



Solution Design Document

ABC Ltd. Group Limited Database Re-host Design

Aug 22, 2019

Version 1.9

Ingram Micro Cloud
Corporate headquarter
3351 Michelson Dr #100,
Irvine, CA 92612, USA

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About This Design Process

Author	Debabrata Howlee
Change Authority	Ingram Micro Cloud
Internal Reference	<Doc ID>
Project Name	Database Migration for ABC Ltd.

Document History

Version	Date	Status	Reason for Change
0.1	26/07/2019	Draft	Initial Draft
0.2	30/07/2019	Draft	Updated proposed architecture
0.3	31/07/2019	Draft	Updated capacity planning
0.4	02/08/2019	Draft	Updated migration strategy
0.5	05/08/2019	Release	Internal release
1.0	08/08/2019	First External Release	Released for Customer review
1.1	12/08/2019	Update Release	Updated customer requirements
1.2	14/08/2019	Update Release	Modified to deployed standard.
1.5	16/08/2019	Released	Tidied up the sections, indexing and overall alignment
1.9	22/08/2019	Released	Removing major sections to align with CAF document

Table 1 Document history

Document Review

After creating an initial draft by Ingram Micro Cloud Architect, the design document will be peer reviewed internally. The process is described in the Solution Design Document in Appendix B. Internal peer reviewed document will have version less than 1 and customer released version will be greater than 1.

- As a standard offering the document will be once internally peer reviewed and once external/customer peer reviewed.
- After peer review all comments/feedback will be captured in appendix A and then updated to the document as a final design.

Version	Review Date	Description	Role	Reviewer
0.5	06/08/2019	Reviewed initial draft released by cloud architect	Cloud Architect	
1.0	13/08/2019	Peer reviewed 1	Sr. Cloud Architect	
1.5	21/08/2019	Peer reviewed 2 – Fit to Release	Manager	

1. Introduction

1.1 Preface

ABC Ltd. Co-operative Group Limited is a New Zealand multinational dairy co-operative owned by around 10,500 **New Zealand** farmers. It is backed by a strong IT infrastructure hosted in traditional data centre which supports the daily operations and millions of transactions that involves a huge amount of data. They currently have a large footprint of Microsoft SQL database. They are in the midst of a digital transformation initiative that cuts across business units and are looking to Azure PaaS solution to get them the needed speed and agility.

The primary purpose of this detail design is to define the Azure solution design to support new Azure cloud-based “**Infrastructure data platform**” / application instances, as replacement of existing on-premise application services. The baseline reference of this detailed design is the customer requirement and around the best practice design recommendations from Microsoft Azure.

This project will create the service described within this document. Putting all infrastructure items in place, installing the application, and testing to ensure everything is operating as expected.

This document covers the following 4 high level phases for the Azure migration process:

- **Phase 1:** Assessing database workloads
- **Phase 2:** Designing & Migrating database workloads
- **Phase 3:** Optimizing SQL workloads
- **Phase 4:** Securing and Managing SQL workloads

Ingram Micro Cloud Architect will do the assessment and generate below documents/spread sheet to be shared with ABC Ltd. technical team.

1. Solution Design Document
2. Test cases report spread sheet
3. Risk assessment report spread sheet
4. Security assessment report spread sheet
5. Migration tool report spread sheet
6. Migration cutover plan spread sheet

1.2 Audience

- ABC Ltd. Services technical team need to provide feedback of all the migration relevant documents mentioned in section 1.1.
- Ingram Micro Cloud Solution Architect who prepare all the migration documents in detail and.
- Ingram Micro Sales can refer to the Migration plan and see the guidelines for any future migrations.

1.3 Customer requirement

ABC Ltd. would like to move on-premise workload to Azure to solve the following challenges:

- Increase the quality, transparency and efficiency of their end customers.
- Fulfill the need of the end user clients requiring storage of data in their own countries
- Non-dependable IT functions or provide clients with the expected speed and reliability required to operate their businesses
- Azure Active Directory Integration
- Scalable PaaS solution for database with a SQL Server Agent, and Service Broker
- On-premises infrastructure cost is scattered across multiple areas. Electricity, internet connectivity, cooling solution, security personnel etc.
- They also want to save cost which needs to keep on updating individual servers or computers and installing new software licenses, cloud computing allows the IT team to focus on using the cloud to better up business processes throughout the organization rather than responding to employee needs.
- They also want to take advantage of CSP program which will bring down their operational cost.

Below are ABC Ltd. Group Limited requirements gathered during assessment,

Req. No	Requirement	Business Priority
1	ABC Ltd. Group Limited has servers which needs to be upgraded and cost associate to migrate to latest OS is significant, also avoid end of support costs (CSA)	High
2	Ensure there is no downtime, no disruption: by performing an OS upgrade on a target clone, ABC Ltd. Group Limited source is never interrupted during the process	High
3	Take advantage of current offers from Ingram Micro CSP program	Medium
4	Validate Upgrade to Target Clone to ensure Application Compatibility with newer OS with no risk	High
5	Mitigate cybersecurity threats from unpatched OSs	High
6	SQL Server Database for application should be swapped with newer OS versions in Azure	Medium
7	All migration should happen during weekend – 3 PM to 11 PM	High
8	All relevant existing documents should be moved into the new repository and classified in accordance with the ABC Ltd. Group Limited defined attribute and security model	High
9	Consistent backups for guaranteed and simple recovery of virtual machines <ul style="list-style-type: none"> - Snapshot, copy & archive: incremental or full, 0-downtime Incremental and archived backups to save storage space - Daily incremental backup - Weekly full backup - MySQL binary logging of each transaction, daily full dump to reduce time of replaying changes 	Medium
10	Mitigated risks of failed recovery, recovery testing and automated consistency checking after recovery <ul style="list-style-type: none"> - All backup and restore functionality should be tested quarterly - Alerts should be sent out should any backup or restore tests fail. 	Low

11	RTO (Recovery Time Objective): 3days	High
12	RPO (Recovery Point Objective): 1h for Git, 1d for JIRA and Application - Zero data loss within RPO requirements	High
13	Encryption Policies Data at rest: Information at rest will be stored in Azure storage account so we take advantage of it out-of-the-box features Data in transit: Any income/outcome data will be sent using an encrypted transport layer (https) - CLI - Azure portal Customer → Azure Storage Account (https) Azure Storage Account → VM (https) Azure Storage Account → RnD (https)	High

Table 2 Customer Requirement

1.4 Review and verification of customer requirements and associated changes

- Ingram Micro Cloud Architect make sure to have detailed analysis of customer requirements.
- Ingram Micro Migration team prepare a report and get verified with customer.
- Ingram Micro Migration team is responsible to make any associated changes after customer reviewed.

1.5 Scope and business benefits

The following deliverables and business benefit from the project “SQL Database migration”.

Deliverables	Business Driver / Benefit
<p>Infrastructure Data software operational on the Azure platform</p> <ul style="list-style-type: none"> • Create a CSP tenant and create Azure SQL server and SQL Managed instance workload into it • Install 1 x DMA instance (On-premises) and push the schema and database to Azure SQL database. • Create Database Migration Service in Azure so that the data can be migrated over to SQL managed instance. • Test and verification of the above task. 	<p>Implementation meets the following business benefit</p> <ul style="list-style-type: none"> • As on-premise workload’s license is in EOL, (Windows Server, SQL) hence decided to move to Azure • On-premises maintenance cost (power, electricity, security personnel etc.) will be off. • Azure CSP – better pricing • Meets Ingevity’s application high availability requirement. • Meets Ingevity’s security requirement

Table 2 Scope and Business Benefit

1.6 Deployment Window Planning

The cutover date & time is confirmed and documented in the Solution Design Document with considering for minimal business disruption. Common attributes considered are customer business office hours, end user impact such as hours of access, day of week, holidays, and critical business volume periods.

Scheduling Worksheet	
Locale	USA - Pacific Time Zone
Preferred Days of Week (MON-SUN)	Saturday
Preferred Hours	6AM – 2PM
Monthly Preference	Code Freeze NOV/DEC

Table 3 scheduling worksheet

1.7 Cost analysis

General purpose tier is available with:

- 8 cores: \$736.29/month
- 16 cores: \$1,472.58/month
- 32 cores: \$2,208.87/month

A deployment comes with 32GiB of storage. Additional costs will include storage:

Capacity: Each 32GiB block, up to 8TiB, will cost \$0.0575/GB

IOPS: Every 1 million requests will cost \$0.10. Charging will start after Dec 30th.

Backup storage: Will cost \$0.05 per GiB. Charging will start after Jul 30th.

1.8 Azure Naming Conventions

Customer advised an existing naming convention will be retained for this implementation.

1.9 Related Documents

SR#	Details	Document link / location
1.	Microsoft Cloud Adoption Framework	https://docs.microsoft.com/en-us/azure/architecture/cloud-adoption/
2.	Azure Database Migration Service	https://azure.microsoft.com/services/database-migration/
3.	Ingram Micro operational docs <ul style="list-style-type: none"> • Incident management • Problem management • Change management • Capacity management 	https://confluence.int.zone/display/PM/ITSM+Management

	<ul style="list-style-type: none"> • Service level management • Request fulfilment 	
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Table 4 Related Documents

1.10 Roles and Responsibilities

Resource	Contact details	Responsibility
		Co-ordinate with reseller IT works and customer ABC Ltd..
		Technical POC from Ingram Micro Lifecycle Services
		Technical POC from Ingram Micro Lifecycle Services

Table 5 Roles and Responsibilities

2. Current architecture

ABC Ltd. has application and database servers deployed in multiple location in Australia. In Australia east location Townville has the primary site where Australia southeast location Adelaide has the secondary site.

2.1 Database Architecture

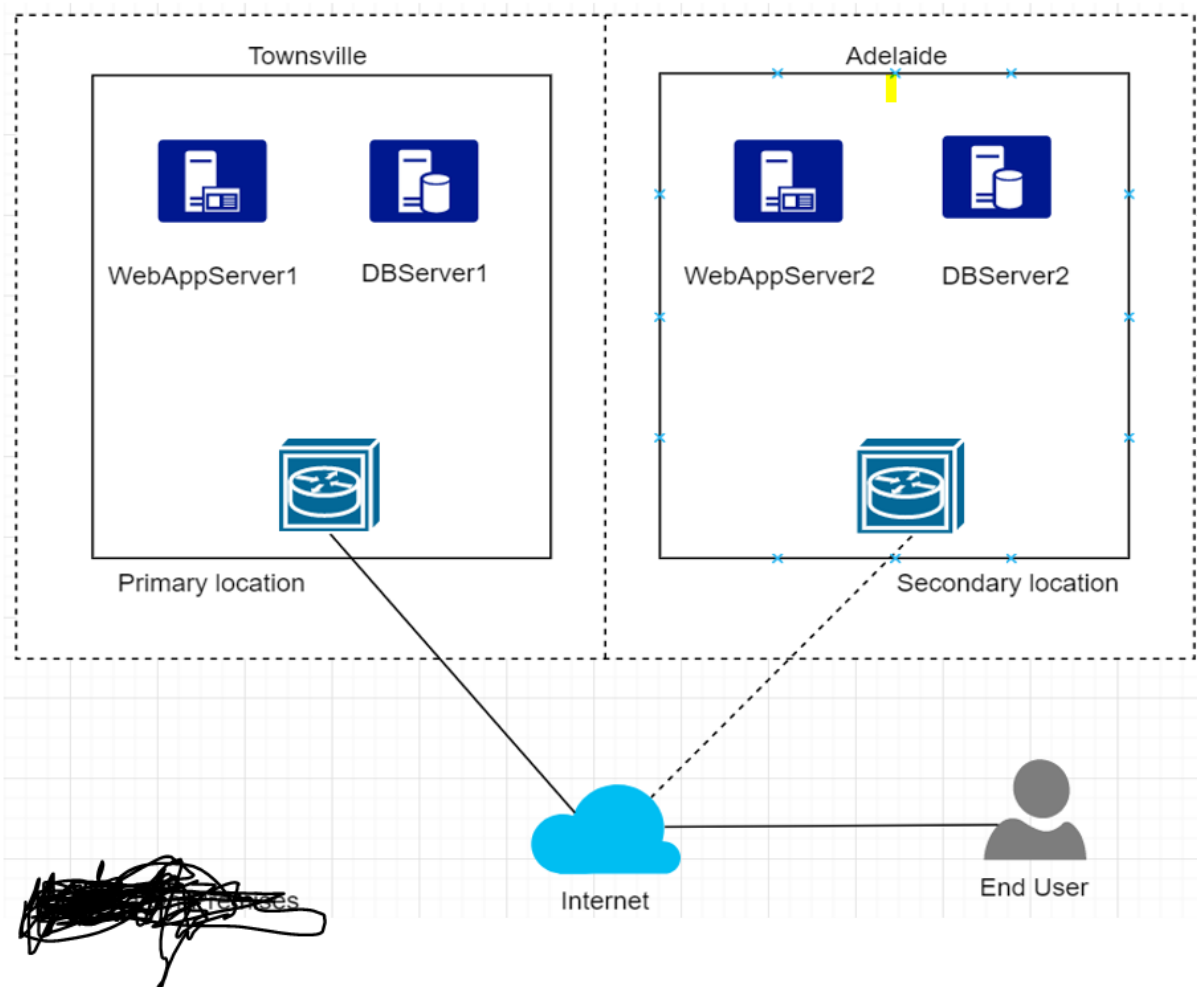


Figure 1 Existing on-premises architecture

Figure 1 Existing on-premises architecture

2.1.1 Application Servers

Server Role	Env.	Server Name	OS	IP address	Core	MEM In GB	NIC.	C:\
Virtual	Prod.	WebAppServer1	Windows Server 2016 Datacenter	X	4	16	1	50 GiB
Virtual	Test/QA	WebAppServer2	Windows Server 2016 Datacenter	X	4	16	1	50 GiB

3. Table 6 Existing on-prem application servers' inventory

2.1.2 Database Servers

Type	Env.	Server Name	OS	SQL Cluster Name	SQL Inst.	IP address	Core	Mem In GB	NIC	C:\	D:\ Data
Virtual	DB	DbServer1	Win 2016 DC	SQLClus1	1	X	8	24	1	80 Gi B	1 TB
Virtual	DB	DBServer2	Windows 2016 DC	SQLClus1	2	X	8	24	1	80 Gi B	1 TB

Table 7 Existing on-prem database servers' inventory

3 Operational process

The Operations process focuses on techniques and approaches to adopt a cloud capability. Below are few components to focus,

- 3.1 Service Management
- 3.2 SLA Strategy
- 3.3 Business Continuity Planning
- 3.4 Performance and Operational Health

4 Assessment

After having the customer workload details, Ingram Micro assesses workloads and creates an assessment report to be produced to the customer. Below section has the assessment tools, steps and assessment reports.

4.1 Assessment Tools

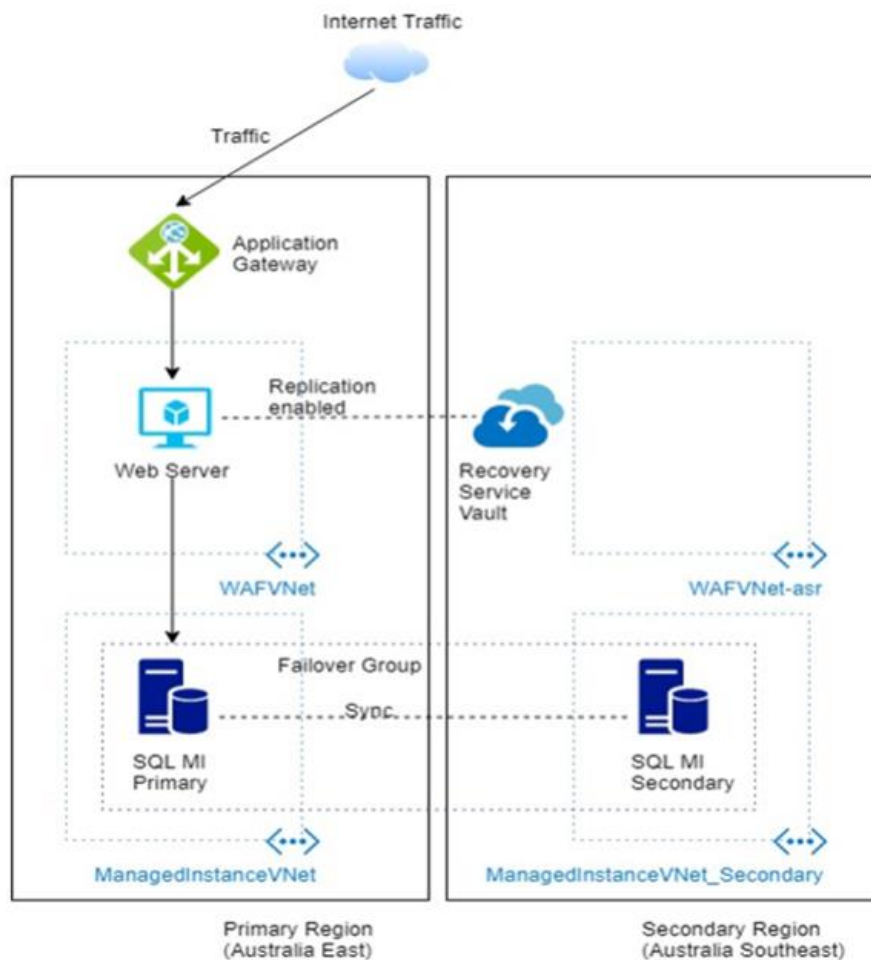
The following tools may be used to accurately assess the existing on-premise infrastructure environment. The tool then produced a report which then will be presented to the customer. Also, all inventory from the assessment report is documented here in the table below:

Tool Name	Purpose
Database migration assistant (DMA)	Used to migrate on-premise database to Azure SQL managed instance (MI)

Table 8 Workload assessment tools

5 Proposed architecture

ABC Ltd.'s on-premise SQL database will be moved to Azure CSP by deploying resources in Australia East and Australia Southeast regions.



The following sums up high level proposed Azure architecture:

- Existing VMs will be migrated into Azure VMs using lift-and-shift methods.
- Azure default authentication service (AAD) will be used for this tenancy within single region, two availability zones.
- For application servers, a separate subnet will be created. Utility and reporting instances will be deployed under same subnet.
- To protect against data centre failures, application server will be replicated using ASR to another availability zone.
- To switch traffic from one availability zone to another availability zone (failover), manual DNS method will be used. There is a requirement in future to leverage Azure traffic manager to route traffic between primary and secondary regions – i.e. If primary regions become unavailable, then traffic manager fails over to the secondary region.
- Two different IP subnets will be used for application and database servers excluding gateway IP subnet for application gateway.
- Managed SQL instance will be used as data solution, existing data will be migrated in DB instance and on-premises DB Server will be scrapped. Due to redundancy requirement, MI VNET will be peer with another Azure MI region. The MI instance will sit in a different VNET.

- The application gateway firewall function will be used to protect the Application servers for application level security. This will be in addition to Azure network security group (NSG). The database servers will only allow traffic from application servers.

5.1 Solution Components

The Azure solution for this project has the following components and will be used within the solution.

SR#	Parameter	Description
1.	Resource group	Resource groups are used to group resources so they can be managed by a lifetime, owner, or other criteria.
2.	Virtual network (VNet) and subnets.	Every Azure VM is deployed into a VNet that can be segmented into subnets. Create a separate subnet for each tier.
6.	Network security groups (NSGs)	Use network security groups (NSGs) to restrict network traffic within the VNet. For example, in the three-tier architecture shown here, the database tier does not accept traffic from the web front end, only from the business tier and the management subnet.
8.	Virtual machines (VM)	For recommendations on configuring VMs, see Run a Windows VM on Azure and run a Linux VM on Azure .
9.	Public IP address	A public IP address is needed for the application to receive Internet traffic.
11.	Azure Monitor	<p>The azure monitor is used to collect all events and logs from different parts of the infrastructure and the ID application to allow an operations team to:</p> <ol style="list-style-type: none"> 1. Monitor the usage of the whole system in real-time. 2. Store log data to aid root cause analysis and problem identification 3. Alert operations when specific metrics have been breached <p>Azure monitor stores data within a data warehouse and uses a query language called 'Azure Monitor log query' to be able to retrieve data. https://docs.microsoft.com/en-us/azure/azure-monitor/log-query/get-started-portal</p>
12.	Azure Security Center	The Azure security centre is a separate service that monitors virtual machines and other Azure services looking for vulnerabilities and exploits. Security centre raises events to Azure Monitor.
13.	Jumpbox	Also called a bastion host. A secure VM on the network that administrators use to connect to the other VMs. The jumpbox has an NSG that allows remote traffic only from public IP addresses on a safe list. The NSG should permit remote desktop (RDP) traffic.
15.	Availability sets	Create an availability set for each tier, and provision at least two VMs in each tier, which makes the VMs eligible for a higher service level agreement (SLA).

16.	Load Balancer	Use Azure Load Balancer to distribute network traffic from the web tier to the business tier, and from the business tier to SQL Server.
17.	SQL Managed Instance	SQL managed instance is a deployment of Azure SQL database which provides automatic backup, patching etc.

Table 9 Propose Azure Solution Components

5.2 High Availability (HA) architecture

The auto-failover group is configured on the primary instance and will connect to the secondary instance in a different Azure region. All databases in the instance will be replicated to the secondary instance. The following diagram illustrates a typical configuration of a geo-redundant cloud application using managed instance and auto-failover group.

However, the application gateway is configured in Australia East region only. The application is not highly available for this reason. A manual process is implemented for DR situation.

5.3 Failover Scenarios

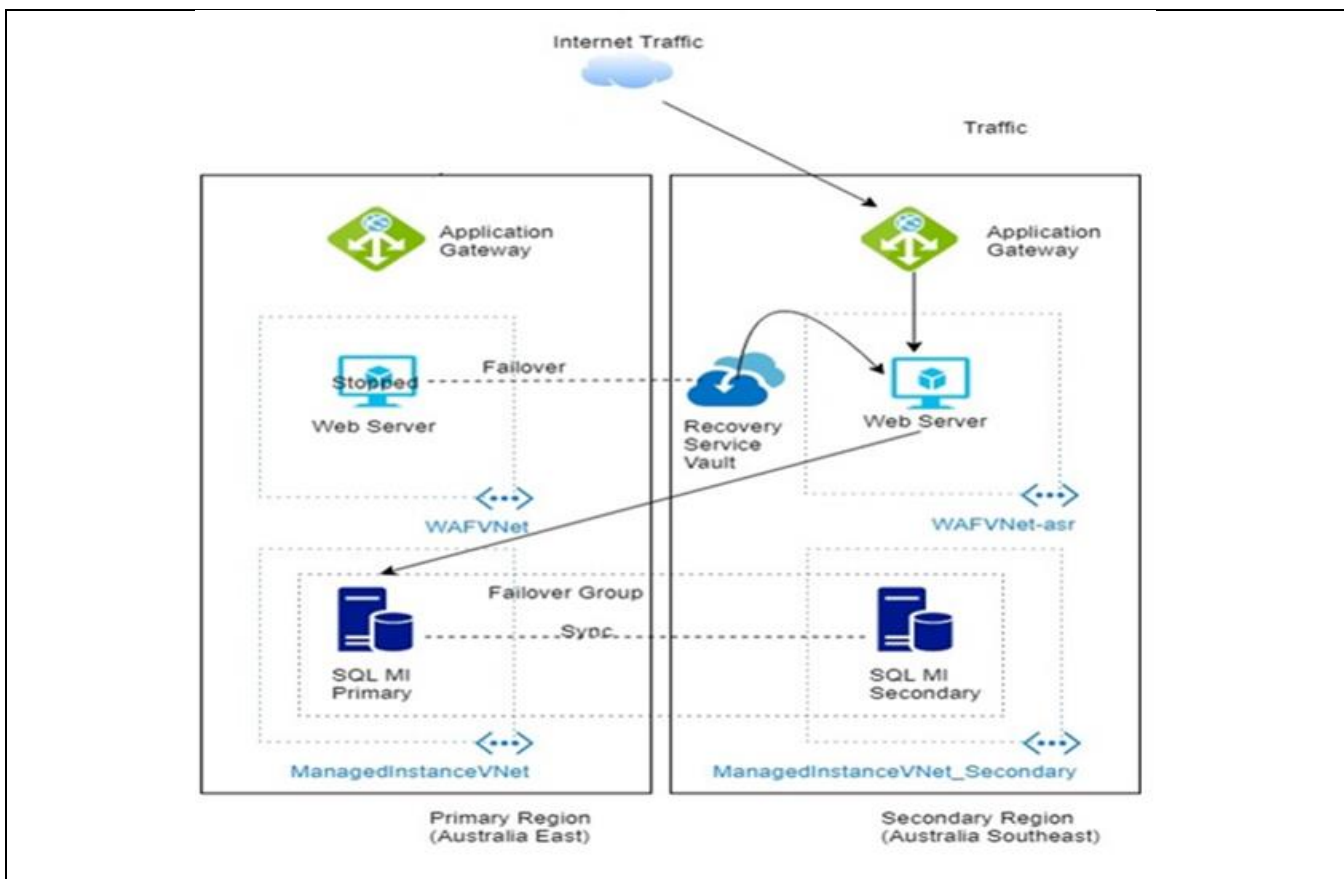


Figure 2 Failover architecture

5.4 Disaster recovery architecture

With disaster recovery, Azure VMs continuously replicate from to a different target region. If an outage occurs, you can fail over VMs to the secondary region, and access them from there. When everything's running normally again, you can fail back and continue working in the primary location.

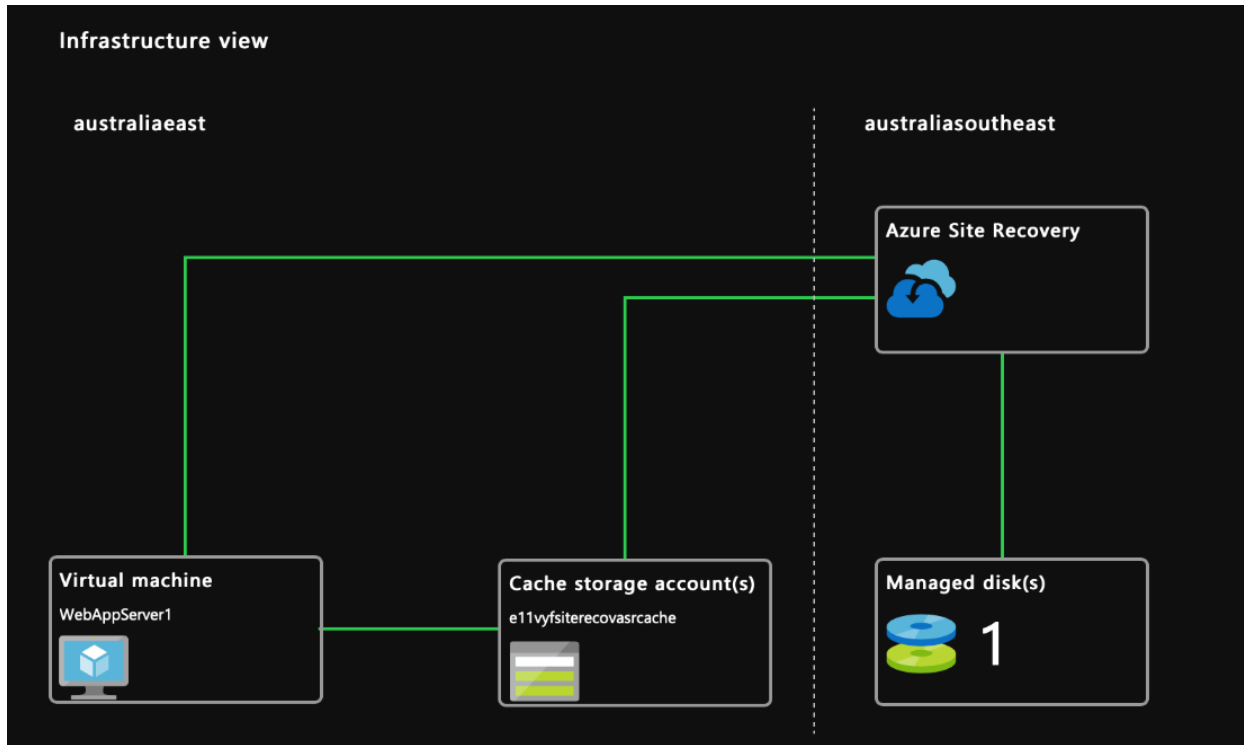


Figure 3 Proposed disaster recovery architecture

5 Architectural review

- Ingram Micro Cloud Architect make sure to setup meeting with customer requirements and share proposed architecture for review.
- Once Proposed architecture get verified by customer, Ingram Micro Migration team is responsible to make any associated changes after customer reviewed.

6 Migration Strategy

Server Name	Scope	Tool		
INGVSQL1	Rearchitect	DMA, DMS		
INGVSQL2	Rearchitect	DMA, DMS		
INGVSQL3	Rearchitect	DMA, DMS		
INGVSQL4	Rearchitect	DMA, DMS		

Table 10 Refactor, Rehost and Rearchitect

7 Configuration Parameters

During the build phase, the following parameters will be enabled throughout all Azure components to achieve the required solution to solve the business requirements.

7.1 Network Configuration

In a migration process, set up networking is one of the critical design steps. Below mentioned points are considered in a typical design process. The design document should consider the points which are as under:

Topics	Details
Virtual Network design	existing vNET will be used for the VPN gateway
Design subnets	add gateway subnet as per diagram 1 above
IP address planning, Setup DNS	
Configure NSG	nsg1 – existing will be used
Setup availability zones	Australia east only
Design hybrid cloud networking	yes – VPN site to site
Configure site-to-site VPN	Yes
Configure vNET peering	No
Configure Azure Virtual WAN	No
Configure application security group	No
DHCP, NTP & DHCP	default Azure provided

Table 11 – Network Configurations

8 Risk Identification and Mitigation

The Risk Identification and Migration section of the Solution Design Document details the process and company specific risks that need to be accounted for and mitigated in the solution design. The number of risks and effects of each risk typically increases as a company moves down the scale from their first few workloads in the cloud towards an all-in posture. It consists of four phases.

Step 1 – Identify

Step 2 – Assess

Step 3 – Mitigate

Step 4 – Enforce / Monitor

Attached is the risk management sheet.



Risk_Assessment_Fo
nterra.xlsx

9 Optimizing Workloads

After Ingram Micro moves resources to Azure, they need to streamline them to improve performance, and maximize ROI with cost management tools. Given that Azure is a pay-for-use service, it's critical for Ingram Micro to understand how systems are performing, and to ensure they're sized properly.

Post-migration operation is performed by Ingram Micro to help the customer decrease the cost and optimize the resources.

Ingram Micro provides decentralized automation capabilities to reduce costs. Features suggested include:

- Auto-snooze Azure VMs based on low CPU.
- Schedule Azure VMs to snooze and un-snooze.

9.1 Azure Cost Management

- To make the most of their cloud investment, Ingram Micro will take advantage of the free Azure Cost Management tool.
- Azure Cost Management provides simple dashboard reports to help with cost allocation, showbacks and chargebacks.
- Cost Management can optimize cloud spending by identifying underutilized resources that Ingram Micro can then manage and adjust.

9.2 Total cost of ownership (TCO)

On-premises cost (per month/year)	Azure cost	Difference(ratio)
Server Cost (\$100)	\$150	+\$50
Electric cost (\$20)	0	-\$20
Storage cost (\$20)	\$20	0
Maintenance cost (\$50)	0	-\$50
Network cost (\$30)	0	-\$30
		-\$50

Table 12 Cost Analysis

10 Secure and Managed

10.1 Secure Migrated Workloads

Securing workloads from threats is the most critical task after migration. Below security measures can be taken to avoid internal and external threats.

Tasks	Parameters
Follow Azure Security centre recommendations.	See security policy in section 6.1.1 to 6.1.3
Encrypt data (IaaS)	Encryption can prevent from unauthorized access. VM – use azure disk encryption. Storage - Storage encryption is by default enabled for all new. And can't be disabled.

Encryption data (PaaS)	For Azure SQL database make sure data is encrypted using Always Encrypted wizard of SQL management studio. Protect the Azure SQL database with real time
VM antimalware protection	Azure Security Centre generally reports about this antimalware protection. https://docs.microsoft.com/en-us/azure/security/fundamentals/antimalware
Web Apps security	Web apps can be secured using- <ul style="list-style-type: none"> ➤ Azure key vault which stores the app secrets and let the application access. ➤ App Service environment which provides isolated dedicated environment ➤ Web application firewall which comes with Application gateway.
Review Subscription and resource access	Should review the IAM access for correct users to subscriptions and resources with correct RBAC.
Review audit and security logs	Sign-in activity logs for who has logged in;
Multi-factor authentication	

Table 13 Azure tools.

10.2 Manage Migrated Workloads

After securing the resources, the following features will be turned on to ensure workloads are managed as standard to minimize the business risk.

Feature to be turned on	Remarks
Resource delete lock on resource groups	
Implement site recovery	
Implement Access policy	
VM management	Keep VMs into availability group for high availability, use managed disk for ease of VM disk and storage management.
Enable diagnostic logs	
Business continuity and disaster recovery	

Table 14 Policy – migrated workload management

11 Service Management Workflows

11.1 Problem/Incident Management

In the Hypercare period the team is available 24/7.

P1 issues	Troubleshooting steps	Contact if not resolved
-----------	-----------------------	-------------------------

Connection to SQL database fails	There might be wrong Firewall configuration that's why Azure SQL database or client-side firewall is blocking connections to Azure SQL Database. For that setup Firewall Rules to allow Client IP address.	Engineer
When an application connects to an Azure SQL database, and the following error message is received: Error code 40613: "Database <x> on server <y> is not currently available. Please retry the connection later. If the problem persists, contact customer support, and provide them the session tracing ID of <z>	This error occurs when the database is being moved (or reconfigured) and application loses its connection to the database. Database reconfiguration events occur because of a planned event (for example, a software upgrade) or an unplanned event (for example, a process crash, or load balancing).	Engineer

Table 15 Refactor, rehost and rearchitect

11.2 Change Management

Below table has the change management topics that can be taken care if required

Topic	Details
Changes can be absorbed	Ad-hoc and minor changes will be absorbed if the impact of change is less and efforts required are less than couple of hours (2 – 3 hours)
Changes must go through process	Any change after the sign-off of the requirements and design, if impacting the project timeline and effort will be notified to the Customer. Any such change will go through the change management process.
Cost and time impact	If there is a change of scope at any stage of the project from previously agreed baselines (scope, timelines, deliverables), Service Provider will assess the impact of such change on the schedule and cost of the project. Service Provider will raise a change request for the estimated efforts, timelines, and cost.

Table 16 Change management

11.3 Availability Measurement

High availability of the Azure services such that the SLA requirements are met

Azure Service	System Availability (%) (24 x 365 basis)
Azure Sql Database	99.99 %
Azure App Service	99.99 %

Table 17 Availability measurement

Appendix A: Comments and Response

SR#	Reviewer Name	Reviewer's comment Customer / internal	Authors Response	Open/ Closed
1.				
2.				
3.				
4.				
5.				
6.				

Table 18 Feedback – comment and response

Appendix B – Peer Review Process

The Solution Peer Review Process is detailed in this section.

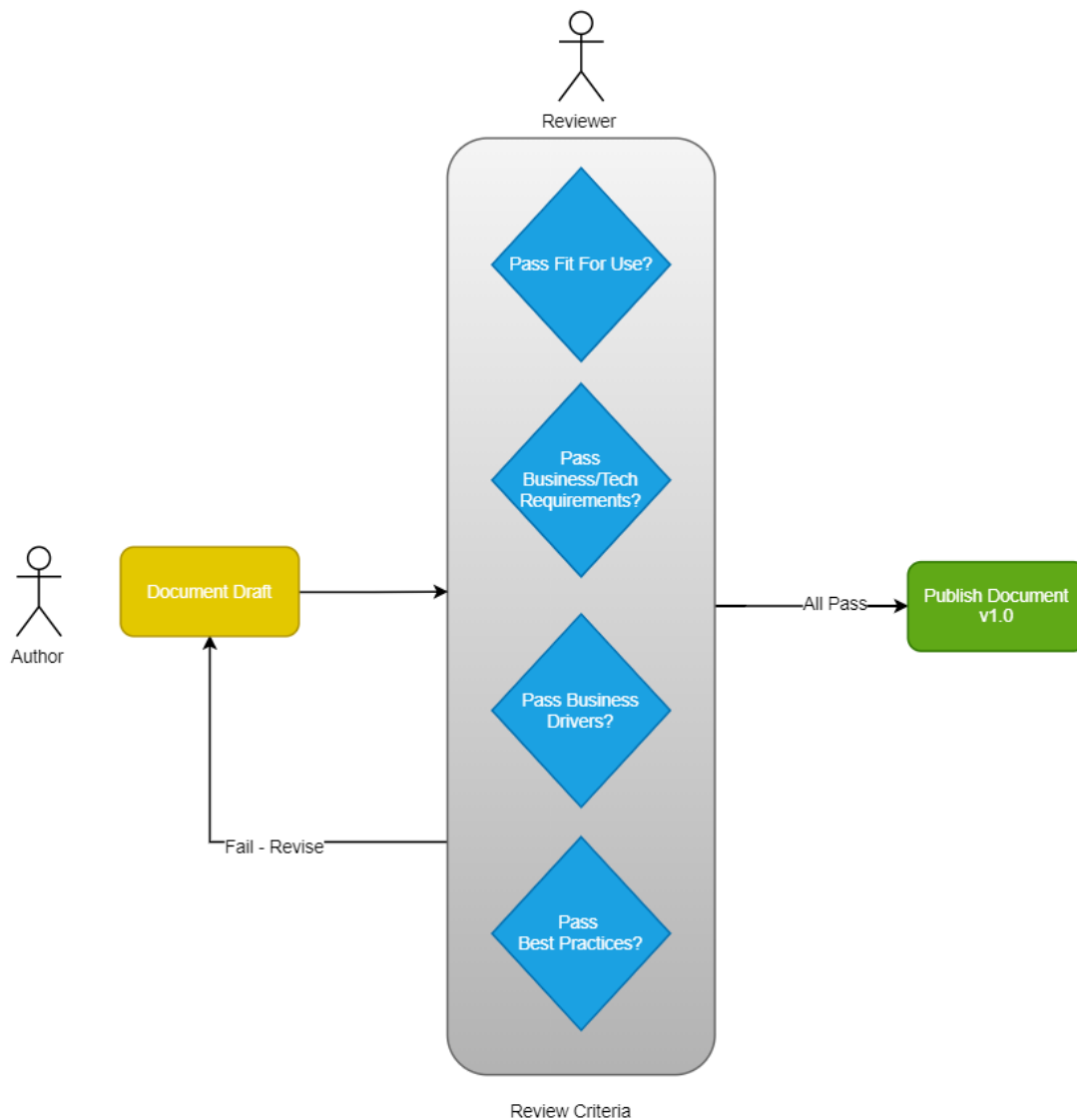


Figure Design Peer Review Process

Author of the design drafts the customer project specific design based on the Solution Design Document template.

The document is peer reviewed for the following:

- The solution is fit for use as described in the requirements section of the Solution Design Document
- The business and technical requirements are covered by the proposed architecture
- The business drivers are met by the solution
- That Best Practices have been incorporated and are fitting to the design, SLAs, and risk profile of the customer

The review will either pass or fail the design based on the four success criteria. The solution must pass all four criteria.

Failed criteria are documented in Appendix A and send back to the author for rework.