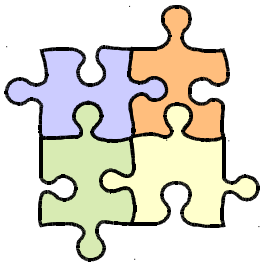


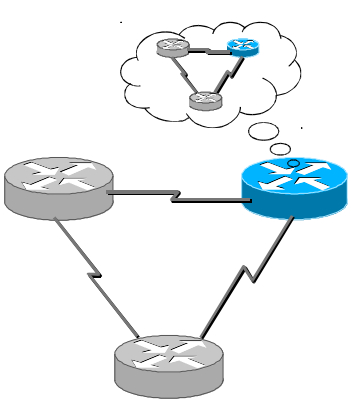
OSPF – Link State Establishment

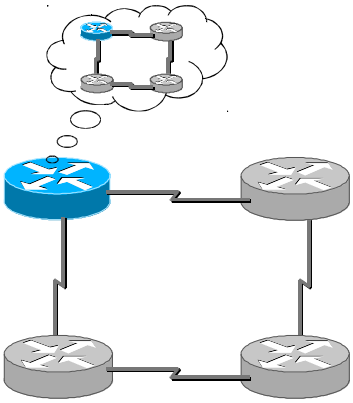
The IETF Routing Master

Part 2

Basic Principle (1)

- Consider two routers, lucky integrated in their own networks...

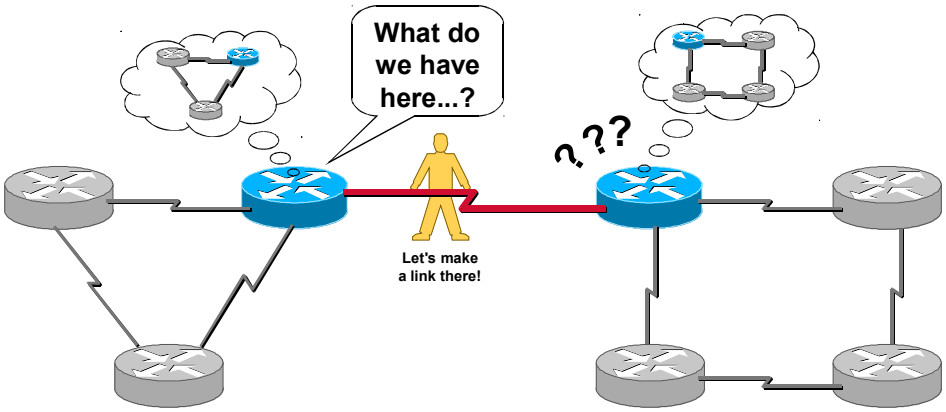




The routers on the slide have 2 stable networks, there are no periodic link state updates, just hello messages.

Basic Principle (2)

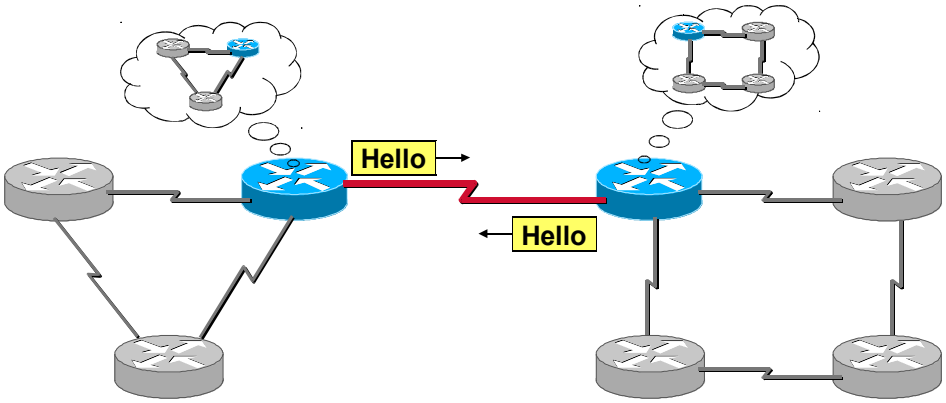
- Suddenly, some brave administrator connects them via a serial cable...
- Both interfaces are still in the "Down state"



After the link is connected, the routers detect a new network (OSPF is configured on the interface and interfaces are enabled).

Basic Principle (3)

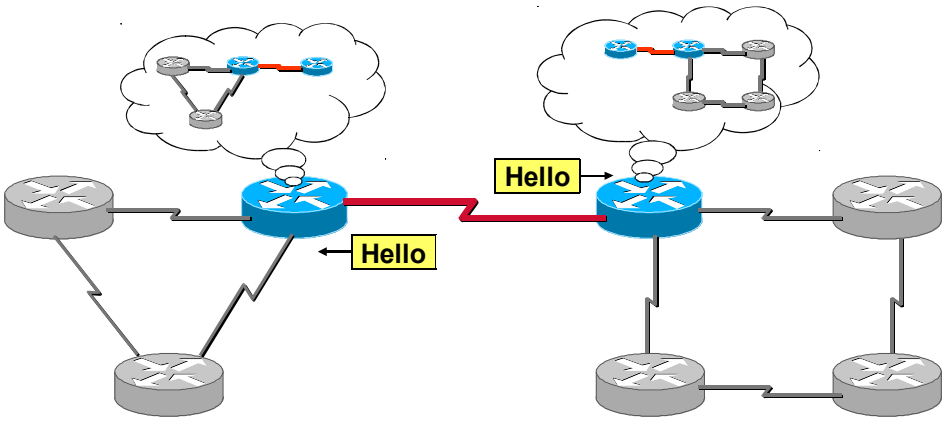
- **Init state:**
  - **Friendly as routers are, they welcome each other using the "Hello protocol"…**



OSPF routers send Hello packets out all OSPF enabled interfaces on a multicast address 224.0.0.5. Then the router waits for a reply (another hello from the other side) which must arrive within 4 x hello interval, otherwise the router falls back to the down state again. That is, the init state lasts only up to 4 times the hello interval.

Basic Principle (4)

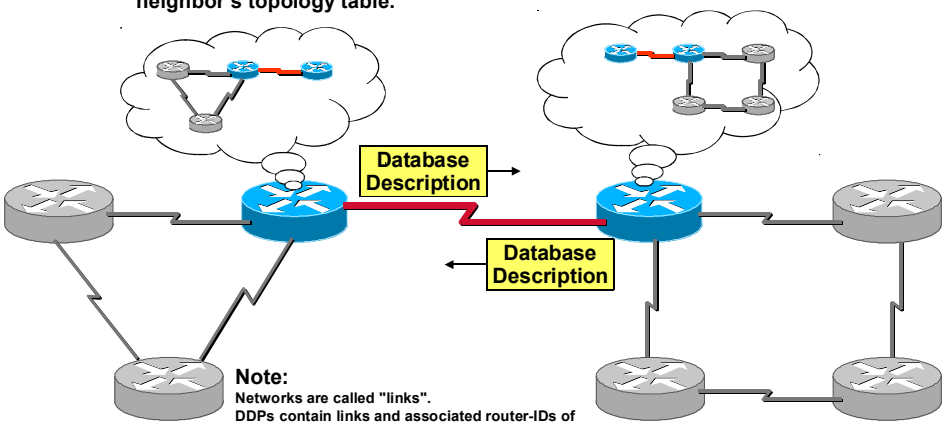
- Two-way state:
  - Each Hello packet contains a list of all neighbors (IDs)
  - Even the two routers themselves are now listed (=> 2-way state condition)
  - Both routers are going to establish the new link in their database...



If two routers sharing a common link and they agree on a certain parameters in their respective Hello packets, they will become neighbours.

Basic Principle (5)

- **Exstart state:**
  - Determination of master (highest IP address) and slave
  - Needed for loading state later
- **Exchange state:**
  - Both router start to offer a short version of their own roadmap, using "Database Description Packets" (DDPs)
  - DDPs contain partial LSAs, which summarize the links of every router in the neighbor's topology table.



After neighbourship is established, the routers enter the "exstart state" and determine who of them is master and who is slave. This will be needed later as the master will begin to send LS-Request packets. The rule is simple: the router with the highest IP address (of the two involved interfaces on that link) is master.

Then, both routers enter the exchange state and exchange database description packets (DDPs), which contain partial LSAs and therefore can be regarded as a summary of their topology database.

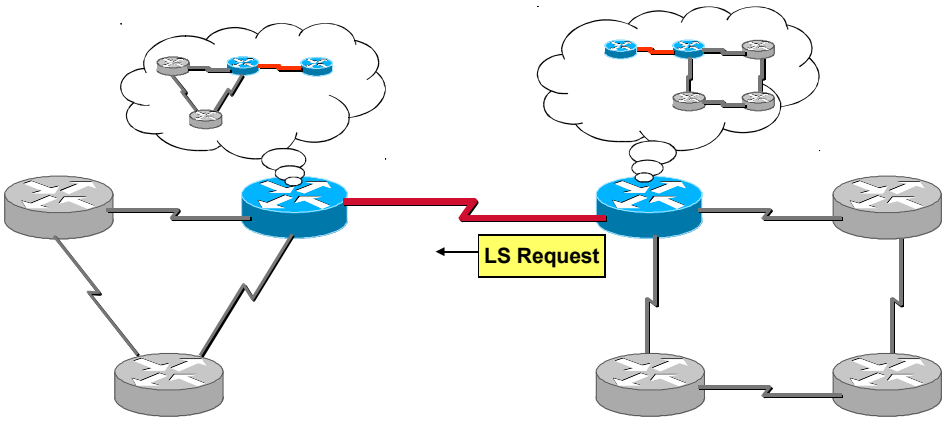
Note: typically a series of DDPs are sent from each side. Each advertised link is identified by a OSPF router ID, which represents the originator of that information.

Both routers send out a series of database description packets containing the networks held in the topology database. These networks are referred to as *links*. Most of the information about the links has been received from other routers (via LSAs). The router ID refers to the source of the link information.

Each link will have an interface ID for the outgoing interface, a link ID, and a metric to state the value of the path. The database description packet will not contain all the necessary information, but just a summary (enough for the receiving router to determine whether more information is required or whether it already contains that entry in its database).

Basic Principle (6)

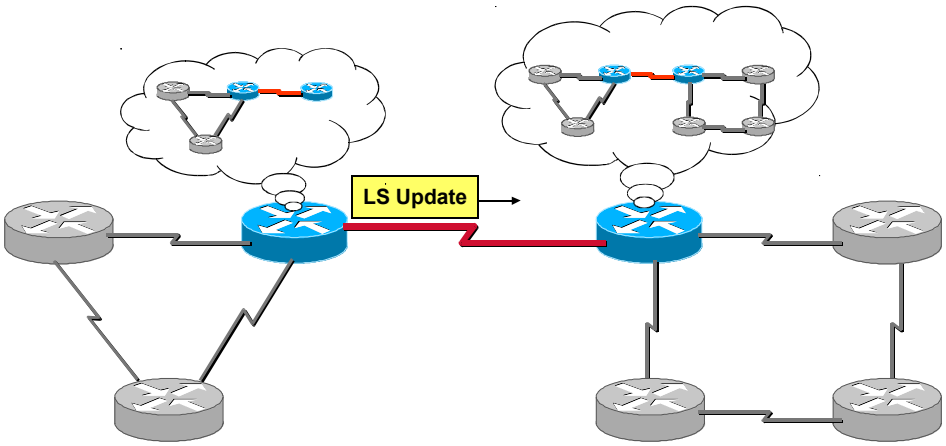
- **Loading State:**
  - **One router (here the right one) recognizes some missing links and asks for detailed information using a "Link State Request" (LSR) packet...**



The reciever checks its database, sees it is a new information and requests a detailed information with Link State Request packet LSR.

Basic Principle (7)

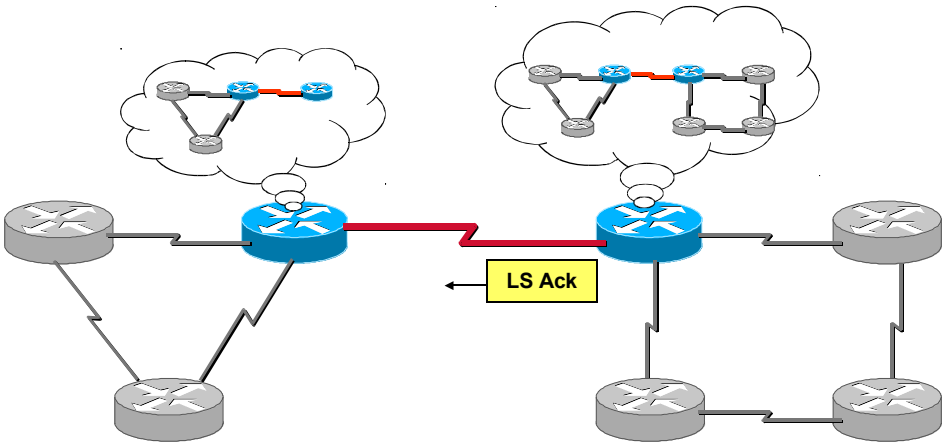
- The left router replies immediately with the requested link information, using a "Link State Update" (LSU) packet ...



As a reply the left router sends a Link State Update packet LSU which contains detailed information about requested links.

Basic Principle (8)

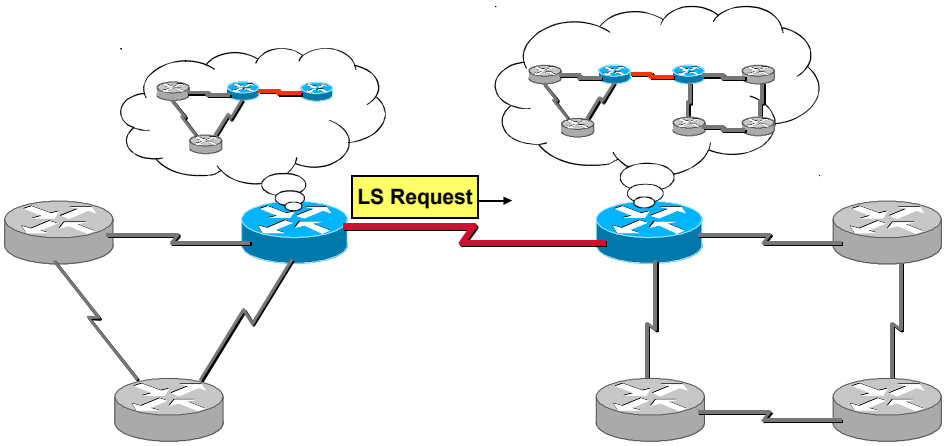
- The right router is very thankful, and returns a "Link State Acknowledgement"...



Link State Acknowledgement LSAck is used to make sure that the information is recieved.

Basic Principle (9)

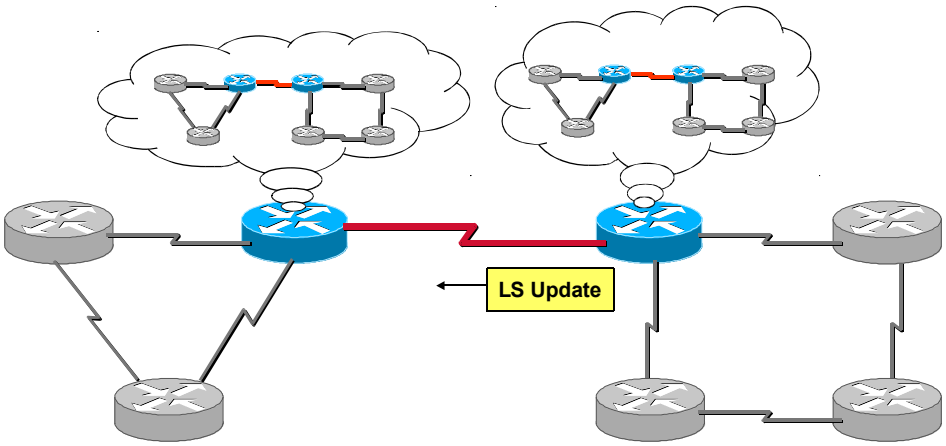
- **Then the left router recognizes some unknown links and asks for further details...**



LSR is sent in the other direction asking for detailed information.

Basic Principle (10)

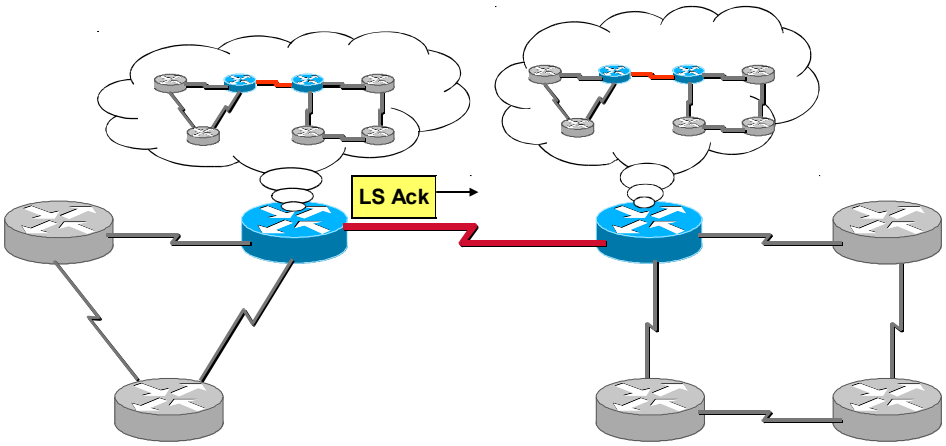
- The right router sends detailed information for the requested unknown links...



Then a LSU is sent back.

Basic Principle (11)

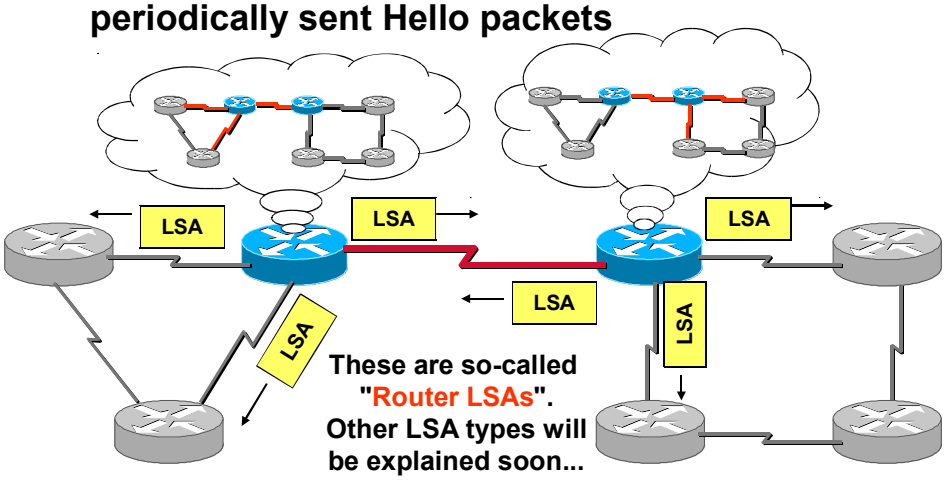
- The left router replies with a link state acknowledgement – a new adjacency has been established...
  - Neighbors are "fully adjacent" and reached the "full state"



LSAck – saying thanks for info.

Basic Principle (12)

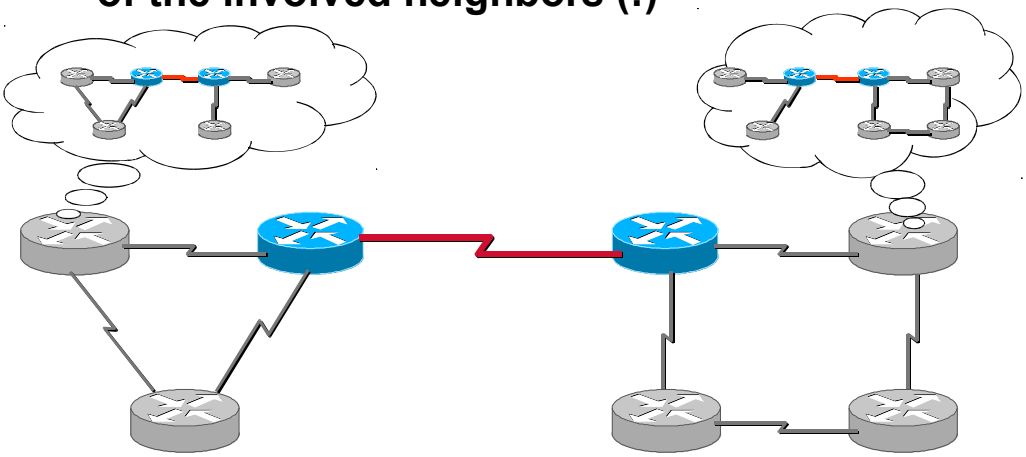
- Both routers tell all other routers about all local adjacencies by flooding link state advertisements (LSAs)
- Both routers now see their own IDs listed in the periodically sent Hello packets



Now the both routers have a new information in their databases. This information is flooded to all othe adjacent routers as a router LSA or LSA type 1 in wich the router sends information about its own links.

Database Inconsistency

- When connecting two networks, LSA flooding only distributes information of the local links of the involved neighbors (!)



It might happen if you connect two existing networks together. Some routers may miss a new information.

Solutions

- Every router sends its LSAs every 30 minutes (!)
  - Long inconsitency times
- Optionally flash updates configured
  - Upon receiving an LSA a router not only forwards this LSA but also immediately sends its own LSAs
  - Cisco default (can be turned off)

According to RFC to solve a problem each router sends a so-called refreshment LSA every 30 minutes.

Finally: Convergence!

- When LSAs are flooded, OSPF is quiet (at least for 30 minutes)
- Only Hello's are sent out on every interface to check adjacencies
  - Topology changes are quickly detected
  - Default Hello interval: 10 seconds (LAN, 60 sec WAN)
  - Hellos are terminated by neighbors

After fooding the routers are recalculating their routing tabeles, using SPF algorithm. There are no periodic updates like in RIP. Just Hello packets are sent every 10 seconds by default. If a router does not get a Hello from the neigbour for 40 seconds, it decides the neigbour is dead and this is a dead interval, which is 4 times the hello interval by default.