Choosing an IGP 101

James Blessing, NetMCR, 9th Feb 2017

Why an IGP?

- Get packets round your network
- This is 101, there are other things you can do (like iBGP in DC, see RFC7938)
- Networks change (usually)

Choices , choices, choices…

- Static Routes
- RIP
- EIGRP
- OSPF
- IS-IS

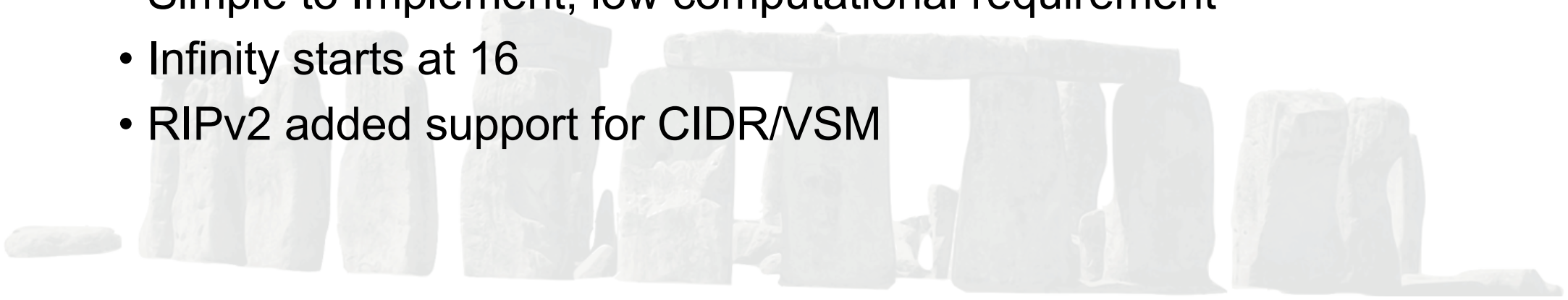
Static Routes

- Go over there…
- Everyone uses it (somewhere)
- Could be used with SDN*

*joke

RIP

- Created in 1988 in RFC 1058, updated in RFC1388 (RIPv2 93) and RFC2483 (98)
- Distance Vector based solution
  - Update all routes periodically
    - High bandwith
    - Slow conversion times
    - Poor control of DV
- Simple to Implement, low computational requirement
- Infinity starts at 16
- RIPv2 added support for CIDR/VSM



EIGRP

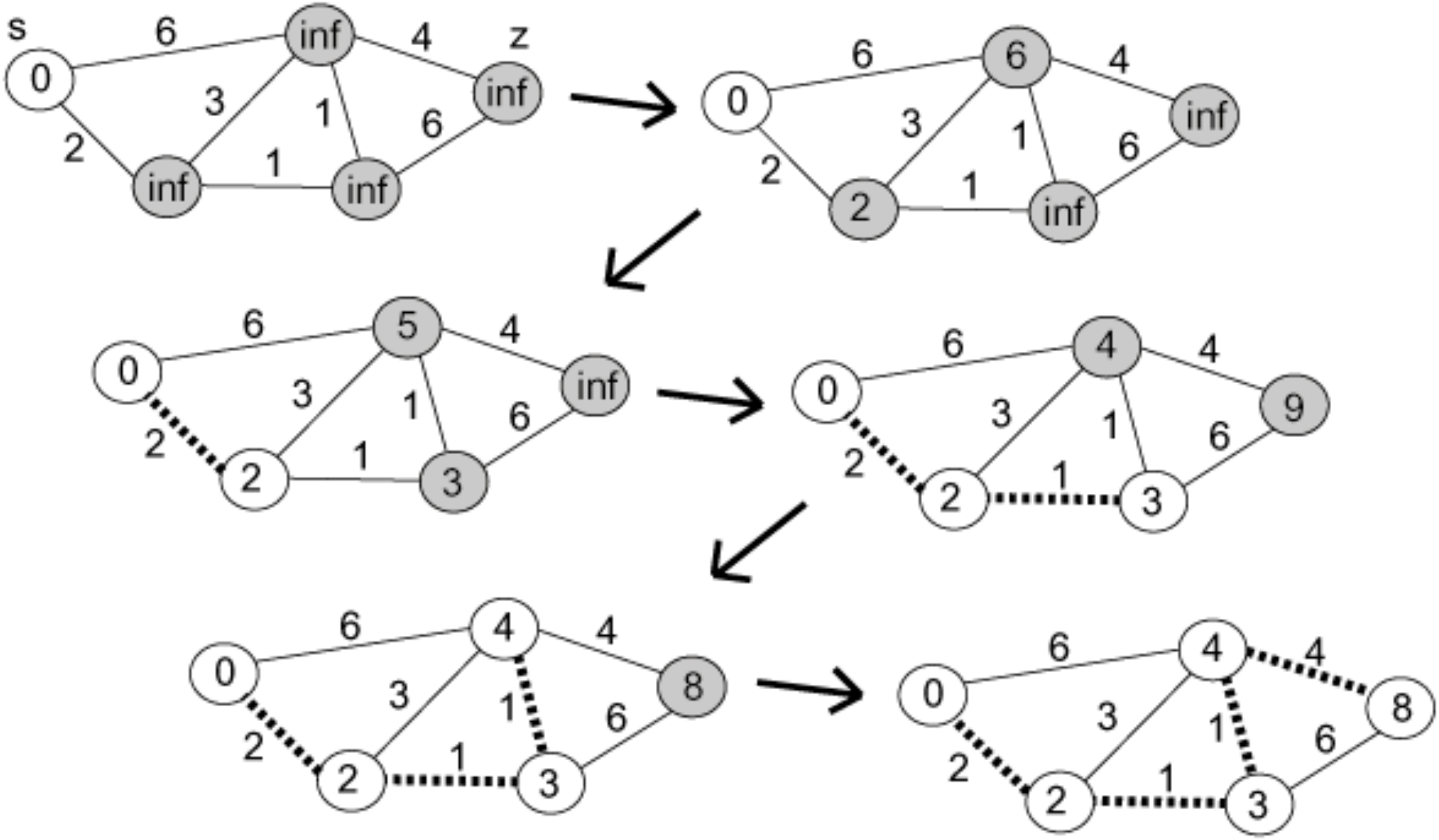
- CISCO Proprietary
- Metric for each link based on delay and bandwidth (and other things)
- General form:

  *Metric = [K1 * Bw + K2 * Bw/(256 - Load) + K3 * Delay] * [K5/(Reliability + K4)]*

- Works for stable networks, only updates on changes
- Redistributing Metric can cause issues with other IGPs

Comparing ISIS and OSPF

- Both are Link State Routing Protocols using the Dijkstra SPF Algorithm
- So what's the difference then?
- And why do ISP engineers end up arguing so much about which is superior?


s
z
0
6
inf
4
inf
3
1
6
2
inf
1
inf
6
6
4
0
3
1
inf
2
1
6
2
inf
6
5
4
0
3
1
inf
2
1
6
2
3
6
4
4
0
3
1
9
2
1
6
2
3
6
4
4
0
3
1
8
2
1
6
2
3
6
4
4
0
3
1
8
2
1
6
2
3

What is IS-IS?

- Intermediate System to Intermediate System
- An “IS” is ISO terminology for a router
- IS-IS was originally designed for use as a dynamic routing protocol for ISO CLNP, defined in the ISO 10589 standard
- Later adapted to carry IP prefixes in addition to CLNP (known as Integrated or Dual IS-IS) as described in RFC 1195
- Predominantly used in ISP environment
- ITU-T mandates it for SDH

What is OSPF ?

- Open Shortest Path First
- Link State Protocol using the Shortest Path First algorithm (Dijkstra) to calculate loop-free routes
- Used purely within the TCP/IP environment
- Designed to respond quickly to topology changes but using minimal protocol traffic
- Used in both Enterprise and SP Environment

Timeline

IS-IS

- 1978ish “New” Arpanet Algorithm
- 1986 to 90 Decnet Phase V
- 1987 ISO 10589 (IS-IS)
- 1990 RFC 1195 (Integrated IS-IS)
- 2008 RFC5308 adds IPv6 support and RFC5120 adds Multi-Topology Routing support

OSPF

- 1987 Development by IETF
- 1989 OSPFv1 RFC1131
- 1991 OSPFv2 RFC1247
- 1999 RFC2740 introduced OSPFv3 (for IPv6)
- 2008 replaced by RFC5340

IS-IS & OSPF: Similarities

- Both are Interior Gateway Protocols (IGP)
  - They distribute routing information between routers belonging to a single Autonomous System (AS)
- With support for:
  - Classless Inter-Domain Routing (CIDR)
  - Variable Subnet Length Masking (VLSM)
  - Authentication
  - Multi-path
  - IP unnumbered links

IS-IS and OSPF Terminology

OSPF

- Host
- Router
- Link
- Packet
- Designated router (DR)
- Backup DR (BDR)
- Link-State Advertisement (LSA)
- Hello packet
- Database Description (DBD)

ISIS

- End System (ES)
- Intermediate System (IS)
- Circuit
- Protocol Data Unit (PDU)
- Designated IS (DIS)
- N/A (no BDIS is used)
- Link-State PDU (LSP)
- IIH PDU
- Complete sequence number PDU (CSNP)

IS-IS and OSPF Terminology (Cont.)

OSPF

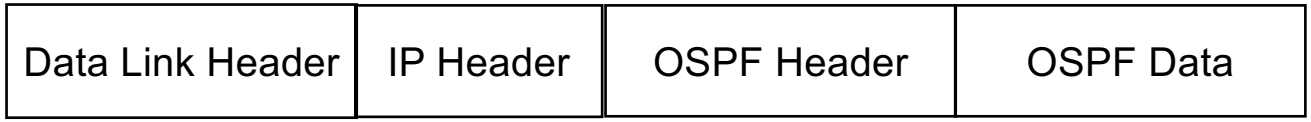
- Area
- Non-backbone area
- Backbone area
- Area Border Router (ABR)
- Autonomous System Boundary Router (ASBR)

ISIS

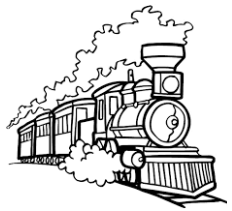
- Sub domain (area)
- Level-1 area
- Level-2 Sub domain (backbone)
- L1L2 router
- Any IS

Transport

- OSPF uses IP Protocol 89 as transport



- IS-IS is directly encapsulated in Layer 2



Which should I choose?

- Both OSPF and ISIS use Dijkstra SPF algorithm
- Exhibit same convergence properties
- ISIS less widely implemented on router platforms
- ISIS runs on data link layer, OSPF runs on IP layer

Biggest ISPs tend to use ISIS – why?

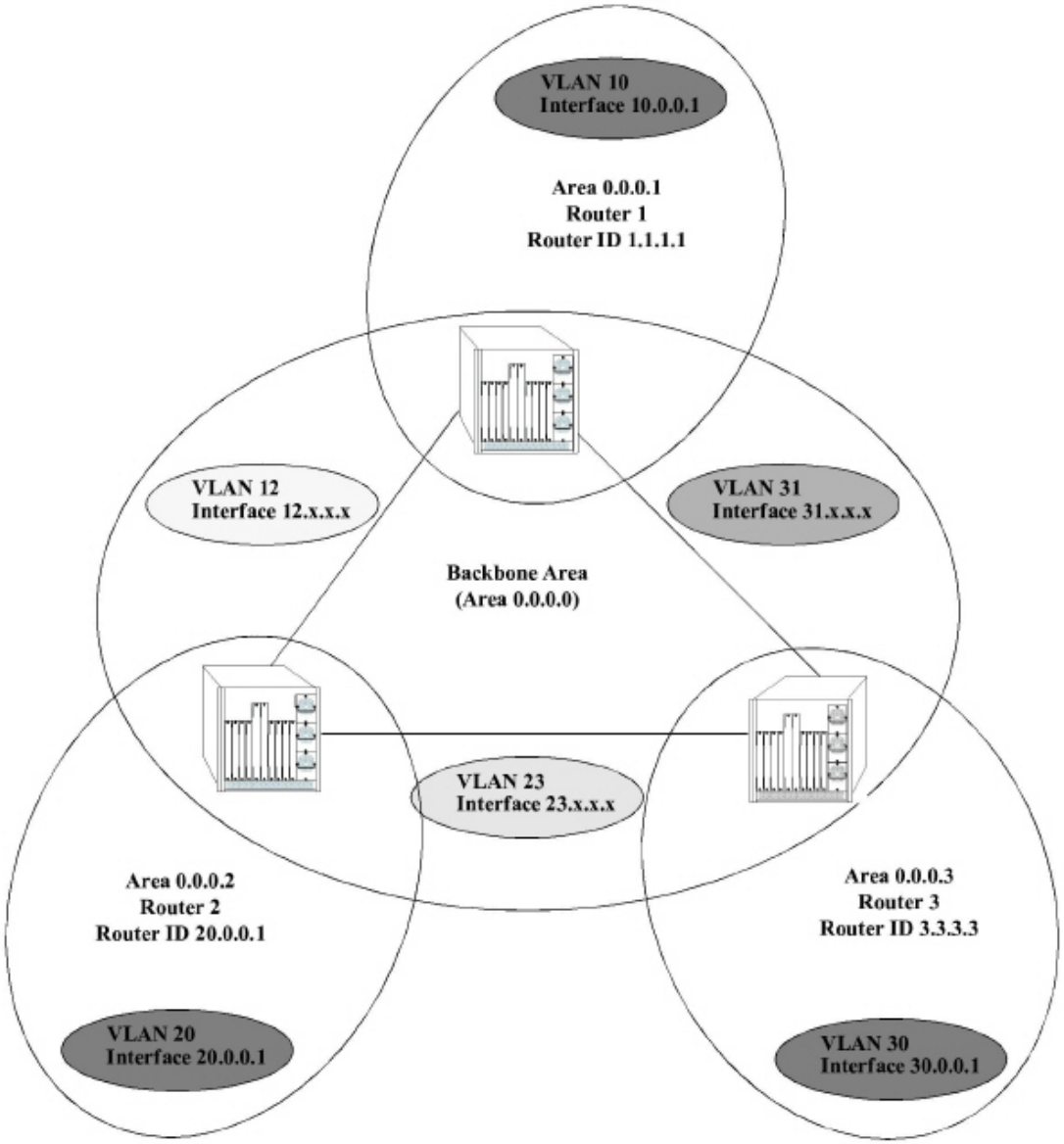
- In early 90s, Cisco implementation of ISIS was much more solid than OSPF implementation – ISPs naturally preferred ISIS
- Main ISIS implementations more tuneable than equivalent OSPF implementations – because biggest ISPs using ISIS put more pressure on Cisco to implement “knobs”

Moving forward a decade

- Early Cisco OSPF implementation substantially rewritten
  - Now competitive with ISIS in features and performance
- Router vendors wishing a slice of the core market need an ISIS implementation as solid and as flexible as that from Cisco
  - Those with ISIS & OSPF support tend to ensure they exhibit performance and feature parity

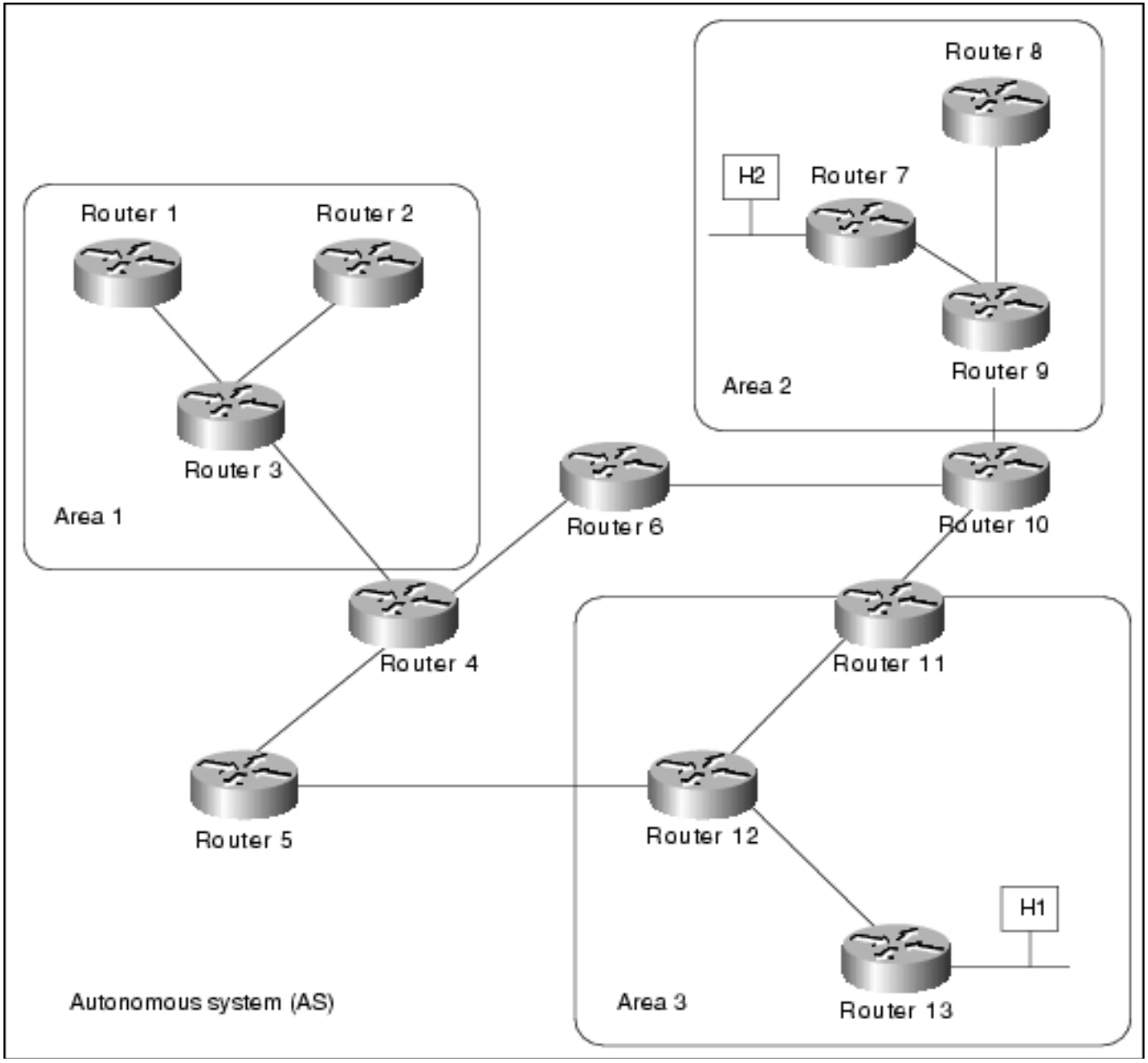
How to choose an IGP?

- OSPF
  - Rigid area design – all networks must have area 0 core, with sub-areas distributed around
  - Suits networks with central high speed core network linking regional PoPs
  - Teaches good routing protocol design practices


VLAN 10
Interface 10.0.0.1
Area 0.0.0.1
Router 1
Router ID 1.1.1.1
VLAN 12
Interface 12.x.x.x
VLAN 31
Interface 31.x.x.x
Backbone Area
(Area 0.0.0.0)
VLAN 23
Interface 23.x.x.x
Area 0.0.0.2
Router 2
Router ID 20.0.0.1
VLAN 20
Interface 20.0.0.1
Area 0.0.0.3
Router 3
Router ID 3.3.3.3
VLAN 30
Interface 30.0.0.1

How to choose an IGP?

- ISIS
  - Relaxed two level design – L2 routers must be linked through the backbone
  - Suits ISPs with “stringy” networks, diverse infrastructure, etc, not fitting central core model of OSPF
  - More flexible than OSPF, but easier to make mistakes too


Router 8
H2
Router 7
Router 1
Router 2
Router 9
Area 2
Router 3
Area 1
Router 6
Router 10
Router 4
Router 11
Router 5
Router 12
H1
Router 13
Autonomous system (AS)
Area 3

Other considerations

- ISIS runs on link layer
  - Not possible to “attack” the IGP using IP as with OSPF
- ISIS’s NSAP addressing scheme avoids dependencies on IP as with OSPF
- Because biggest ISPs use ISIS, major router vendors tend to apply new optimisation features before they are added to OSPF
- There is an RFC that says it should be OSPF https://tools.ietf.org/html/rfc1371 - it’s wrong (probably)

Mashup

- Noting to stop you using different IGP in different parts of network…

Questions?