Australian Dignity Furniture

Background Documentation

Australian Dignity Furniture (ADF) is a multinational furniture company with more than 3,000 employees all around the globe. The company was founded 30 years ago. The business did not go well initially, so it grew slowly, but five years ago, it started to grow rapidly.

Orhan Ergun founded ADF in Sydney in 1985, selling wooden swords, but a while later, he converted his business into wooden furniture.

Later, the company opened its first branch in Sydney. ADF had made a massive investment in the American Furniture company, founded by Michael Marks, who had begun his career as a lumberman. American Furniture started to do production work for ADF.

They had many problems in the past while merging their networking infrastructure. They had to invest significant money to make that merger happen. Due to that, upper management has cut 70% of the IT budget.

ADF IT infrastructure:

ADF has 2 Head Quarters located in:

1. Sydney, Australia, with 800 employees.
2. New York, USA with 750 employees;

Rest 1500+ of the employees are spread across the stores.

ADF has three distributed Data Centers located in:

1. Sydney, Australia.
2. Melbourne, Australia.
3. Washington, DC, USA.

ADF has 450 stores in different locations and plans to open another 200 stores within three years. ADF stores located:

1. 100 stores in Australia.
2. 250 stores in the USA.
3. 50 Stores in Asia.
4. 30 stores in Canada.
5. 20 stores in UAE.

All stores are connected to DCs using different Frame Relay and ATM Service Providers.

Head Quarter in Australia is connected to all DC with redundancy using OC-48 10G SONET links. Headquarters in New York is connected to DCs in Sydney and Melbourne with OC-12 links. All Data Centers are interconnected using 1Gbps P2P Pseudowires.

ADF used single-process flat OSPF area 0 as their primary routing protocol. It's been growing since the beginning and grew naturally without significant changes.

Three large IP blocks from the pool 10/8 are used in DC1, HQ1, and Au stores. The rest of the networks use random IP addresses from different non-overlapping pools. Also, please note that QoS is not currently enabled in the ADF network.

ADF runs a few Business applications with different traffic patterns:

1. HR is a web TCP-based business-critical application.
2. SAP is both a TCP and UDP-based application. TCP is used for server-to-client communications, and UDP is used for uploading reports via FTP.
3. IP Telephony is based on the Open Source VOIP project. ADF plans to implement Videoconferencing soon.

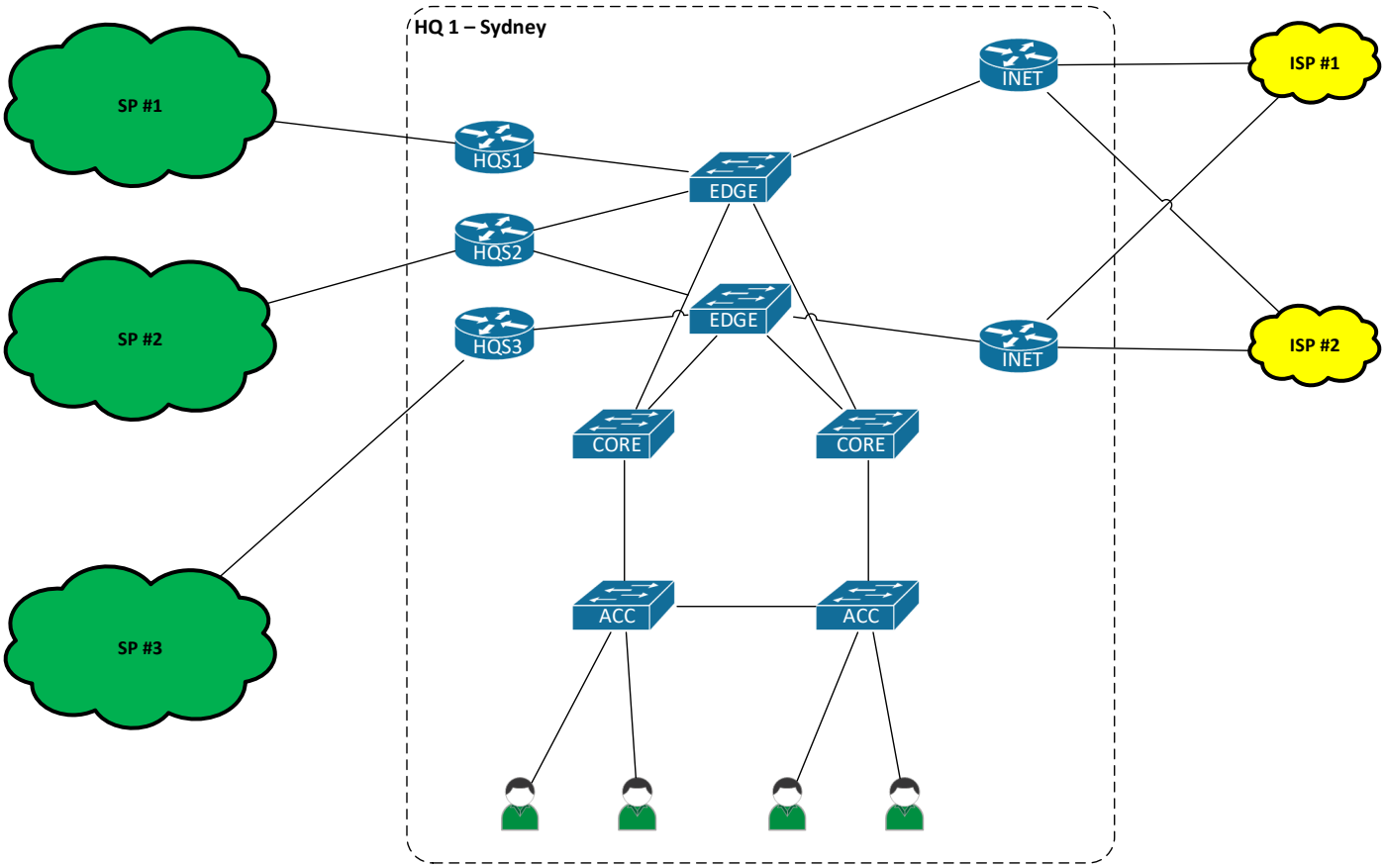
Most ADF stores in Australia still use 10-15-year-old routers, which are experiencing problems because of periodical link flaps between HQ and DC.

A few months ago, there was an issue on the network after configuring multiple routers simultaneously. they wanted to learn what was changed and which engineers performed it, and they wanted to roll back the updates, but it took so long, and the network stayed down for a long time.

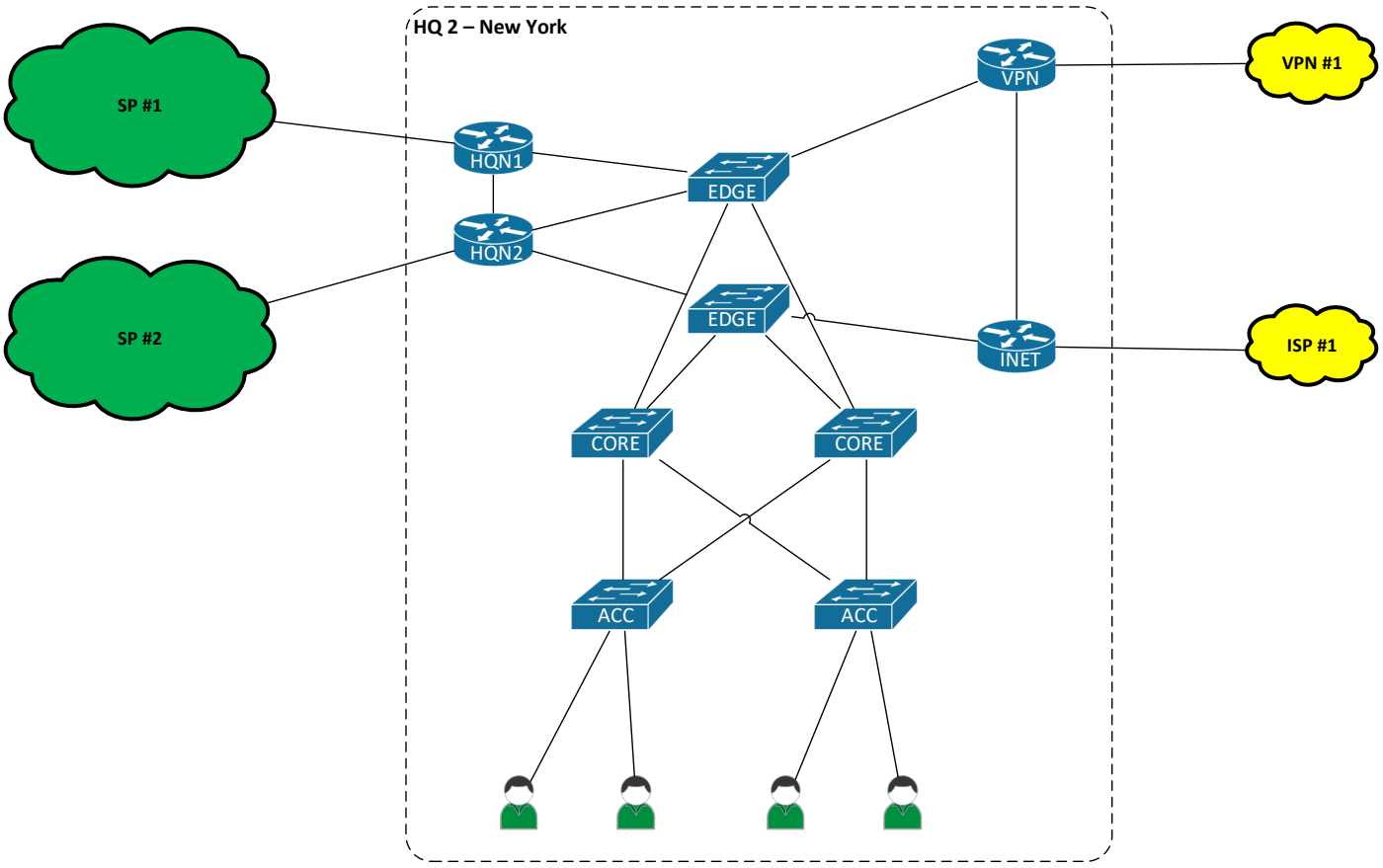
Their upper management suggested finding a solution to track any future changes; when needed, they can quickly roll back to the previous configurations.

Several design diagrams are given below to help you understand ADF network design.

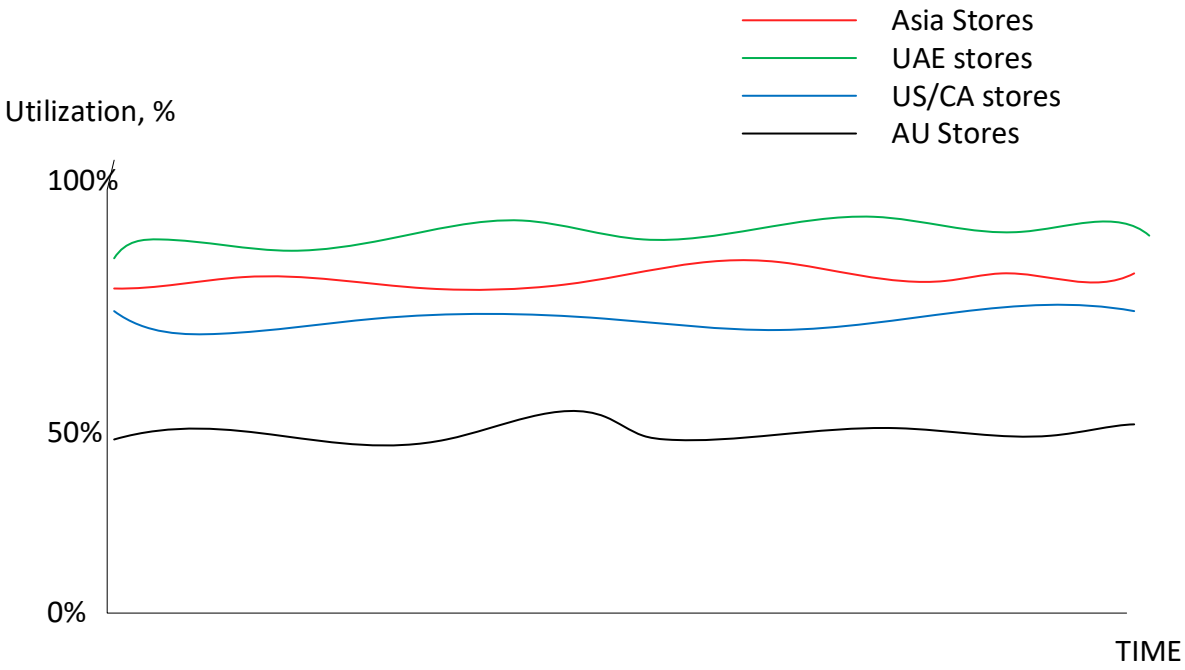
HQ1 Design



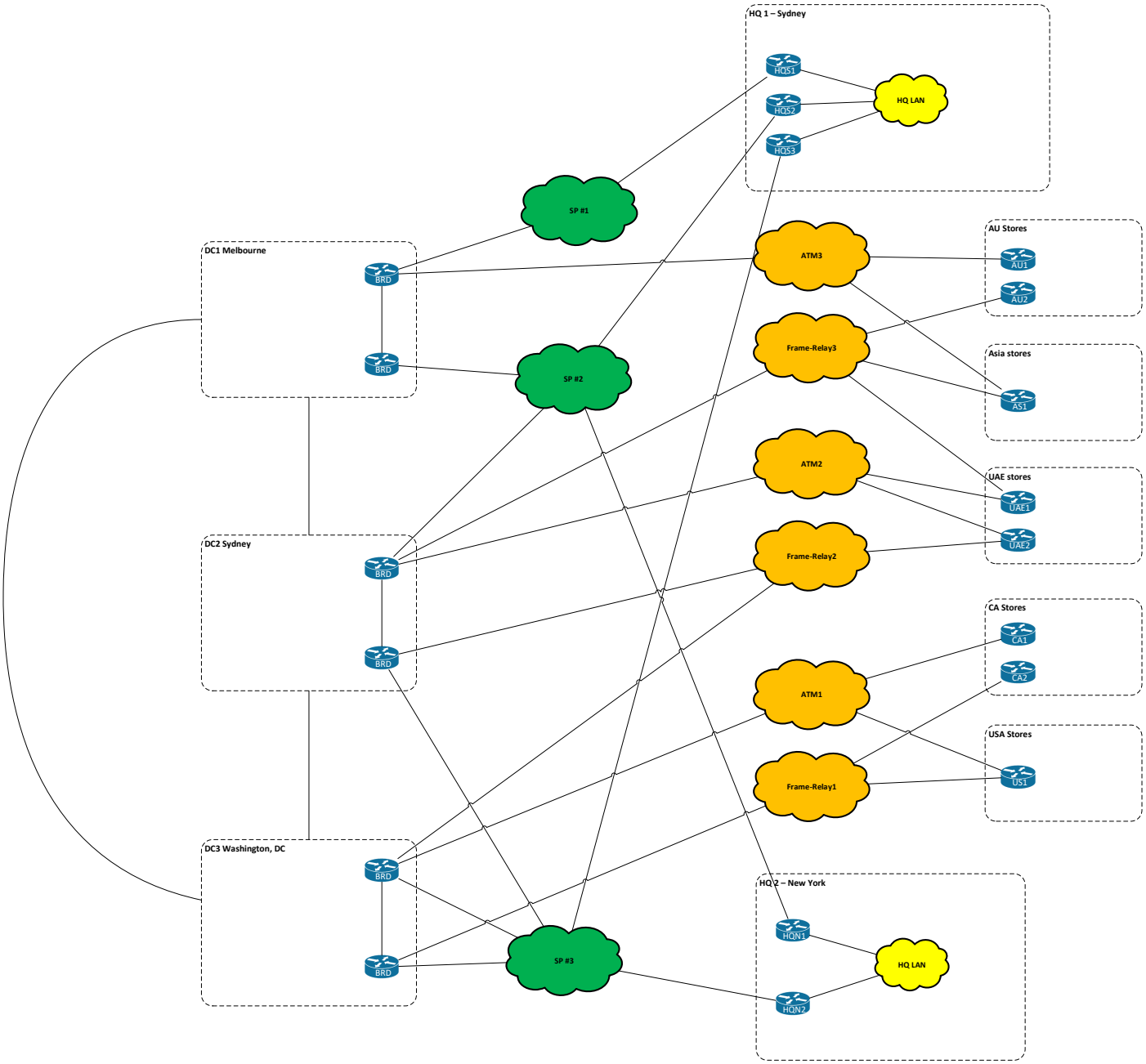
HQ2 Design



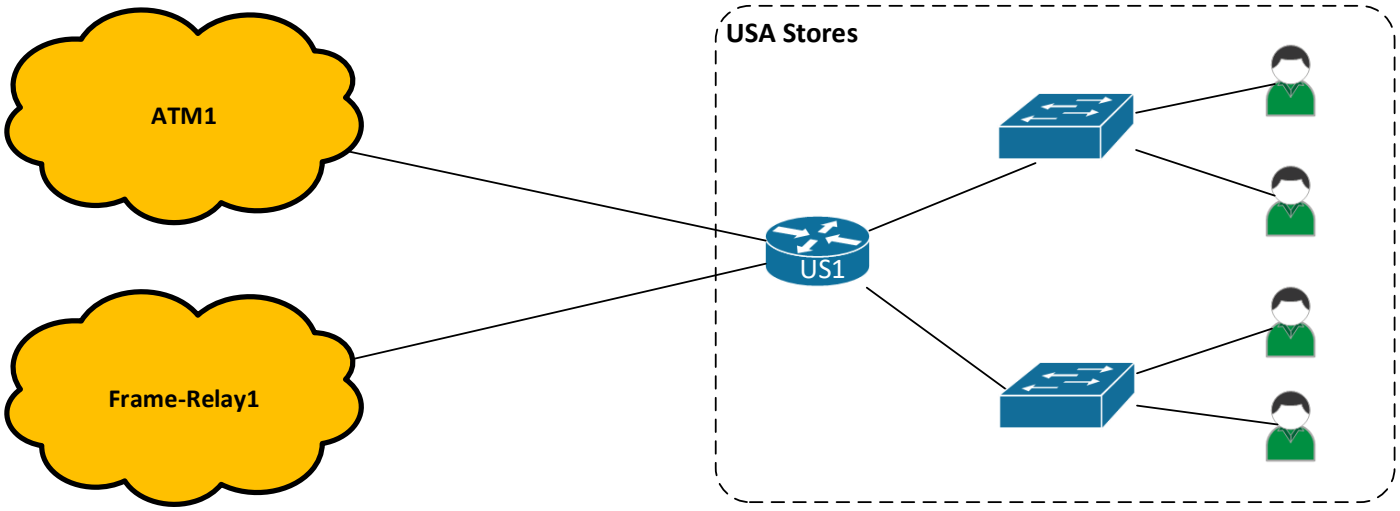
Network Bandwidth Utilization



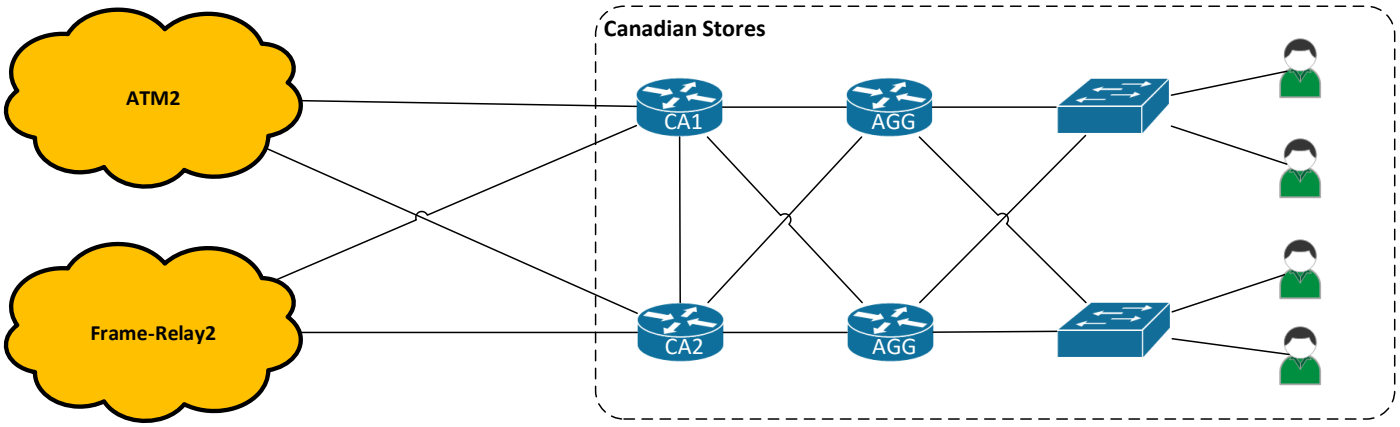
High-Level Design



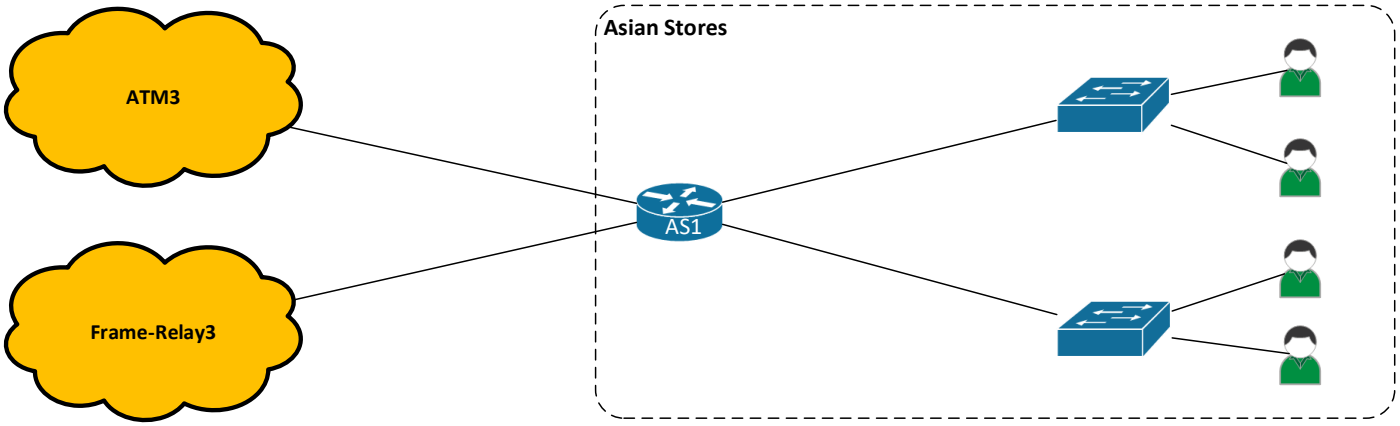
USA Stores Stores Design



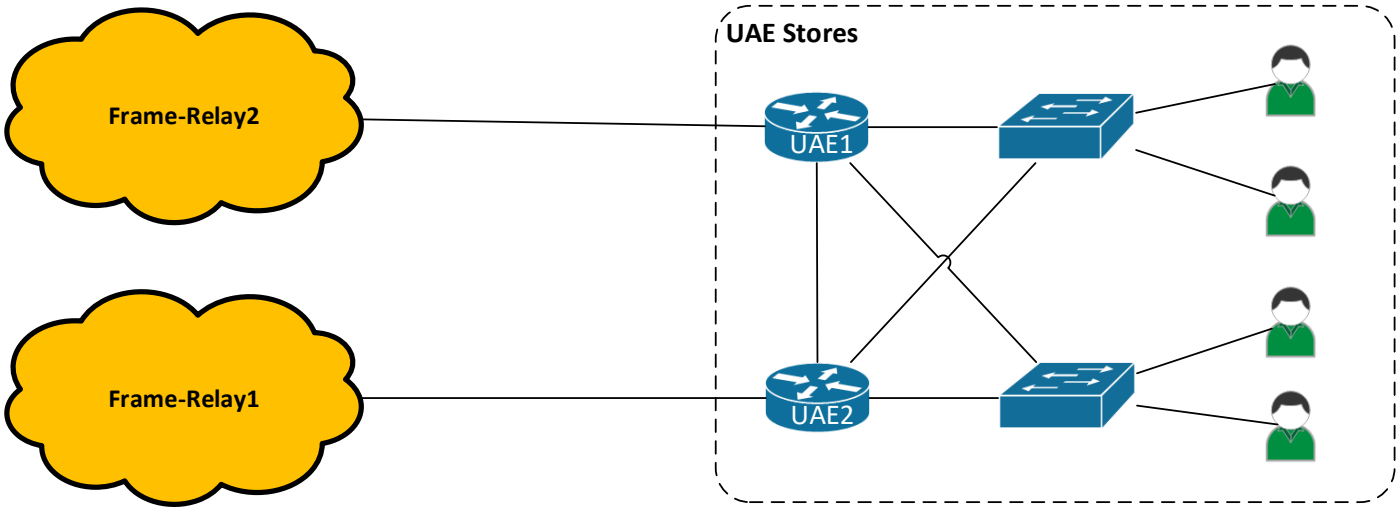
Canadian Stores Design



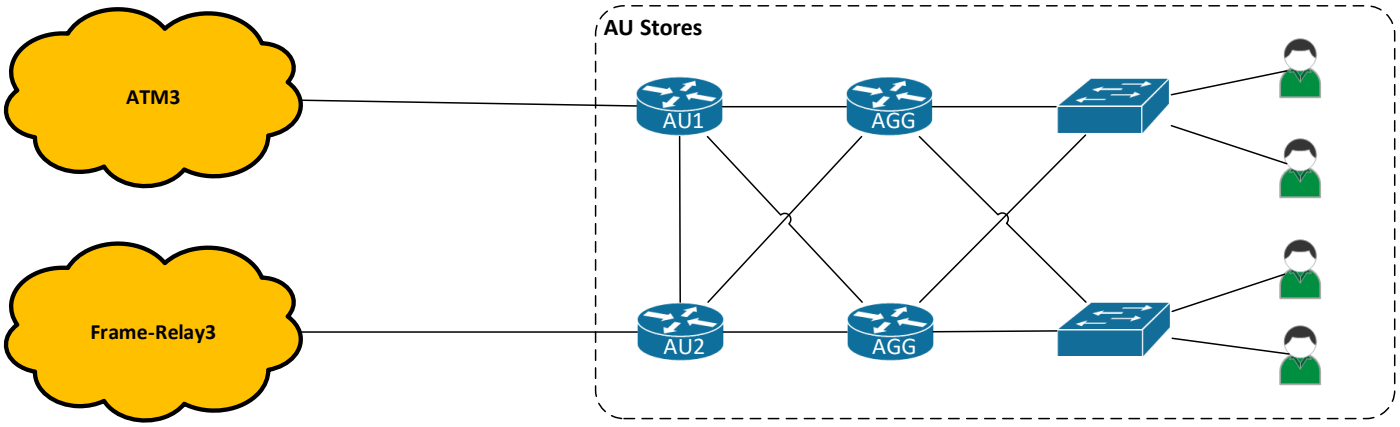
Asian Stores Design



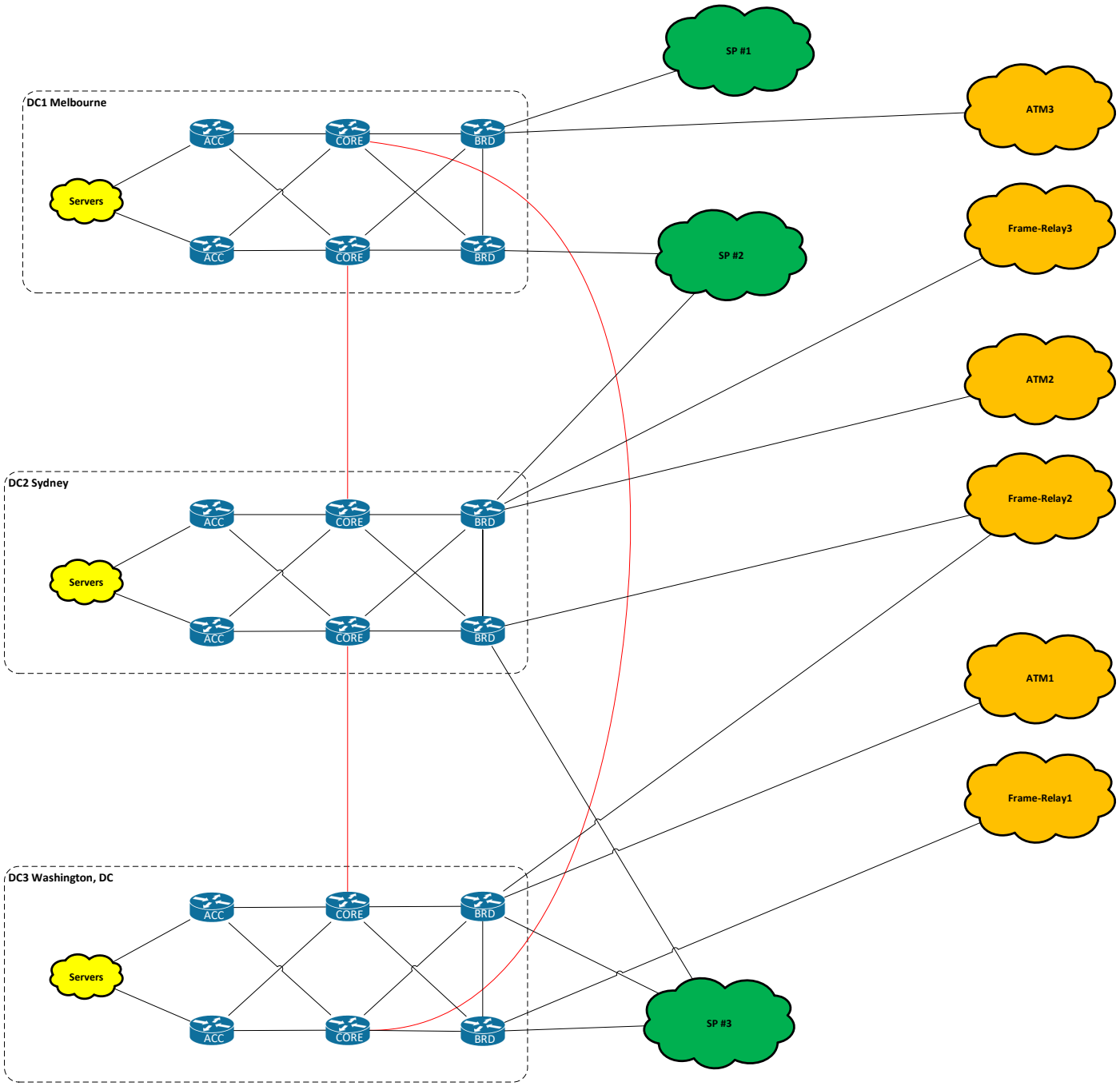
UAE Stores Design



AU Stores Design



Data Centers Design



Email 1 is Available

From: Michael Nolan <michael@adf.com>

To: OE Advisor <advisorl@orhanergun.net>

Subject: Urgent: Australian Store Routers Performance

Date: 18.09.2023

Dear Advisor

I hope this message finds you well. I am bringing to your attention a critical concern regarding the performance of our Australian store routers.

Last night, a significant link outage occurred in the US, resulting in a complete freeze of operations in the Australian region for approximately 30 minutes during peak work hours. This outage had a cascading effect, causing some routers to become unresponsive and necessitating a hard reboot. Unfortunately, this reboot introduced another set of operational challenges.

Given the impact of this incident on our operations and the potential risks it poses, I believe we must take immediate action to address the performance issues with our Australian store routers.

I would appreciate the opportunity to discuss this matter further and explore potential solutions to ensure the reliability and stability of our network in the Australian region. Your guidance and support in resolving this issue would be greatly appreciated.

Please let me know a suitable time for us to connect and discuss this matter in detail.

Thank you for your attention to this critical matter.

Sincerely,

Michael Nolan,

ADF CTO

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Question 1: What needs to be done to solve the problem with the routers in the Australian region?

A- Replace the routers in Australian stores
B- Redesign the current IGP to overcome the problems
C- Do nothing
D- Replace IGP with the BGP

Question 2a: Why do you want to replace the routers in Australian stores?

A- Replacing routers is the best option and will solve all the problems in Australian stores.
B- They have a hardware issue in Australian stores; thus, we should replace the routers.
C- Replacing routers is the fastest option to solve the problem.
D- It is always better to have a long-term solution.

Question 2b: Why do you think redesigning IGP will solve the current ADF Australia routers issue?

A. When IGP is redesigned, we can limit the fault domains; thus, flaps in some sites can impact only those sites.
B. Redesigning IGP is always the best.
C. It is the most secure option.
D. IGP redesign provides fast rerouting, thus helping to resolve the Australia store routers issue.

Question 2c: Why shouldn't we do anything for the Australian stores?

A. There is no severe impact on the Australian stores.
B. More than 3x9 of availability in network design is acceptable for high availability, and 3 minutes of downtime stays within that range.
C. We need to take action for the sites with the routers flapping interfaces, not in the Australia store routers.
D. They complain once; it may not happen again.

Question 2d. Why should we replace IGP with the BGP to solve the issue in Australian stores?

A. BGP is less CPU intensive and designed to handle the route flaps.
B. Traffic Engineering is better with BGP compared to IGP protocols.
C. BGP can scale better than IGP.
D. BGP can carry millions of prefixes.

Question 3: How do you want to redesign your IGP?

A- Separate the OSPF domain into several areas.
B- Implement Type3 LSA filters on existing OSPF domain
C- Redistribute directly connected routes instead of advertising them as Type3 LSAs
D- Changing OSPF with IS-IS

Question 4: Which area type is suitable for Australian store routers? (Choose all that apply)

A- NSSA
B- Stub
C- Totally NSSA
D- Totally Stub
E- Normal
F- Normal + type3 LSA filters

Question 5: Why is this option the best?

A- It avoids sub-optimal routing and keeps the number of LSA low.
B- It's the best option to reduce the number of LSAs
C- It gives better visibility of the network.
D- It allows external routes to be injected into the Area.

Question 6: Among the options below, which OSPF area types will you put the other stores into if we have to put the other stores in a hierarchical design as well?

A- NSSA
B- Stub
C- Totally NSSA
D- Totally Stub
E- Normal Non-Backbone Area

Question 7: Where are you going to place Area Border Routers?

A- Data Centers' Border Routers
B- Data Centers' Core Routers
C- Head Quarters Routers
D- Store's Local Routers

Question 8: What is the reason for putting ABR there? (Choose all that apply)

A- Allow flexible OSPF Area design
B- It prevents routing loop
C- It does not give any advantage to the current OSPF design.
D- It is the same as other options, but I feel uncomfortable placing ABR at HQ routers.
E- It helps to reduce the backbone area size.

Email 2 is Available

From: Michael Nolan, ADF CTO <michael@adf.com>

To: OE Advisor <advisor@orhanergun.net >

Subject: Design Architect's Feedback

Date: 18.09.2023

Dear Mr. Advisor,

I hope this message finds you well. I wanted to bring to your attention some important feedback from our design architect regarding our previous design decisions.

Our design architect has expressed concerns that the previous design may not fully satisfy all of ADF's requirements. Specifically, there are a few key requirements that need to be addressed:

1. **Optimal Routing for AU Stores: ** the Australian stores must have optimal routing to all DC infrastructures. Our architect believes that this aspect of the design needs further consideration.

2. **External Route Injection for Asia and UAE Stores: ** The Asia and UAE stores should be able to inject external routes. This requirement is crucial for their network operations.

3. **Introduction of RIP Protocol: ** A plan is to introduce another routing protocol, potentially RIP (Routing Information Protocol), to connect the stores' vending machines and coffee makers to the network. This is an essential aspect of the design that needs to be accommodated.

Our design architect's feedback underscores the importance of reevaluating and possibly revising our design decisions to ensure they align with these critical requirements. We should collaborate to address these concerns and make any necessary adjustments to our design.

Let's schedule a meeting at your earliest convenience to discuss these feedback points and work towards a solution that meets all of ADF's requirements.

Thank you for your attention to this matter, and I look forward to our discussion.

Sincerely,

Michael Nolan, ADF CTO

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Question 9: What must be changed at AU stores to satisfy the above requirements?

A- Place ABRs at AU stores
B- Place ASBRs at AU stores
C- Change area type to NSSA + Type3 LSA filters
D- Change area type to Normal + Type3 LSA filters
E- Change area type to Totally NSSA.

Question 10: What would be the additional benefit of changing the AU store router area type if the company implements MPLS on its network in the future?

A- It prevents suboptimal routing.
B- It prevents routing loops.
C- It provides better scalability by preventing more specific routes.
D- MPLS LSP can be set end-to-end.
E- It doesn’t bring additional benefits for MPLS.

Question 11: Which below option would you recommend for Area separation?

A- Place all AU, Asia, and Canada stores in one large area.
B- Have a separate OSPF Area for each Australia store.
C- Place all Australia stores in a single OSPF Area
D- Place all Asia and UAE stores in one large area.

Question 12: Fill out the table below based on the decisions made.

Routes → / **Routers ↓**	DC1	HQ1	HQ2	Default	CA sites	AU sites	UAE sites	Asia sites	US sites
DC Border									
HQ1									
HQ2									
AU sites									
CA sites									
US sites									
Asia sites									
UAE sites									

Email 3 is Available

From: Michael Nolan, ADF CTO <michael@adf.com>

To: OE Advisor <advisor@orhanergun.net>

Subject: Progress Update and Request for QoS Advice

Date: 18.09.2023

Dear OE Advisor,

I hope this message finds you well. I wanted to provide you with an update on our network situation.

We've made significant progress, and our network is much more stable. As part of our ongoing efforts to enhance our network capabilities, we plan to implement a Videoconferencing solution to connect both of our HQ offices.

While we have conducted initial tests, we've noticed room for improvement in video quality and voice clarity. We need a solution to optimize our network performance.

One of our network engineers suggested implementing Quality of Service (QoS) might be the key to resolving our video and voice quality issues. Given your expertise in this area, we are reaching out to seek your advice on the correct approach to implementing QoS in our network.

It's important to note that all internal network traffic, including voice communications and SAP applications, is susceptible to drops, so a well-defined QoS strategy is essential. Additionally, we have already initiated discussions with our service providers, and they have informed us that they can offer us a standard QoS model, which includes 1PQ and 3 Bandwidth Queues.

We value your insights and guidance in helping us make the right decisions for our network. Please advise us on the best practices for implementing QoS in our network, considering the specific challenges and requirements we've outlined.

We are open to scheduling a meeting or discussion at your earliest convenience to delve deeper into this matter and create an effective QoS implementation plan.

Thank you for your attention, and we look forward to your valuable recommendations.

Sincerely,

Michael Nolan, ADF CTO

www.orhanergun.net

Question 13: Is 1PQ and 3BQ enough for the given requirements?

A- YES
B- NO

Question 14: How should ADF mark its application traffic based on the information provided?

	EF	AF	BE	Scavenger
Video				
Voice				
SAP				
HR				
Web browsing				
Youtube/Gaming				

Question 15 : Which QoS tools should be applied to the applications in the below chart ?

	Video	Voice	SAP	HR	Web browsing	Youtube/Gaming
HQoS						
Shaping						
Policing						
WRED						
PQ						
CBWFQ						

Question 16: Why would you apply WRED for SAP and HR traffic?

A- WRED shouldn't be applied to SAP and HR traffic
B- To drop all packets at once in case of congestion
C- To drop packets randomly based on some criteria in case of congestion.
D- To buffer packets to send when the link is less congested
E- WRED is only used for UDP traffic.

Question 17: Is there any disruption in implementing QoS in the network?

A- Little to no disruptions
B- Implementing QoS throughout the network is disruptive and requires several hours of maintenance.
C- It is disruptive and requires separate maintenance windows for every network device at each location.
D- For some locations, it would be disruptive.

Question 18: Which Stores most likely benefit from the QoS implementation?

A- AU Stores
B- US Stores
C- UAE Stores
D- Canada Stores
E- Asia Stores

Email 4 is Available

From: Michael Nolan, ADF CTO <michael@adf.com>
To: Mr. Designer <advisor@orhanergun.net>
Subject: Seeking Better SP Option for Videoconferencing

Date: 18.09.2023

Dear Mr. Designer,

I trust you are doing well. I wanted to discuss a crucial matter regarding our network and the deployment of our Videoconferencing solution.

As you are aware, we have been diligently working on deploying Videoconferencing capabilities between our HQ offices, and the results have been promising. Our goal is to extend this solution throughout our entire network to enhance collaboration across all locations.

Recently, we conducted a pilot project at one of our stores in the US to assess the feasibility of running Videoconferencing on our network. Unfortunately, we encountered some of the same challenges we initially faced when implementing Videoconferencing between our headquarters and remote offices. This includes issues related to video quality and overall performance.

Considering these challenges, we are actively exploring alternative service provider (SP) options that can offer a more reliable and high-quality video experience with minimal effort on our part. Finding the right SP partner is critical to achieving our objectives.

Furthermore, it's worth mentioning that we are fully capable and willing to manage our WAN network, as it allows us to make necessary modifications within our OSPF domain to optimize our network's performance, and for a long time we have been happy to manage our Frame-Relay and ATM networks, the technology that you recommend should provide the similar operational behavior.

I would greatly appreciate your input and recommendations in identifying suitable SP options that align with our requirements and objectives. Your expertise in network design and configuration is invaluable, and your guidance will help us make an informed decision.

Let's meet to discuss this matter further and explore potential SP partners who can help us achieve our goals efficiently.

Thank you for your attention, and I look forward to your insights.

Sincerely,

Michael Nolan, ADF CTO
www.orhanergun.net

Question 19: Can you please fill in the table below to help understand the technology selection for ADF?

	VPLS	MPLS L3VPN	PTP MPLS L2 VPN
Easier QoS Implementation			
Better QoS Implementation			
More Number of prefixes			
Less Number of Adj			
Ease of configuration			
Faster Convergence			
Better Latency			
Better Security			

Question 20: Which below technology would you recommend the ADF to replace with their legacy WAN network?

A- PTP MPLS L2 VPN
B- MPLS L3VPN
C- VPLS
D- IPSEC VPN

Question 21: Why would you recommend deploying VPLS?

A- It has better QoS implementation.
B- It provides much better scalability compared to their legacy infrastructure.
C- It will provide similar operations behavior and optimal connectivity between offices and headquarters.
D- It reduces the connectivity requirements between the locations since MPLS L3 VPN is a peer-to-peer technology.
E- It provides better security compared to all the other options.

Question 22: What would be the critical design consideration based on your new technology recommendation?

A- Traffic should be encrypted between the locations
B- Spokes should be prevented from being an OSPF DR
C- Traffic between the remote offices should go first to the Datacenter
D- There is no special consideration.

Email 5 is Available

From: Michael Nolan, ADF CTO <michael@adf.com>

To: OE Advisor <advisor@orhanergun.net>

Subject: Decision to Implement L3VPN and Multicast Infrastructure

Date: 18.09.2023

Dear Mr. Designer,

I hope this message finds you well. I wanted to provide you with an update on our recent decisions regarding our network infrastructure.

After carefully considering your proposal and discussions with our team, we have decided to implement L3VPN (Layer 3 Virtual Private Network) for our network.

Additionally, we are looking to establish a proper multicast infrastructure to enhance our network's capabilities. Currently, we have been using multicast dense mode in our network. However, our network

engineers have suggested exploring alternative multicast options that suit our needs better.

One of the key uses of multicast in our network is to deliver important messages from our executive directors and CEO to specific sites. We also utilize two servers to distribute recorded content via multicast. However, it's important to note that we lack significant expertise in multicast technologies, so we are seeking user-friendly and easy-to-manage solutions.

It's worth mentioning that one of our service providers only supports PIM Dense mode, which adds complexity to our decision-making process.

Given these considerations, we request your expert guidance in helping us make the right choice for our multicast infrastructure. Your knowledge and experience in network design are essential in ensuring we select a solution that aligns with our requirements and can be efficiently implemented.

We would greatly appreciate a meeting or discussion at your earliest convenience to delve deeper into this matter and explore suitable multicast options and configurations.

I appreciate your support, and we look forward to your valuable recommendations.

Sincerely,

Michael Nolan, ADF CTO
www.orhanergun.net

Question 23: Please fill in the comparison table below

	ASM	BIDIR	SSM
239/8			
232/8			
Redundant RP			
RP Load Balancing			
Source tree			
Shared tree			
Fastest Convergence			
IGMPv1			
IGMPv2			
IGMPv3			

Question 24: Do you think ADF should replace its Multicast protocol?

A- Yes
B- No

Question 25: What alternative Multicast technology would be based on current ADF requirements?

A- DVMRP
B- OSPF Multicast
C- PIM ASM
D- PIM SSM
E- PIM Bidir

Question 26: Which multicast technology would you recommend if ADF had multiple sources in different datacenters and would be willing to spend time and budget learning advanced multicast?

A- PIM SSM
B- PIM ASM
C- PIM Bidir
D- VPLS

Question 27: Is there any problem with carrying Multicast Sparse mode traffic through the Service Providers network?

A- YES
B- NO

Question 28a: What kind of problem is that?

A- There's no IGMP support over Dense Mode.
B- It will not scale well in the SP network.
C- Only BSR is supported in Dense mode
D- Dense mode is not compatible with ASM

Question 28b: Why do you think there is no problem?

A. PIM Dense and PIM Sparse works best together
B. Running both PIM Dense and PIM Sparse Mode is a best practice in the networks.
C. They can handle the PIM Sparse mode traffic even though they run only PIM Dense mode in their network.

D. They can quickly deploy the PIM Sparse Mode for this customer and get extra revenue.

Question 29: How to solve that problem?

A- Change Service Provider with the one that supports Sparse mode
B- Run the GRE tunnel with Sparse mode on top of it.
C- Tell your current SP to replace their equipment to support Sparse mode.

Question 30: What steps would be necessary to migrate the PIM Dense mode multicast to PIM ASM?

Please pick the correct order for implementing multicast Any Source Multicast (ASM)

A- Adjust IGP if necessary
B- Configure static RPs
C- Configure the same loopback addresses on all RPs for Anycast RP
D- Switch to Sparse mode
E- Configure MSDP
F- Enable Sparse-Dense mode
G- Verify that multicast traffic is operational

Question 31: Based on the given information about ADF, what is their problem with the configuration change?

A. Configuration Management is complex; they need a tool for that.
B. Their network configurations should be kept in a safe location.
C. They need a version control system to track the changes and roll back them when necessary.
D. They need to have a virtualized environment to test the configurations before deployment.

Question 32: IF ADF wants to deploy configuration management tools that don't require so much expertise and don't want to deploy an agent on their devices, which option below is suitable?

A. Python
B. Ansible
C. Jenkins
D. Chef
E. Puppet

Question 33: ADF would like to have Automated Tests of the configuration before they deploy the code to the production and after the deployment on the production. Which tool below provides a test framework for these requirements?

A. Napalm
B. PyATS/Genie
C. TesterABC
D. Nornir
E. XML/JSON/YAML