



## 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.

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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.

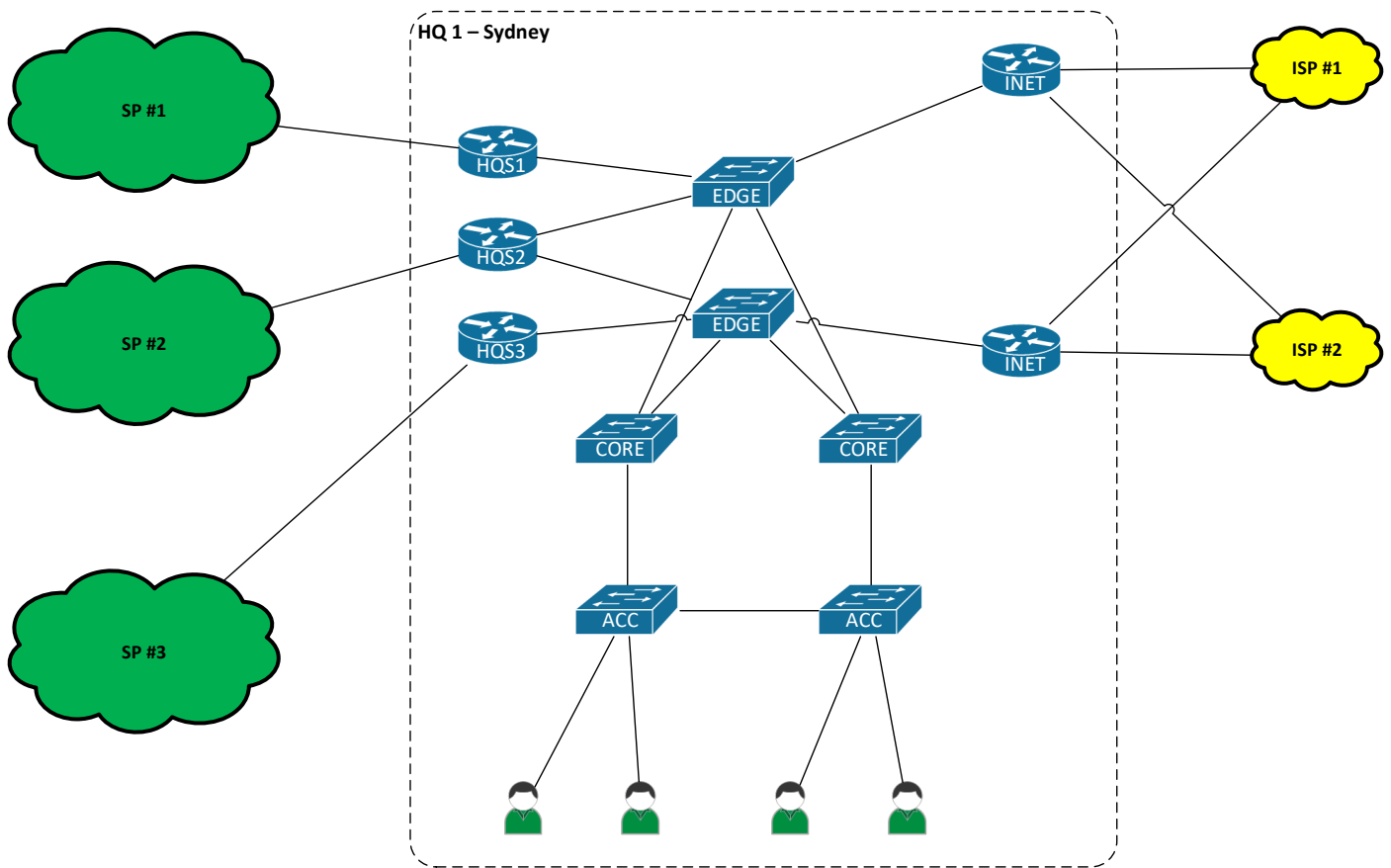
A few months ago, there was an issue on the network after configuring multiple routers simultaneously. they wanted to learn what was changed and which engineers performed it, and they wanted to roll back the updates, but it took so long, and the network stayed down for a long time.

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

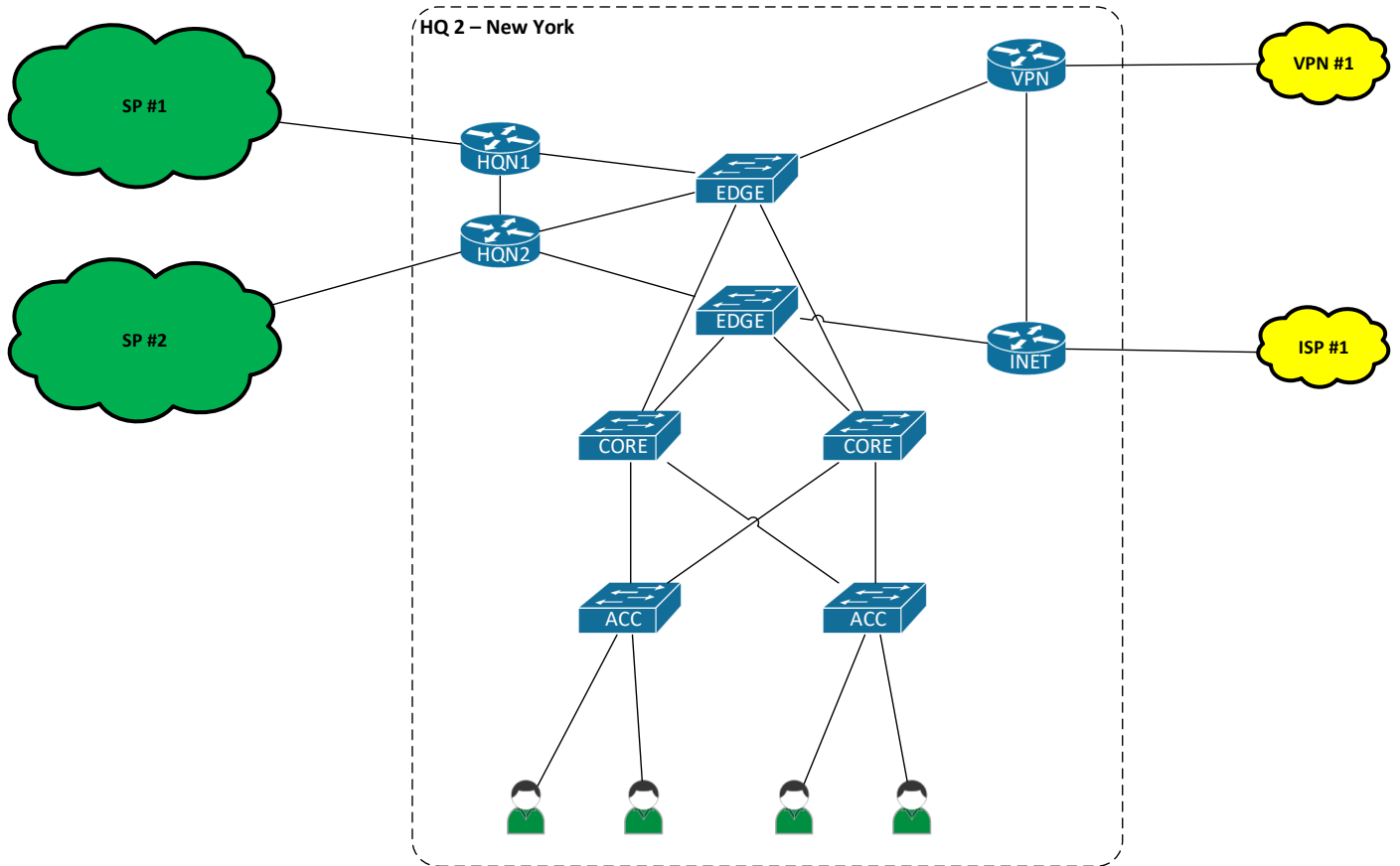
## Design Documents

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

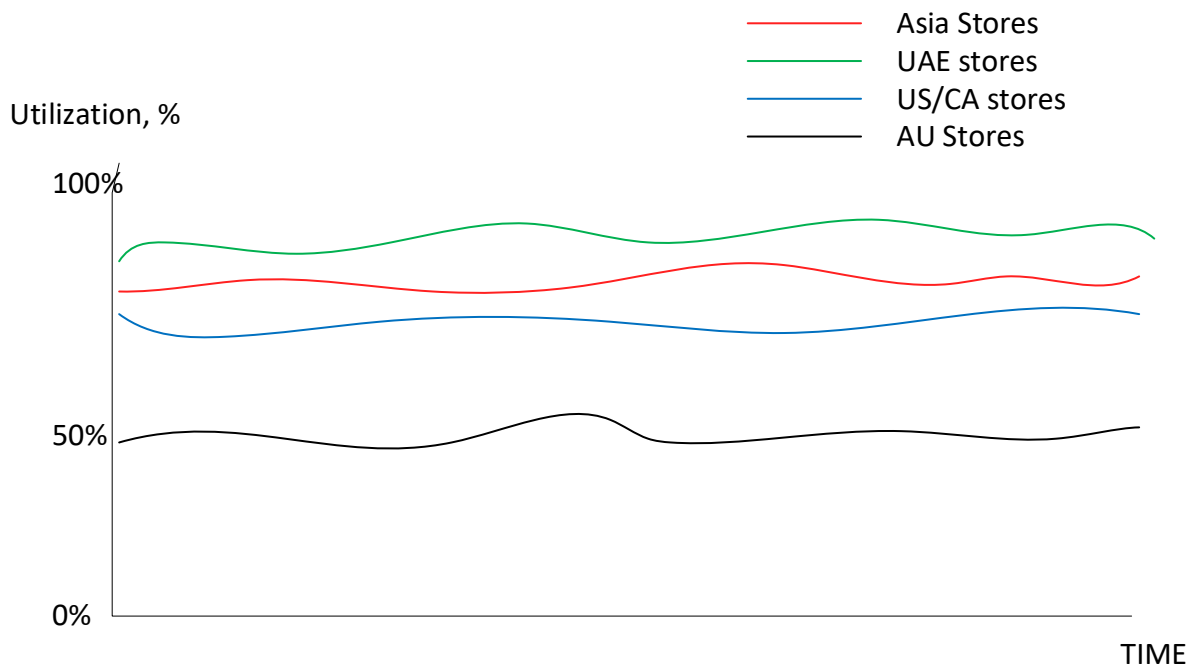
### HQ1 Design



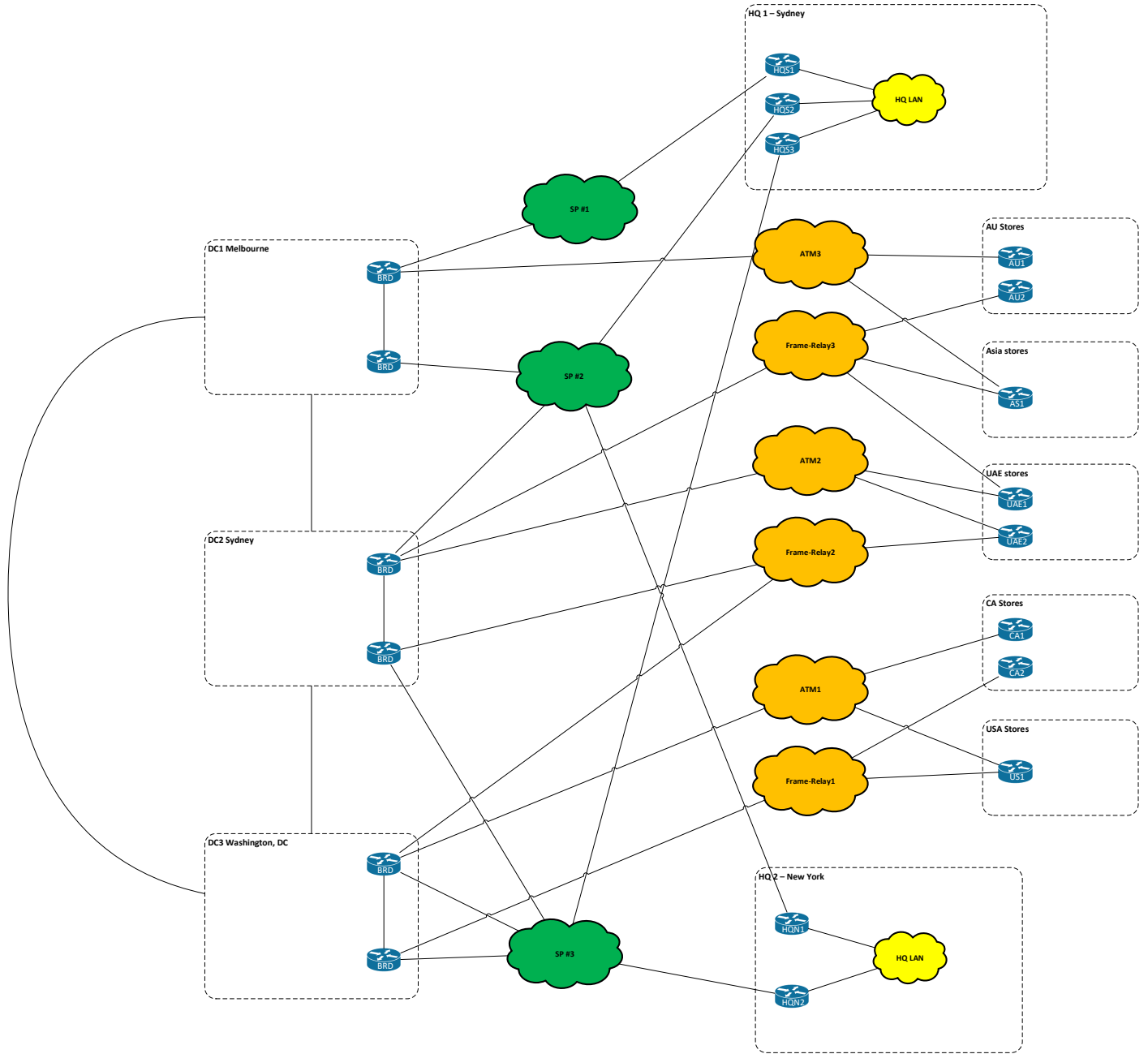
## HQ2 Design



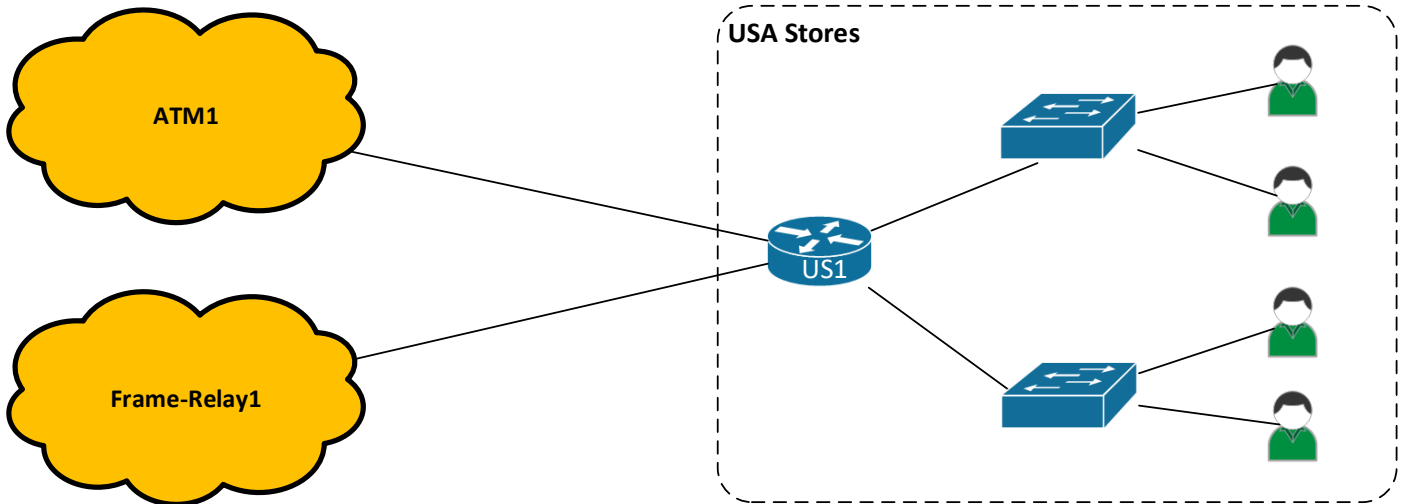
## Network Bandwidth Utilization



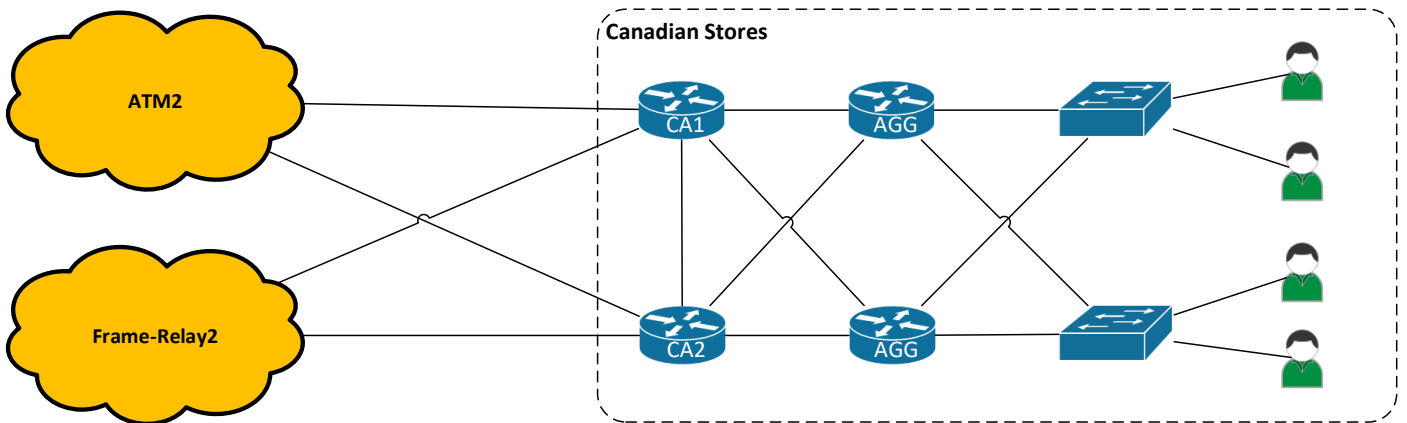
# High-Level Design



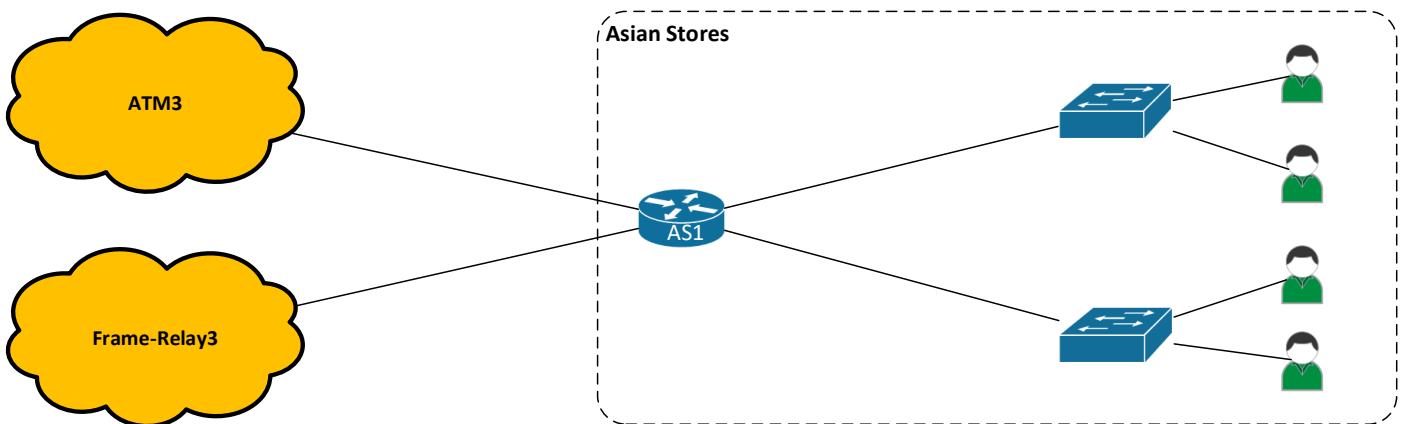
### USA Stores Stores Design



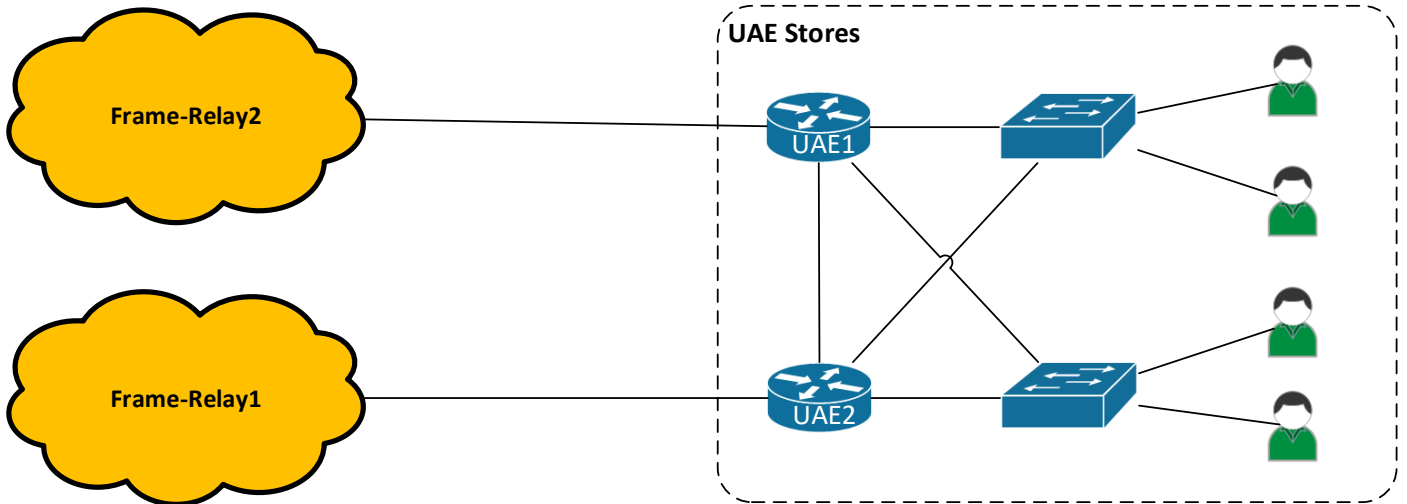
### Canadian Stores Design



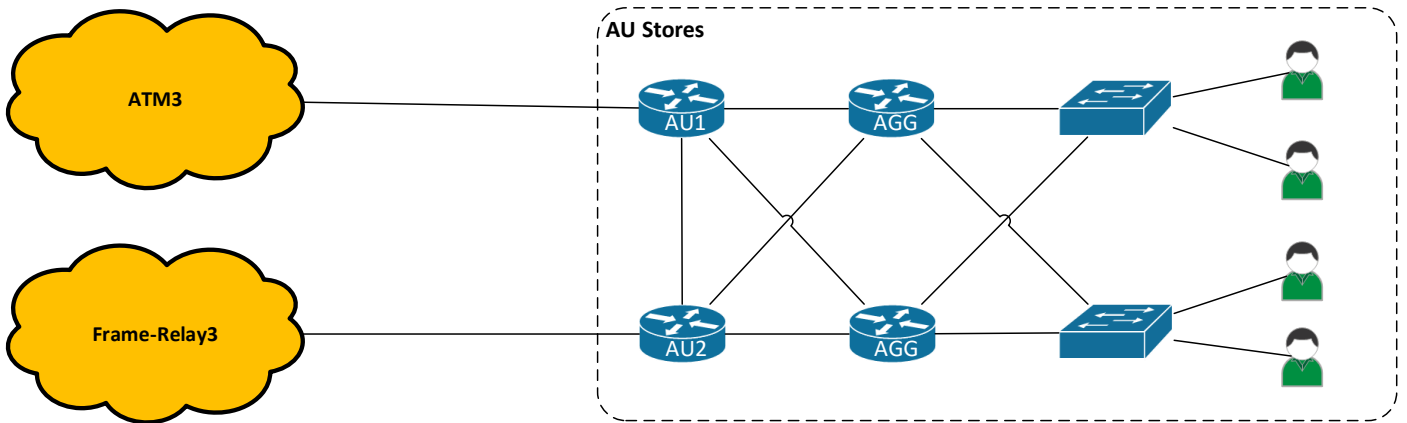
### Asian Stores Design



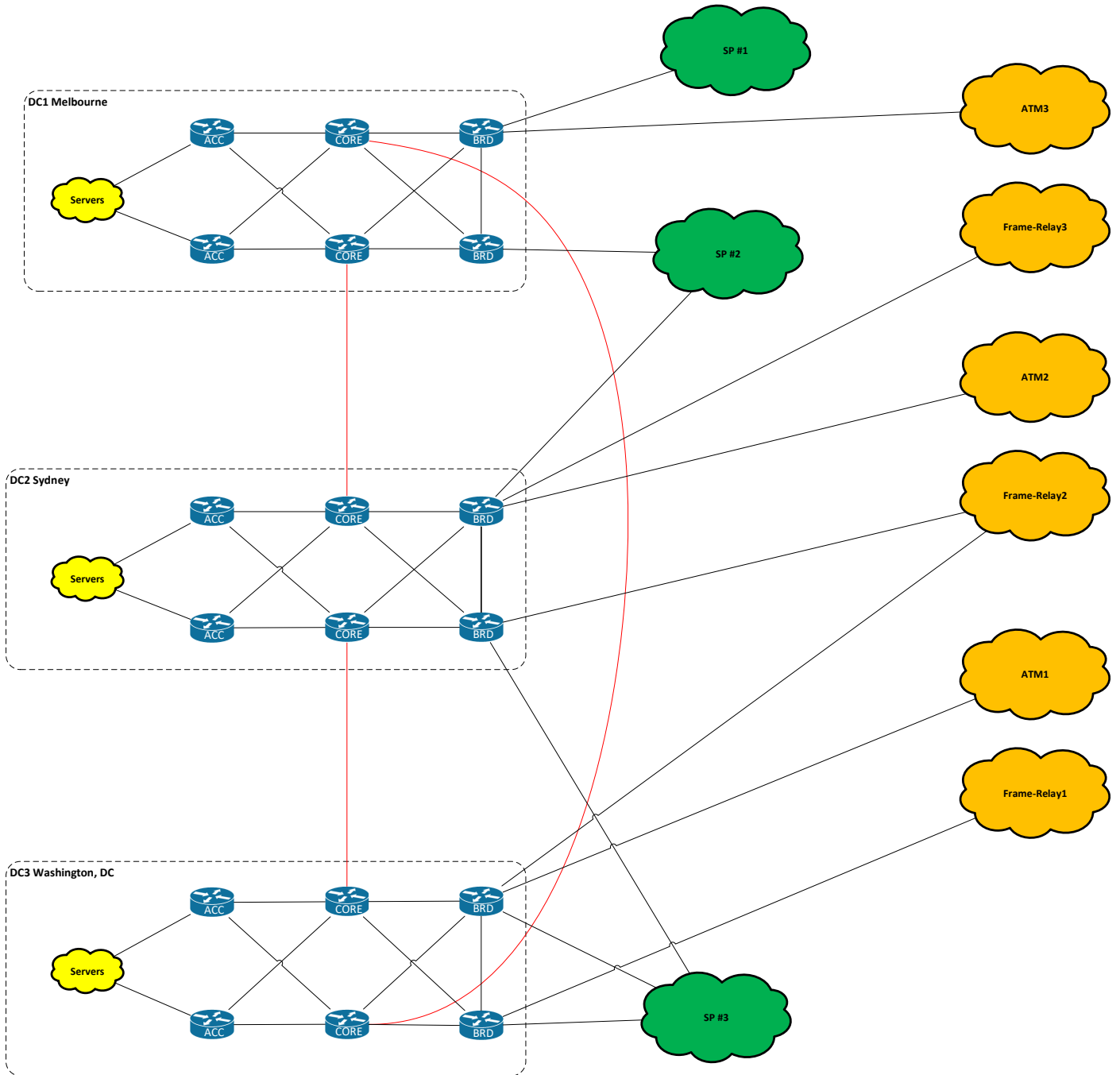
## UAE Stores Design



## 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.

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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

**Answer 1:**

The problem with the ADF Australia stores is that they are like the other routers in Flat OSPF design; specifically, in the scenario, it is given that Australia store routers are old and have resource problems.

In this case, although replacing the Australian store routers might be one of the correct options, the background information also says that the budget is cut by 70 %, so replacing is not an option.

In the CCDE exam, it is all about carefully understanding the requirements and the constraints.

Constraints mean limitations.

One of the limitations given so far is the budget. Thus, we can't replace the routers.

We should do something because they explicitly say we should do something.

In real life, you may not take action if the impact is not worth taking action on, but the Australia router issue is severe and one of ADF's pain points.

Also, replacing IGP with BGP is not an option since BGP is not designed as an IGP protocol. Also, since there is a less costly and much easier routing action to fix the problem, a hierarchical routing design is used for scalability.

We should redesign IGP (OSPF) in this scenario to overcome the problem.

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**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.

**Answer 2a:**

Replacing routers, based on given requirements and constraints, is not the best option. None of the options in this question can be correct because all the options are trying to justify why we should replace the routers.

But, because this company has a budget cut, we can't replace the routers; instead, one of the constraints of our network design for ADF will include a budget cut.

Option A is technically incorrect because we don't know whether Australian stores might have other problems; saying replacing will solve all the problems is a big assumption.

Option B is saying hardware issue, but they never also mentioned this.

Option C states that replacing routers is the fastest option; we can't know whether it would be the fastest, and the company is not looking for the fastest option.

Option D uses the 'always' keyword in design; if there is always keyword, without giving the content, that is wrong.

**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.

**Answer 2b:**

Option A is the correct one.

Fault domain means what will be the scope when there is a failure? Which devices or links will be affected, and what will be the effect?

If we can keep the impact small and not distribute them to the Australian stores, we can at least solve the current issue.

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Option B is not true because it says redesigning is always the best. There is no best in design.

Option C is also wrong because it may not be the most secure, and our concern is not security.

Option D is wrong, too. Because IGP redesign may not provide FRR, FRR is not related to our current topic.

### 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.

**Answer 2c:** There is an impact on the Australian store routers, and most importantly, one of the business owners, the CTO, is complaining about that. Without doing anything, we can't wait; we have to take action.

That's why none of the Options in Question 2c is also correct.

### 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.

### Answer 2d:

Another question, after wrongly choosing the answer in question 1, is this one.

We shouldn't replace the IGP with BGP because this is unnecessary. Although technically, all the options in this question are correct, they are not related to our problems in Australian store routers.

For example, BGP can carry millions of prefixes and scales better than IGP protocols; our problem is unrelated to the number of prefixes.

They didn't give us a number of prefixes, memory concerns, etc. Flaps are causing CPU impact and should be avoided by the IGP redesign with the minimum effort and without an extra budget.

If, after question 1, other than the IGP redesign question you are receiving in the exam, then because all the options of question 2 would be incorrect, you would not just answer the first question wrong; you wouldn't get any points from question 2 either.

If you select the IGP redesign as the correct option in the first question, then as a second question, you will get Question 2b, and you can select the 'Fault domain isolation' option.

### 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

Answer 3: Currently, we are still having the Flat OSPF design.

We will divide the OSPF domain into several areas. General OSPF Multi area design rules will apply.

Implementing Type 3 LSA filters is not an option currently. Because we are still using Flat OSPF design, we cannot perform a Type 3 filter on the regular routers. They have to be an ABR for Type 3 LSA filtering.

Since multiple area design will prevent the topology information change in one area from propagating to the other areas, dividing the flat OSPF domain into multiple areas will prevent full SPF run in the individual OSPF area if something changes/fails in the other OSPF areas.

Redistributing directly connected routes as Type 5 LSA instead of Type 3 LSA from the other domains will not give a benefit since both LSA Types cause Partial SPF run in case something changes in the domain in OSPFv2.

### 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

**Answer 4:** Currently. We are not giving the sub-optimality or any other design constraints.

We want to minimize the number of routes and the impact of changes in the other stores in the Australian Routers. Because in the Mail-1, it is given those Australian Store routers have resource issues.

That's why Totally NSSA and the Totally stubs are the best options.

The chance of suboptimal routing and blackholes increases whenever we turn the normal area into Stub, Totally Stub, NSSA, or Totally NSSA area.

Among all the options, Totally NSSA and Totally Stub keep the minimum number of routes in the routing table.

If Redistribution would be given in the business information or the email up to this question, then we couldn't choose Totally Stub since the Stub area doesn't allow redistribution.

**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.

**Answer 5:** The question is whether you can analyze the information. Did the scenario give you any constraint on suboptimality, external route redistribution, blackholing, and so on? No.

Suppose we consider the options, sub-optimality, visibility, and external route redistribution. They are all related to the OSPF design and good abilities but have yet to be given in the information.

Only we know that Australian routers have resource issues, and this can be prevented by keeping the routing table size as small as possible.

**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

**Answer 6:** All the other store routers will be placed in the Normal area since there is no requirement in the scenario.

If we select any OSPF area other than the Normal Non-Backbone area, we assume they also have a problem. Assumption is our enemy in the CCDE exam.

We couldn't continue using the OSPF Backbone area for stores other than Australia because the question asks if we have to put the other stores in a hierarchical design.

In this network, the datacenter as a transit location has to be a Backbone area; thus, the rest of the sites, such as Stores, HQs, etc., need to be in the non-backbone areas.

**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

**Answer 7:** If we look at the High-Level design diagram and analyze the information, we can see that the ABR should be placed at the Data Center Border Routers.

The reason is asked after this type of question in the CCDE exam.

In this scenario, the reason will be asked in Question 8, and the detailed answer will be provided in Answer 8.

**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.

**Answer 8:** If we examine each router for an ABR, we will also understand the Multi Area OSPF Design ABR Placement.

Look at the High-Level Design diagram ( You need to go back and forth in the actual exam as well; looking at the earlier emails, business information, topology, and diagrams are allowed ) if we would choose the Head Quarters Routers as ABR (Area Border Router), all the datacenters and the store routers would be in the non-backbone area and the same area since Store routers are connected to the Datacenters.

Let's say data centers are in Area 10, all the other stores would be in Area 10 as well, and then the stores like Australia would suffer significantly since those routers have a resource problem.

If you put stores in different OSPF areas than Area 10, say Area 20, then a virtual link would be necessary from all the store routers. Virtual link is not a good design tool.

If we choose Site Local Routers as an ABR, the backbone area would be too big. When Store routers are selected as an ABR, all the data center routers and the link between the stores and the DC Border routers would be in the backbone area; that's why the backbone area would be significant.

Another problem with choosing Site Local Routers (Store Routers) as an ABR is that when the link between site local routers and the DC Border routers fails, it will affect all the backbone devices, including HQ routers, DC Core routers, and so on.

We want to isolate the store router link/node failure issue.

If the DC Core router were chosen as an ABR, then we couldn't have the flexibility to put the low-end devices, such as the Australian Store router, in the isolated area since all the routers, including DC Border, HQ, and all the store routers have to be in the same area.

The best place in this topology for an ABR is DC Border Routers.

## 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.

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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.

**Answer 9:** Now we have new requirements with the Mail 2.

It is said that Australian store routers need to have optimal routing to all DC infrastructure.

The question is asking what needs to be changed at Australian Store Routers.

If you remember, previously, the Totally NSSA or Totally Stub area has been chosen for the Australian Store Routers.

There is no option for the Stub area, so we need to select the answer related to the NSSA area type.

Since we need an optimality to DC Infrastructure, we need to leak only the DC prefixes to the AU stores.

As you know, Totally NSSA doesn't allow Type 3 LSA, so we can't leak into Totally NSSA Area. That's why we need to change the area type to NSSA Area. We can leak the DC prefixes from DC Border ABRs into AU store routers selectively with Type 3 LSA filtering.

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That's why the answer is NSSA + Type 3 LSA Filtering.

**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.

**Answer 10:** The correct answer is Option D.

MPLS relies on the distribution of label information through protocols like LDP (Label Distribution Protocol) or RSVP-TE (Resource Reservation Protocol with Traffic Engineering). If particular prefixes are hidden, such as loopback interfaces to set up MPLS LSP, these protocols may not distribute labels for those prefixes, causing the LSP setup process to fail.

There are several ways to change this behavior, such as enabling LDP RFC 5283, carrying the loopback prefixes in BGP, such as not summarizing the loopback prefixes, and so on.

When we don't summarize or filter our loopbacks, we can set up end-to-end LSP.

The other options in this question are not related to our problem.

**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.

**Answer 11:** The correct answer is Option C.

Our main issue is Australian stores; we are focusing on this. And we don't know whether other stores are having issues or not.

We can place each Australia store in a separate OSPF area; in this case, we would have hundreds of OSPF areas. Instead, we group the Australia store routers in a single OSPF area; if the problem continues, ADF company might complain. But having hundreds of Areas would create unnecessary management complexity, and other scalability issues might arise.

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

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

Routes →	DC1	HQ1	HQ2	Default	CA sites	AU sites	UAE sites	Asia sites	US sites
Routers ↓									
DC Border	X	X	X	In case Default is coming from edge	x	x	x	x	x
HQ1	x	x	x	Same as DC Border	x	x	x	x	x
HQ2	x	x	x	Same as DC Border	x	x	x	x	x
AU sites	x	No	No	Same as DC Border	No	x	No	No	No
CA sites	x	x	x	Same as DC Border	x	x	x	x	x
US sites	x	x	x	Same as DC Border	x	x	x	x	x
Asia sites	x	x	x	Same	x	x	x	x	x
UAE sites	x	x	x	Same	x	x	x	x	x

## 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.

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Sincerely,

Michael Nolan, ADF CTO

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

A- YES

B- NO

**Answer 13:**

Sometimes, in the CCDE exam, questions and options are very short, like this question.

Yes, or NO.

The answer seems very easy, but you should be able to follow every change so far, you should understand the company background information, emails, and any deployments since the beginning of the scenario.

If you are okay with these points up to this question, let's start answering this question.

Yes, based on the given application profile.

If we look at the applications and their transport traffic profile, such as P2P, P2MP, etc., as we can see, we have TCP and UDP-based applications, voice, and videoconferencing.

So, we can put voice in the PQ and Video conferencing in the Bandwidth queue, as per RFC 4594.

In the CCDE exam and the real-time, for the IP and MPLS QoS, we will follow RFC 4594 and its best practices and suggestions as much as possible.

Of course, by taking the companies' requirements and constraints into account all the time.

Based on that, all the unmarked traffic is also in a separate BW queue.

1 PQ, 3BW Queue is enough; more than that would be okay, but less than that is not ideal for this company and the applications and their requirements.

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				

Answer 14 :

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

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						

Answer 15 :

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

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.

Answer 16:

The answer is Option C

We should understand what WRED is- Weighted Random Early Detection to answer this question.

WRED (Weighted Random Early Detection) selectively drops or marks packets during congestion to manage network traffic. It's effective for TCP-based applications because it helps TCP congestion control work efficiently by signaling congestion through packet loss, prompting TCP flows to reduce transmission rates.

It drops the packets randomly based on their IP Precedence or DSCP bits; this way, the queue can be guaranteed to be prioritized with the desired application traffic.

Option E says that WRED is only used for UDP Traffic, it is the opposite, WRED is used only for the TCP-based applications.

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.

Answer 17: The answer is Option A

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Sometimes, deploying a feature or protocol to the network might be disruptive.

For example, if your network doesn't have IPv6 and if you enable IPv6, you might end up with resource issues depending on the hardware and the resources you have on the devices. Some devices may be unable to handle IPv4 and IPv6, so deploying IPv6 in this network without careful planning might result in disaster.

Conversely, QoS is usually enabled to prioritize some traffic, punish others, or rate limiting or traffic shaping purposes. Usually, we consider all of these purposes as harmful. Thus, enabling QoS on the networks usually has little to no-disruption but is still recommended to be deployed during the maintenance windows.

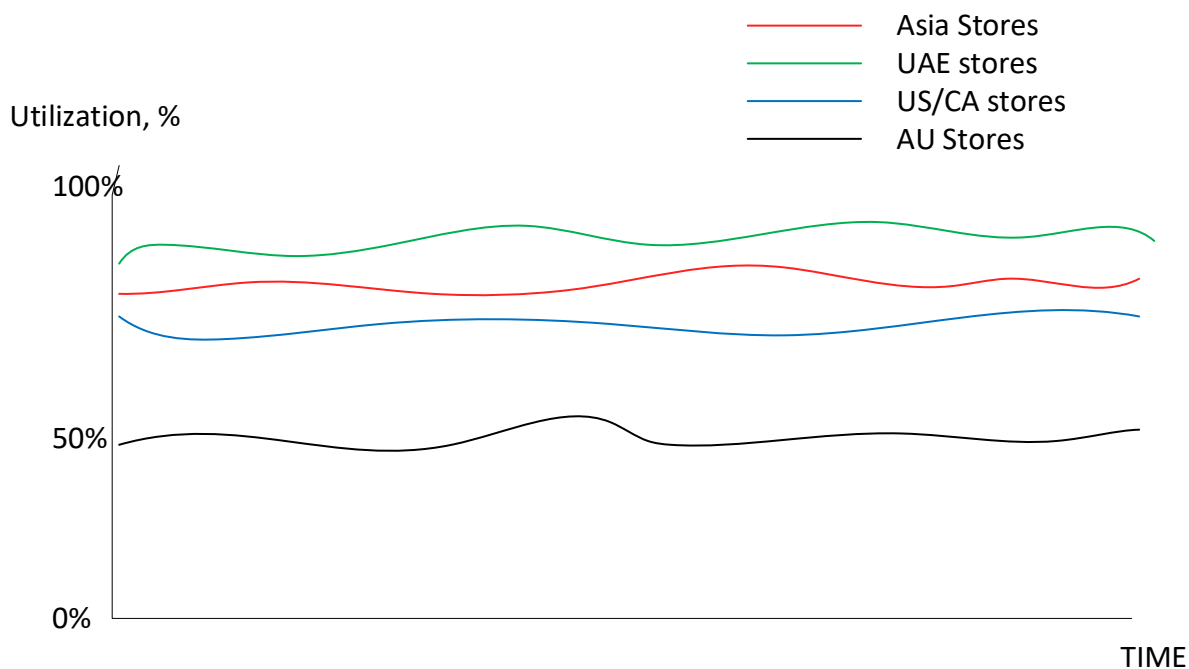
**Question 18: Which Stores most likely benefit from the QoS implementation?**

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

**Answer 18: The answer** is Option C

At the beginning of this scenario, a link utilization graph was shared inside the Background documentation.

Based on this graph, it is evident that if QoS is implemented, the stores that will get the advantage from the QoS deployment would be the most congested sites, UAE 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

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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

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**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			

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

**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

**Answer 20: The answer** is Option C, VPLS.

The next question will ask why; thus, the detailed answer will not be shared here.

**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.

**Answer 21: The answer** is Option C.

From the given requirements and the constraints, we can see that in the last email, they specifically say they want to manage their WAN network and have similar operational behavior.

From the similar operational behavior, they want to say that they want to continue with the Layer 2 VPN type of connectivity.

We can understand that because they use Frame-Relay and ATM for their WAN connections.

Both Frame-Relay and ATM were used in the past years, and they are Layer 2 based technologies.

In the other options in this question, we see QoS, Security, or Scalability as options, but these are not the concerns for their replacement for their legacy WAN.

**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.

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**Answer 22:** The answer is Option B.

When VPLS is used for the WAN, you must ensure Spokes is prevented from being an OSPF DR.

In a WAN setup using VPLS (Virtual Private LAN Service), it's important to prevent spokes from becoming OSPF (Open Shortest Path First) Designated Routers (DR) for the following reasons:

1. **Suboptimal Routing:** If a spoke router becomes the OSPF DR, it can lead to suboptimal routing. This is because the DR is responsible for sending OSPF updates to all other routers in the network. Suppose a spoke router, typically remote and not centrally located, becomes the DR. In that case, it may introduce longer paths for OSPF updates to reach other routers, causing delays and suboptimal routing decisions.
2. **Increased Network Overhead:** The DR is responsible for processing and forwarding OSPF updates, which can generate additional network traffic. Suppose a remote spoke router becomes the DR. In that case, it may contribute to increased network overhead and utilization of the WAN link, which could have been avoided by having a more central and well-connected router as the DR.
3. **Network Stability:** Having a stable and well-connected router as the DR improves the overall stability of the OSPF network. Remote spokes may have less reliable connections than Hub routers, and if a spoke router becomes the DR, it could lead to network instability if its connection experiences issues.

## 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.

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

Sincerely,

Michael Nolan, ADF CTO

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**Question 23: Please fill in the comparison table below**

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

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

- A- Yes
- B- No

Answer 24: Yes, Option A is correct.

Yes, they should because they want to send the multicast traffic from a few locations to multiple places. Few to many is better with the PIM Sparse mode models. But the detailed answer will be provided in the next question.

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

Answer 25: The answer is Option D.

They want to send from a few to many but don't forget that they said they don't have much expertise.

Suppose we are looking to deploy PIM Sparse mode because they wanted to deploy few to many or single to many, but also, they are looking for simplicity. In that case, the solution is best provided with the PIM SSM-Source-Specific Multicast.

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

Answer 26: The answer is Option B, PIM ASM.

Although they need to run PIM ASM, their traffic pattern is not two ways; thus, PIM Bidir is unnecessary.

They can run PIM ASM if willing to learn advanced Multicast, but this is also unnecessary.

Usually, the best practice is to run PIM SSM if the Multicast sender/source is known.

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

- A- YES
- B- NO

**Answer 27:** Yes, there is.

As we discussed many times, in the CCDE exam, they sometimes ask for justification after the questions. Why did you select Yes or No?

In this question, we will do the same; in the next question, we will ask Why Yes, Why No. Thus, a detailed explanation will be shared in the next question.

**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

**Answer 28a:** Option D is the correct answer.

Options A, B, and C are technically incorrect; also, we should understand that the SP network doesn't support Sparse Mode, and Dense Mode cannot work with the PIM ASM, one of the PIM Sparse mode deployment models.

**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.

**Answer 28b:** None of the options is correct; when you select in the previous question as NO, there is not any problem; you accept that PIM Sparse mode traffic can be carried over PIM Dense mode backbone, but you cannot carry.

You don't get any points from these two questions.

### 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.

Answer 29: Option B is the correct answer.

When the Service Provider doesn't support/provide the services we need, we can create an overlay tunnel and run the services we need.

This can be Multicast, QoS, IPv6, or any other service.

Usually, Service Providers provide MPLS L3 VPN Service; by default, it is provided for the IPv4 Unicast traffic.

All the other traffic is considered as Value Added Services (VAS).

### 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

Answer 30: Correct order of operation:

C-B-E-A-F-G-D

Order of operation type of questions is quite common in the exam.

Here, we are first setting up the necessary functions in PIM ASM, such as RP- Rendezvous Point, its redundancy, and controlling IGP cost to prevent un-desired behavior such as sub-optimal routing, etc., running Sparse-dense mode to avoid possible blackholing until we finish the migration. Lastly, we always verify the end-to-end tests after deployment.

Some steps can be in a different order; for example, you can change B-E steps and deploy E first, then B after that, and you will still get the total points from this question.

**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.

**Answer 31:**

Their problem is not configuration management; with configuration management, you can configure the devices simultaneously in a scalable manner by writing code on some tools. But it doesn't track the changes, their history, and whenever necessary, changing with one of the previous changes on multiple devices simultaneously.

You can achieve this with a source/version control system tool, such as Git.

Option C is the correct answer to this question.

Their problem is not also with the testing on the physical or virtual devices, even if they test in the test environment; when there is a problem with the production network environment, they want to track who made it, when it was made and quickly rollback on every device that was changed.

**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

**Answer 32:** Python can be used as a configuration management tool, but it is a full-blown programming language and requires expertise compared to other configuration management tools, such as Ansible. Chef or Puppet.

Jenkins is an Orchestration platform that coordinates and automates various tasks and processes within a software development pipeline or workflow. In this context, Jenkins is the central hub that manages and executes tasks.

Ansible, Chef, and Puppet can be used as configuration management tools, and among them, only Ansible satisfies the constraint in this question, which is an agentless configuration management tool. The correct Answer is Option B, Ansible.

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

**Answer 33:** Napalm and Nornir are both Python frameworks that provide configuration abstraction, thus hiding the complexity of the many configurations. But they are not the configuration test tools.

Similarly, none of XML/JSON/YAML are configuration test tools. They are primarily used to represent the data. They are known as serialization or encoding tools as well.

TesterABC is just a made-up term; there is no tool, library, or framework in automaton like TesterABC.

PyATS/Genie is a well-known and commonly deployed test tool that can create complex network tests.