OSPF Version 2 (RFC 2328)

- Interior gateway protocol (IGP).
- Routers maintain link-state database.
  - Describes Autonomous Systems (AS) topology.
  - Propagated by flooding: Link State Advertisements (LSAs).
- Router constructs tree rooted at itself.
- Traffic distributed equally over multiple equal-cost paths to destination.
OSPF Metrics

- Internal metrics: cost associated with output side of router interfaces.

- External metrics: denote externally derived routing data.
  - Type 1: treated the same as internal metrics.
  - Type 2: always greater than cost of any internal path.

- Both external metric types can simultaneously exist in an AS.

- Ability to specify *forwarding address* in LSA to:
  - Reduce extra hops.
  - Enable some routers to acts as route servers.
OSPF Hierarchical Organization

- Autonomous System split into areas.

- Each area has its own link-state database.

- Motivation for hierarchy: scalability.

- Area border router: router connected to multiple areas.
  - Stores different link-state database for each of its areas.
Autonomous System Backbone

- Special area 0 (0.0.0.0).

- Contains all area border routers.

- Logically contiguous:
  - Employ virtual links if physical contiguity is not possible.
OSPF Classification of Routers

- Internal routers.
- Area border routers.
- Backbone routers.
- AS boundary routers.

A router may belong to multiple categories.

Every router in an AS knows the path to every AS boundary router.
**OSPF Adjacency Determination**

- Routers send and receive *OSPF Hello* packets to acquire neighbors.

- Hello packets sent to *AllSPFRouters* multicast address (224.0.0.5).

- Hello packets also used to elect *Designated Router* in broadcast and non-broadcast multi access (NBMA) networks.

- Routers form adjacencies with some newly acquired neighbors and synchronize LS database.

- In broadcast and NBMA networks, adjacencies from Designated Router and other routers, and Backup Designated Router and other routers.

- *AllDRouters* address (224.0.0.6) used by other routers to send information to Designated and Backup Designated routers.
Intra-area Routing

- Routers flood LSAs in the area: periodically and on topology change.

- Reliable flooding through acknowledgments.

- All routers in an area have identical LS database.
Inter-area Routing

Area border router:

- Summarizes topology information of its area.
- Sends the summary to all other area border routers in the AS.
- Receives summary from other area border routers and calculates inter-area paths.
- Advertises inter-area paths to its attached area.
AS-External Routing

- AS boundary routers flood their external routing information to all routers.

- Exception: not flooded into stub areas.

- All routers, except those in stub areas, know the path to AS boundary routers.
Authentication

- All OSPF packets are authenticated.
- 64-bit authentication type field in OSPF packet header.
- Authentication type configurable on per-interface basis:
  - 0: null authentication.
  - 1: simple password.
  - 2: cryptographic authentication.
  - others: reserved for future use.
Simple Password Authentication

- All OSPF packets in a network use the same password.

- 64-bit clear password.

- Guards against router inadvertently joining a routing domain.

- Possible to determine password if one has physical access to network.
**Cryptographic Authentication**

- Shared key configured in all routers attached to a common network.

- *Message digest* generated using the key, and appended to packet.

- Implicit agreement among routers about algorithm.

- Cryptographic sequence number to prevent replay attacks:
  - Non-decreasing, 32-bit value.
  - Initialized to zero.
  - Rollover procedure not specified.
  - May be used to denote “seconds since reboot”.

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