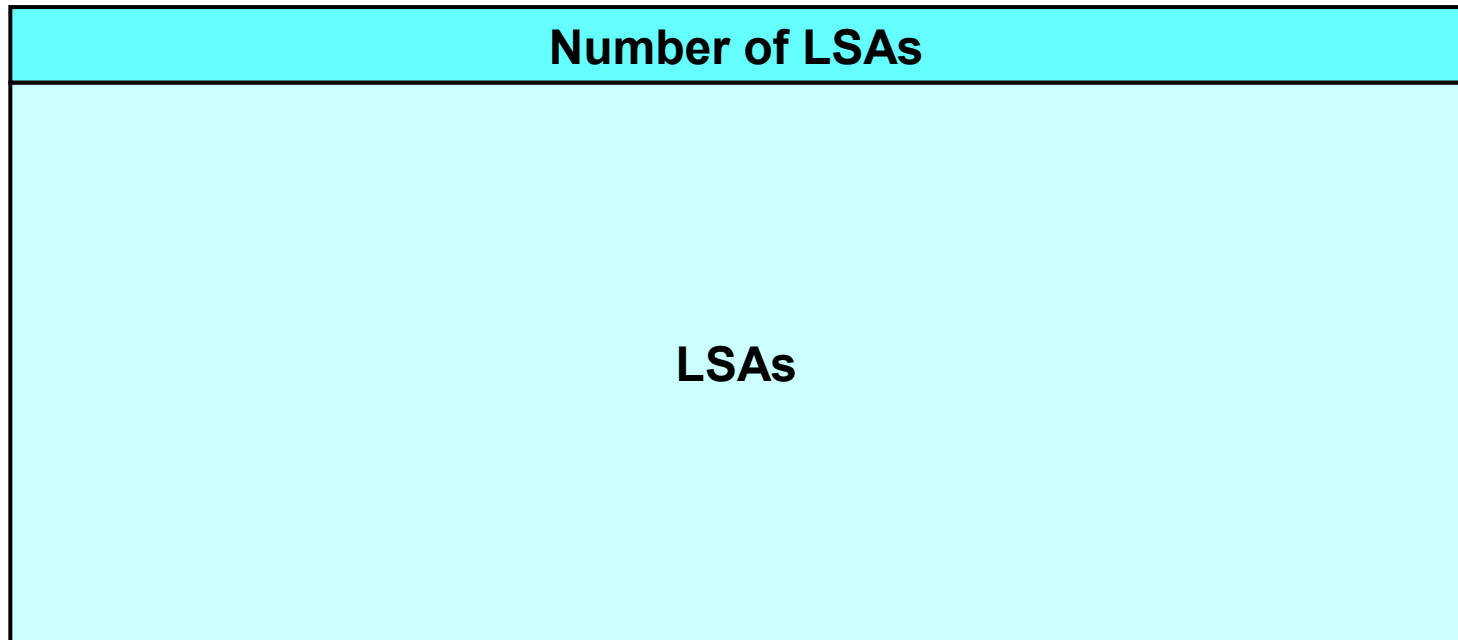
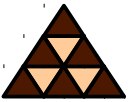
Usage depends on the LSA type

Router ID of originator of this LSA



Link State Update Packet

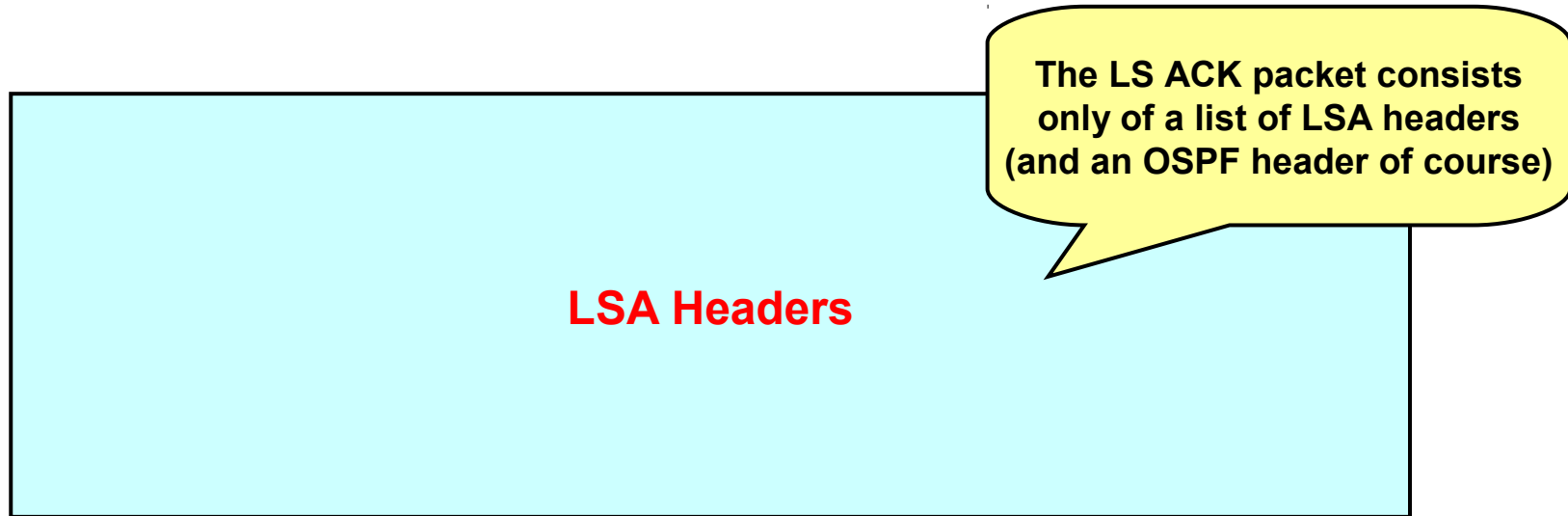
Type 4



- LSUs contain one or more LSAs (limited by MTU)
- Used for flooding and response to LS requests
- LSUs are carried hop-by-hop

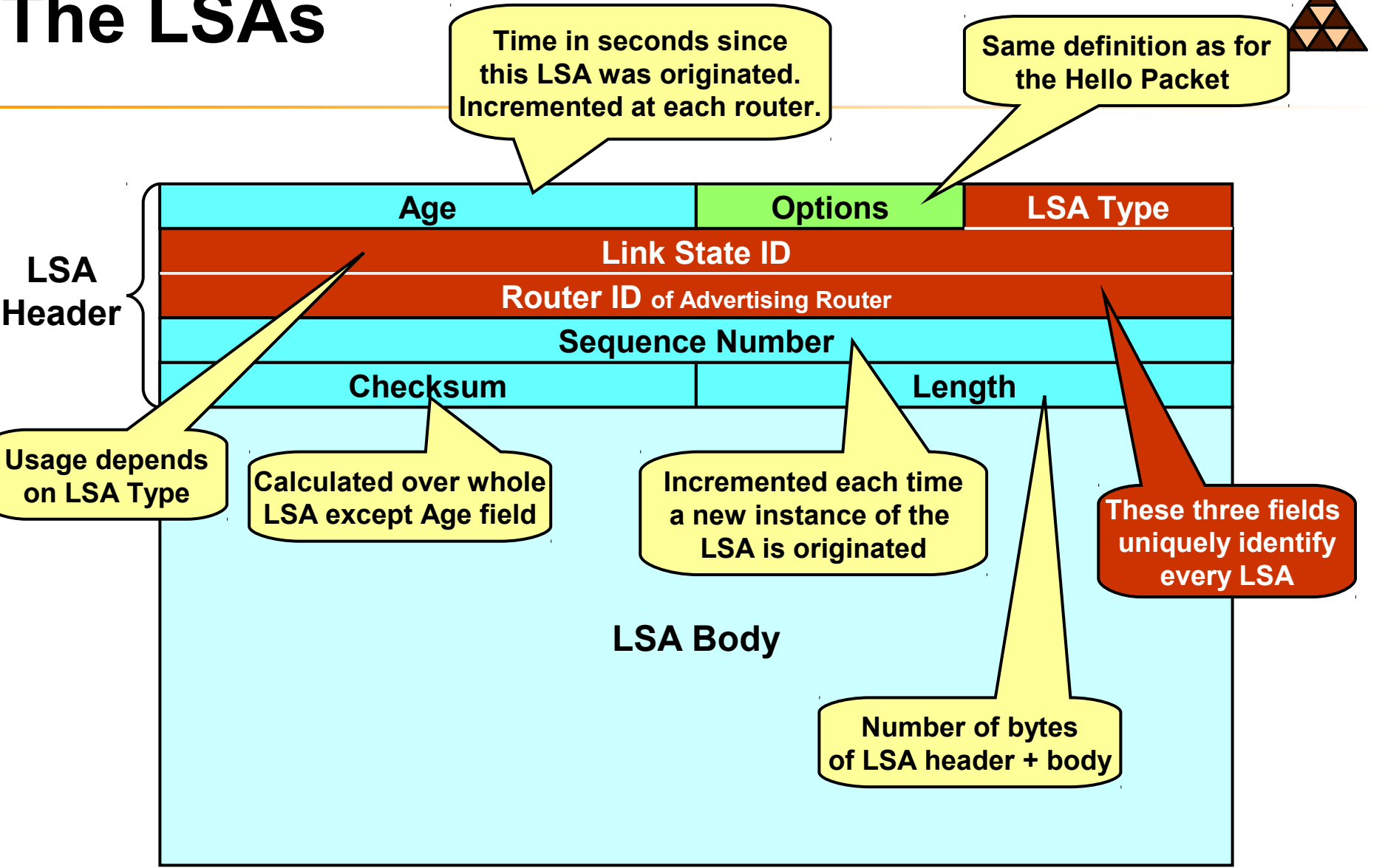
Link State ACK Packet

Type 5

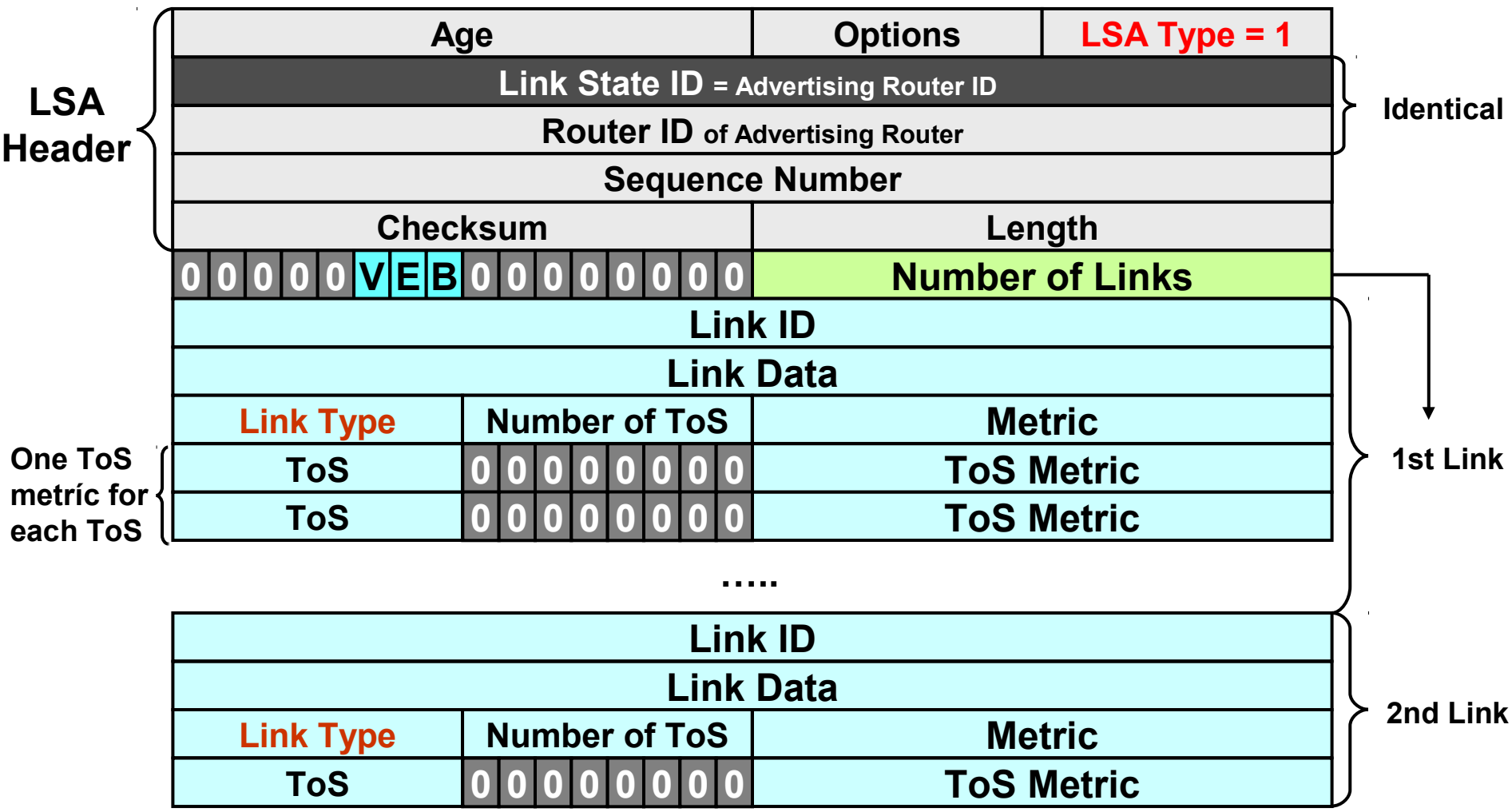


- Each LSA received must be **explicitly** acknowledged
→ reliable flooding!
- Acknowledged LSA is identified by **LSA header**
- Single Link State ACK packet can acknowledge multiple LSAs

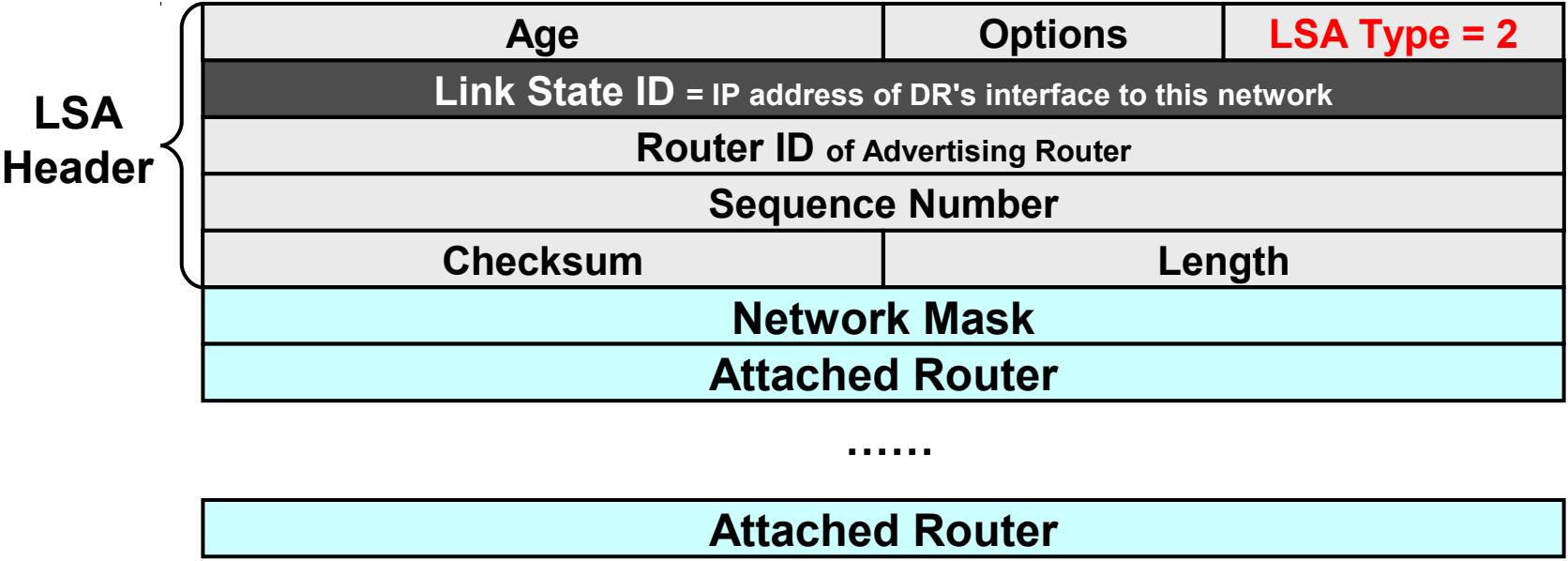
The LSAs



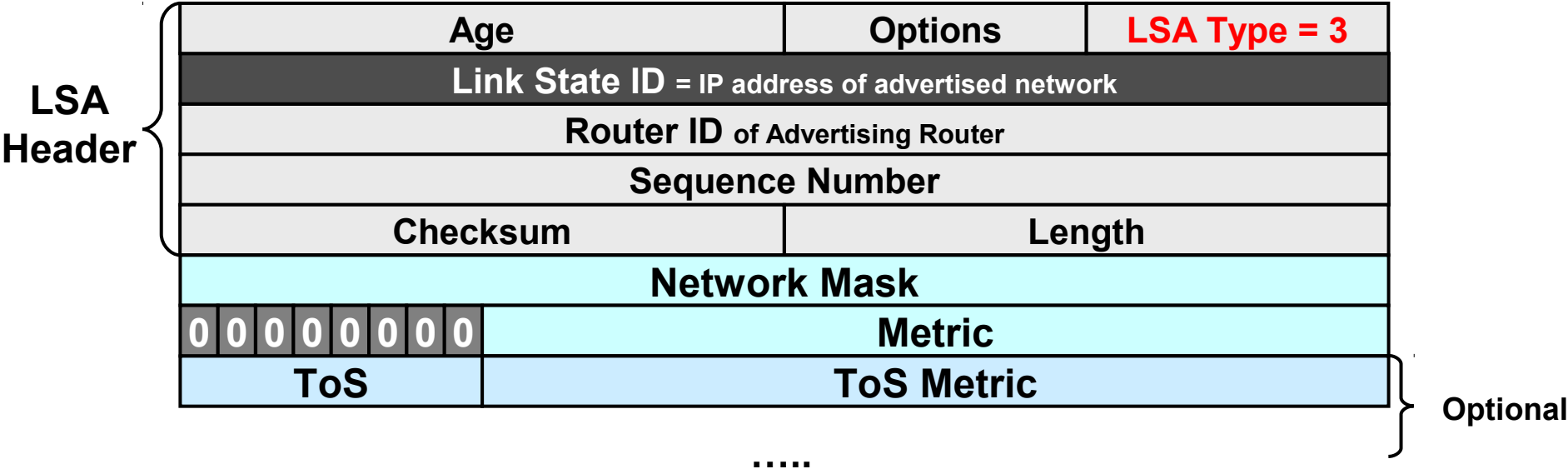
Router LSA



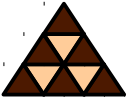
Network LSA



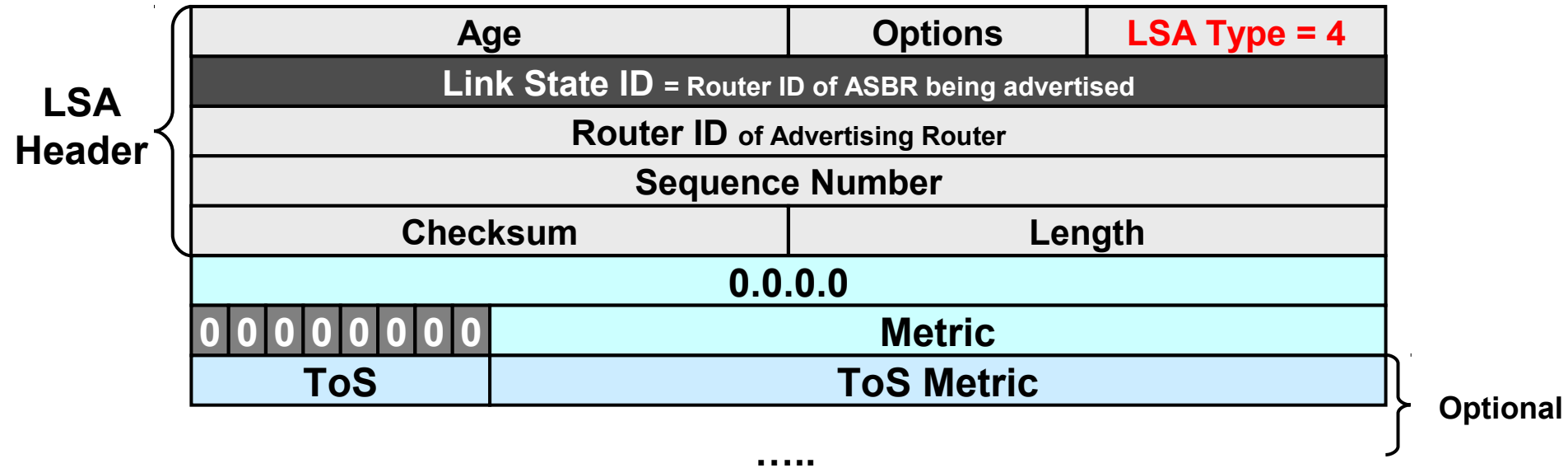
Network Summary LSA



- If a **default route** is advertised, both the Link State ID and the Network Mask fields will be 0.0.0.0
- Also used for route summarization
- Note: Cisco only supports ToS=0

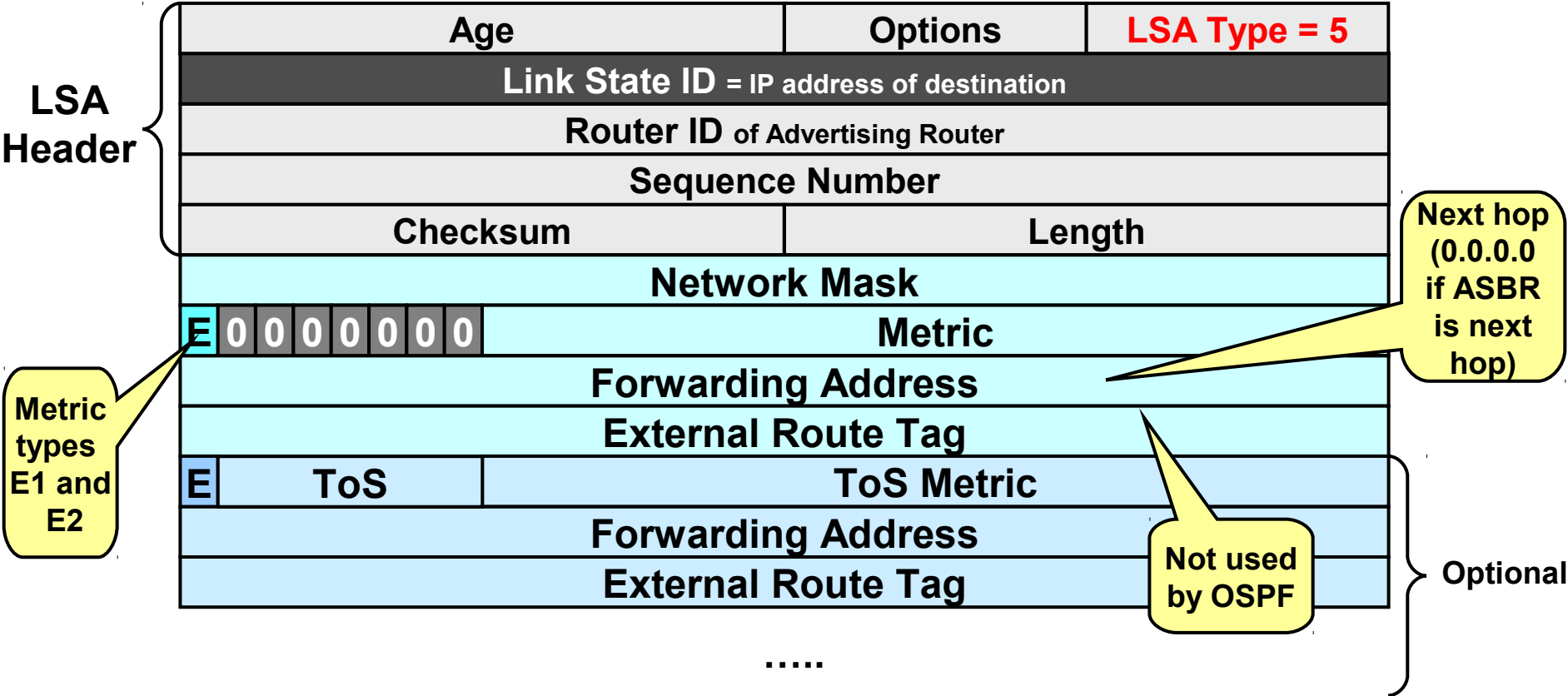


ASBR Summary LSA



- Note: Cisco only supports ToS=0

Autonomous System External LSA



- When describing a default route, both the Link State ID and the Network Mask are set to 0.0.0.0.



- **Same structure as AS External LSA**
- **Forwarding address is**
 - ◆ **Next hop address for the network between NSSA and adjacent AS, if this network is advertised as internal route**
 - ◆ **Router ID of NSSA-ASBR otherwise**