

OSPF-Open Shortest Path First

Routing Algorithms - OSPF

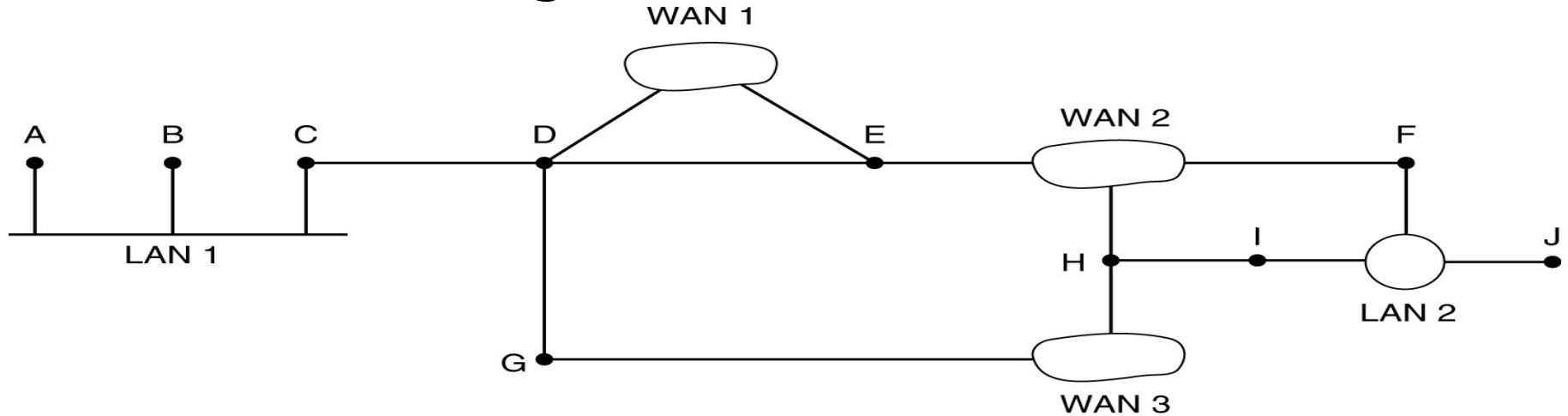
- ❖ The original Internet interior gateway protocol was a distance vector protocol (RIP) based on the Bellman-Ford algorithm inherited from the ARPANET.
- ❖ It worked well in small systems
- ❖ but less well as ASes got larger.
- ❖ It also suffered from the count-to-infinity problem and generally slow convergence
- ❖ so it was replaced in May 1979 by a link state protocol.
- ❖ In 1988, the Internet Engineering Task Force (IETF) began work on a successor.
- ❖ That successor, called **OSPF (Open Shortest Path First)**, became a standard in 1990.
- ❖ Most router vendors now support it, and it has become the main interior gateway protocol.

Routing Algorithms - OSPF

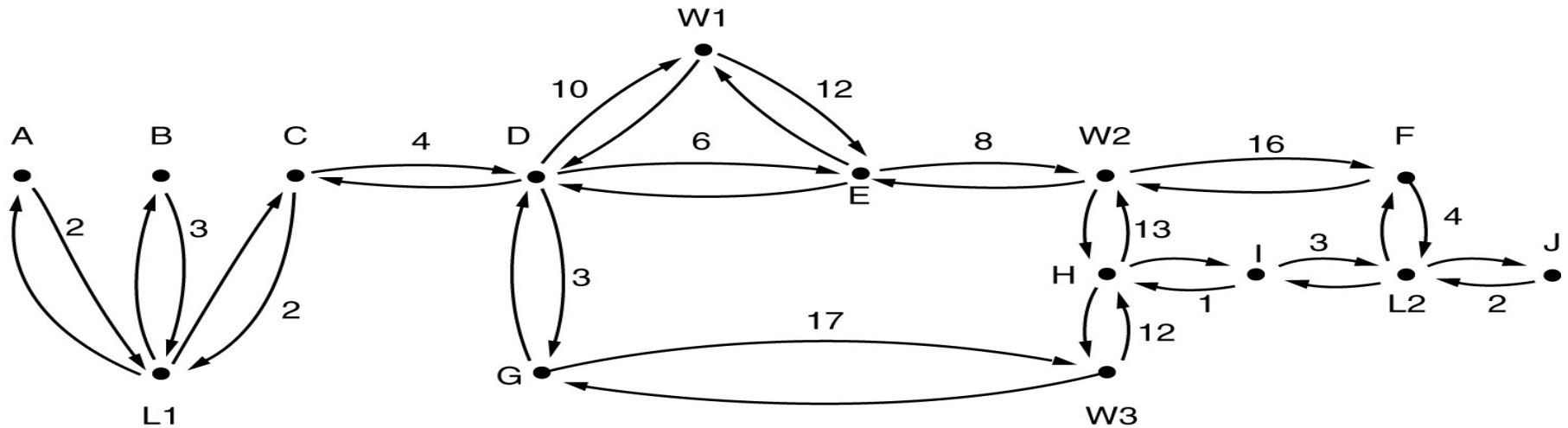
- OSPF supports three kinds of connections and networks:
 1. Point-to-point lines between exactly two routers.
 2. Multiaccess networks with broadcasting (e.g., most LANs).
 3. Multiaccess networks without broadcasting (e.g., most packet-switched WANs).
- A multiaccess network is one that can have multiple routers on it, each of which can directly communicate with all the others.
 - All LANs and WANs have this property.

OSPF

AS containing all three kinds of networks



(a)



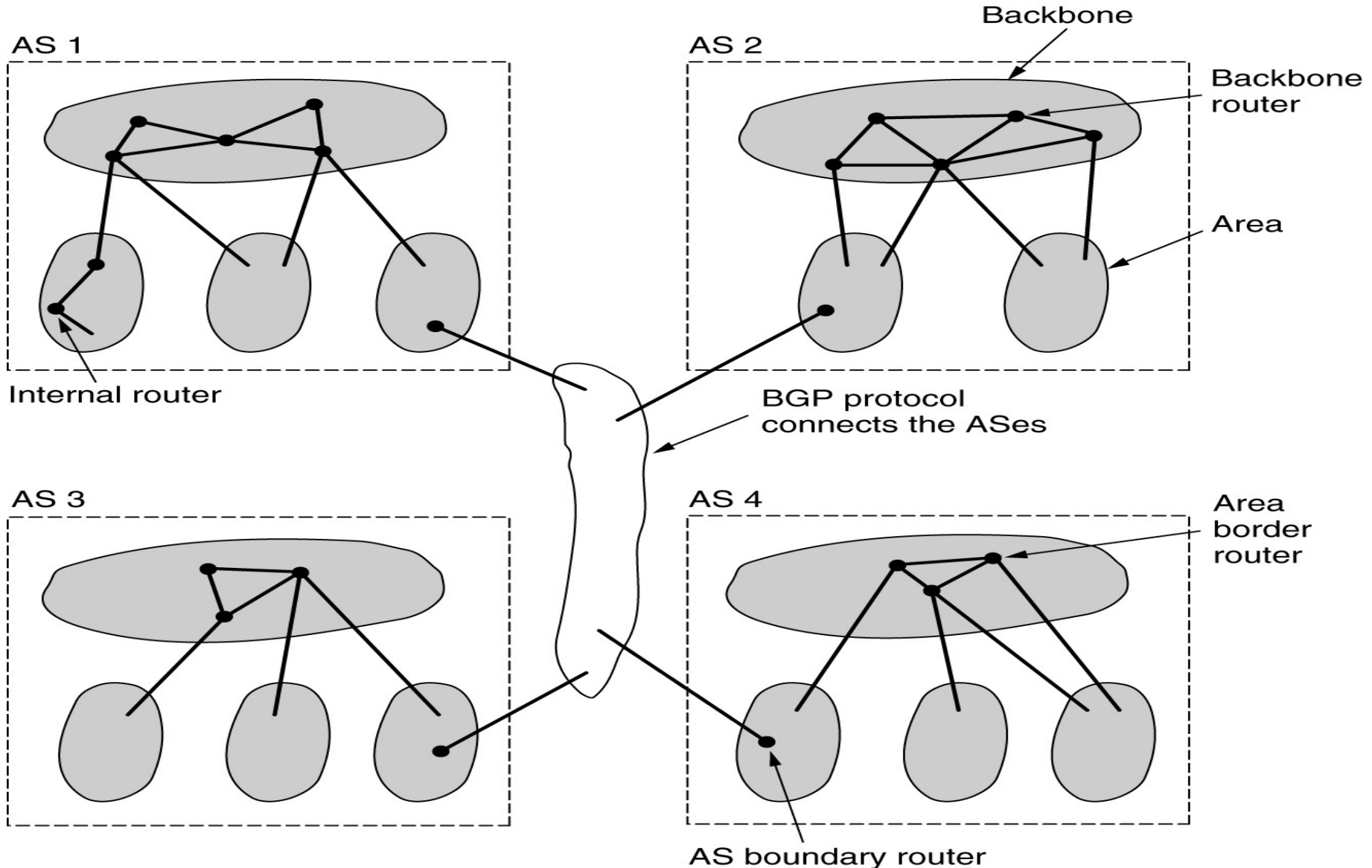
(b)

(a) An autonomous system. (b) A graph representation of (a).

Routing Algorithms - OSPF

- OSPF operates by abstracting the collection of actual networks, routers, and lines into a directed graph in which each arc is assigned a cost (distance, delay, etc.).
- It then computes the shortest path based on the weights on the arcs.
- A serial connection between two routers is represented by a pair of arcs, one in each direction.
- Their weights may be different.
- A multiaccess network is represented by a node for the network itself plus a node for each router.
- Weights are symmetric, unless marked otherwise.
- **What OSPF fundamentally does is**
 - To represent the actual network as a graph like this and then compute the shortest path from every router to every other router.

OSPF



The relation between ASes, backbones, and areas in OSPF.

Routing Algorithms - OSPF

- Many of the ASes in the Internet are themselves large and nontrivial to manage.
- OSPF allows them to be divided into numbered areas, where an area is a network or a set of contiguous networks.
- Areas do not overlap but need not be complete, that is, some routers may belong to no area.
- An area is a generalization of a subnet.
- Outside an area, its topology and details are not visible.
- Every AS has a backbone area, called area 0.
- All areas are connected to the backbone
- so it is possible to go from any area in the AS to any other area in the AS via the backbone.
- Each router that is connected to two or more areas is part of the backbone.

Routing Algorithms - OSPF

- Within an area, each router has the same link state database and runs the same shortest path algorithm.
- Its main job is to calculate the shortest path from itself to every other router in the area, including the router that is connected to the backbone.
- A router that connects to two areas needs the databases for both areas and must run the shortest path algorithm for each one separately.

Routing Algorithms - OSPF

- OSPF distinguishes **four classes of routers**:
 1. Internal routers are wholly within one area.
 2. Area border routers connect two or more areas.
 3. Backbone routers are on the backbone.
 4. AS boundary routers talk to routers in other ASes

Routing Algorithms - OSPF

- **Working:**
- When a router boots, it sends HELLO messages on all of its point-to-point lines and multicasts them on LANs to the group consisting of all the other routers.
- From the responses, each router learns who its neighbors are.
- Routers on the same LAN are all neighbors.
- OSPF works by exchanging information between adjacent routers
- In particular, it is inefficient to have every router on a LAN talk to every other router on the LAN.
- To avoid this situation, one router is elected as the **designated router**.
- It is said to be **adjacent** to all the other routers on its LAN, and exchanges information with them.

Routing Algorithms - OSPF

- Neighboring routers that are not adjacent do not exchange information with each other.
- A **backup designated router** is always kept up to date to ease the transition if the primary designated router crash and need to be replaced immediately.

OSPF

The five types of OSPF messages.

Message type	Description
Hello	Used to discover who the neighbors are
Link state update	Provides the sender's costs to its neighbors
Link state ack	Acknowledges link state update
Database description	Announces which updates the sender has
Link state request	Requests information from the partner

Routing Algorithms - OSPF

- OSPF sends Hello (greeting) messages on each link periodically to establish and test neighbour reachability
- Database Description messages are exchanged by routers to initialize their network topology database.
- After exchanging Database Description message, router may discover that some part of its database is outdated.
- Link State Request message is used to request the neighbour to supply the updated information

Routing Algorithms - OSPF

- **Summary:**
- Using flooding, each router informs all the other routers in its area of its neighbors and costs.
- This information allows each router to construct the graph for its area(s) and compute the shortest path.
- The backbone area does this too.
- In addition, the backbone routers accept information from the area border routers in order to compute the best route from each backbone router to every other