OSPFv2 Cheat Sheet — Reference Tables

OSPFv2 — General

Link State Routing Protocol (RFC 2328)
Interior Gateway Protocol (IGP)
IP Protocol 89 (not TCP/UDP)
Dijkstra SPF algorithm
Classless — supports VLSM and CIDR
Metric: Cost = 10^8 / bandwidth (bps)
Admin Distance: 110 (internal)
Multicast: 224.0.0.5 (all OSPF) / 224.0.0.6 (DR/BDR)
Supports authentication (MD5 / SHA)
Fast convergence — incremental updates
Hierarchical design using Areas

Admin Distance

Internal	110 — intra-area OSPF routes
External E1	110 — external, cost accumulates
External E2	110 — external, cost fixed (default)
NSSA E1	110 — NSSA external, cumulative
NSSA E2	110 — NSSA external, fixed cost

Timers

Hello	10s (30s on NBMA) — neighbour discovery
Dead	40s (120s on NBMA) — 4x Hello
Retransmit	5 seconds
Transmit delay	1 second
LSA MaxAge	3600 seconds (1 hour)
LSA refresh	1800 seconds (30 min)

OSPF Packet Types

Hello	Type 1 — Neighbour discovery / keepalive
DBD	Type 2 — Database Description summary
LSR	Type 3 — Link State Request
LSU	Type 4 — Link State Update (LSAs inside)
LSAck	Type 5 — Link State Acknowledgement

Router Types

Internal	All interfaces in same area
Backbone	Connected to Area 0
ABR	Area Border Router — connects areas to Area 0
ASBR	AS Boundary Router — redistributes external routes
DR	Designated Router — elected on broadcast/NBMA
BDR	Backup DR — takes over if DR fails
DROther	Non-DR/BDR — forms adj with DR+BDR only

Area Types

Backbone	Area 0 — all other areas must connect here
Standard	Normal area — all LSA types allowed
Stub	Blocks Type 5 (external) LSAs — uses default
Totally Stubby	Blocks Type 3+5 — Cisco ext. — default only
NSSA	Like stub but allows Type 7 for local ASBR
Totally NSSA	Blocks Type 3+5+7 — only local NSSA routes

Network Types

Broadcast	Ethernet — DR/BDR elected — multicast
NBMA	Frame Relay — DR/BDR — unicast hellos
P2P	Serial / subintf — no DR/BDR — fastest conv.
P2MP	Non-broadcast P2MP — no DR/BDR
P2MP NB	Like P2MP but unicast
Loopback	Always /32 — treated as stub

LSA Types

Type 1	Router LSA — intra-area links
Type 2	Network LSA — DR generates for transit net
Type 3	Summary LSA — ABR, inter-area prefixes
Type 4	ASBR Summary — ABR advertises ASBR location
Type 5	AS External — ASBR, external routes
Type 7	NSSA External — ASBR in NSSA area
Type 9-11	Opaque LSAs — TE, extensions

Routing Table Codes

O	OSPF intra-area
O IA	OSPF inter-area (Type 3 summary)
O E1	External Type 1 (cumulative cost)
O E2	External Type 2 (fixed cost — default)
O N1	NSSA External Type 1
O N2	NSSA External Type 2

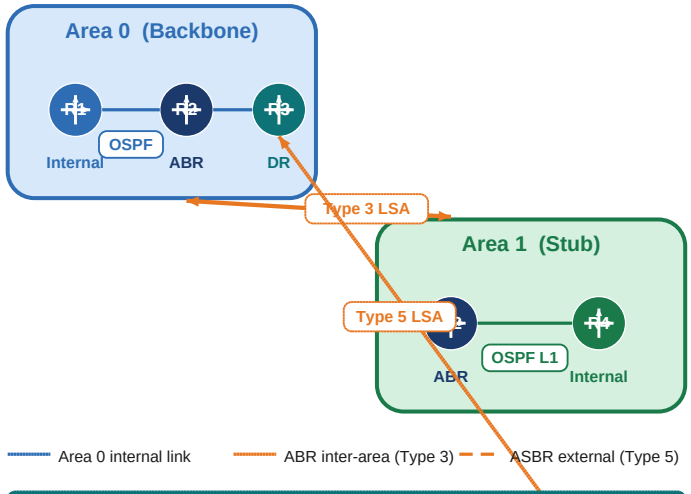
Neighbour Adjacency States (in order)

1	Down — initial state
2	Attempt — unicast Hello sent (NBMA only)
3	Init — Hello received but not 2-way
4	2-Way — bidirectional; DR/BDR election here
5	ExStart — master/slave negotiated; DBD sequence
6	Exchange — DBD packets exchanged
7	Loading — LSR / LSU exchanged
8	Full — databases synchronised (adjacency formed)

Key Cisco IOS Commands

```
router ospf <process-id>
  network <ip> <wildcard> area <id>
  router-id <rid>
  auto-cost reference-bandwidth <Mbps>
  area <id> stub / stub no-summary
  area <id> nssa / nssa no-summary
  area <id> authentication message-digest
  passive-interface <intf> / default
  default-information originate
  redistribute <proto> subnets
  summary-address <ip> <mask> (ASBR)
interface <intf>
  ip ospf <process-id> area <id>
  ip ospf cost <value>
  ip ospf priority <0-255>
  ip ospf hello-interval <sec>
  ip ospf dead-interval <sec>
  ip ospf network <type>
  ip ospf authentication message-digest
  ip ospf message-digest-key 1 md5 <key>
show ip ospf neighbor
show ip ospf database
show ip ospf interface
show ip route ospf
clear ip ospf process
```

OSPFv2 Multi-Area Topology (ABR / ASBR / DR roles)

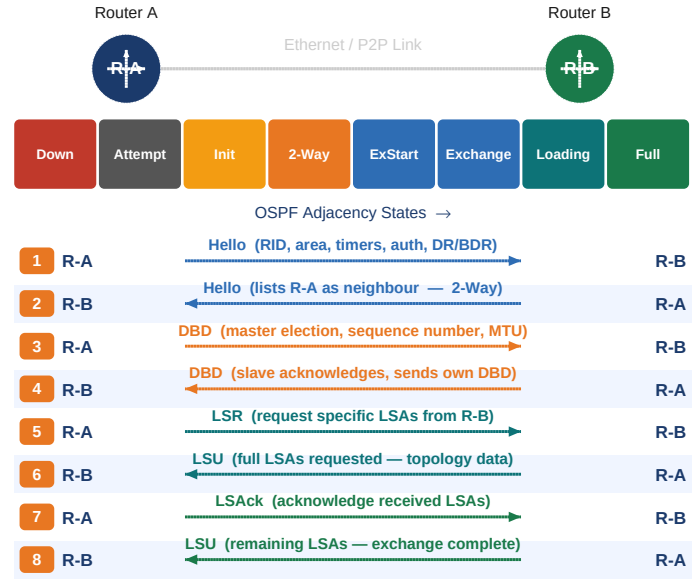


Area 0 internal link — ABR inter-area (Type 3) — ASBR external (Type 5)

DR / BDR Election (Broadcast & NBMA networks)

Highest OSPF priority (0-255) wins — default 1. Priority 0 = never DR.
Tiebreaker: Highest Router-ID (or highest loopback IP).
Election is non-preemptive — DR stays until it fails.
DROther forms Full adj with DR+BDR only — 2-Way with others.
Use ip ospf priority 0 to prevent a router from becoming DR.

Neighbour Adjacency Formation (8-state FSM)



Adjacency FULL — SPF runs — routes installed

Adjacency Requirements (must match both sides)

Area ID must match
Hello and Dead timers must match
Authentication type and password must match
Subnet / mask must match (same network)
MTU must match (or ip ospf mtu-ignore)
Stub area flag must match

OSPF Cost Calculation & Tuning

Default cost = 10^8 / interface bandwidth (bps).
FastEthernet: cost 1 | T1: cost 64 | Serial 64k: cost 1562.
All Gigabit+ get cost 1 with default ref-bw — must tune!
Fix: auto-cost reference-bandwidth 10000 (for 10G links).
Manual: ip ospf cost <1-65535> on interface.

OSPF Packet & LSA Structures

IP Frame (OSPF uses IP Protocol 89 — no TCP/UDP)

OSPF Common Header (24 bytes — prepends every OSPF packet)

Hello Packet (Type 1 — Neighbour discovery & keepalive)

LSA Header (20 bytes — common to all LSA types)

Default OSPF Cost by Interface Type (ref-bw = 100 Mbps)

Loopback	1	Always /32 — use ip ospf network p2p
GigabitEthernet	1	Same as FastE with default ref-bw — tune!
FastEthernet	1	10^8 / 10^8 = 1 (minimum)
T3 (45 Mbps)	2	10^8 / 45,000,000 ≈ 2
E1 (2 Mbps)	48	10^8 / 2,048,000 ≈ 48
T1 (1.544 Mbps)	64	10^8 / 1,544,000 ≈ 64
512 kbps	195	10^8 / 512,000 ≈ 195
128 kbps	781	10^8 / 128,000 ≈ 781
64 kbps	1562	10^8 / 64,000 ≈ 1562

Area Type — LSA Filtering Summary

Standard: Type 1,2,3,4,5,7 — all LSAs allowed.
Stub: Blocks Type 4+5 — ABR injects default route.
Totally Stubby: Blocks Type 3+4+5 — only default from ABR.
NSSA: Blocks Type 5 but allows Type 7 (local ASBR).
Totally NSSA: Blocks Type 3+4+5; Type 7 only from local ASBR.