



# SPEEDNET SCENARIO



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## **Background Information:**

SpeedNet Telecom is a US Service Provider Company, which was founded in 1990. Company started their business with the Residential Wire line Dial up customers. They had Metropolitan Wireless infrastructure in Rural Areas in the beginning. When the Broadband become mainstream, they started to deploy DSLAMs in every major cities throughout U.S

Beginning of 2000, SpeedNet started to deliver Metro Ethernet service as well. They deployed 1000 CPE devices throughout U.S and started to provide MPLS VPN Services for the Business Customers. They upgraded their Core backbone uplinks two times in the past. Although inside the POPs they have 10Gbps and 40Gbps uplinks, their all POPs are connected through minimum 2x10Gbps.

Today SpeedNet is serving around 6.5 Million customers including more than 5.5 Million Residential Broadband customers, L2 and L3 VPN Services, some Rural Wireless deployments and so on.

Their customer growth forecast is 30% year-to-year basis for the next 5-6 years. All the forecasts had been successful for far.

Their Internal IPv4 Addressing scheme as below:

For Internal purposes they are using 10.0.0.0/8 block:

- /16 per Data Center
- /16 per Region
- /31 for point to point links
- /32 for the Loopbacks

They don't currently have IPv6 in their network due to lack of demand from their customers. SpeedNet haven't implemented QoS on their network since they rely on 50% rule on their core network. So if any of the redundant links fail, remaining link doesn't become congested. When the overall bandwidth requirement exceeds 50% of the link capacity, they upgrade the link capacity.

Their IGP is flat ISIS L1. They are running BGP as external protocol and they are also providing BGP as a PE-CE protocol to their MPLS L3VPN customer due to the corporate network security policy and the operational challenges with the other protocols.



Services provided to clients:

- Residential Internet Access
- L3VPN for Business Customers
- L2VPN VPLS for Business Customers
- L2VPN VPWS for Business Customers
- MPLS NNI (Inter-AS Connections with some providers)
- Metropolitan Wireless

SpeedNet is using a TCP based home built application, as their CRM. It is very sensitive to any kind of delay and drops.

There's also a billing system that primarily using IPFIX to communicate with networking HW and their Corporate File Exchange protocol is NFS.

SpeedNet doesn't have currently Multicast on their network but their all Layer 2 switches support IGMP Snooping and MLD, and their routers support all Multicast Routing protocols.

SpeedNet is internally using Voice over IP and the video conferencing. They are utilizing FTP heavily for their HR applications specifically. They are using an entertaining application but they don't want these applications to consume more bandwidth.

#### HyperCom Background Information

HyperCom is another U.S based Service Provider Company which has much smaller network and customer reach compare to SpeedNet.

HyperCom have started also by providing Dial up Internet Access for the Residential home users back in early 2000. They quickly upgraded their residential broadband customers over DSLAM and recently they replaced their all DSLAM access nodes with GPON.

Two retired Network Engineers founded HyperCom and today they have over a million customers. HyperCom acquired three smaller Service providers in the different parts of US. As there might be in any merger and acquisition, there was some IP addressing overlap between the POPs in Raleigh and Austin but they have been able to fix it.



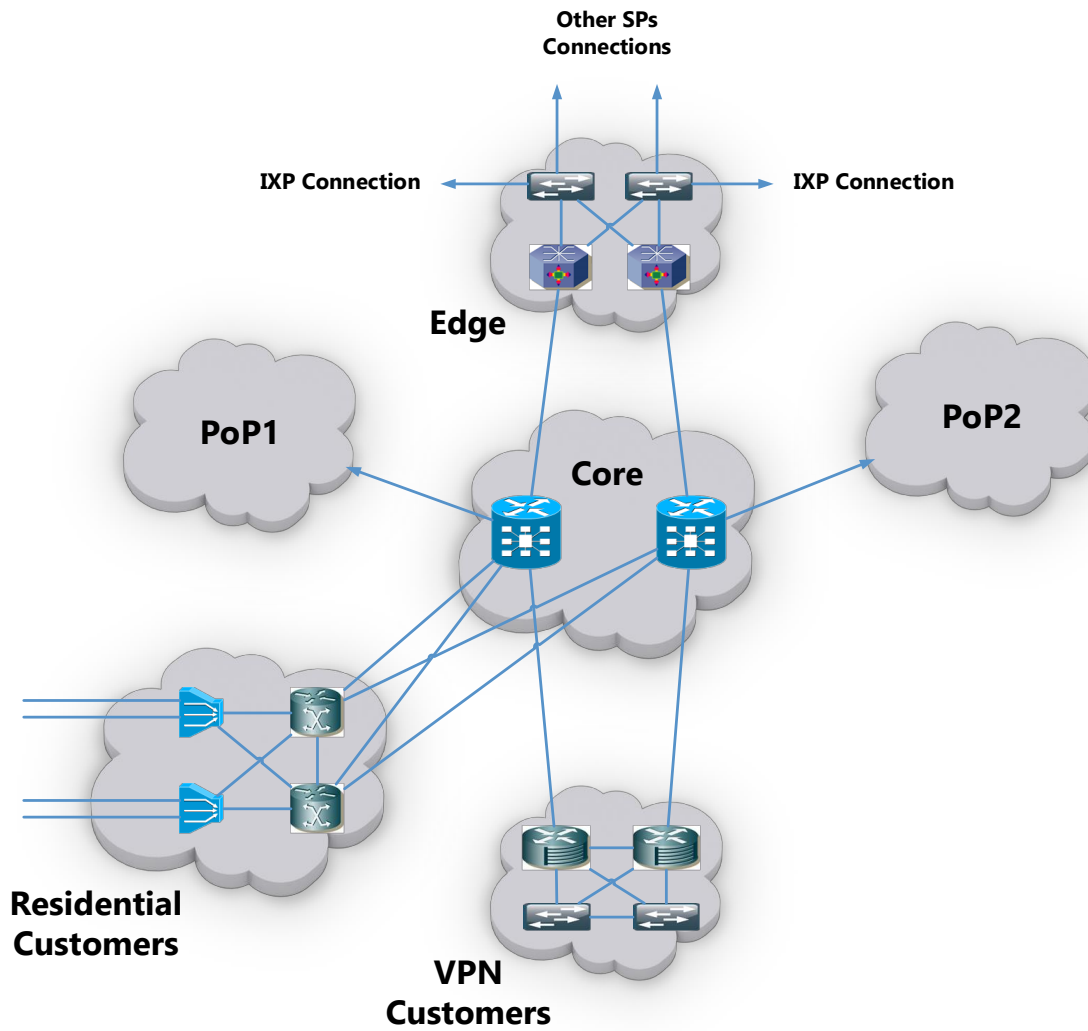
Full mesh GRE tunnels connect all these smaller SPs, which HyperCom acquired, over the Internet.

HyperCom is using single area OSPF in their network. Their network is very stable and they don't have any resource issue with their routers. They don't have any plan to design a multi area OSPF.

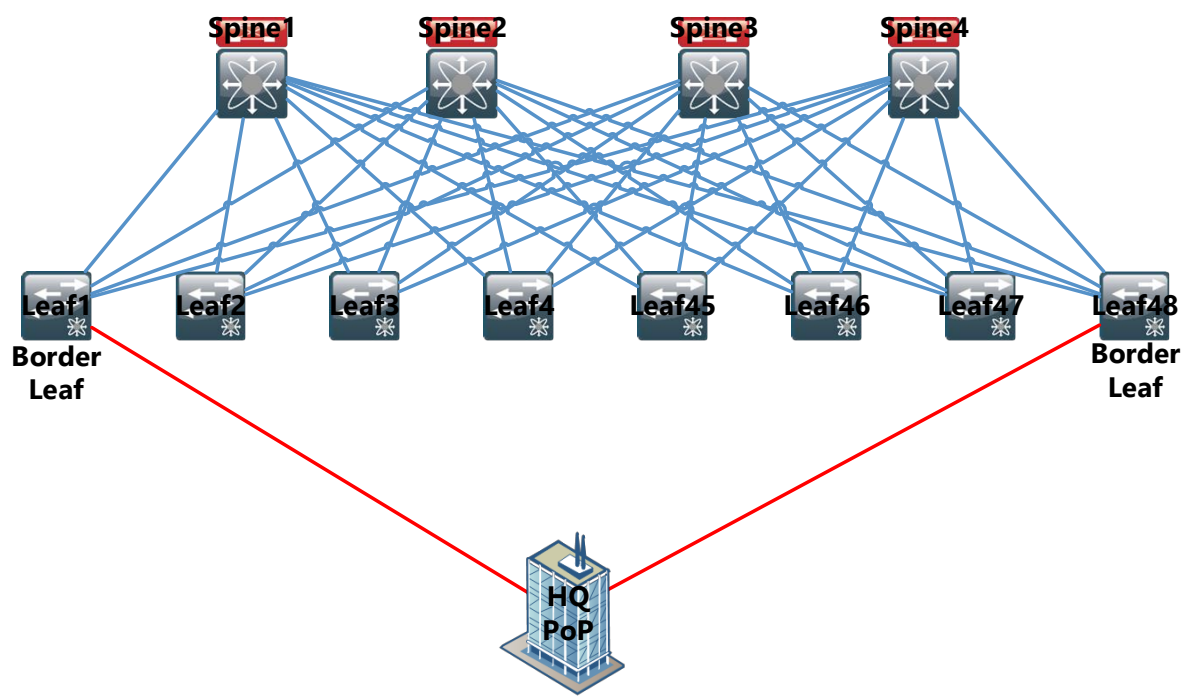
They did an IPv6 readiness assessment last year and checked whether all their IPv4 features are supported with IPv6 software and hardware and their networking and applications team are totally ready for IPv6.

So far HyperCom was providing only the Internet service to their residential broadband customers.

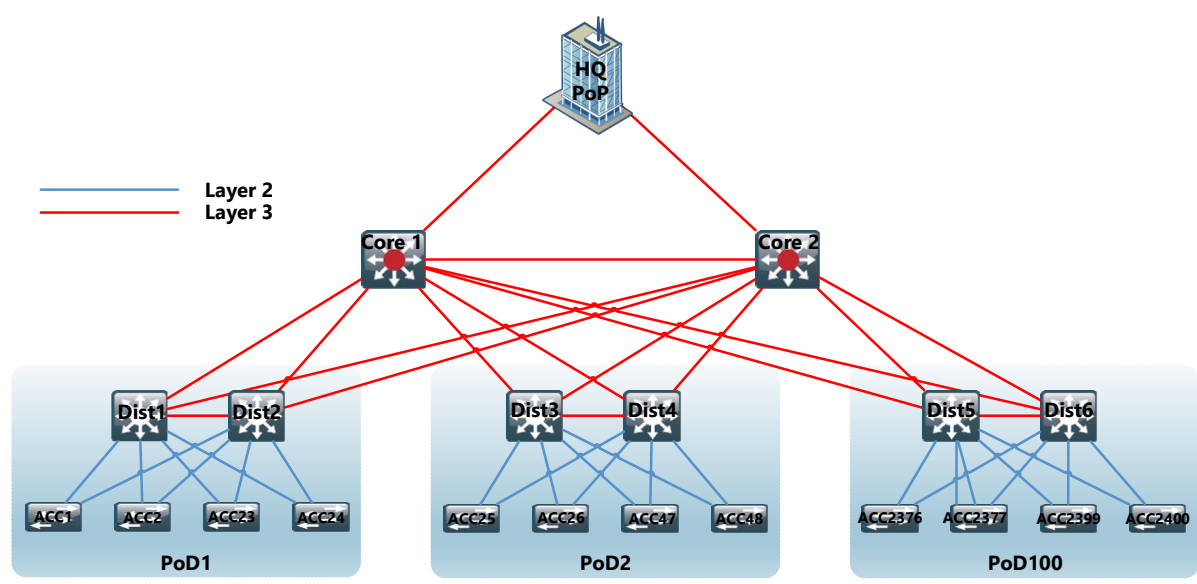
Core and DC topologies:



**Figure:** SpeedNet Telecom Core Network Diagram



**Figure:** HyperCom Data Center Diagram



**Figure:** SpeedNet Telecom Data Center Diagram

**E-Mail 1 is Available:**

*As we have mentioned previously, HyperCom made three acquisitions few years ago. Unfortunately, they could not keep their promises to main investors so they have just sold the company to SpeedNet. Two network will be merged but first thing to do is analyzing which kind of information we are still missing before we proceed with merging both SpeedNet and HyperCom networks.*

*There may not need for some POP and Datacenters when merge of two networks are completed because HyperCom POP and DC operational costs are too low compare to SpeedNet.*

*Main concern and top priority is that merged network should be able to provide all of current SpeedNet MPLS customers.*

**Q) What information do you need from SpeedNet to start merging the two networks? (Choose Two)**

- a) IPv4 addressing scheme
- b) IGP routing information
- c) BGP architecture
- d) POP Architecture
- e) Backbone speed
- f) QoS information
- g) MPLS Services Support

**Q) What information do you need from HyperCom to start merging design? (Choose Three)**

- a) IPv4 addressing scheme
- b) IGP routing information
- c) BGP architecture
- d) POP Architecture
- e) QoS information
- f) MPLS Services support



## **E-Mail 2 is Available:**

*This is some of the information we have been able to get for you:*

- *SpeedNet BGP architecture is single AS in their network. Each POP location has separate BGP RR for Internet and VPN services.*
- *We decided to continue with the existing POPs and DCs for now. In the future we can reevaluate but currently we will not redesign any physical location.*

*HyperCom backbone uplink between the POPs is 2x10G links. They are considering to connect the POPs via direct links since there is too much overhead with GRE tunnels and they don't want to see GRE tunnels on their network.*

*HyperCom is using 10.10.0.0/16, 10.0.0.0/16, 172.16.0.0/18 and 172.22.0.0/16 IP addressing blocks*

*HyperCom has currently full mesh IBGP peering at the moment.*

**Q) One of our new network architects was concerned about current IS-IS in SpeedNet. He thinks that we might be facing some issues while merging SpeedNet and HyperCom networks together. Is there any problem with the current ISIS design?**

- a) Yes
- b) No

**Q) What might be the concern of the SpeedNet for their IS-IS?**

- a) Migration from IS-IS L1 to Multiple flooding domains is hard
- b) IS-IS L1 does not support traffic engineering
- c) Redistribution is not possible to ISIS L1
- d) ISIS L1 is not a scalable solution

**Q) Should they migrate the IGP protocols to run a common IGP for the merged network?**

- a) Yes
- b) No

**Q) What can be the problem if HyperCom wants to deploy BGP Route Reflector based on their current BGP design? (Choose Two)**

- a) They would lose path visibility
- b) There is no problem, it is same as running full mesh
- c) BGP RR always bring benefits to BGP design
- d) BGP RR puts additional load into the control plane
- e) BGP RR can cause suboptimal routing

**Q) Which below methods can be used to eliminate the possible path visibility problem of BGP Route Reflector? (Choose all that apply)**

- a) Using BGP Add-Path
- b) BGP Shadow Sessions
- c) Not using BGP Route Reflector
- d) Using full-mesh and BGP Route Reflector in the same network
- e) BGP Shadow Route Reflectors
- f) BGP Best External
- g) BGP PIC-Prefix Independent Convergence

**E-Mail 3 is Available:**

*One of our customers asked us about the best way to provide connectivity between their HQs and the remote sites. Could you help us out?*

**Q) Please fill in the table below:**

|           | Multicast support over Internet (Yes/No) | Multicast replication at Hub/WAN (Yes/No) | Topology (P2P/P2MP/MP2MP) | Overlay/Underlay routing | Redundancy (Yes/No) | Runs over (Internet/Private WAN/Any) |
|-----------|--|---|---------------------------|--------------------------|---------------------|--------------------------------------|
| DMVPN     |  |   |                           |                          |                     |                                      |
| GETVPN    |  |   |                           |                          |                     |                                      |
| mGRE      |  |   |                           |                          |                     |                                      |
| P2P IPSEC |  |   |                           |                          |                     |                                      |
| GRE       |  |   |                           |                          |                     |                                      |

**Q) What is the best solution for VPN security with minimal OpEx?**

- a) GETVPN
- b) DMVPN
- c) mGRE
- d) P2P IPsec

**E-Mail 4 is Available:**

*Top management and company owners have been pushing to come up with new backbone design as soon as possible. They wanted new backbone network to be simple and flexible, efficient and be able to handle any single point of failure at POPs connecting to Data Centers.*

*After merging both SpeedNet and HyperCom we have started experiencing bandwidth utilization problems. Between different region the traffic flow always follow the shortest IGP path. Please can you help us to start sending traffic over all the available paths?*

**Q) Which below option would be the best short-term solution in this case?**

- a) Use MPLS Traffic Engineering- Tactical Approach and distribute the traffic between the regions based on bandwidth constraint
- b) Use static routes and GRE tunnels and optimize traffic flow
- c) Implement DiffServ QoS all over the backbone network
- d) Implement DiffServ QoS at places of traffic congestion
- e) Redesign Backbone network and add few more inter-POP Links
- f) Use MPLS Traffic Engineering Strategic Approach

**Q) What about permanent solution?**

- a) Use MPLS Traffic Engineering Strategic Approach
- b) Use static routes and GRE tunnels and optimize traffic flow
- c) Implement DiffServ QoS all over the backbone network
- d) Implement DiffServ QoS at places of traffic congestion
- e) Redesign Backbone network and add few more inter-POP links
- f) F. Use MPLS Traffic Engineering- Tactical Approach and distribute the traffic between the regions based on bandwidth constraint

**E-Mail 5 is Available:**

*It seems that MPLS Traffic Engineering Strategic Approach can provide us a better capacity management. Can you help us to setup MPLS Traffic Engineering on our network?*

*Also we will have series of questions for you regarding MPLS Traffic Engineering. We have been also told to provide QoS all across the new network within the next couple of months. We need your expert recommendations.*

**Q) Which features need to be enabled in order for MPLS TE to function properly?  
(Choose Four)**

- a) LDP
- b) RSVP
- c) MP-BGP
- d) Unidirectional tunnel headend
- e) Unidirectional tunnel tailend
- f) Bidirectional tunnel headend and tailend
- g) IGP TE (TED)
- h) VRF
- i) Send-label

**E-Mail 6 is Available:**

*We created an MPLS tunnels, RSVP and other necessary extensions are in place but unfortunately our traffic doesn't go through the TE tunnels.*

*Once you help to get the traffic into the MPLS TE tunnels one little thing will left.*

*We still need to enable DiffServ QoS throughout our new network. One of our engineers told us that it is not possible to run both IntServ and DiffServ QoS. As a company policy, we allow YouTube and Gaming applications but we prefer to limit this traffic on our network.*

*Yes productivity is good but we are selling our bandwidth capacity as you know!*

**Q) Why do you think SpeedNet cannot send traffic into the MPLS TE tunnels although everything is set?**

- a) Multicast traffic can pass but unicast traffic might have an issue
- b) Routing table should point to the tunnel interface for the TE destination prefixes
- c) TE tunnel links must be advertised into the IGP protocol
- d) SpeedNet probably didn't create reverse unidirectional Tunnel

**Q) Is it possible and recommend to run IntServ and DiffServ QoS in the same network?**

- a) Yes, it's possible but it's not a good idea to run both IntServ and DiffServ in the same network
- b) No, there's no specific restrictions and they can both run in the same network

**Q) We are considering several QoS models. Which one is the best fit for us?**

- a) 1 PQ, 3 BQ
- b) 1 PQ, 4 BQ
- c) 3BQ
- d) 5BQ
- e) 3PQ, 1BQ

**E-Mail 7 is Available:**

*All our users have a problem accessing to cloud gaming application we have deployed recently and it looks like the somewhere in our network, but we are not sure where. We need your help to identify the problem!*

**Q) Which part of the network should we focus on?**

- a) Place the monitoring probes closer to application
- b) Place the monitoring probes closer to end users
- c) Place the probes closer to both end users and application
- d) Place the probes at all the POPs
- e) Place the probes everywhere in the network

**E-Mail 8 is Available:**

*Since we have done merging, we have lots of requests from the SpeedNet customers to extend their current VPN networks to different locations where HyperCom have presence. SpeedNet wants to have separation of their core network task from the Inter domain task, that's why they implemented a new ASBR routers but HyperCom is okay with the existing routers for new inter domain communication.*

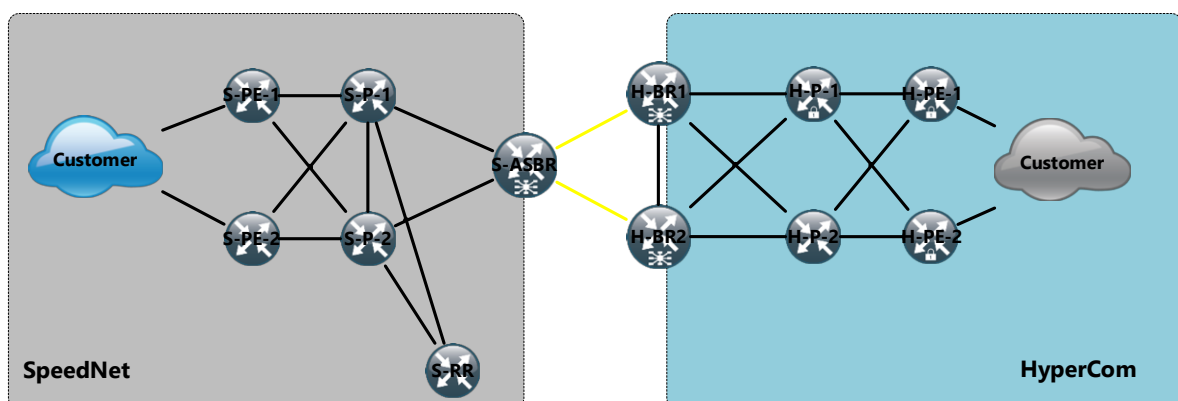
**Q) Which below option would you suggest to implement in order to extend your VPNs to HyperCom backbone?**

- a) Inter-AS Option A
- b) Inter-AS Option B
- c) Inter-AS Option C
- d) Redistributing the prefixes of two networks to each other

**Q) What is the main reason to implement it?**

- a) It is the most secure option among the others
- b) It fits SpeedNet scalability needs
- c) It is the easiest option to configure
- d) It provides end-to-end LSP

**Q) Please check the right boxes to implement Inter-AS Option B between the SpeedNet and Hypercom networks**



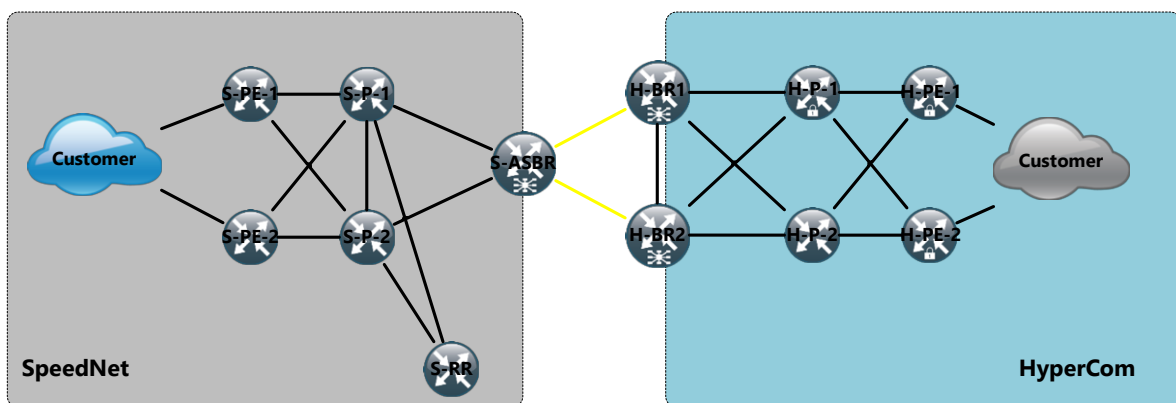
| Protocols    | S-PE-1                   | S-RR                     | H-S-ASBR                 | H-BR-1                   | H-P-1                    |
|--------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| VRF          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| MP-iBGP      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| MP-eBGP      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Infra IGP    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Customer IGP | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Send-label   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| MPLS         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**E-Mail 9 is Available:**

*One of our lead architect came up with new IP addressing scheme that new network is going to migrate to within the next 6 months. And HyperCom Full Mesh IBGP is migrated to Route Reflector topology. RRs will be placed in the centralized location, they will not be used as inline RR.*

*It gives us opportunity to use Inter-AS Option C.*

**Q) Please check the right boxes to implement Inter-AS Option C.**



| Protocols    | S-PE-1                   | S-RR                     | H-S-ASBR                 | H-BR-1                   | H-P-1                    |
|--------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| VRF          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| MP-iBGP      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| MP-eBGP      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
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| Customer IGP | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Send-label   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| MPLS         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**Q) What is the main benefit of implementing Inter-AS Option-C between SpeedNet and HyperCom?**

- a) The only option with the support of 6vPE
- b) Better scalability compared to Inter-AS Option B
- c) The easiest Inter-AS Option to implement
- d) More secure compare to Inter AS Option B

**E-Mail 10 is Available:**

*Hi Mr. Designer,*

*As you know we have MPLS Layer 3 VPN, Internet, Point to point MPLS VPN and VPLS customers. Especially for the VPLS customers, when we want to add a new site to the current VPLS of the customers, it is operationally very hard for us to touch every PE of the customer.*

*We afraid that this will be a bigger problem for the merged network since we want to span the VPLS and our other services throughout the merged network. But especially for the VPLS issue, we want to have an immediate solution.*

*Please note that we have an LDP-based VPLS in our network and the HyperCom network doesn't have VPLS at all currently.*

*Can you help us to fix our operational problem?*

**Q) Which below option is defined the SpeedNet's operational problem?**

- a) Their network engineers don't have a capability to manage merged network
- b) Their existing gear don't have a capability to keep the state of merged network
- c) They want to reduce the operational touch point for the existing services, especially VPLS
- d) They don't know whether VPLS service can be extended over the Inter-AS links

**Q) What would be your solution for their VPLS service?**

- a) Use H-VPLS
- b) Use A-VPLS
- c) Replace VPLS with EVPN
- d) Replace VPLS with PBB-EVPN
- e) Use BGP AD for their VPLS solution

**Q) If SpeedNet would request to have the most granular QoS support for their Inter-AS VPLS service, which below option you would recommend?**

- a) Inter-AS Option A
- b) VPLS cannot be extended over Inter-AS

- c) Inter-AS Option B
- d) Inter-AS Option C
- e) Inter-AS Option AB

**Q) Would you recommend SpeedNet to deploy BGP-VPLS on the HyperCom network?**

- a) Yes
- b) No

**Q) Is there any problem for LDP and BGP based VPLS to support end-to-end VPLS?**

- a) Yes
- b) No

**E-Mail 11 is Available:**

*One of our customers is asking whether we can provide IPv6 L3VPN services for them. We have not been thinking about it, but as our assessment all our networking nodes support IPv6*

**Q) Which technology will help SpeedNet to meet the requirements above?**

- a) 6PE
- b) DMVPN
- c) 6vPE
- d) NAT64
- e) NAT46

**Q) Which additional technology/protocol is needed as an underlay transport to support 6VPE service for SpeedNet?**

- a) IPv6 LDP in the core
- b) IPV6 IGP in the core
- c) IPv6 RSVP-TE
- d) Both IPv6 IGP and LDP
- e) IPv4 transport is enough for 6VPE

**E-Mail 12 is Available:**

*In the future, we are planning to expand to EMEA region. Our management has found one of the small local service providers in UK that they are going to acquire within the next several months. We are looking for a cost effective short-term solution for acquisition to extend MPLS VPN services between the two networks.*

*We also need a good design and migration plan for a long-term solution if this acquisition goes well. We don't have a budget issue for long haul links. As we are planning to provide different value added services for our customers, both short-term and long-term solutions must support end-to-end QoS and Multicast.*

**Q) What is the fastest short-term solution to connect current SpeedNet network and a new one in the UK?**

- a) Use L2VPN from another MPLS Service Provider to connect current SpeedNet network and a new one with MPLS and QoS over that L2VPN
- b) Use L3VPN from another MPLS Service Provider to connect current SpeedNet network and a new one with MPLS and QoS over that L3VPN
- c) Build GRE tunnels over Internet and run MPLS and the necessary services on top of it
- d) Order dedicated circuits

**Q) What would be the problem with this short-term solution? (Choose Three)**

- a) It is not reliable and there is no SLA guarantee
- b) It is not secure
- c) QoS is not under control of SpeedNet
- d) For each customers require separate overlays
- e) Multicast routing is not supported with it
- f) All of the above