



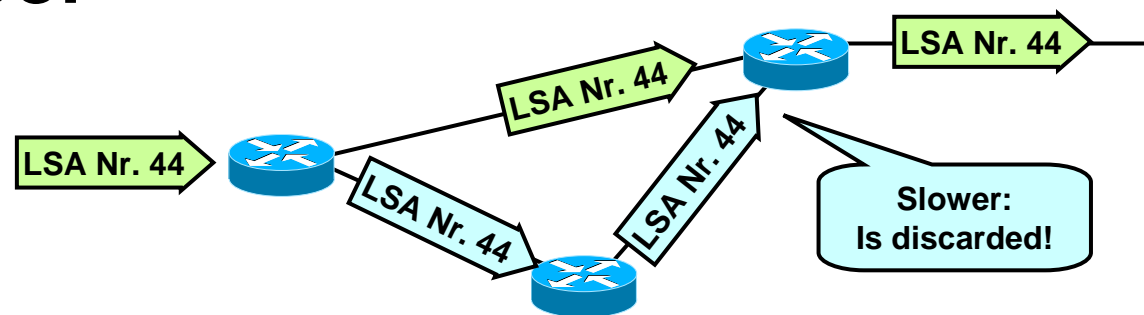
# OSPF – LSAs

Why there is a dirty dozen of them  
**Part 3**

# LSA Sequence Number



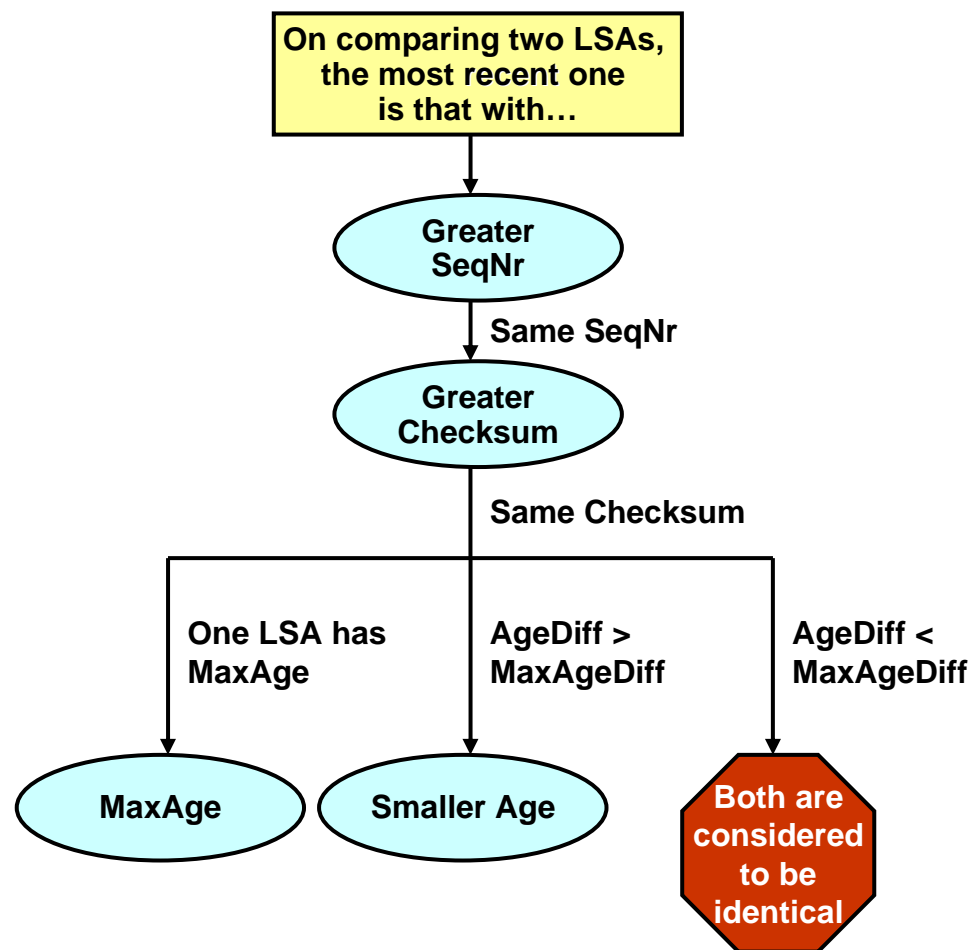
- In order to stop flooding, each LSA carries a sequence number
- Only increased if LSA has changed
  - ◆ So each router can check if a particular LSA had already been forwarded
  - ◆ To avoid LSA storms
- 32 bit number



# 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



# LS Age



- **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**

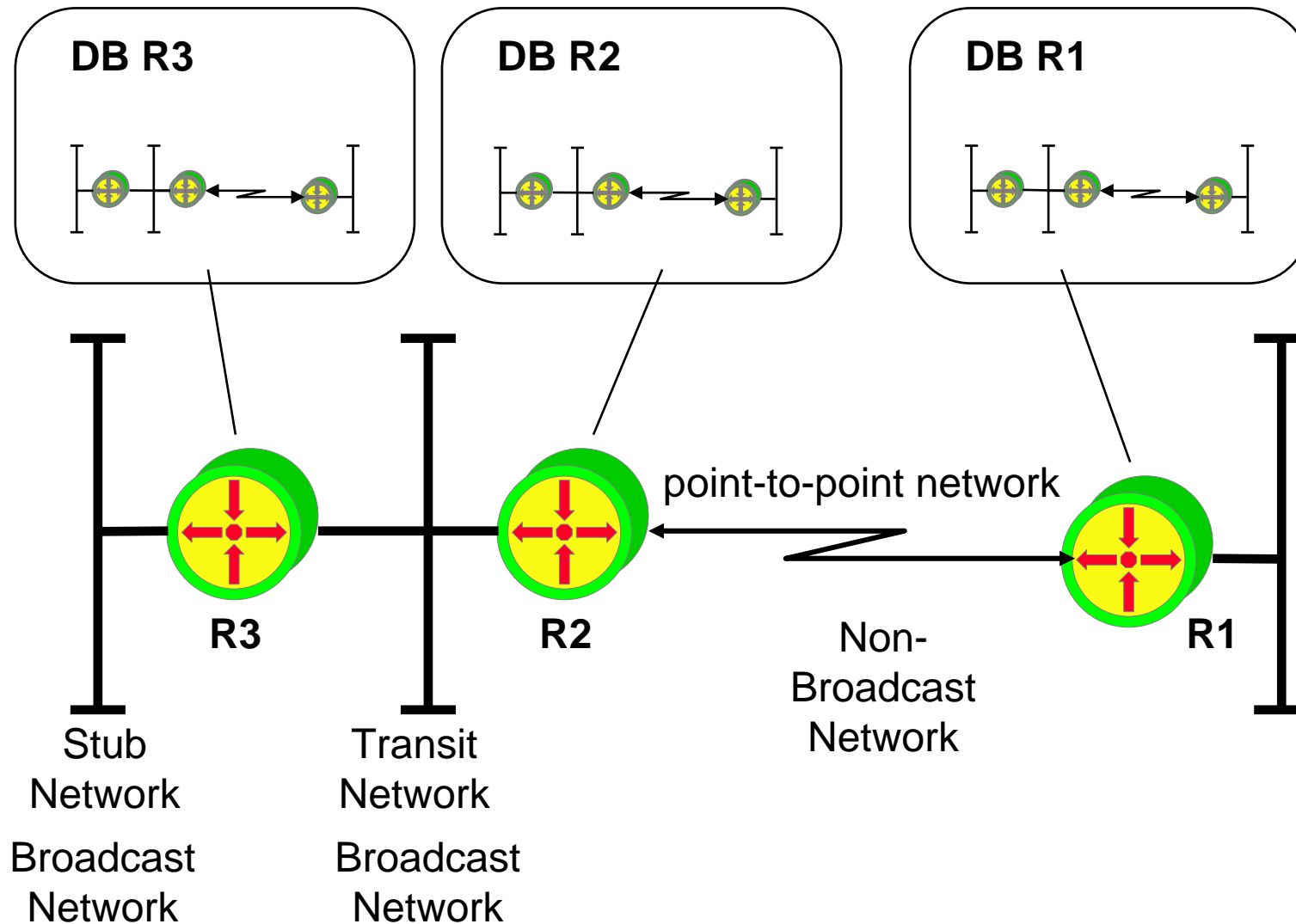
# Router LSA – Type 1

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- **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**

# Router-LSA Types



# Network LSA – Type 2

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- **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

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- 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**

# Other LSAs



- **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

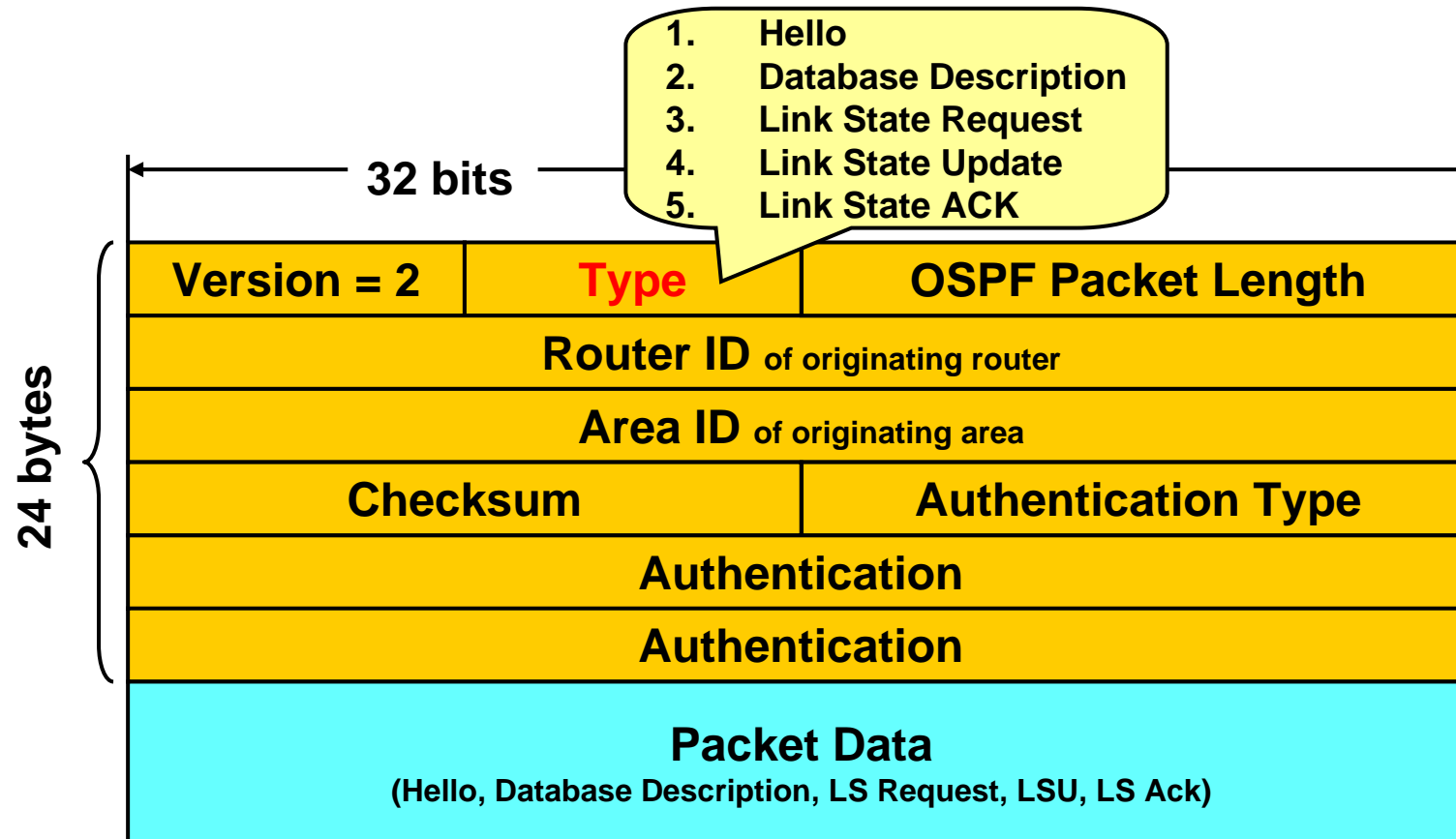
# Other LSAs

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

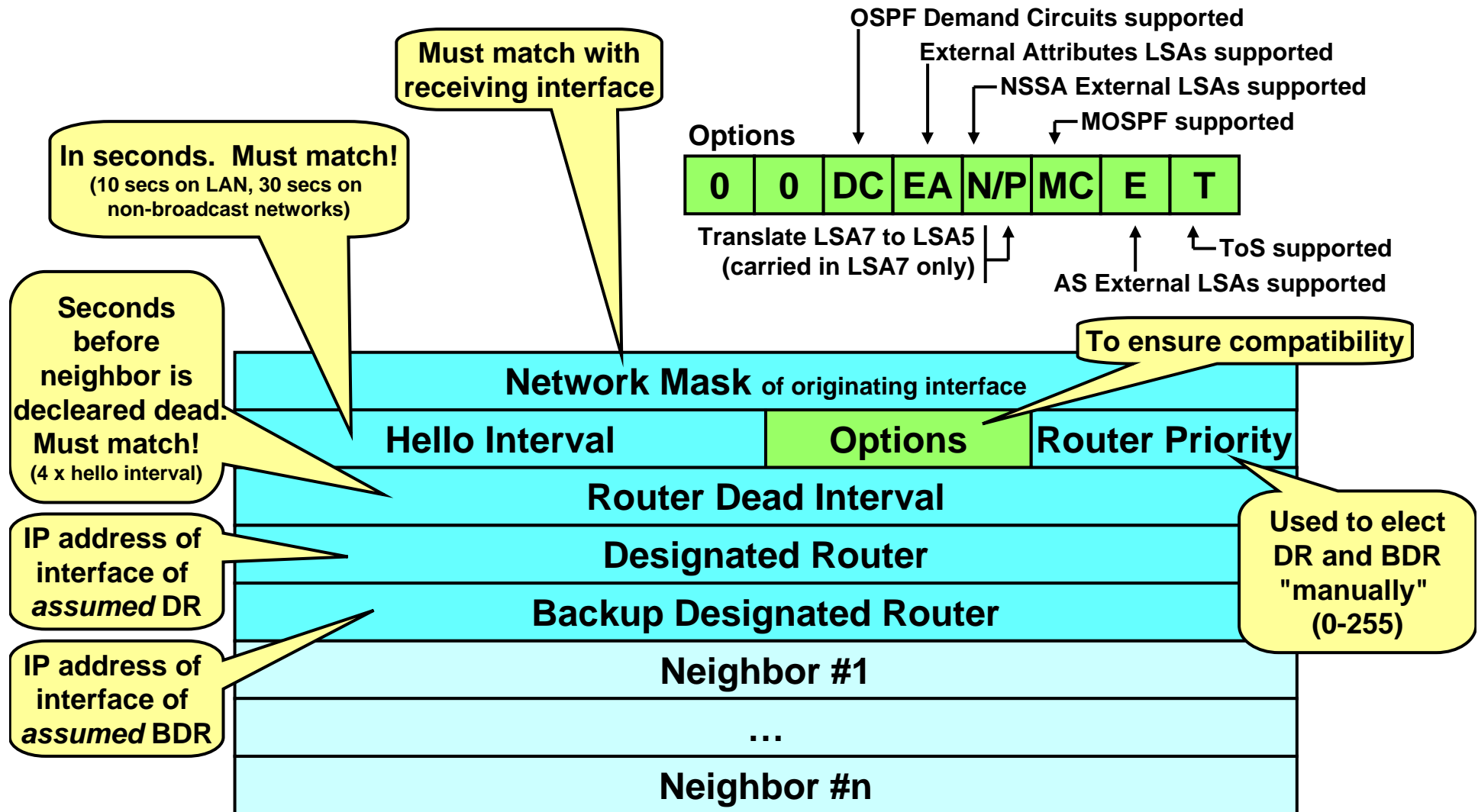
# General OSPF Packet Structure



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

# Hello Packet

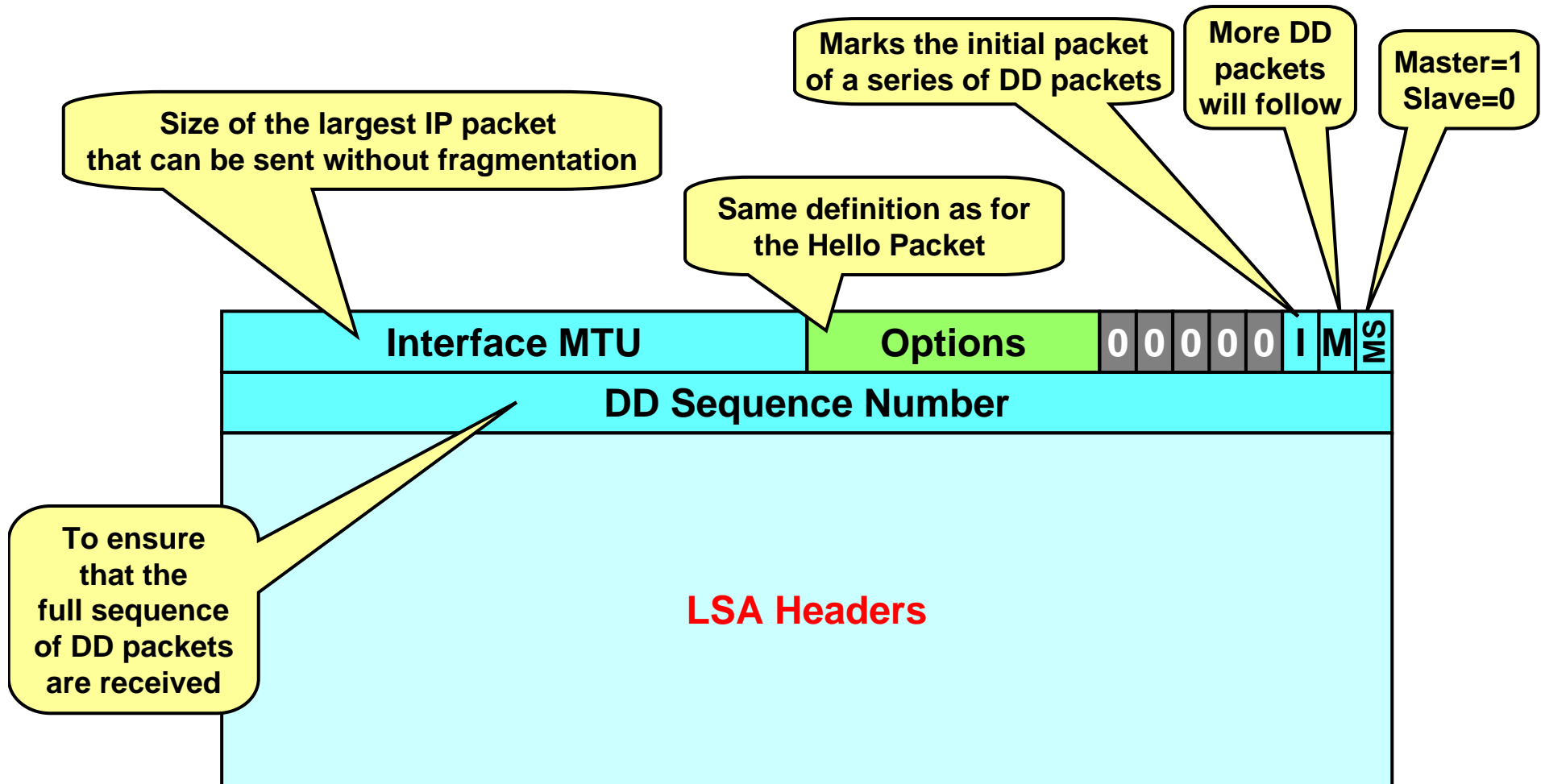
Type 1



# Database Description Packet

Also called "DDP"

Type 2





# Link State Request Packet

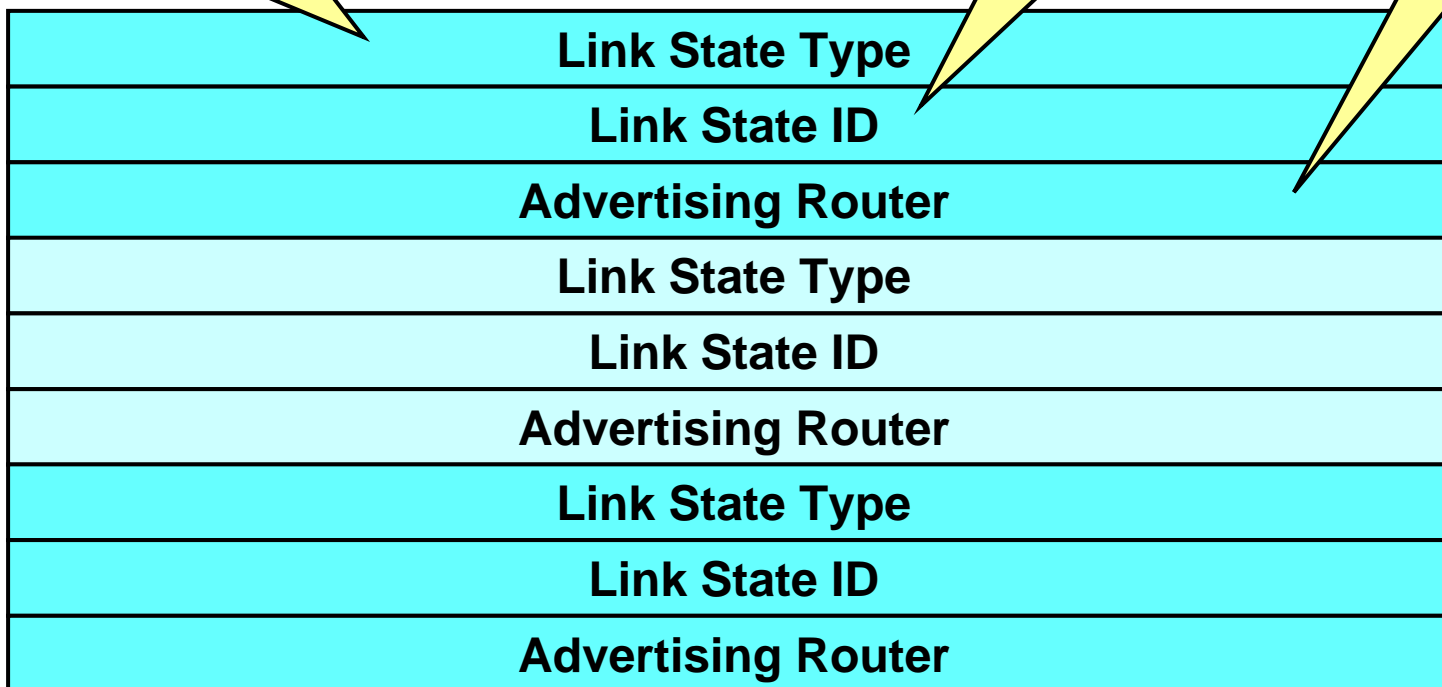
Type 3



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

Usage depends on the LSA type

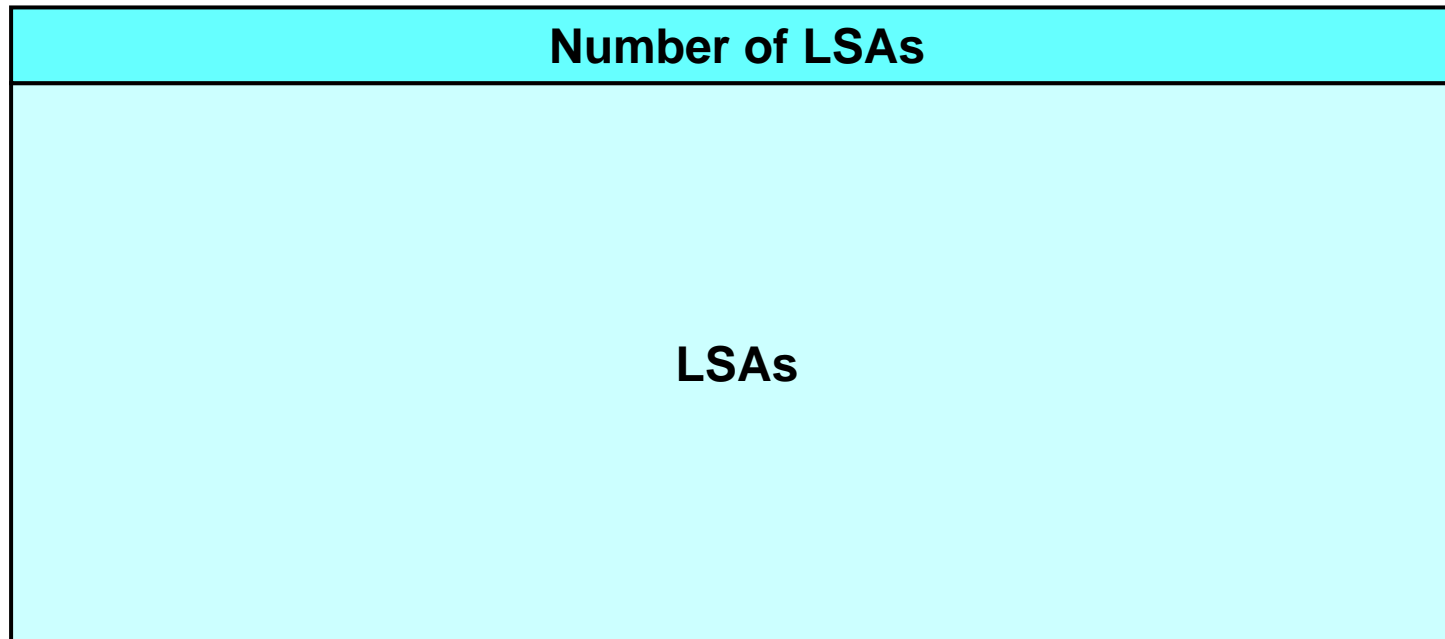
Router ID of originator of this LSA



.....

# Link State Update Packet

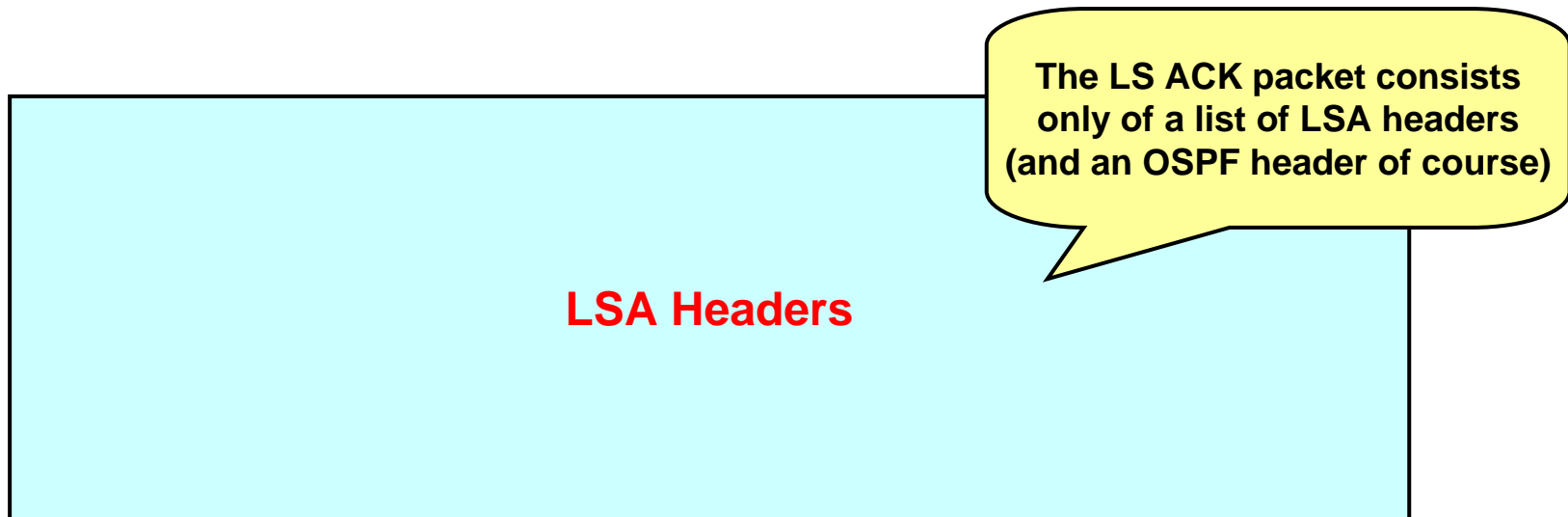
Type 4



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

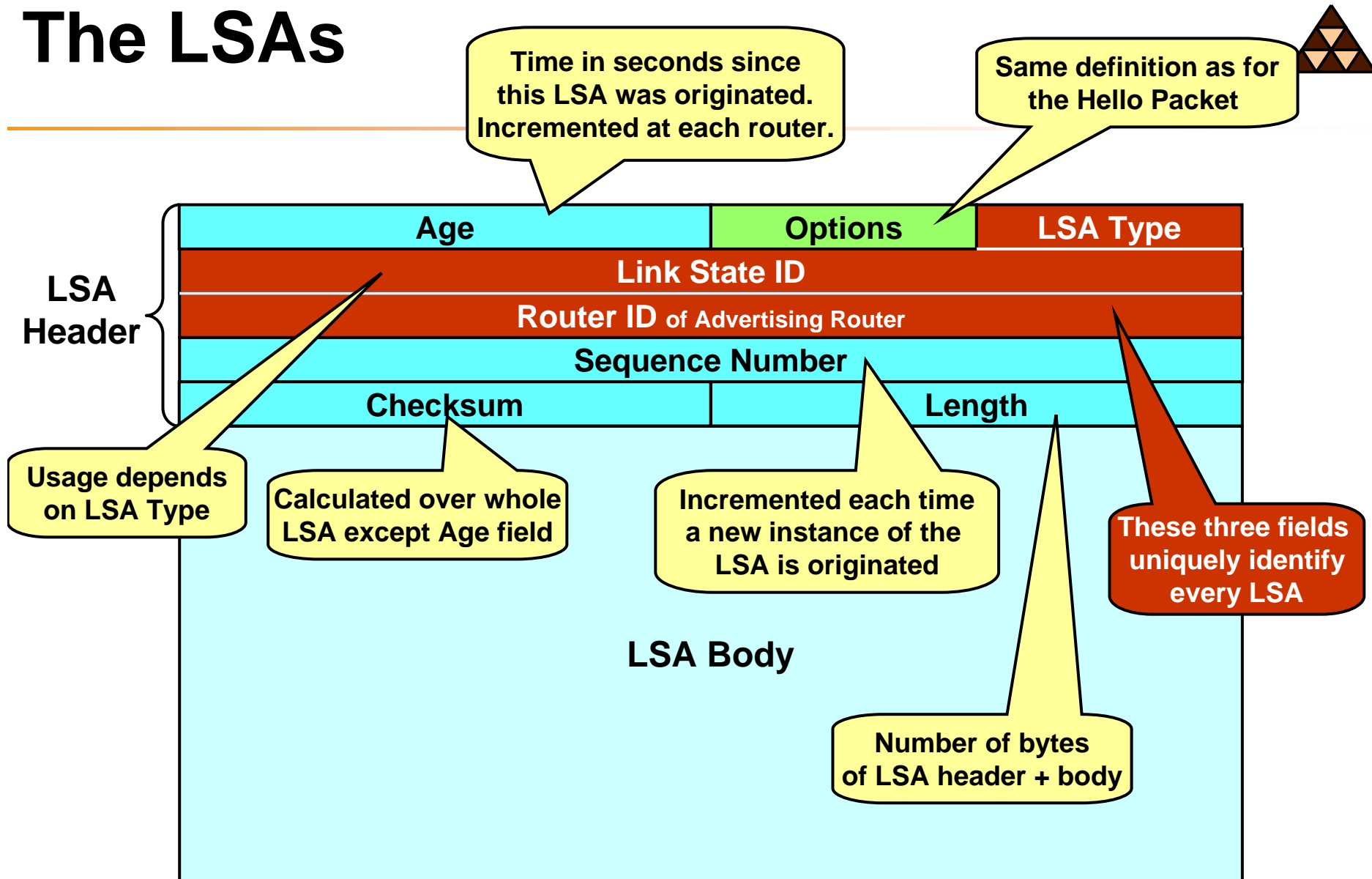
# Link State ACK Packet

Type 5

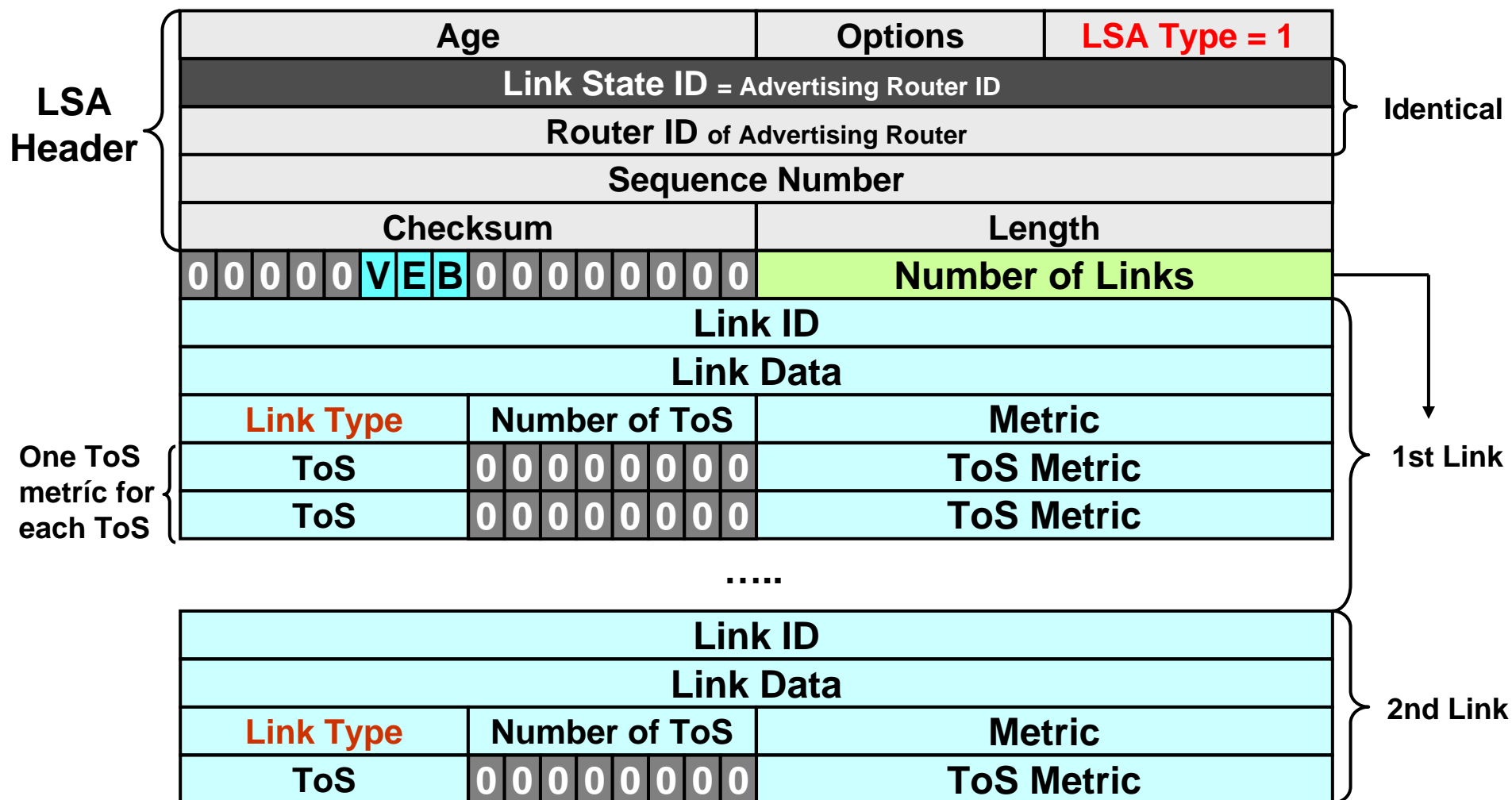


- Each LSA received must be **explicitly** acknowledged → reliable flooding!
- Acknowledged LSA is identified by **LSA header**
- Single Link State ACK packet can acknowledge multiple LSAs

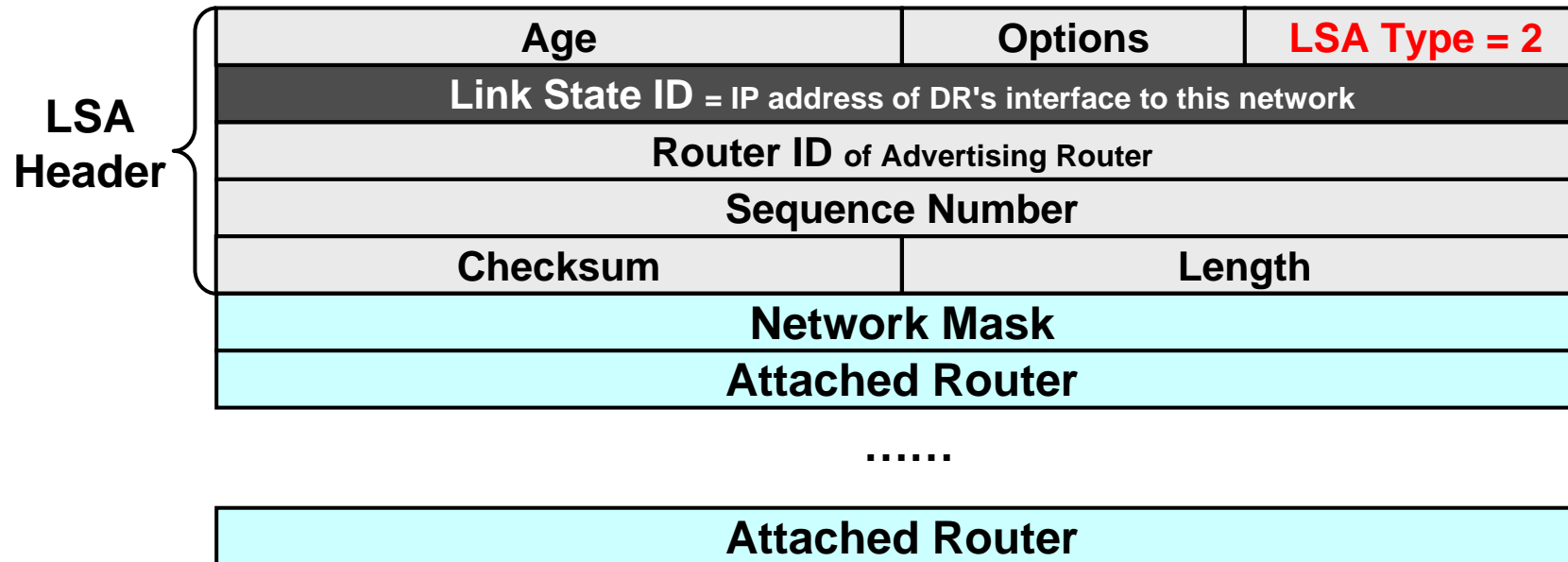
# The LSAs



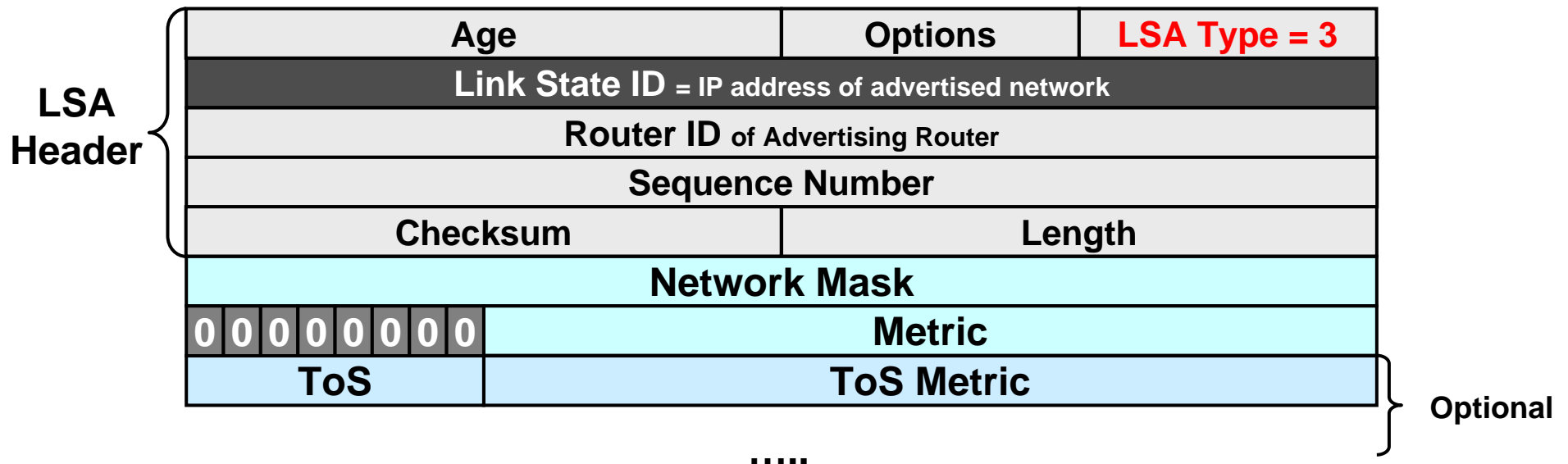
# Router LSA



# Network LSA

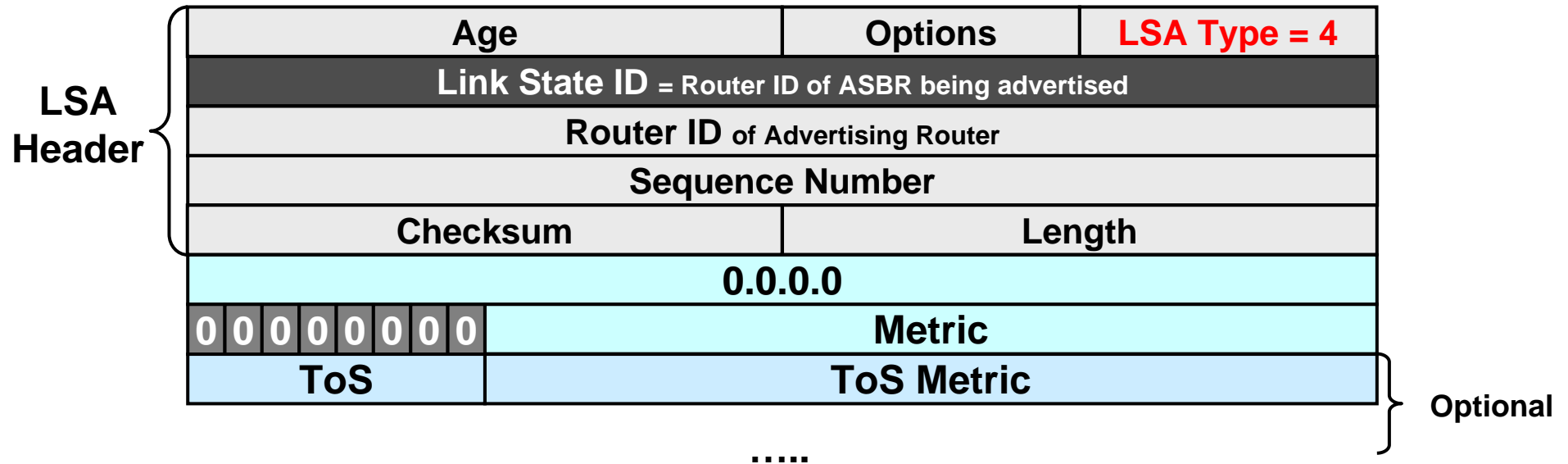


# Network Summary LSA



- 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

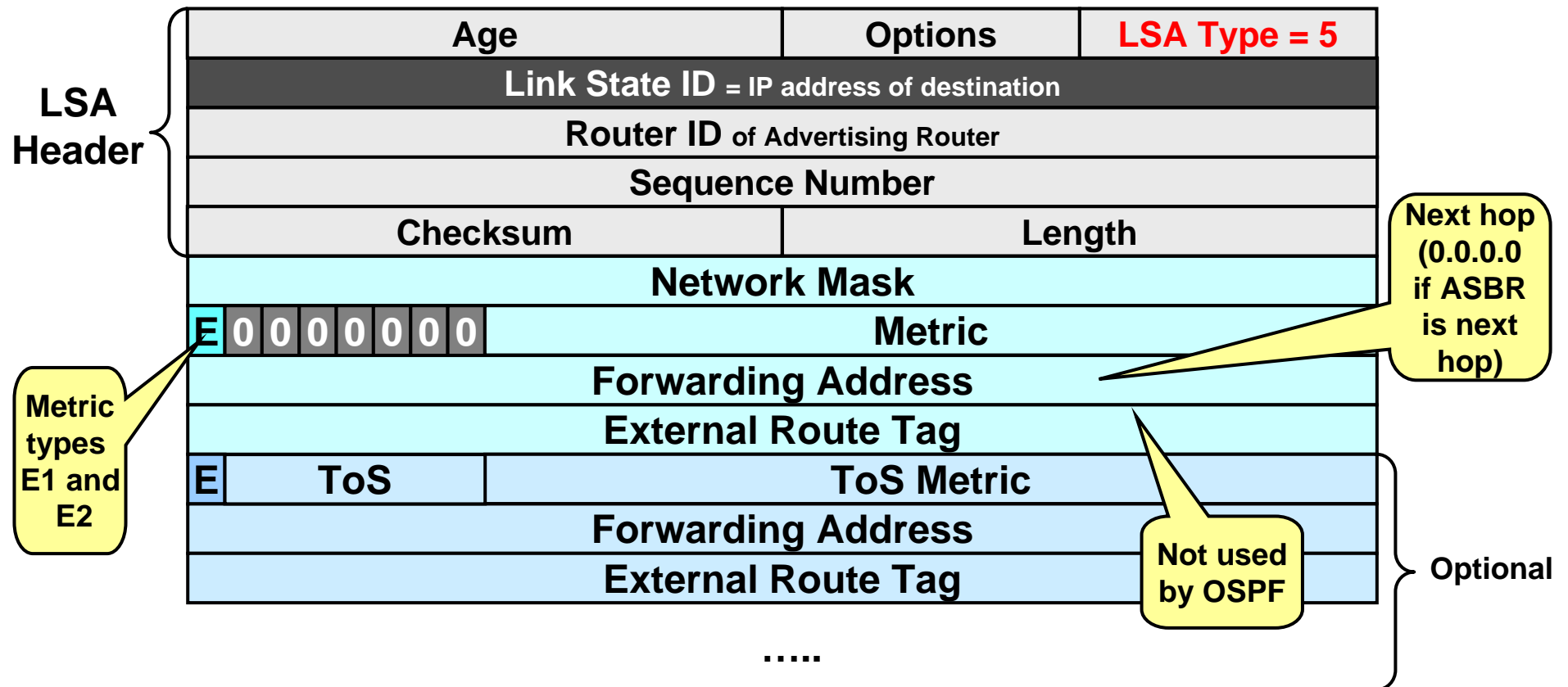
# ASBR Summary LSA



- 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.

# NSSA External LSA



- **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**