Network Design Principles

Network Design Principles

Carrier grade

IP Address Management

Content

- Dynamic Routing Protocols
  - BGP
  - OSPF
- Logical Network Design
  - Switched
  - Statically Routed
  - Dynamically Routed

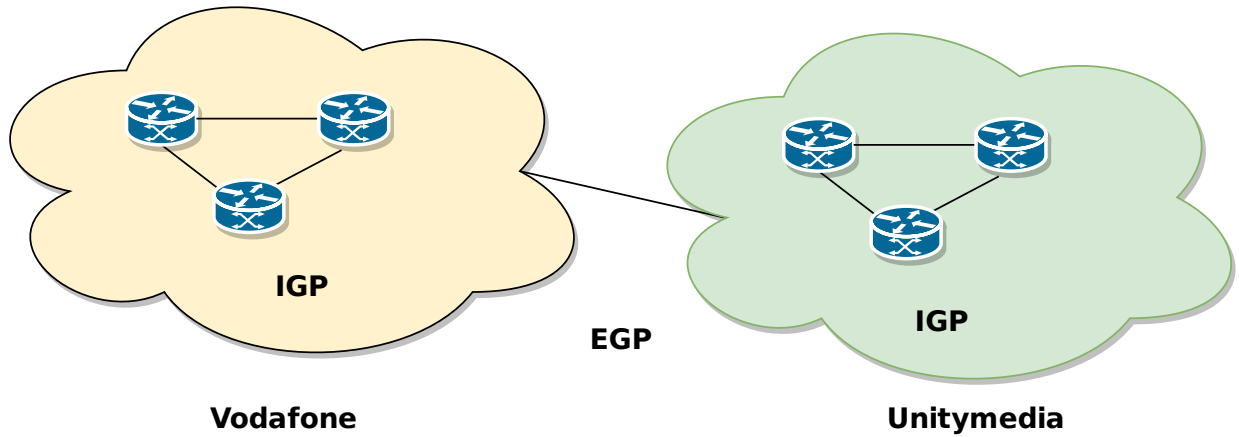
Dynamic Routing

- Why?

Dynamic Routing

- Handle failover
- Discover remote networks
- Choose the best path to the destination
- Lower configuration costs
- Lower failure points?

Dynamic Routing



- IGP = Interior Gateway Protocol
- EGP = Exterior Gateway Protocol

Dynamic Routing

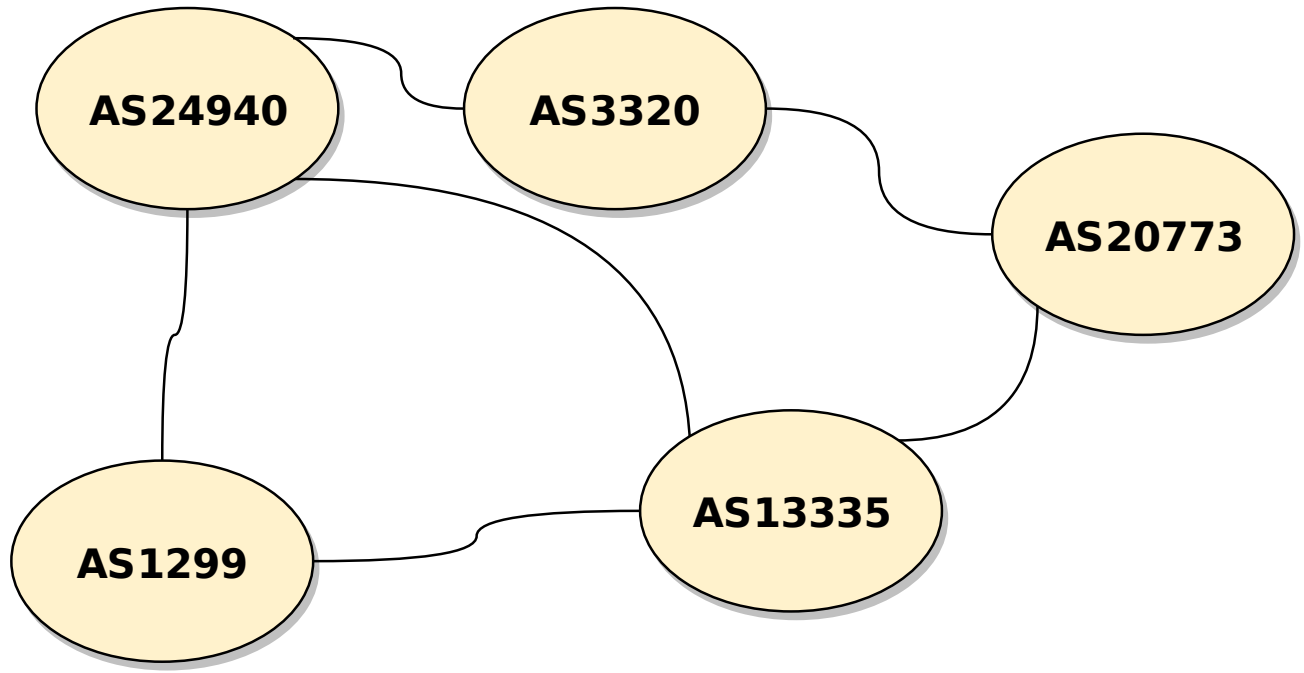
BGP

- Border Gateway Protocol
- Distance Vector Routing Protocol
- EGP
- Aggregates all vectors to the most simple one
- Pushes updates based on events
- Only talks to direct peers
- Prevents routing loops by checking the AS-Path
- Announces the configured routing table

Dynamic Routing

BGP

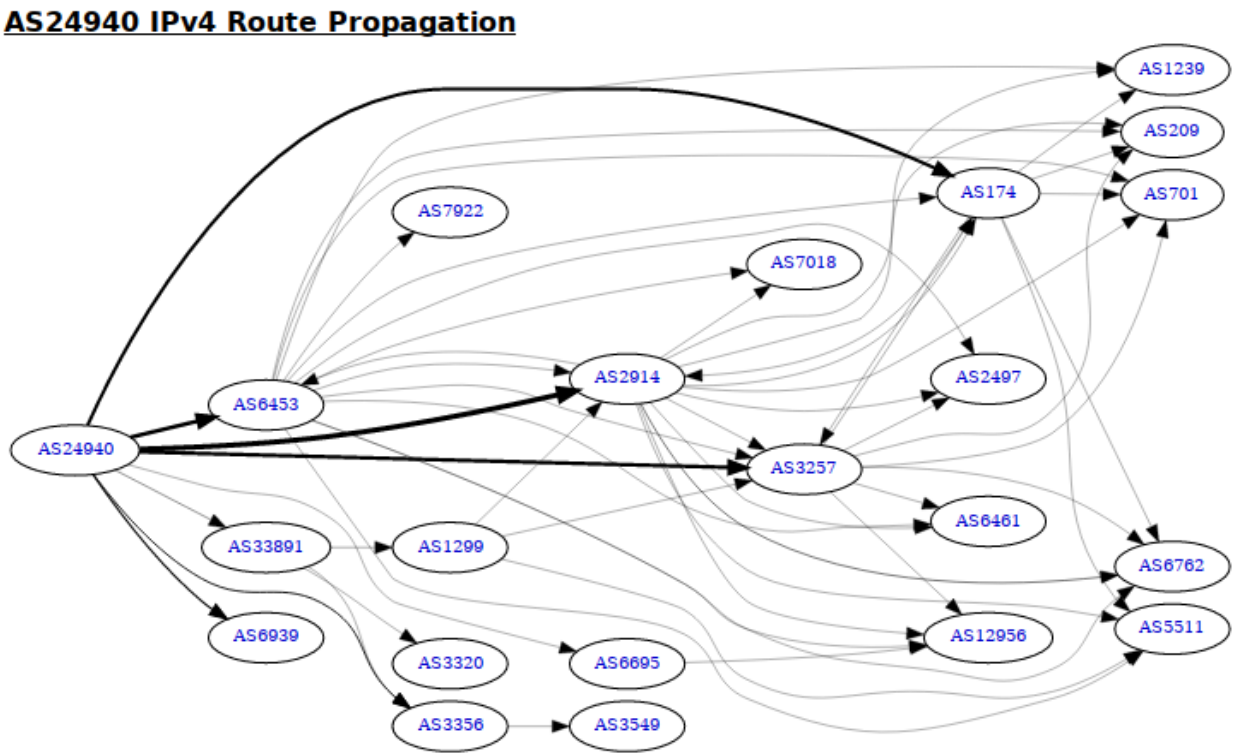
Distance Vector Routing




```
Element | Vector
------- | ----------------------------
AS24940 | AS3320
AS24940 | AS3320 -> AS20773 -> AS13335
AS24940 | AS3320 -> AS20773 -> AS1299
AS24940 | AS1299
AS24940 | AS1299 -> AS13335
```

Dynamic Routing

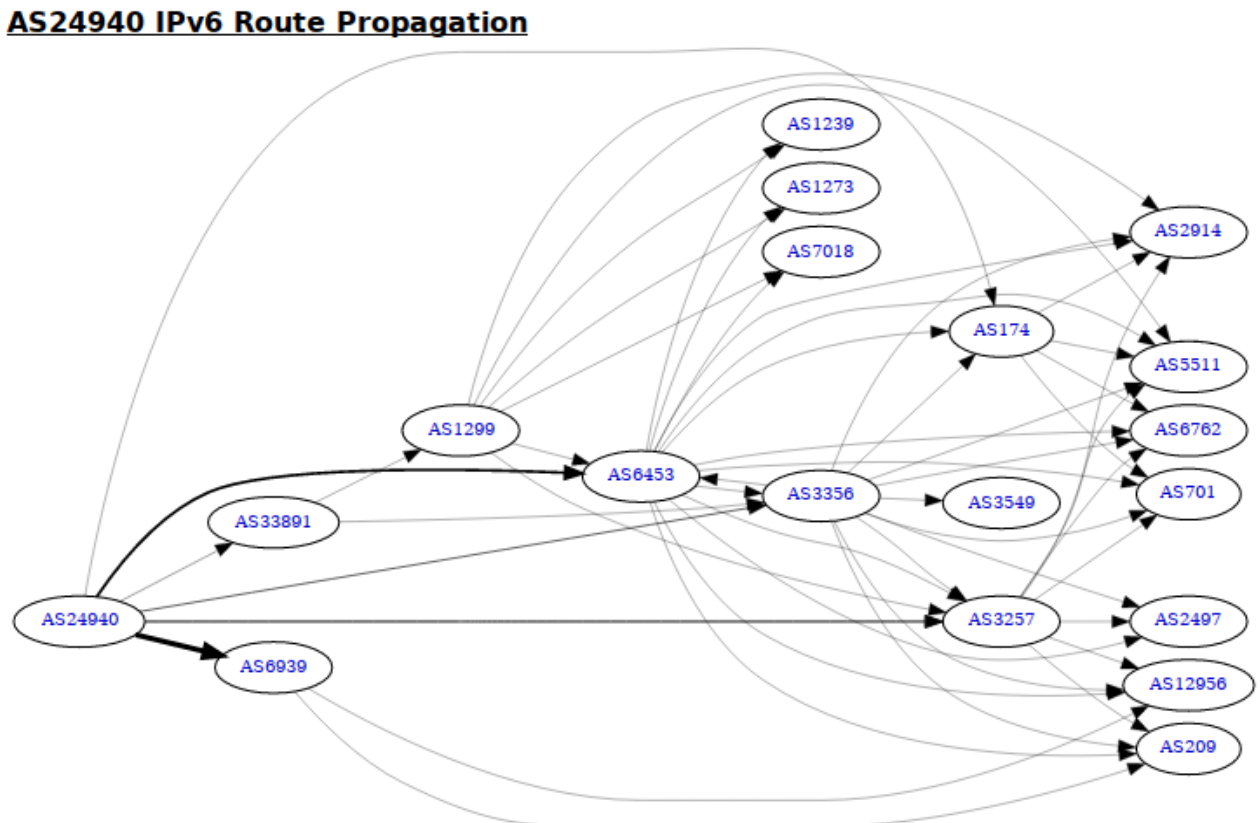
BGP



© http://bgp.he.net/AS24941#_asinfo

Dynamic Routing

BGP



© http://bgp.he.net/AS24940#_asinfo

Dynamic Routing

BGP

Route Selection

- Ignores Link-State
- Ignores Hop Count
- Honors AS-Path
- Honors propritary values

Dynamic Routing

BGP

OSPF

- Open Shortest Path First
- Link-state routing protocol
- IGP
- Interval based

Dynamic Routing

BGP

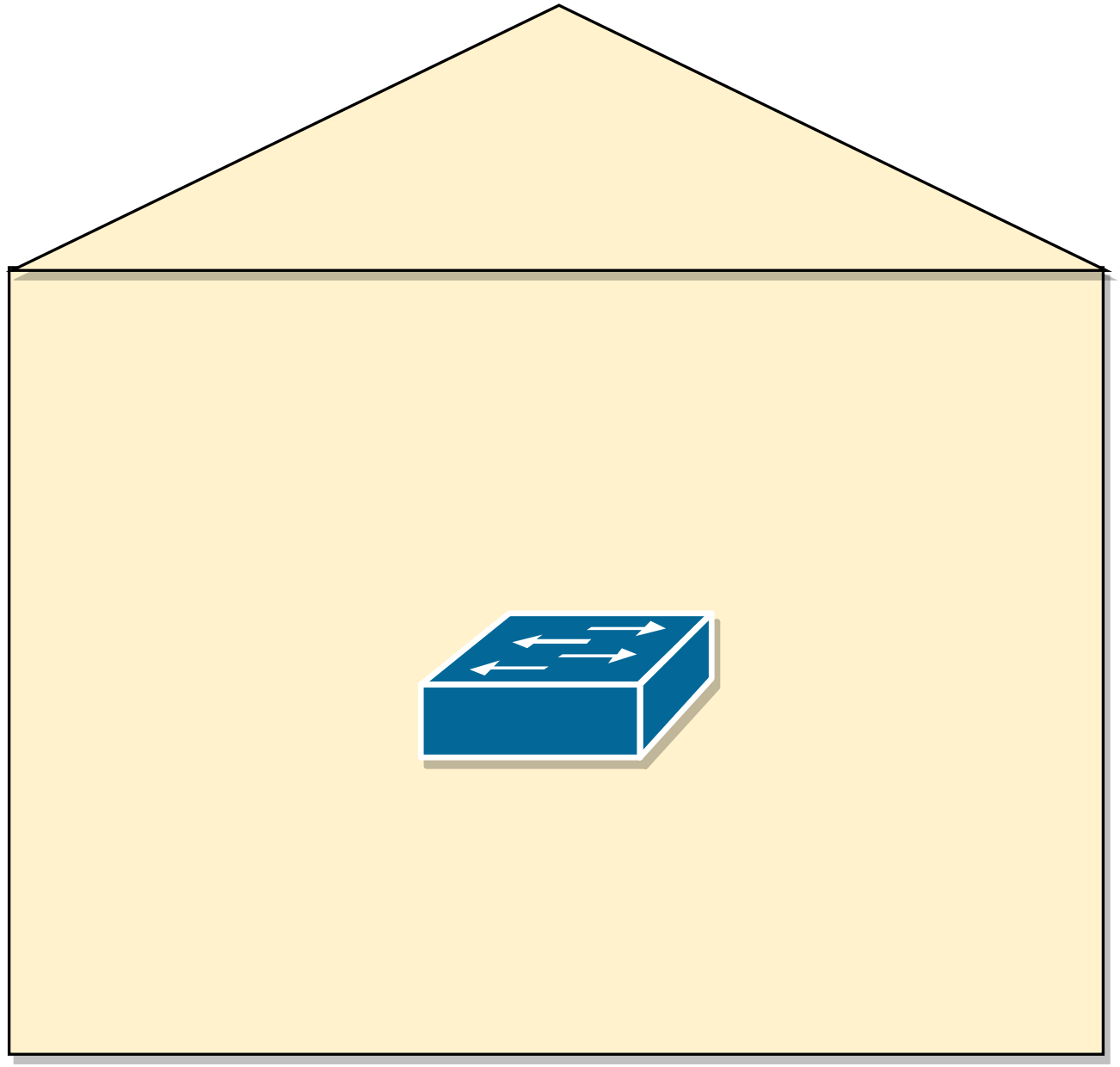
OSPF

Link-state routing

- Every router in an AS talks to every other
- Uses SPF to create a tree
- Periodically sends a flood
    - Causes a huge amount of traffic

Logical Network Design

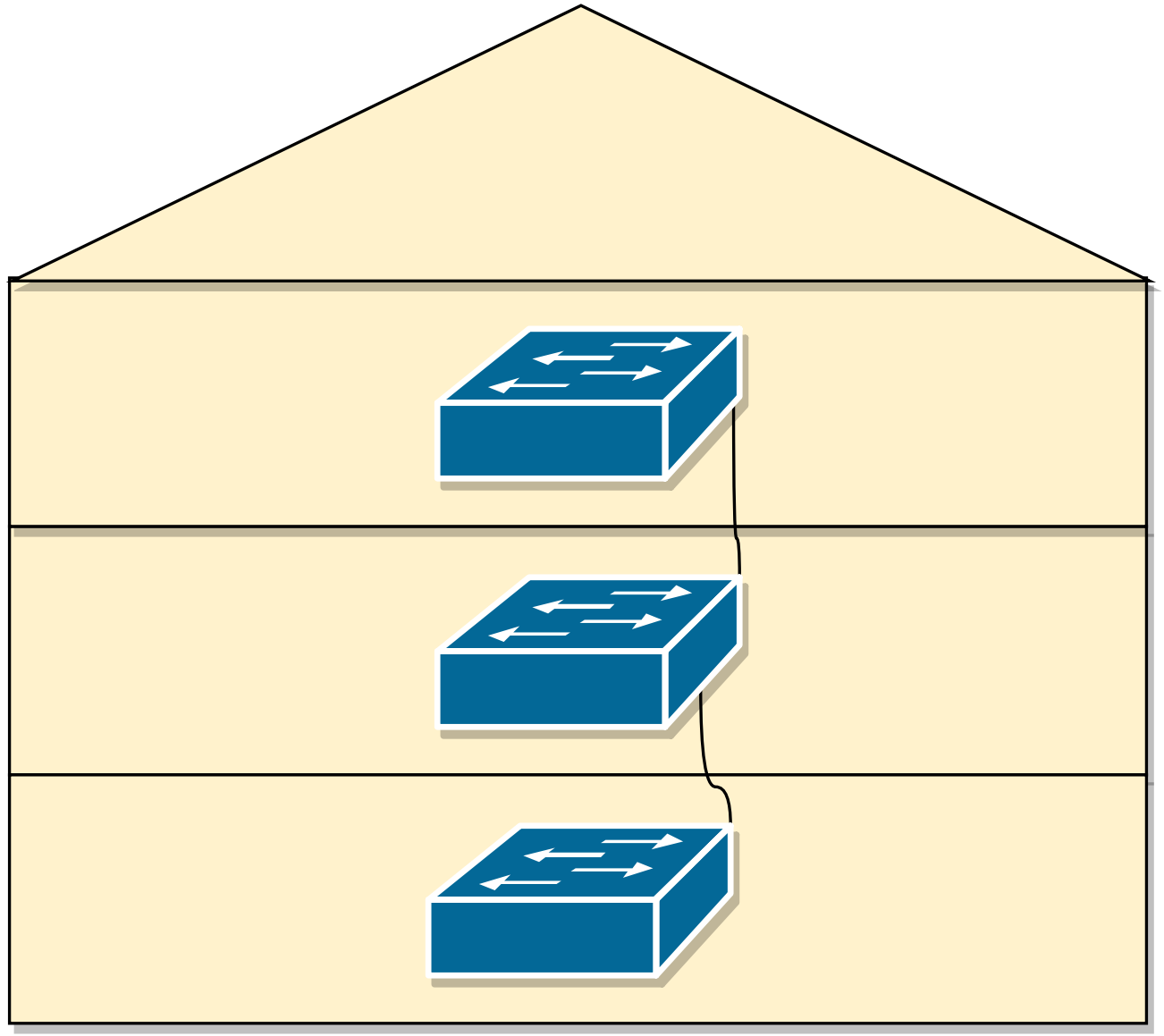
Switched



One Classroom in one house

Logical Network Design

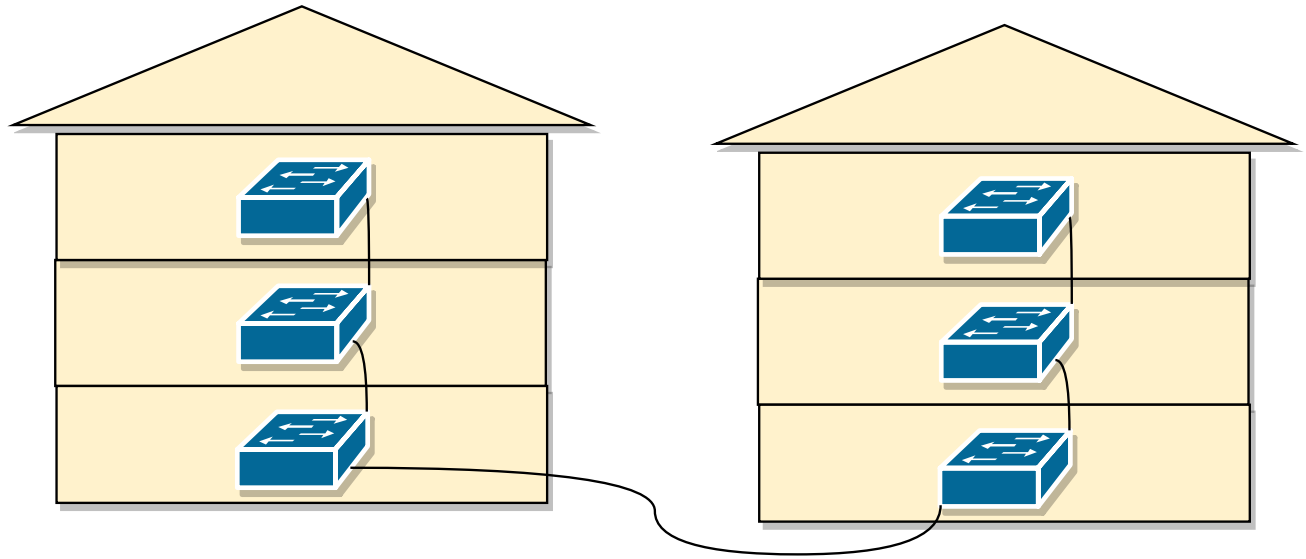
Switched



Three classrooms in one house

Logical Network Design

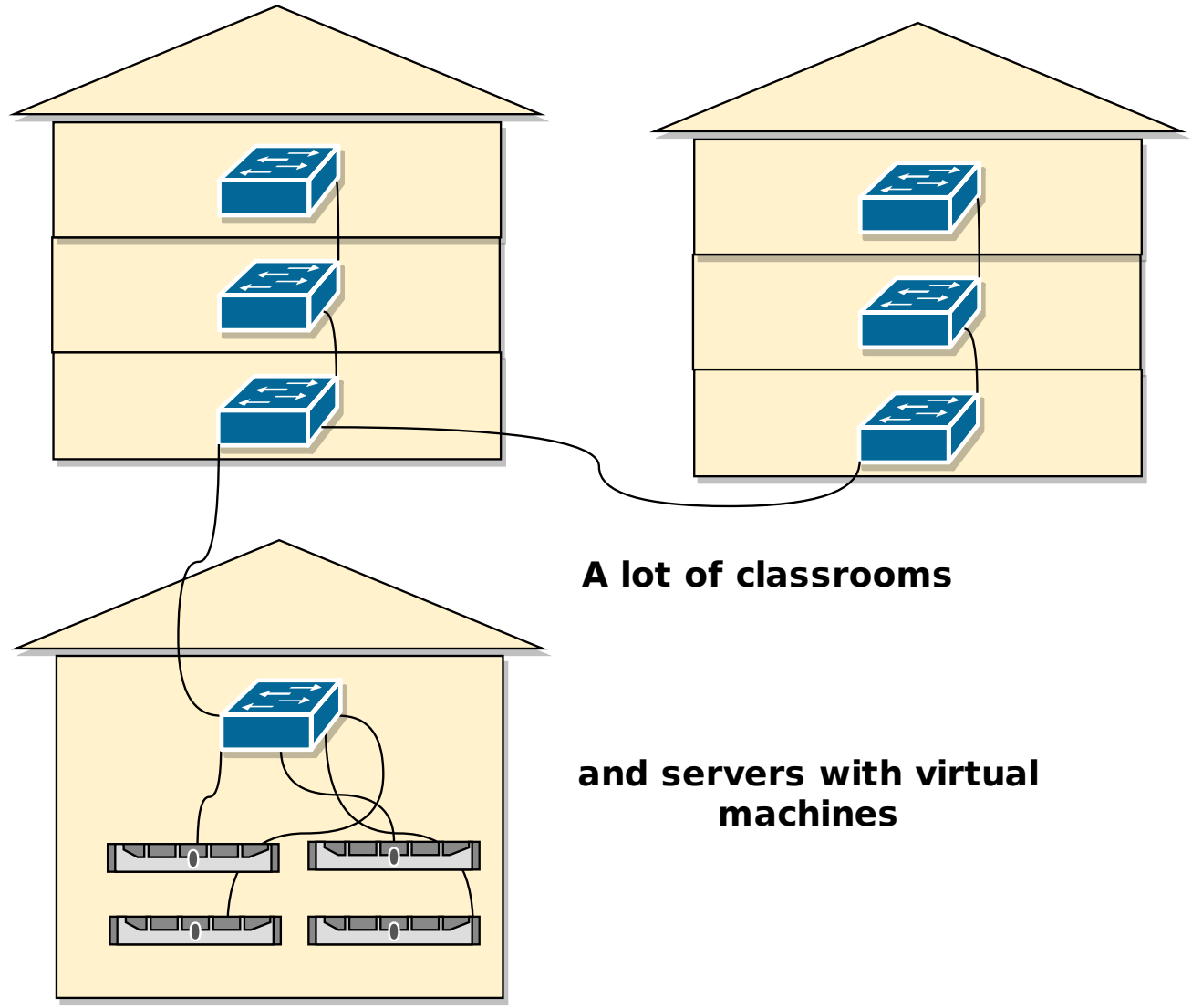
Switched



A lot of classrooms

Logical Network Design

Switched



Logical Network Design

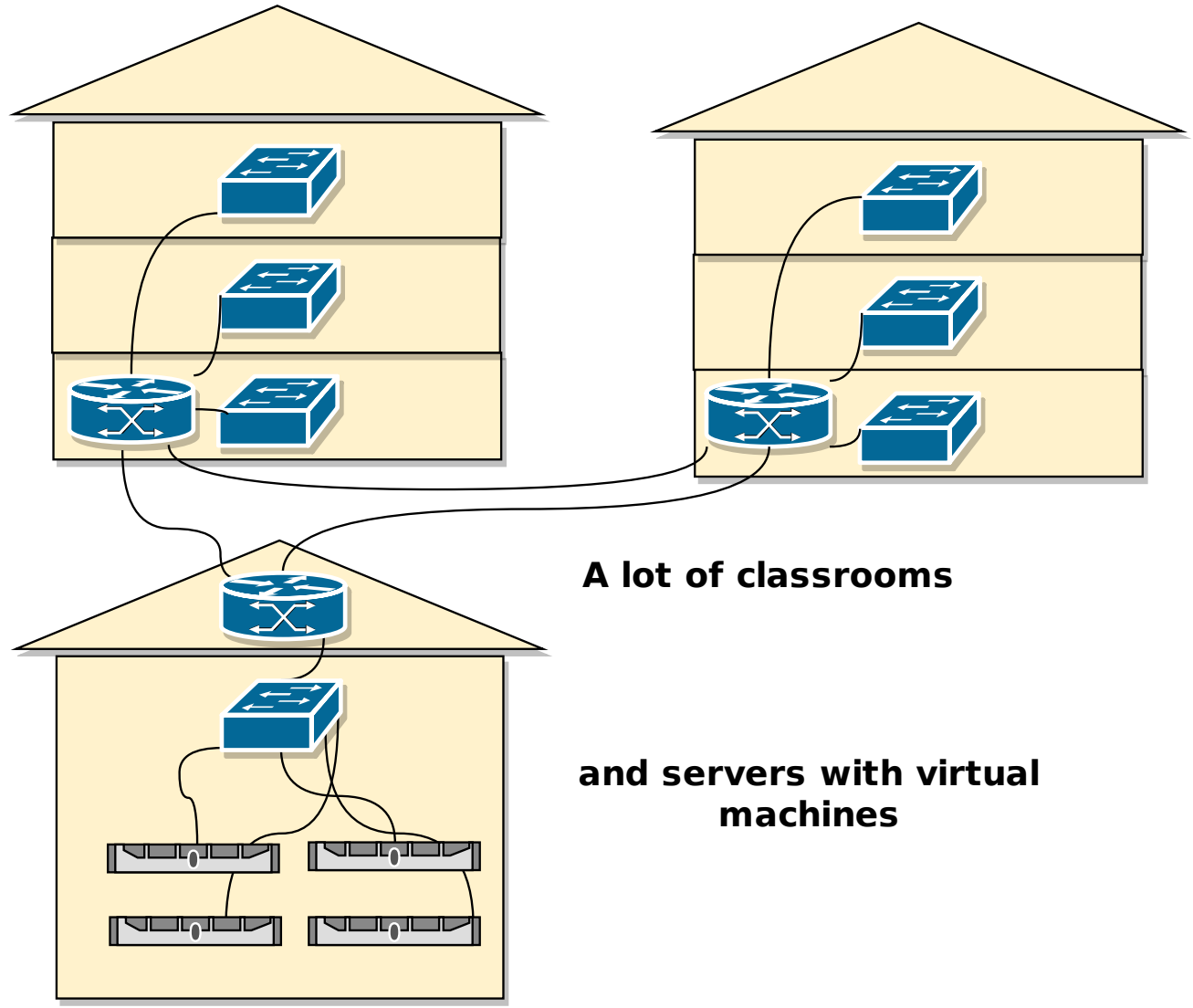
Switched

- Many SPOF, unable to mesh
  - would create loops
- CAM table size is limited
  - Content Addressable Memory = MAC table
- All switches hold up all MAC addresses in the same Layer2/VLAN
  - limit is around ~512-4096 addresses per device
  - Juniper EX2200-48T: 16.000 entries, 864€
  - Juniper EX3200-48T (EOL): 32.000 entries, 1975€
  - TP-Link T3700G-28TQ: 32.000 entries, 1698€
  - Netgear GS724Tv4: 16.000 entries, 150€

Logical Network Design

Switched

Statically Routed



- One Subnet for each switch

Logical Network Design

Switched

Statically Routed

- Static routes configured on all switches
- Works fine on Layer 2 until there are VLANs across routers
  - CAM tables will again be too big
- Requires manual configuration for routes
- Redundant ring

Logical Network Design

Switched

Statically Routed

Dynamically Routed

- Less stuff to configure by hand
- Better failover for new links
- TOR switch for hypervisors is still a bottleneck
- We could use OSPF or RIP

Logical Network Design

Switched

Statically Routed

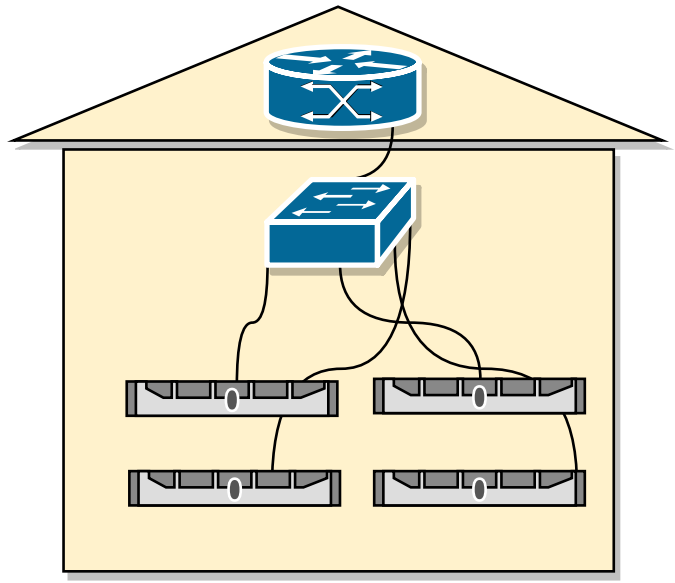
Dynamically Routed

Logical Network Design

Switched

Statically Routed

Dynamically Routed



and servers with virtual machines

Logical Network Design

Switched

Statically Routed

Dynamically Routed

Figure 1 Topology of Cisco MSDC Design Evolution—Phase 1

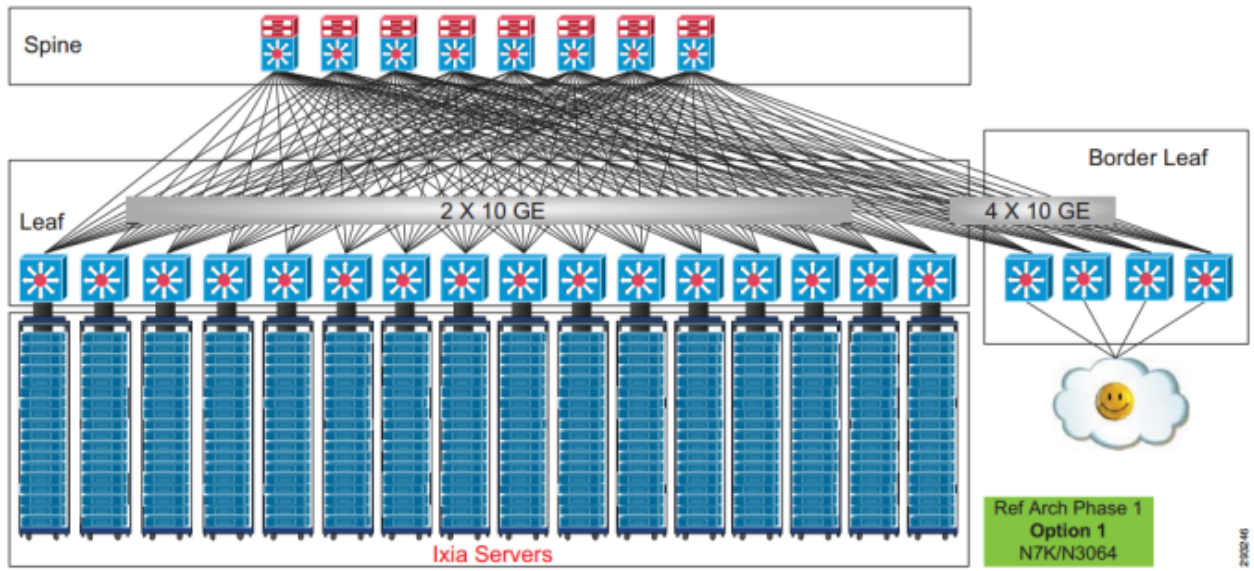


Figure 2 Topology of Cisco MSDC Design Evolution—Phase 2

- 16 Racks
- 16 Switches
- 8 Routers
- 16*40 = 640 Servers
- 640 * 100 = 64.000 Virtual Machines

Logical Network Design

Switched

Statically Routed

Dynamically Routed

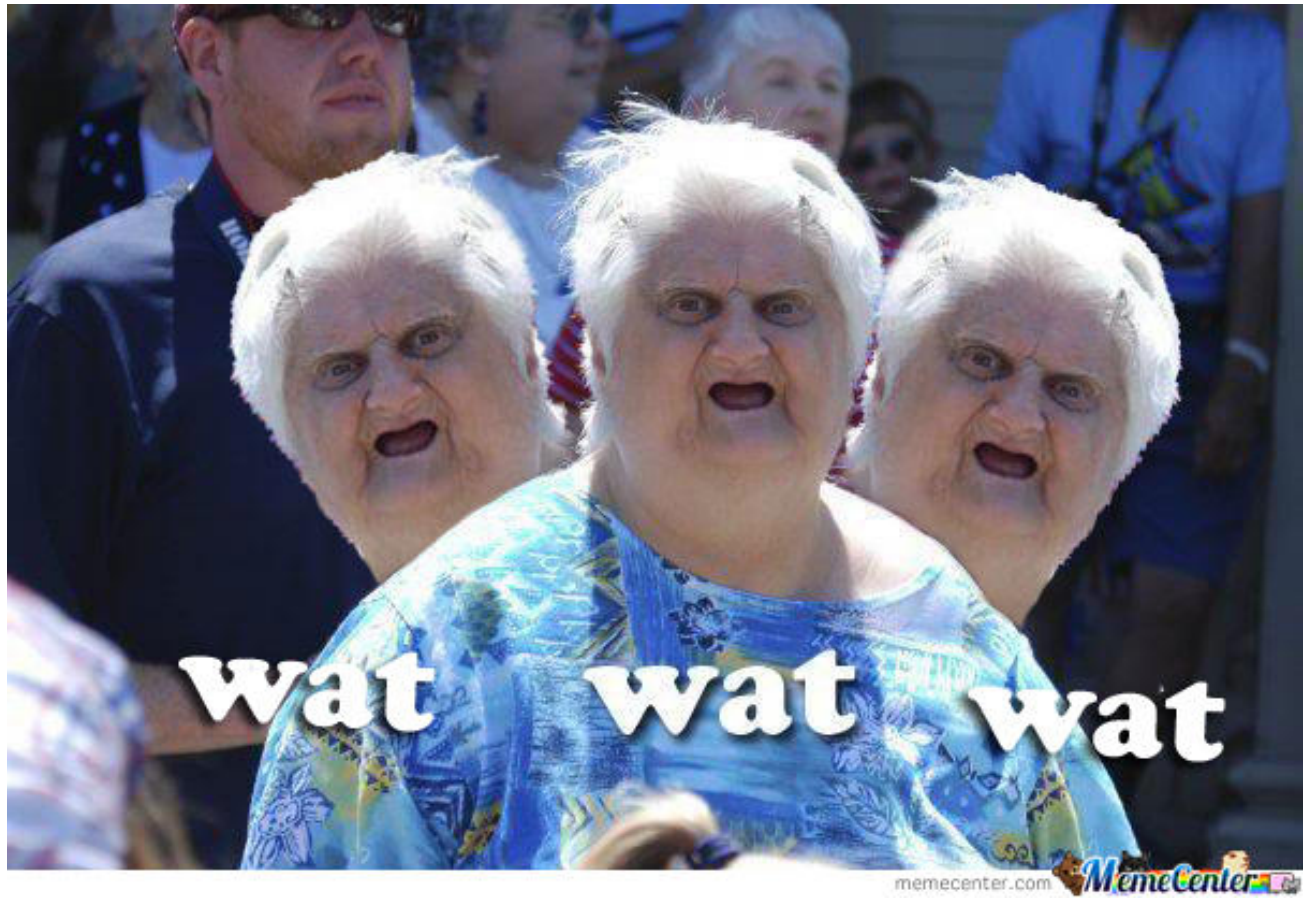
- Impossible to have 64.000 Virtual Machines + Hypervisors in the same Layer 2
  - Would require switches with 64,000 MAC entries
  - Juniper EX92008, 8RU, ~45.000€, per rack
- Dynamic routing protocols route prefixes to a next hop
- Normally used to route nets to a router
- You can route to any IP address?

Logical Network Design

Switched

Statically Routed

Dynamically Routed



Logical Network Design

Switched

Statically Routed

Dynamically Routed

BGP as IGP

- Bad: Every router would talk to every other router (fully meshed)
  - Fine for small networks, doesn't work in this size
  - Each hypervisor will act as a router
- Bad: Needs something to get the routing table
  - "Announces the configured routing table" - Slide 7
- Nice: Simple Table of: Sourcenet -> Next Hop

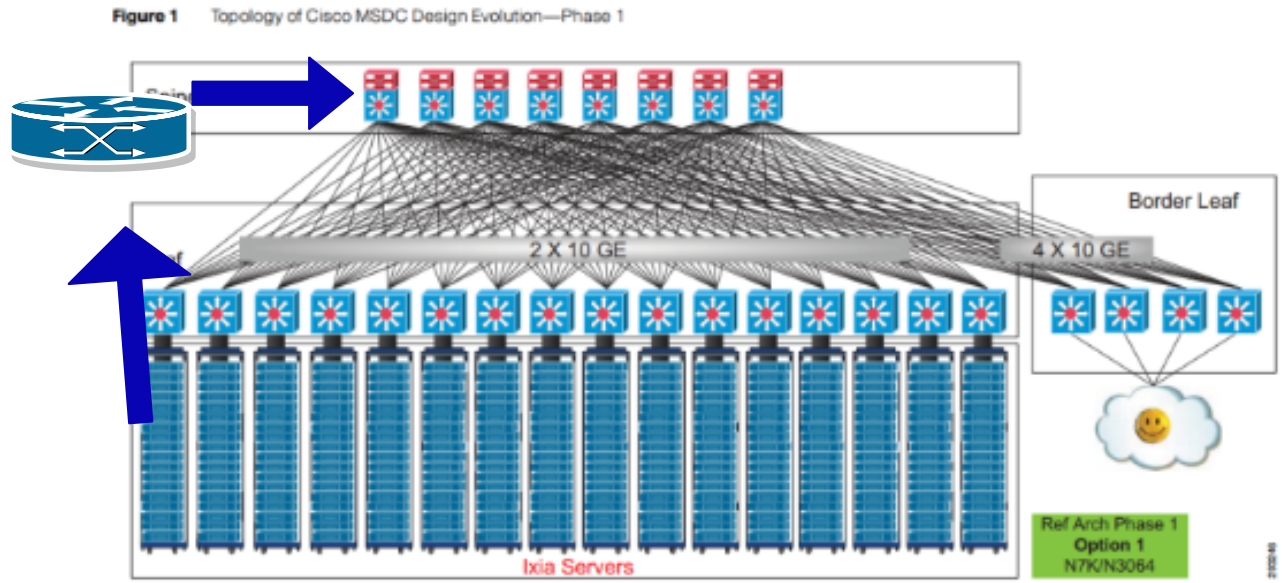
Logical Network Design

Switched

Statically Routed

Dynamically Routed

BGP route reflector



- Everybody sends updates to a central router
- Router pushes updates to all routers that need this information

Conclusion

- Dynamic routing is fun
- OSPF is fine for announcing hypervisor networks
- BGP is perfect for cloud
- Don't trust vendors for CAM table size