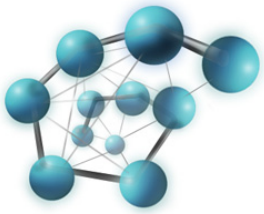


OSPF – Areas

Why OSPF *is* Complicated
Part 2

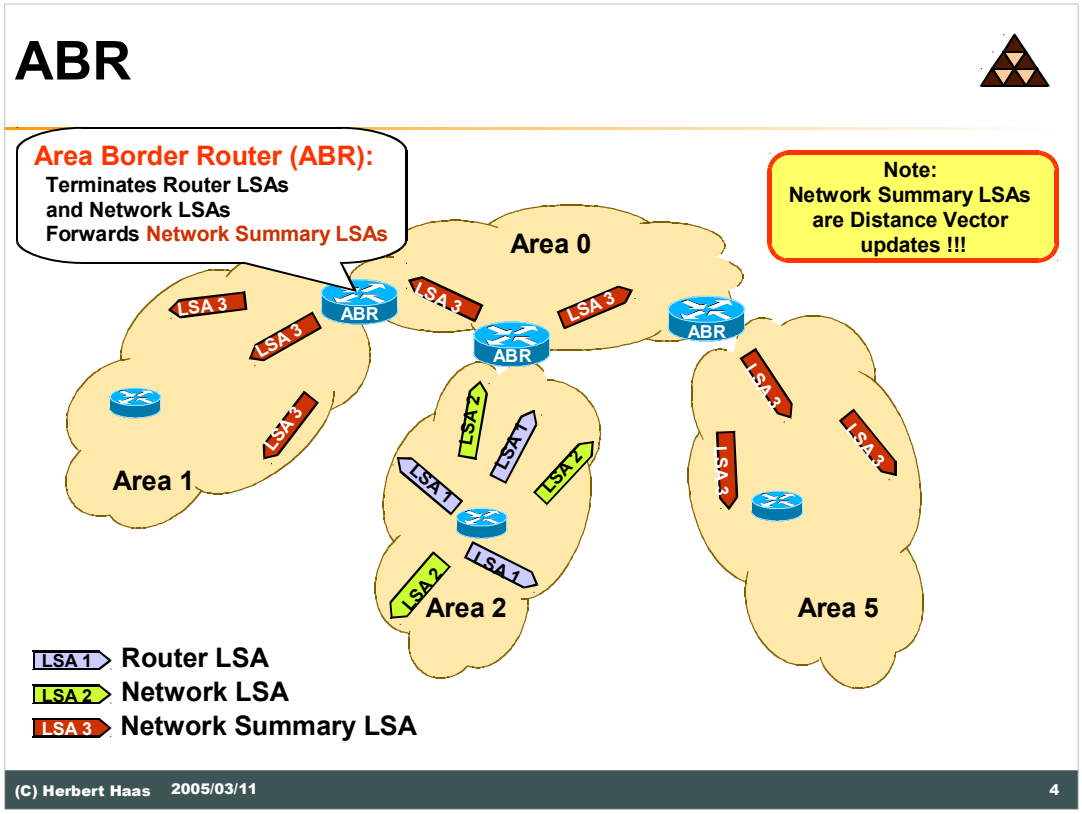
“An algorithm must be seen to be believed”

Donald .E. Knuth

OSPF Areas

- To improve performance divide the whole OSPF domain in multiple Areas
- Restrict Router LSA and Network LSA within these Areas
- All areas must be connected to the so-called "Backbone Area"
  - "Area 0"

As each link is identified by a router LSA in the OSPF database, the total OSPF routing traffic increases with the number of links and thus with the size of the network. Also the amount of network LSA will increase in larger networks. The basic idea of OSPF to overcome these limitations is to partition the whole OSPF domain into smaller "areas". The basic idea is to filter router LSAs and network LSAs on the borders between areas. Network reachabilities from outside is advertised through other LSA types. These details are discussed next.



Traffic from one area to another area flows through dedicated routers only, so called Area Border Routers (ABRs). The ABRs filter Router LSAs and Network LSAs. Network destinations in other areas are advertised by so-called "Network Summary LSAs", which carry simple distance-vector information i. e. which networks can be reached by which ABR.

Actually, we will deal with the following OSPF router types:

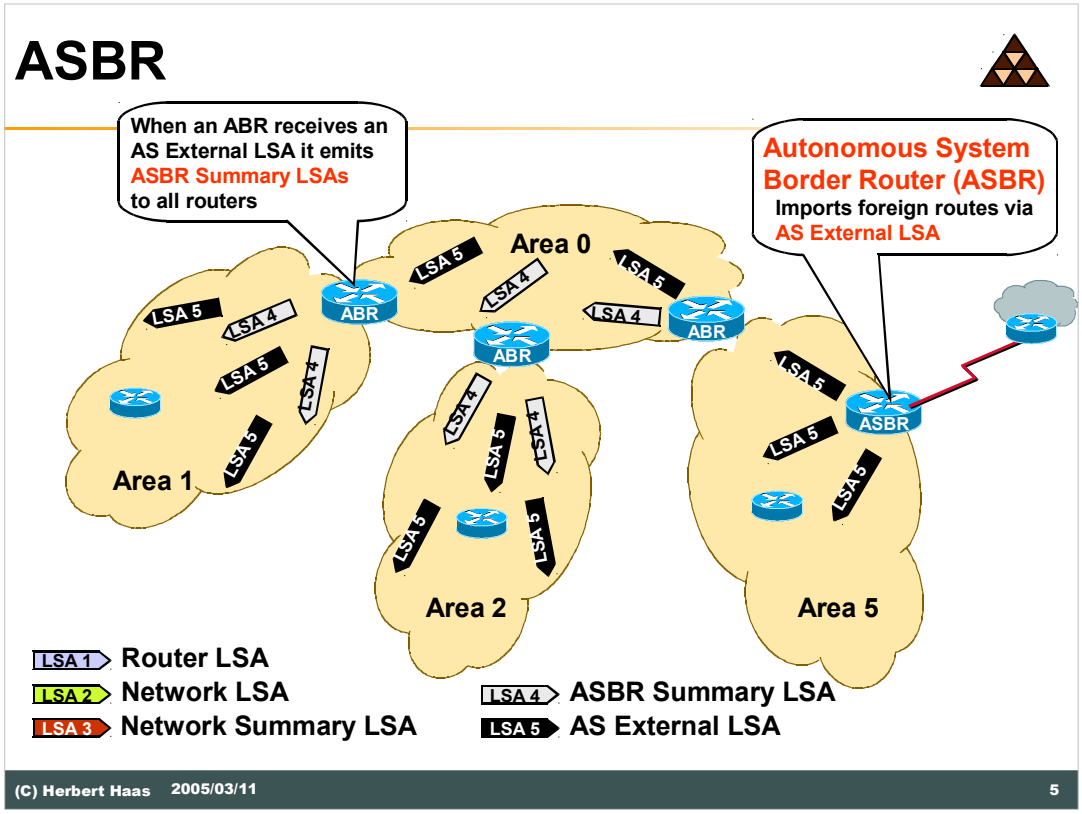
Internal Routers (IR): Has all interfaces inside an area

Backbone Routers (BR): Has at least one interface in the backbone area

Area Border Routers (ABR): Has interfaces in at least two areas

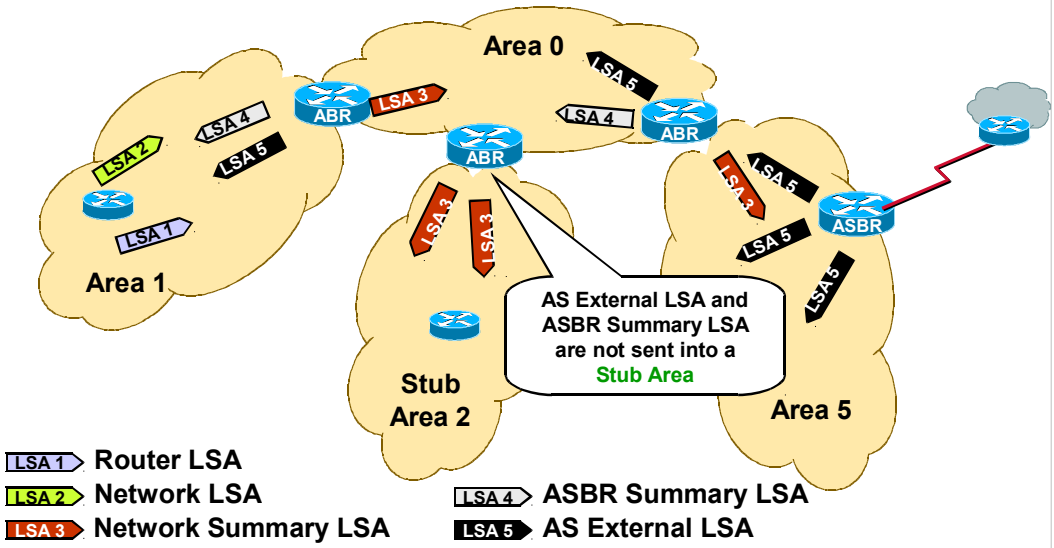
Autonomous System Boundary Routers (ASBR): Has at least one interface in a non-OSPF domain; redistributes external routes into the OSPF domain

ASBRs are discussed next.



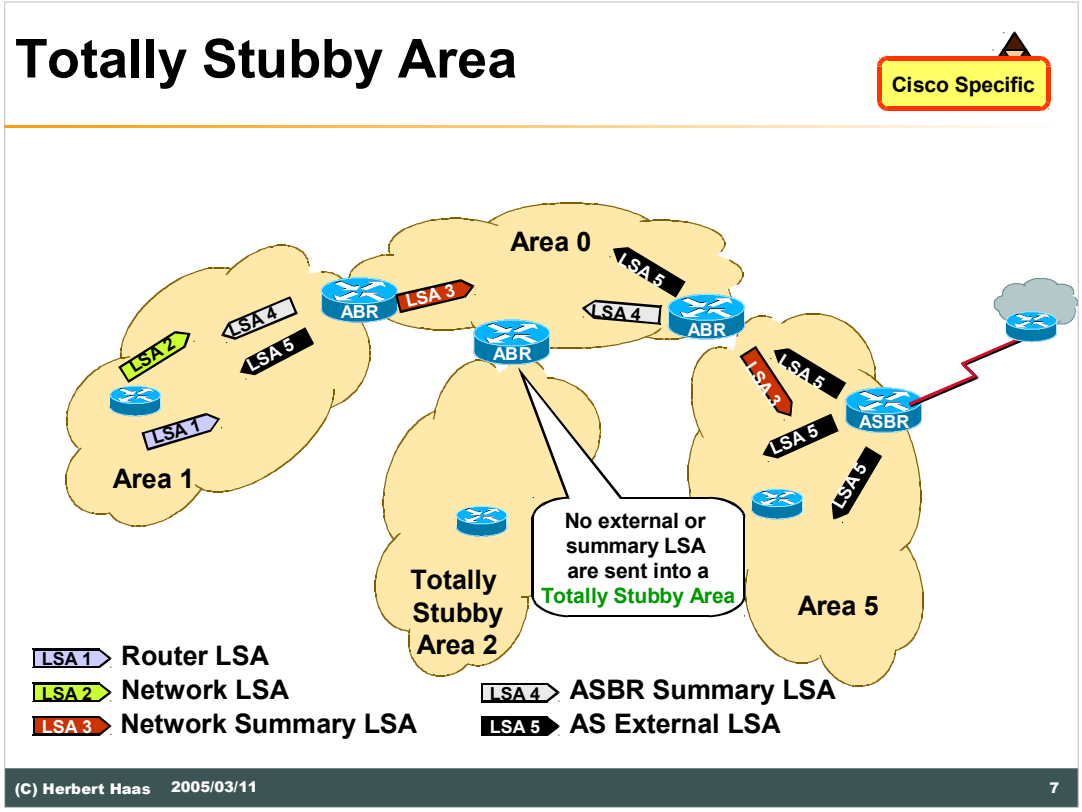
An **Autonomous System Border Router (ASBR)** sends the summary information about foreign networks to OSPF networks, using LSA type 5. On ASBRs you have to run 2 routing processes: OSPF and some other routing protocol—the router **redistributes** routing infomation between OSPF and other routing process.

Stub Area



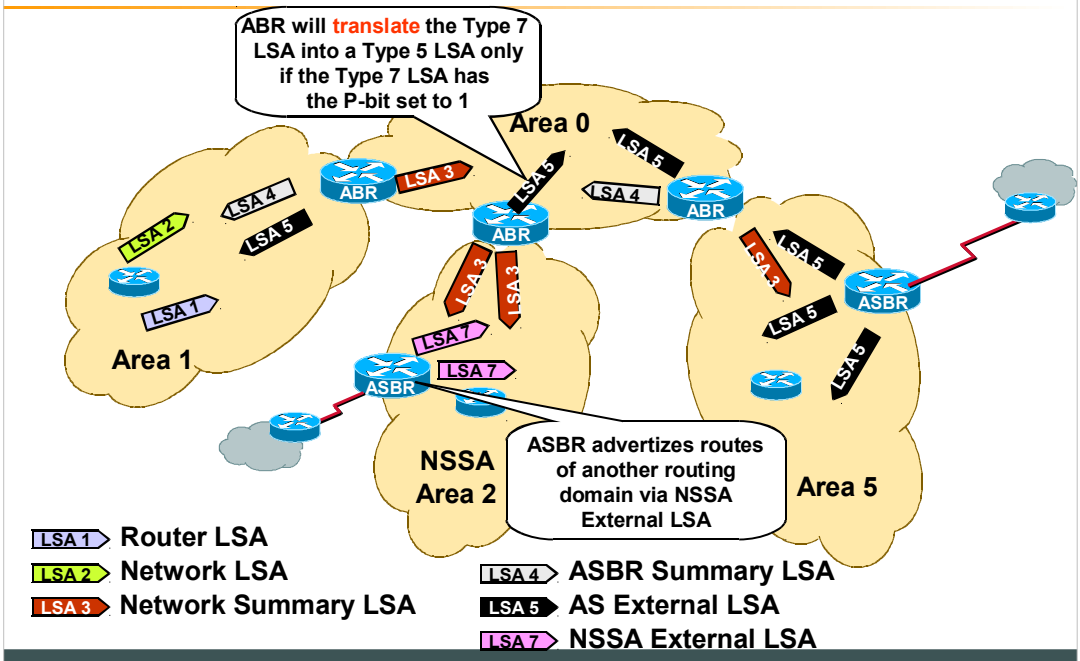
(C) Herbert Haas 2005/03/11 6

An ASBR could send a lot of external routes, tose will be flooded into OSPF network. ABRs propogate this information into other OSPF areas, each router in the area knows all external links and they are stored in link state database. In order to reach the external destination, the router still needs to send a packet to ABR. We can make a database of internal router smaller, if we create a stub area. A stub area means that ABR does not sent an external LSAs into this area, instead ABR advertises a default route (0.0.0.0)



A Cisco‘s propritary extention to the Stub Area. The ABR will not advertise an external LSAs, like into a stub area, in addition ABR will not send a summary LSAs from other areas, instead a default route is injected into Totally Stubby area.

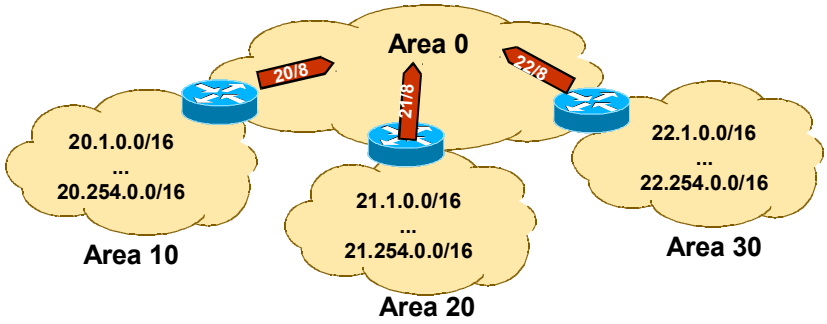
Not So Stubby Area (NSSA)



The NSSA ASBR has the option of setting or clearing the P-bit in the NSSA External LSA. If the P-bit is set any ABR will translate this LSA into an AS External LSA (Type 5).

Summarization

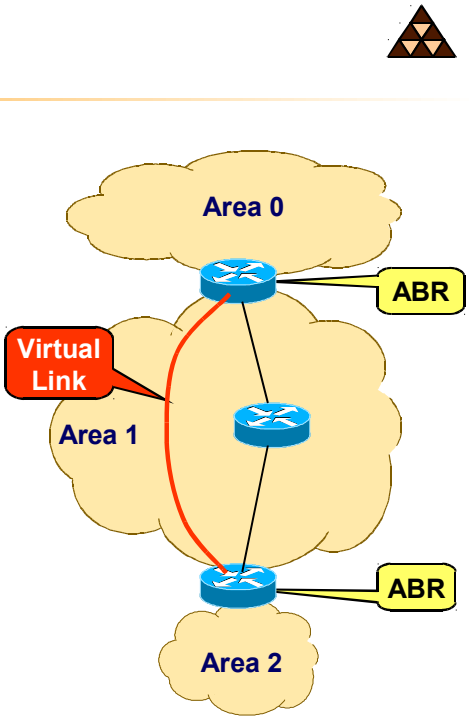
- Efficient OSPF address design requires hierarchical addressing
- Address plan should support summarization at ABRs



(C) Herbert Haas 2005/03/11 9

Summarization is an other way to keep a router database smaller. The ABR instead of sending each single subnet from the area, creates a summary route and advertises it into a different area. Note that summarization is turned off by default (i. e. must be explicitly turned on).

Virtual Links

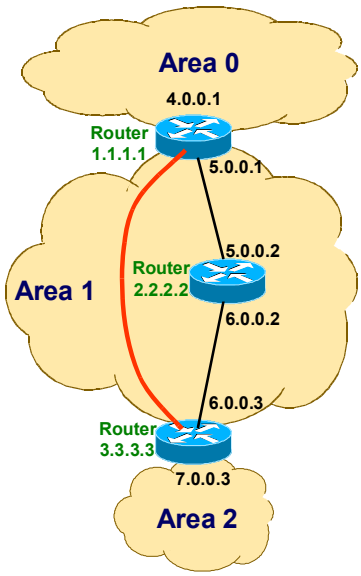


- Another way to connect to area 0 using a point-to-point unicast tunnel
- Transit area must have full routing information
  - Must *not* be stub area
- Bad Design!

An OSPF design requires that all areas have to be contiguous and must be connected to the backbone area. If it is not a case, like on the slide, you have to use a Virtual Link in order to connect area 2 to area 0 A virtual link is considered as part of area 0 thus the area ID is 0.0.0.0.

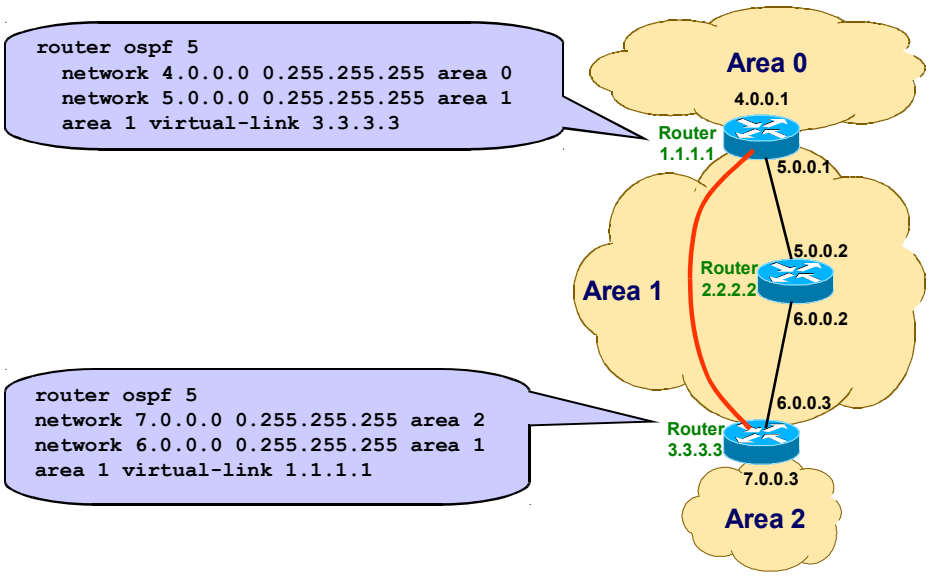
Virtual Link Example

- Now router 3.3.3.3 has an interface in area 0
- Thus router 3.3.3.3 becomes an ABR
  - Generates summary LSA for network 7.0.0.0/8 into area 1 and area 0
  - Also summary LSAs in area 2 for all the information it learned from areas 0 and 1



A router 3.3.3.3 is now connected to area 0 „directly“ and like a normal ABR generates a summary LSAs in both directions

Virtual Link Configuration Example



Note virtual link goes to a router ID on the other end not to an ip address on the interface

GRE instead of Virtual Link

- Alternative solution
- Good: Transit area can be a also a stub area
- Bad: All traffic is encapsulated
  - Not only routing traffic
  - Increased overhead

In some cases it is not possible to use a virtual link, as a possible solution ap ip tunnel could be implemented.

Summary

- Area concept supports large networks
  - Keeps topology table small
  - Reduces routing traffic
- But additional LSA types necessary
- Inter-Area Routing is Distance Vector
- Originally OSPF designed for ToS routing – too resource greedy!

Quiz

- When should we split the OSPF domain into areas?
- What about Areas and addressing plans?
- Why must all areas be connected to the backbone area?