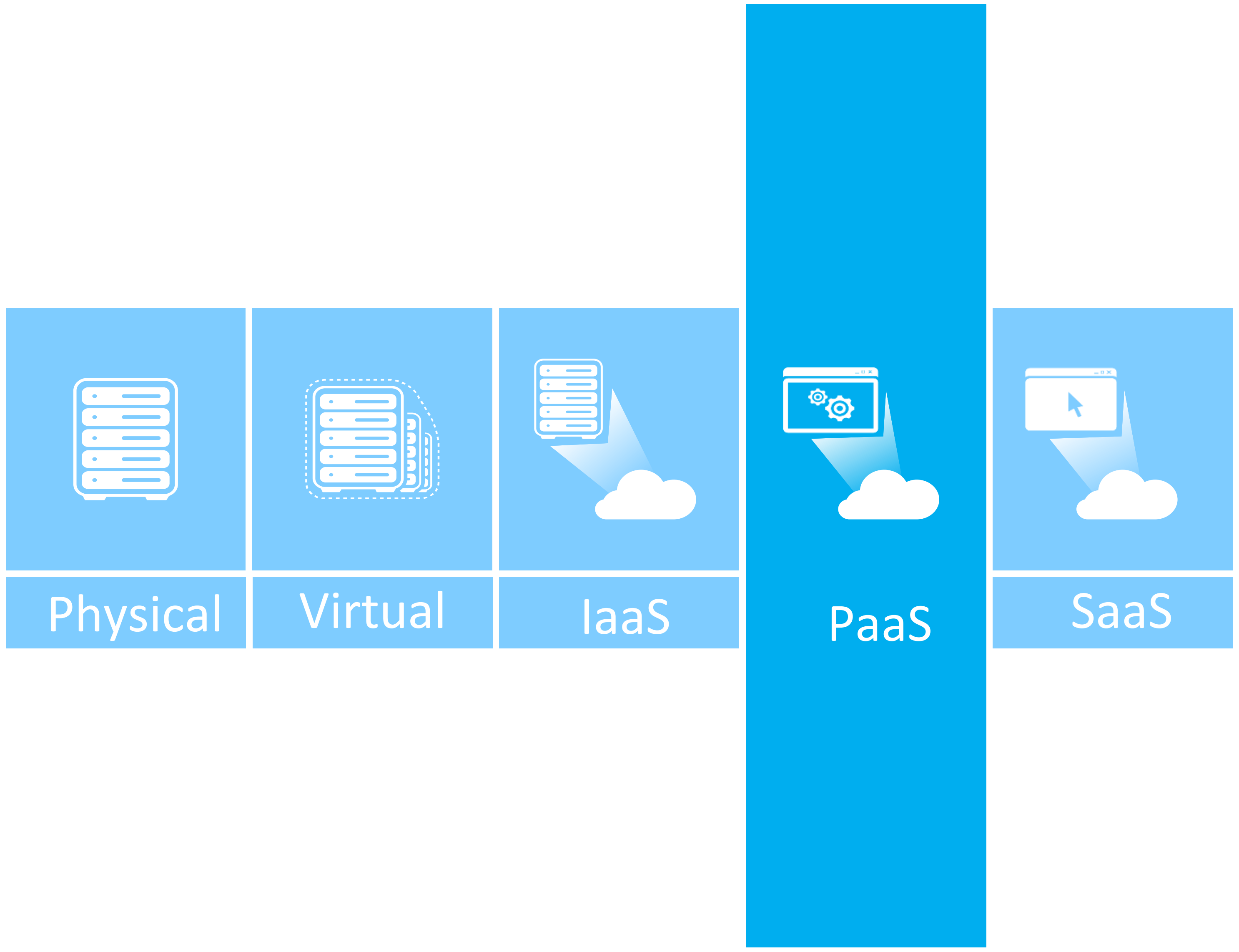
Microsoft

Azure SQL

Crystal Tenn
Crystal.Tenn@microsoft.com

A Continuous Offering From Private to Public Cloud



The Basics

- Azure SQL (PaaS)
  - SQL Database technology as a service
  - Fully managed
  - Enterprise-ready with automatic support for High Availability
  - Designed to scale-out elastically with demand
  - Ideal for simple and complex applications
  - Three copies of the database for the cost of one database - always in sync

SQL Database Service

- A relational **database as a service**, fully managed by Microsoft
- For cloud-designed apps when **near-zero administration** and **enterprise-grade** capabilities are key
- Perfect for cloud **architects and developers** looking for programmatic DBA-like functionality

Elastic Scale and performance

Predictable performance levels

Programmatic scale-out

Dashboard views of database metrics

Business continuity and data protection

Self-service restore

Disaster recovery

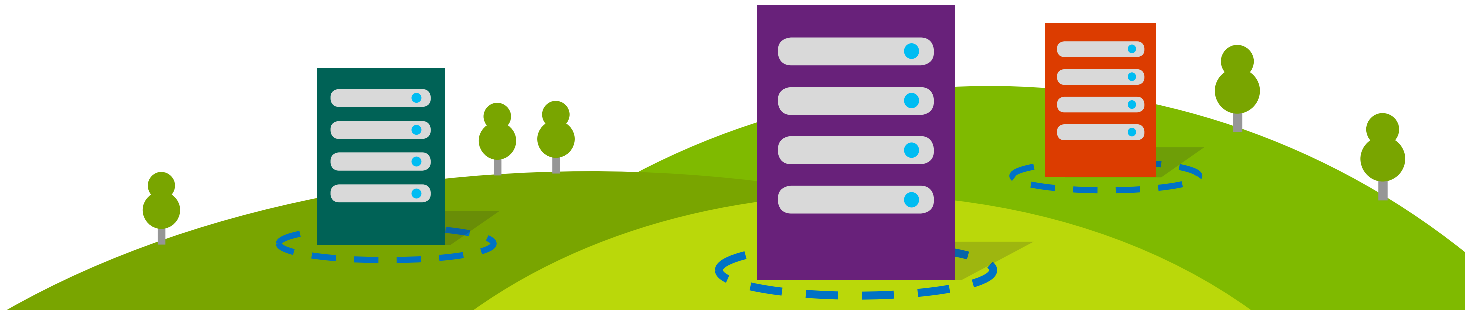
Compliance-enabled

Familiar and self-managed

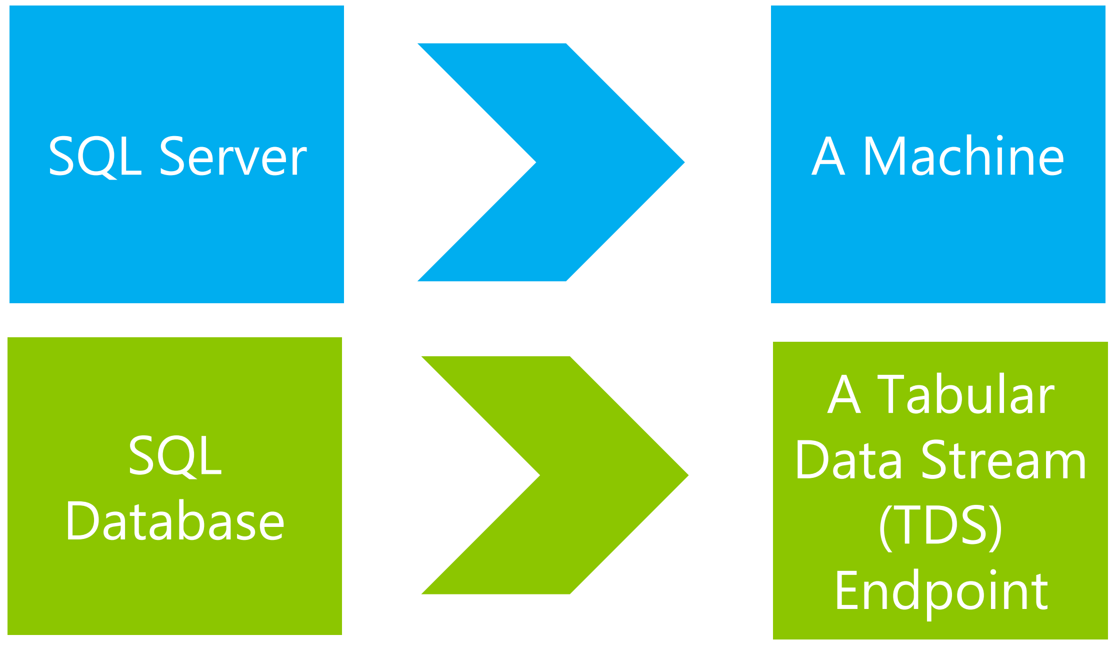
Familiar & compatible

Programmatic

Self-managed



An *Azure SQL Server (SQL Database)* Is Not a Machine

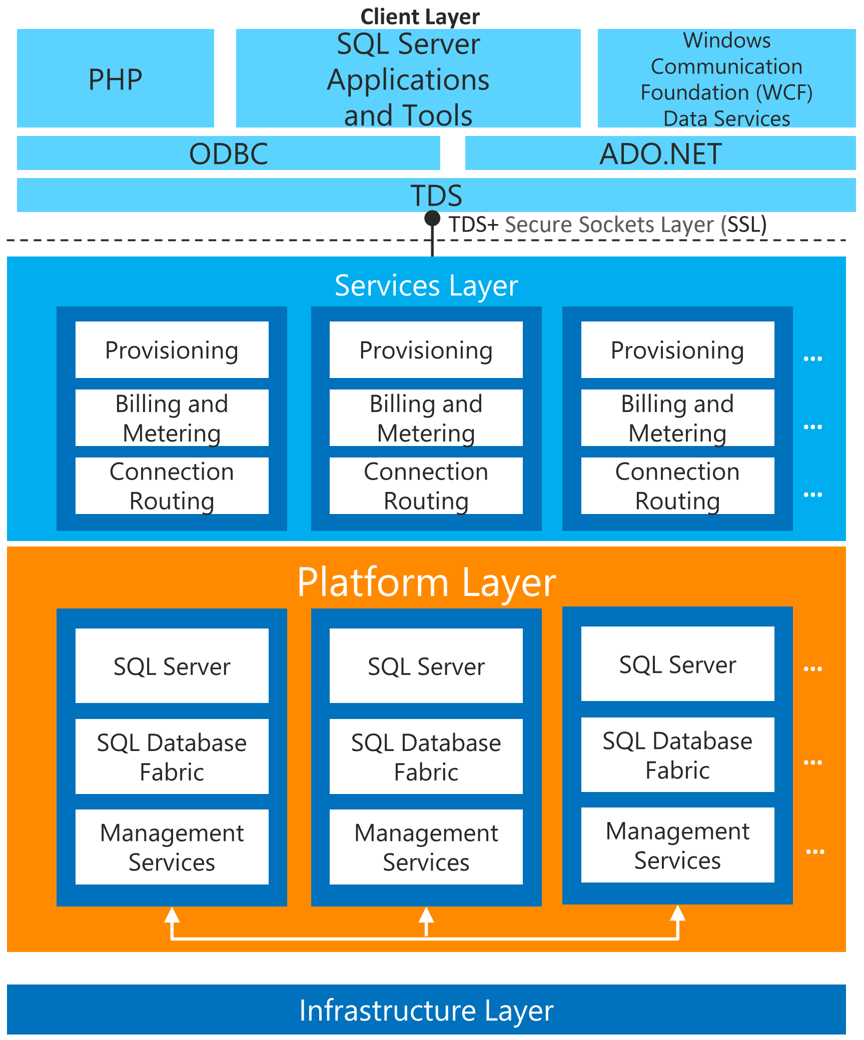


Understand that while there are physical computers running SQL Server behind the scenes, when connecting to SQL Database, you are not connecting to a physical server, but to a Tabular Data Stream (TDS) endpoint.

A TDS endpoint is the SQL Server object that represents the communication point between the SQL Server and a client. SQL Server automatically creates an endpoint for each of the four protocols supported by SQL Server.

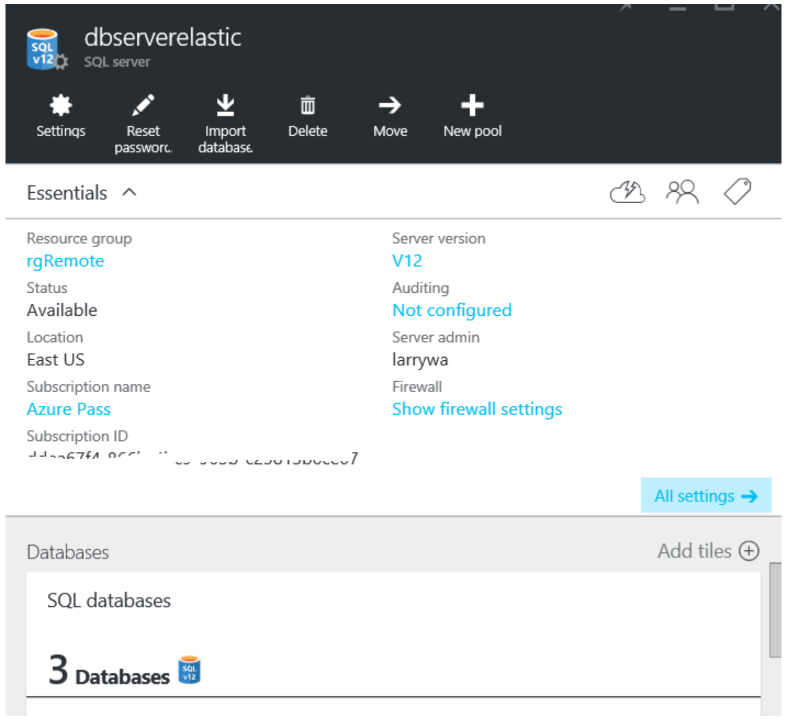
How It Works

- Architecture
  - Client layer—used by application to communicate directly with SQL Database
  - Services layer—gateway between the client layer and the platform layer
  - Platform layer—includes physical servicers and services that support the services layer
  - Infrastructure layer—IT administration of the physical hardware and operating system

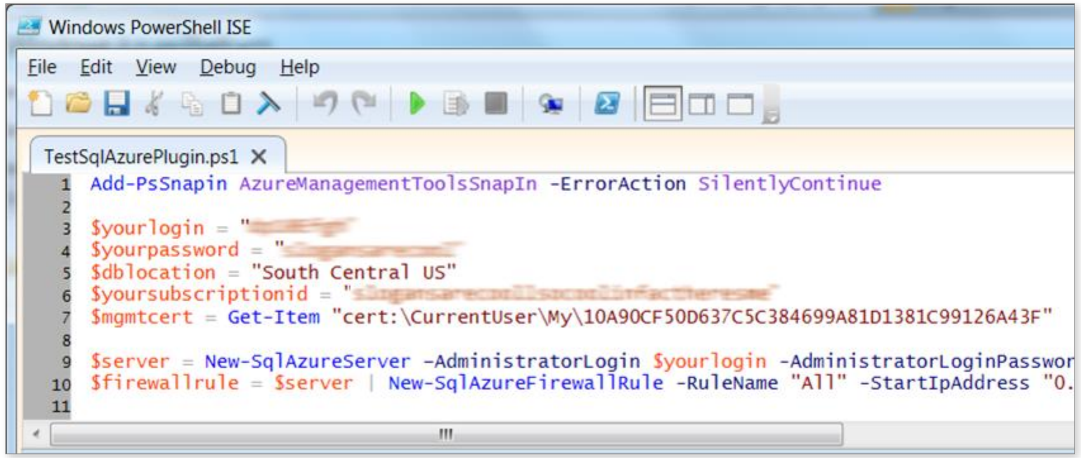


Server Provisioning

- Server defined
  - Service head that contains databases
  - Connect via automatically generated fully qualified domain name (FQDN) (xxx.database.windows.net)
  - Initially, contains only a master database
- Provision servers interactively
  - Log on to Microsoft Azure Management Portal
  - Create a SQL Database
  - Specify admin login credentials
  - Add firewall rules and enable service access
- Automate server provisioning
  - Use Microsoft Azure module for Windows PowerShell cmdlets (or use Representational State Transfer (REST) API directly)
  - https://www.windowsazure.com/en-us/downloads/?fb=en-us



Resource group	Server version
rgRemote	V12
Status	Auditing
Available	Not configured
Location	Server admin
East US	larrywa
Subscription name	Firewall
Azure Pass	Show firewall settings
Subscription ID	
[illegible]	



```
Add-PsSnapin AzureManagementToolsSnapIn -ErrorAction SilentlyContinue

$yourlogin = "[redacted]
$yourpassword = "[redacted]
$dblocation = "South Central US"
$yoursubscriptionid = "[redacted]
$mgmtcert = Get-Item "cert:\CurrentUser\My\10A90CF50D637C5C384699A81D1381C99126A43F"

$server = New-SqlAzureServer -AdministratorLogin $yourlogin -AdministratorLoginPasswor
$firewallrule = $server | New-SqlAzureFirewallRule -RuleName "All" -StartIpAddress "0.

```

Point-in-time restore

Automatic backup

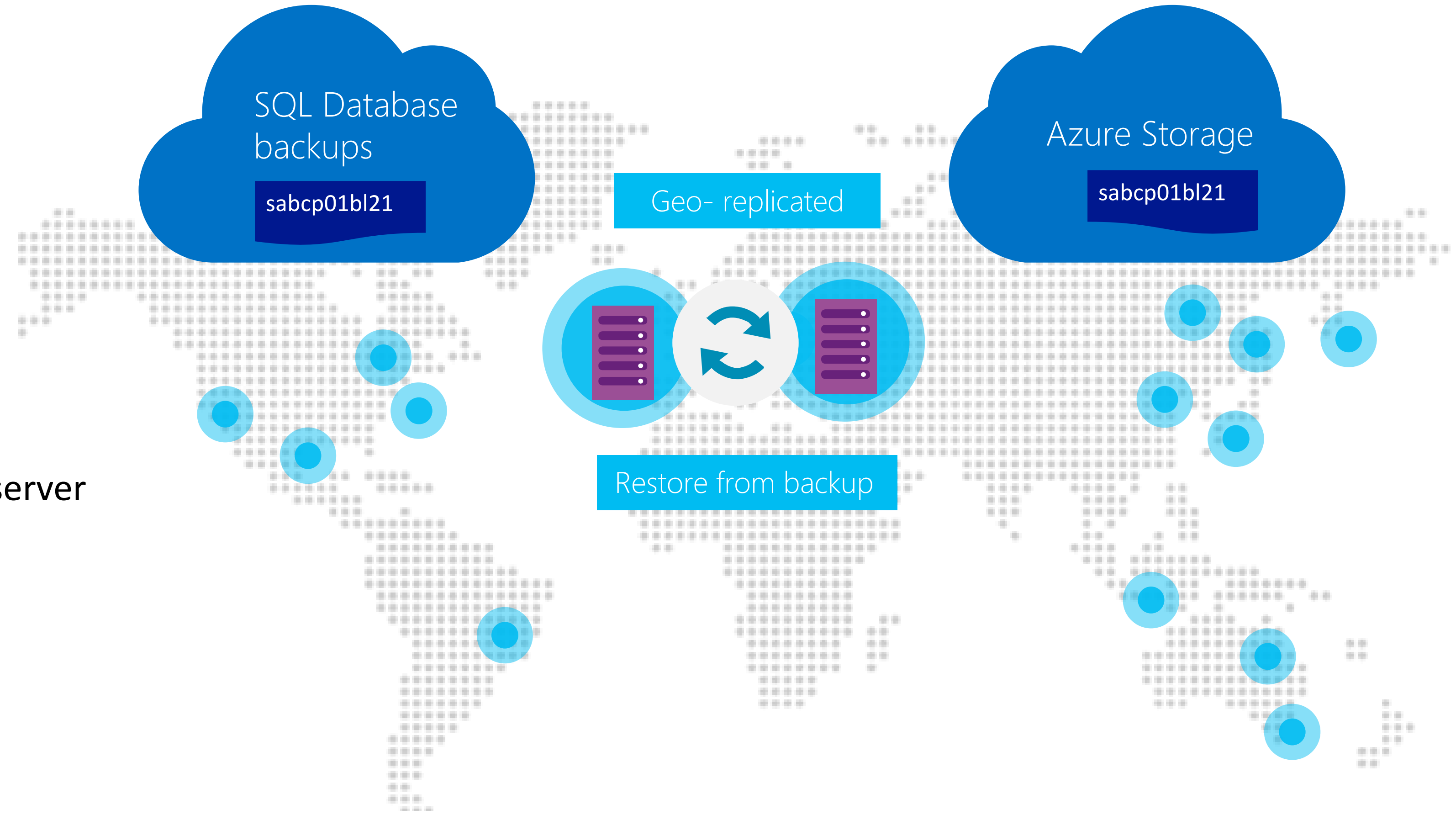
- Full backups weekly, different backup daily, log backups every 5 minutes
- Daily and weekly backups automatically uploaded to geo-redundant Azure Storage

Self-service restore

- Point-in-time up to a second granularity
- REST API, PowerShell, or Portal
- Creates a new database in the same logical server

Tiered retention policy

- Basic - 7 days
  Standard - 35 days
  Premium - 35 days
- No additional cost to retain backups



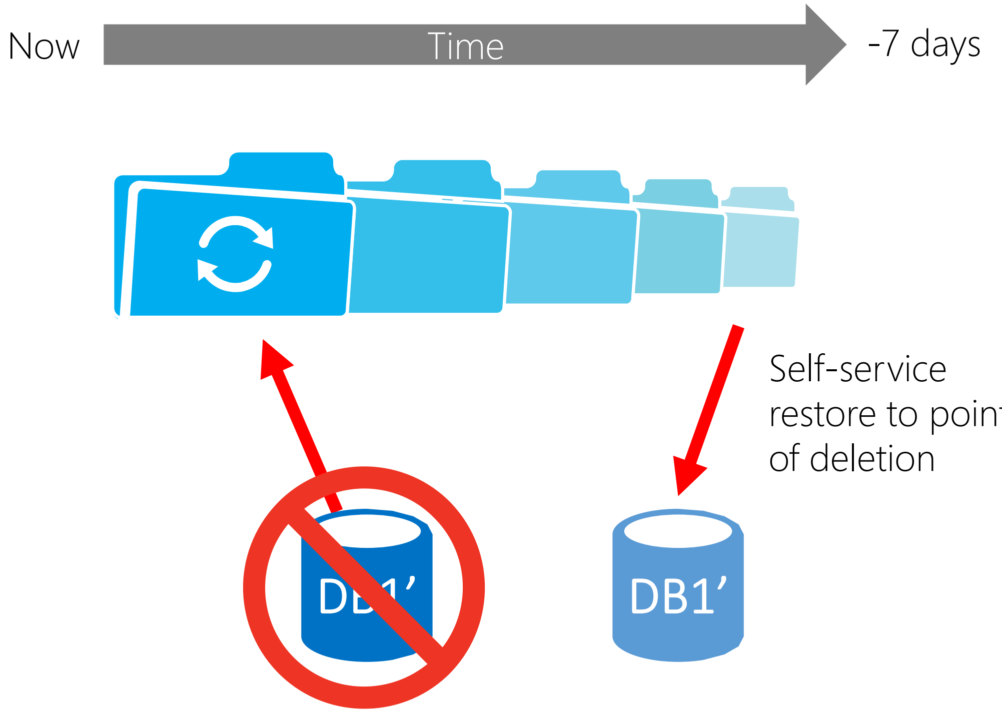
Restore deleted database

Recovery after accidental database deletion

- Restores the database to the point of deletion
  (earlier backups are deleted)
- Creates a new database on the server used by the original database
- You can choose to failover to the restored database or use scripts to recover data

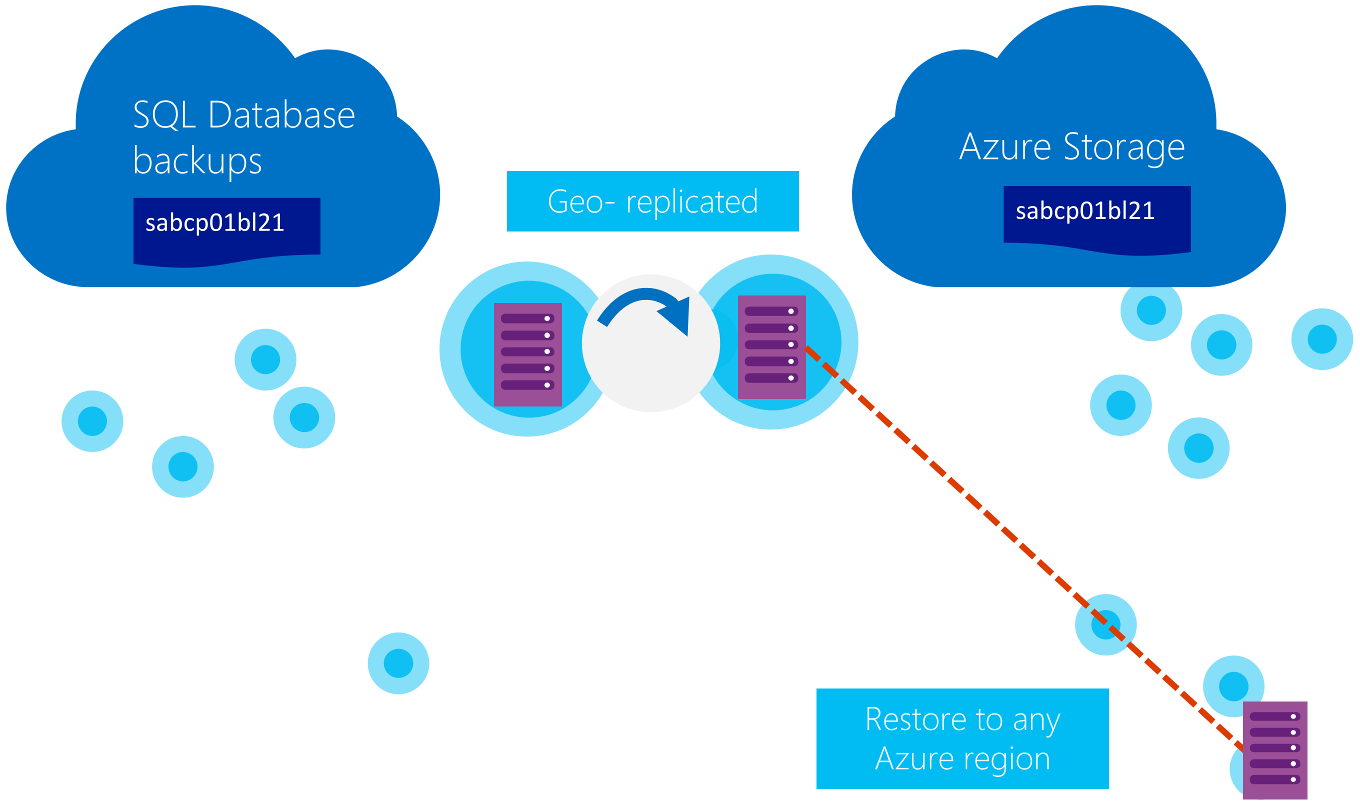
Length of time backups are retained:

- Basic service tier is 7 days.
- Standard service tier is 35 days.
- Premium service tier is 35 days.



Geo-restore

- Self-service restore API
- Restores last daily backup
- No extra cost
- **estimated recovery time** ERT >= 12h
- **recovery point objective** RPO=1h (the application can tolerate losing when recovering after the disruptive event)
- Database URL will change after restore
- You will need to change your connection string to point to geo-replicated database



Database Transaction Unit – DTU

Bounding box

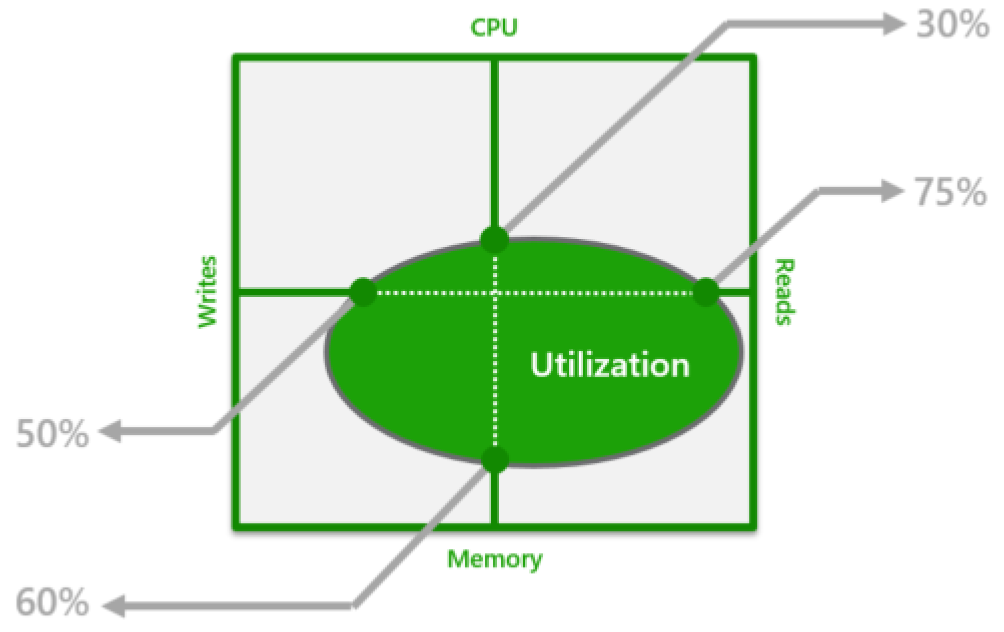
Monitoring database workload utilization within bounding box

Represents the relative power (resources) assigned to the database

Blended measure of CPU, memory, and read-write rates

Compare the power across performance levels

Simplifies talking about performance, think IOPS vs. %



- DTUs provide a way to describe the relative capacity of a performance level of Basic, Standard, and Premium databases. DTUs are based on a blended measure of CPU, memory, reads, and writes.
- As DTUs increase, the power offered by the performance level increases.
- For example, a performance level with 5 DTUs has five times more power than a performance level with 1 DTU.

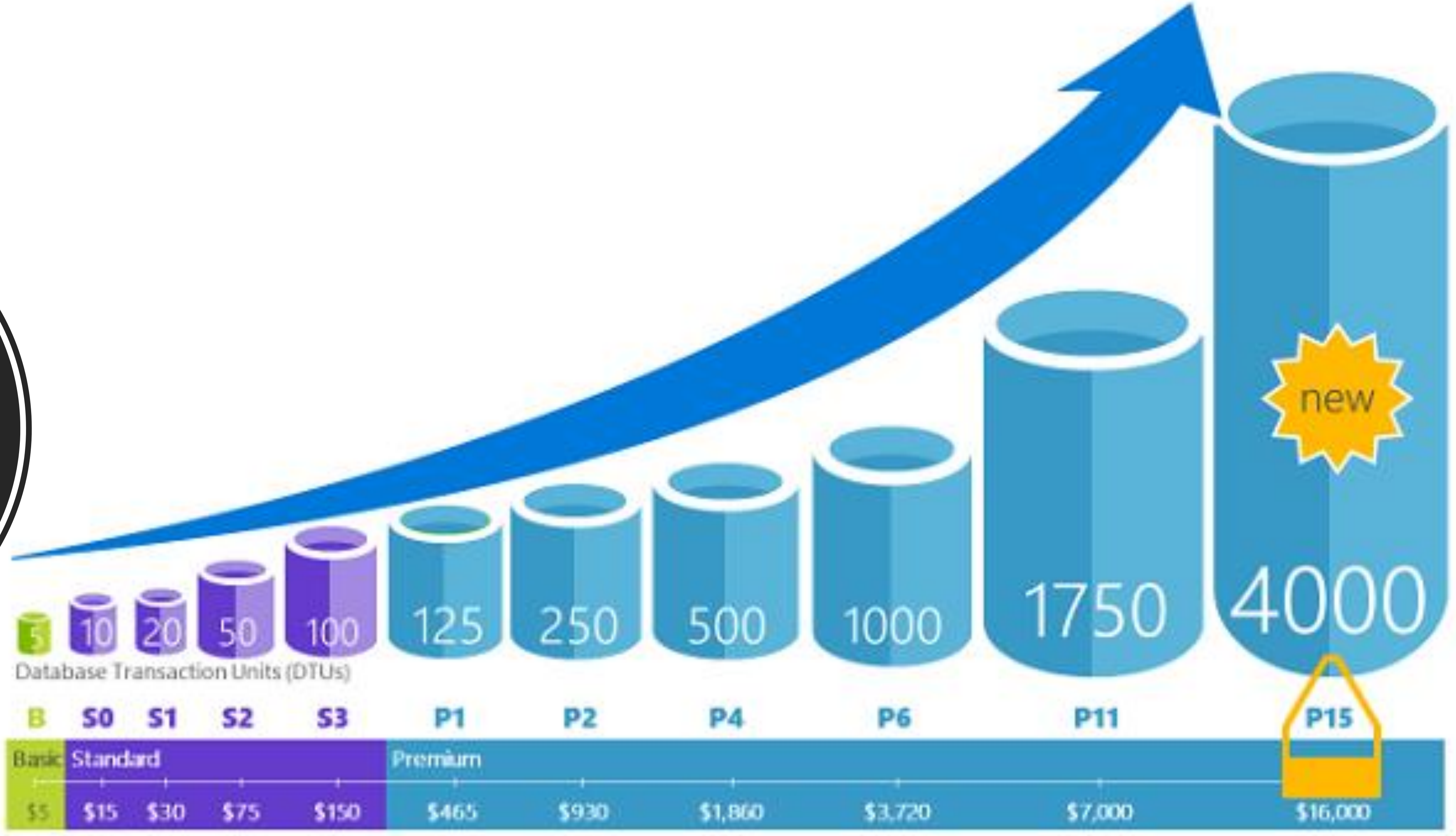
DTU

```
SELECT end_time,
  (SELECT Max(v)
   FROM (VALUES (avg_cpu_percent), (avg_data_io_percent),
(avg_log_write_percent)) AS
   value(v)) AS [avg_DTU_percent]
FROM sys.dm_db_resource_stats;
```

Max of avg_cpu_percent, avg_data_io_percent and avg_log_write_percent

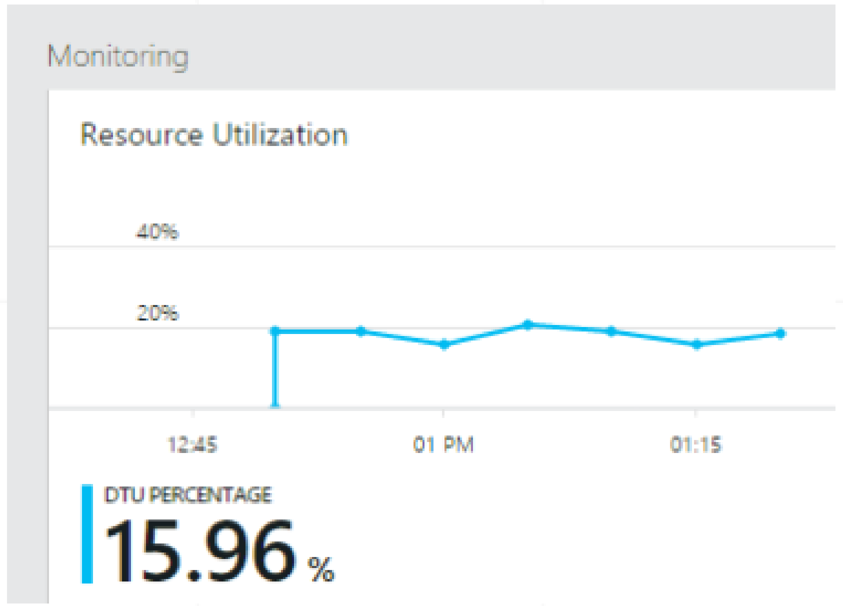
https://docs.microsoft.com/en-us/sql/relational-databases/system-dynamic-management-views/sys-dm-db-resource-stats-azure-sql-database

DTU Cost per month



Resource Monitoring

- Percentages relative to performance level
- master.sys.resource_stats
  - **Averages over 5 minutes**
  - All editions
- userdb.sys.dm_db_resource_stats
  - **Averages over 15 seconds**
  - Only Basic/Standard/Premium
- Accessible though Azure Portal
  - Allows to configure alerting!



What is scaling…

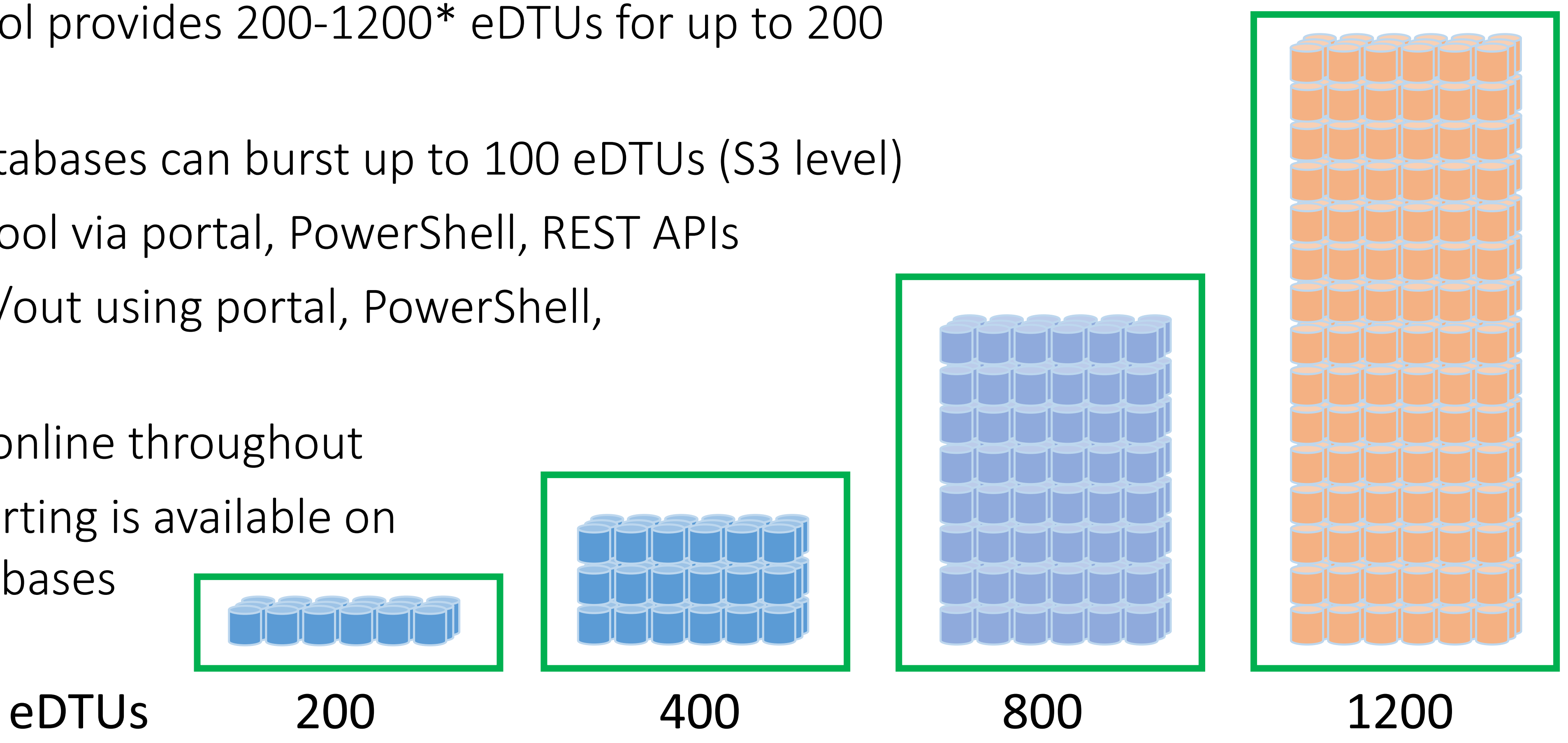
- Vertical scaling – easy, cost management, can be automated, not very “cloudy” – give me a larger machine
- Horizontal scaling – more “cloudistic”, also can be automated, multi-tenet databases, has tool support
- The ability to elastically scale databases and share resources
- Multi-shard queries / multi-shard connections

When is Elastic Scale the right consideration?

- Application workload can be partitioned across a number of scale units, and workload directed to each partition can fit into the biggest scale unit available
- Application workload doesn't contain large scans or aggregations that need to touch the entire data set
- Total capacity demands (CPU, IO, memory, storage) of the application exceed the hard limits of a single Azure SQL Database scale unit
- Application requires on-demand or automatic policy-driven scale out or scale in
- Caveat: Typical data warehousing does not easily fit the patterns for Elastic Scale

Elastic Database Pools

- Elastic databases, Elastic database pools
- Pooled resources leveraged by many databases
- **Standard** elastic pool provides 200-1200* eDTUs for up to 200 databases
- **Elastic Standard** databases can burst up to 100 eDTUs (S3 level)
- Create/configure pool via portal, PowerShell, REST APIs
- Move databases in/out using portal, PowerShell, REST APIs, T-SQL
- Databases remain online throughout
- Monitoring and alerting is available on both pool and databases

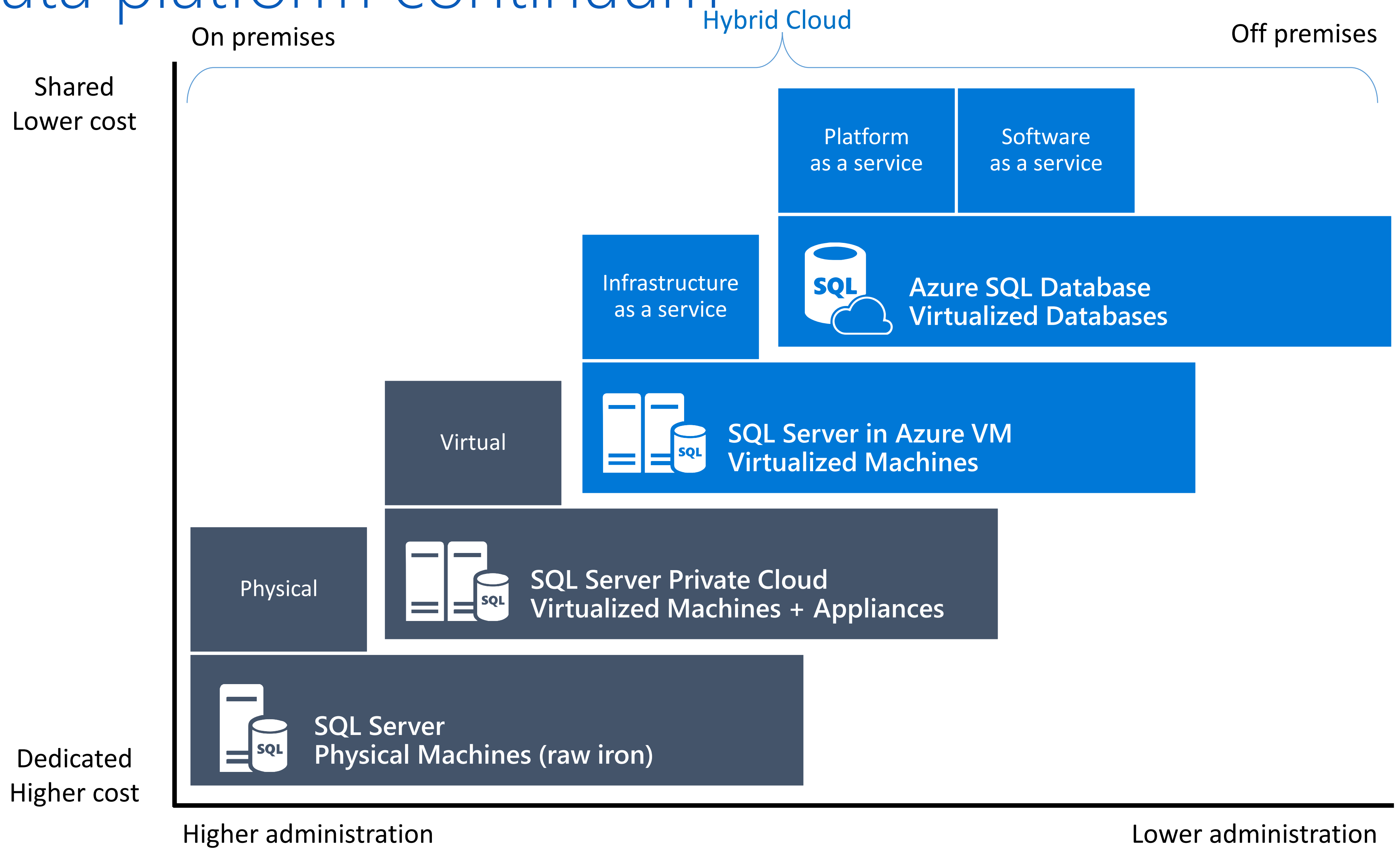


Microsoft

Azure SQL vs. SQL Server on VM

Crystal Tenn
Crystal.Tenn@microsoft.com

Data platform continuum



How is it different from virtual machines?

	Azure SQL Database	SQL Server in a virtual machine
Best for…	Applications that need elastic scale and/or reduced infrastructure management overhead	Migrating existing applications with no modifications, or very minor changes
Resources	Customer does not want to add additional IT resources for support and maintenance	IT has adequate resources and bandwidth for support and maintenance
TCO benefits	Avoiding CAPEX and OPEX (operating expense)	Removing CAPEX (capital expenditure)
Scalability	Scale out to thousands of databases, process terabytes of OLTP (Online Transaction Processing) data	Scale up to 20,000 IOPS*

Feature Comparison

	PaaS	IaaS
Features	Less features than box	Full box product features
Performances	Max 1750 DTU in Premium Tier	Depends on VM SKU/Storage
DB Size	Max 1TB in Premium Tier (P11)	64TB on G-SERIES
Workload	Sizing by average usage	Sizing based on peaks
High-Availability	Built-in by platform	Manual configuration by AlwaysOn AG
Fault-Handling	Necessary fault-handling & retry	Recommended fault-handling & retry
Locality	No co-location with application	Co-located by VMs and VNETs
Segregation	Internet exposed endpoint	Internal private endpoint
Versioning	No control on upgrades	Full control over DB upgrade
TCO	Very low, almost self-managed	High (as on-premises)

Feature Comparison

	PaaS	IaaS
Administration	No full-time DBA required	Full staffed DBA required
Management	Easy to manage many DBs	Complex to manage many DBs/VMs
Scale-Out	Tools & Frameworks available	No easy scale-out
Configuration	No setup customization	Full access to OS and SQL
Authentication	Only SQL standard authentication *	SQL standard and integrated
Security	No Fixed IP, fixed 1433 port	Fixed IP possible, port can be changed
Backup	Backup files not accessible, 35 days PITR	Full control of backup files, unlimited PITR
Hybrid	No AlwaysOn AG support	Can join on-premises AlwaysOn AG topology
Cross-DB Access	NO: DTC, Linked Srv, USE, 4-parts names	YES: DTC, Linked Srv, USE, 4-parts names

Best For

PaaS	IaaS
New cloud-designed applications that have time constraints in development and marketing.	Existing applications that require fast migration to the cloud with minimal changes. Rapid development and test scenarios when you do not want to buy on-premises non-production SQL Server hardware.
Applications that need built-in high availability, disaster recovery, and upgrade mechanisms.	Existing applications that require fast migration to the cloud with minimal changes. Rapid development and test scenarios when you do not want to buy on-premises non-production SQL Server hardware.
Teams that do not want to manage the underlying operating system and configuration settings.	If you need a customized IT environment with full administrative rights.
Databases of up to 1 TB in size, or larger databases that can be horizontally or vertically partitioned using a scale-out pattern.	Databases that are bigger than 1 TB in size that cannot be horizontally or vertically partitioned.
Building Software-as-a-Service (SaaS) applications	Building hybrid applications

Azure SQL vs VM SQL Server

Final notes:

- VM is traditional box product of SQL so you can do SSAS / SSRS / SSIS in additional to the DB engine and SQL Agent. You're responsible for the OS and HA/DR (high availability / disaster recovery) setup.
- Azure SQL, on the other hand, has HA baked in but not SSIS or SSRS. There's an SSAS offering but it's a different PaaS product.
- Azure SQL doesn't support every data type and has limits on DB size based on service tier.
- Azure SQL is a public IP secured by a firewall. IaaS SQL can have private IPs.
- Both support AD Auth.

https://docs.microsoft.com/en-us/azure/sql-database/sql-database-paas-vs-sql-server-iaas

Final Notes

- Azure SQL Database is cheaper in the long run, and easier to manage and maintain, but has **less features and performance capabilities** than a SQL Server running on Premium VMs.
- The Premium Virtual machines will have better CPU and IO throughput than what the highest Azure SQL Database service tier (P11) can offer, but they are also more expensive.

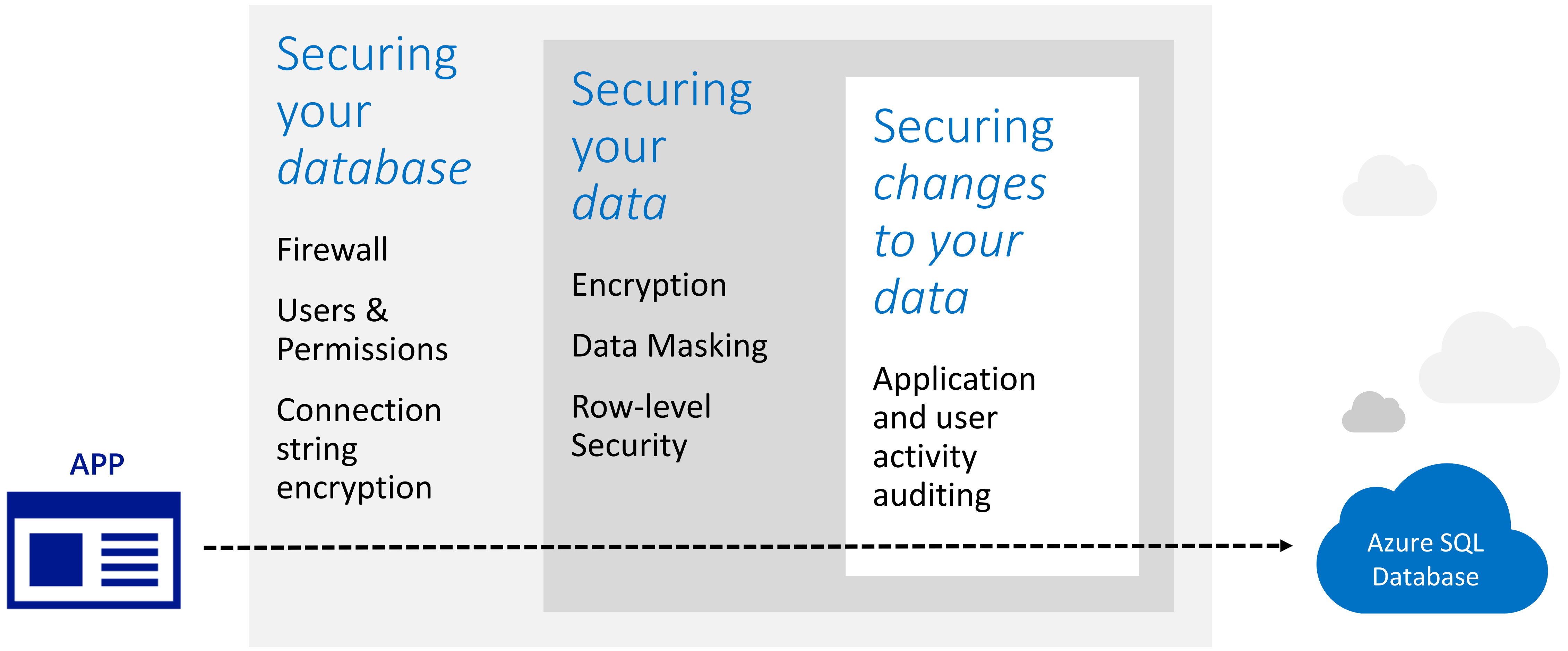
Microsoft

Azure SQL Database

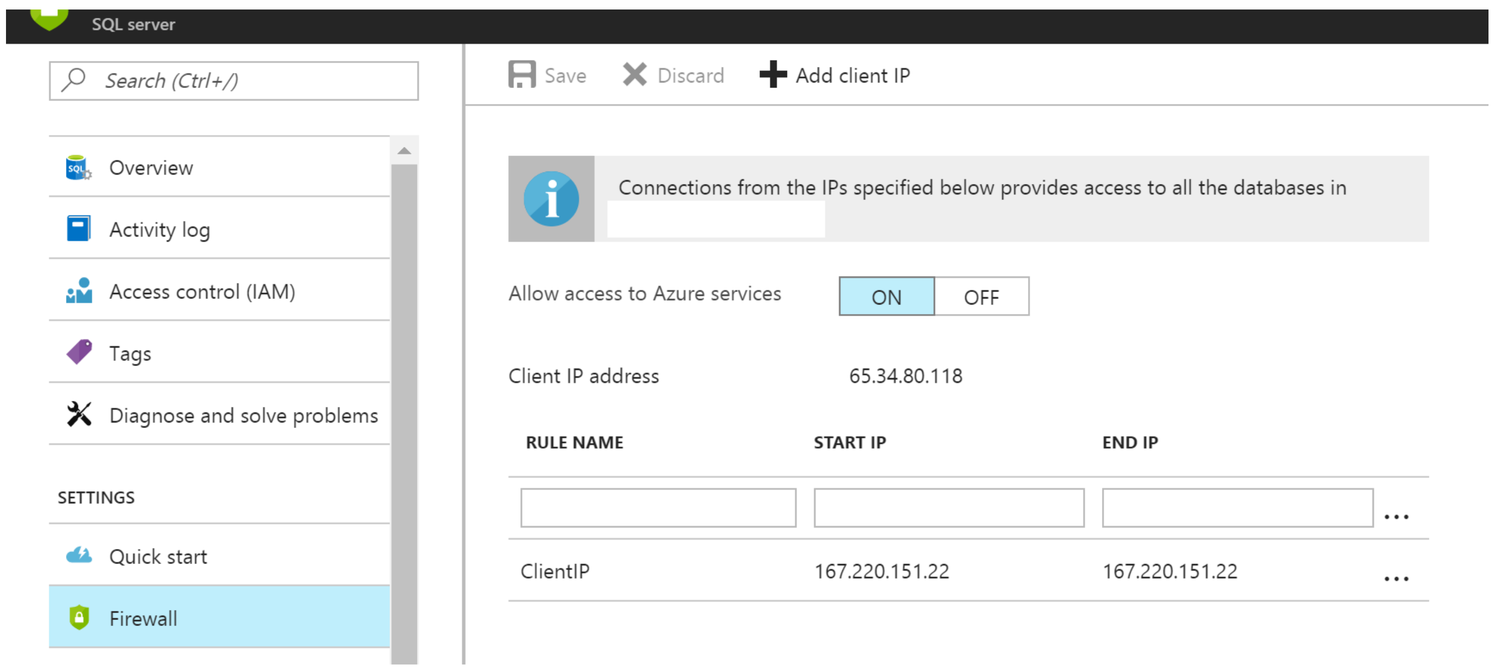
Securing your Database

Microsoft Services

Layered Approach to Security



Firewall configuration using portals


SQL server

Search (Ctrl+/)

- Overview
- Activity log
- Access control (IAM)
- Tags
- Diagnose and solve problems

SETTINGS

- Quick start
- Firewall

Save | Discard | Add client IP

Connections from the IPs specified below provides access to all the databases in

Allow access to Azure services: [✓ ON] OFF

Client IP address: 65.34.80.118

RULE NAME	START IP	END IP
ClientIP	167.220.151.22	167.220.151.22

By default, Azure blocks all external connections to port 1433 (default port for SQL Server)

Enabled in the following ways:

Azure portal

- Classic portal: Server level – **configure** page
- New portal: Server **settings** – **firewall** – **firewall settings** blade

Overview SQL Database Security Administration

Point of Difference	On-premises SQL Server	Microsoft Azure SQL Database
Where you manage server-level security	The **Security** folder in SQL Server Management Studio's **Object Explorer**	The **master** database
Server-level security role for creating logins	`securityadmin` fixed server role For more information, see Server-Level Roles	`loginmanager` database role in the master database

Commands for managing logins	`CREATE LOGIN`
	`ALTER LOGIN`
	`DROP LOGIN`
		`CREATE LOGIN`
		`ALTER LOGIN`
		`DROP LOGIN`
		(There are some parameter limitations and you must be connected to the **master** database)

View that shows all logins	`sys.syslogins` (`sys.sql_logins` for SQL Server authentication logins)	`sys.sql_logins` (You must be connected to the **master** database)
Server-level role for creating databases	`dbcreator` fixed database role For more information, see Server-Level Roles	`dbmanager` database role in the master database
Command for creating a database	`CREATE DATABASE`	`CREATE DATABASE` (There are some parameter limitations and you must be connected to the **master** database)
Dropping databases	`DROP DATABASE`	`DROP DATABASE` If a user is in the **dbmanager** role, they have permission to DROP any database, regardless of which user originally created it.
View that lists all databases	`sys.databases` (view)	`sys.databases` (You must be connected to the **master** database)

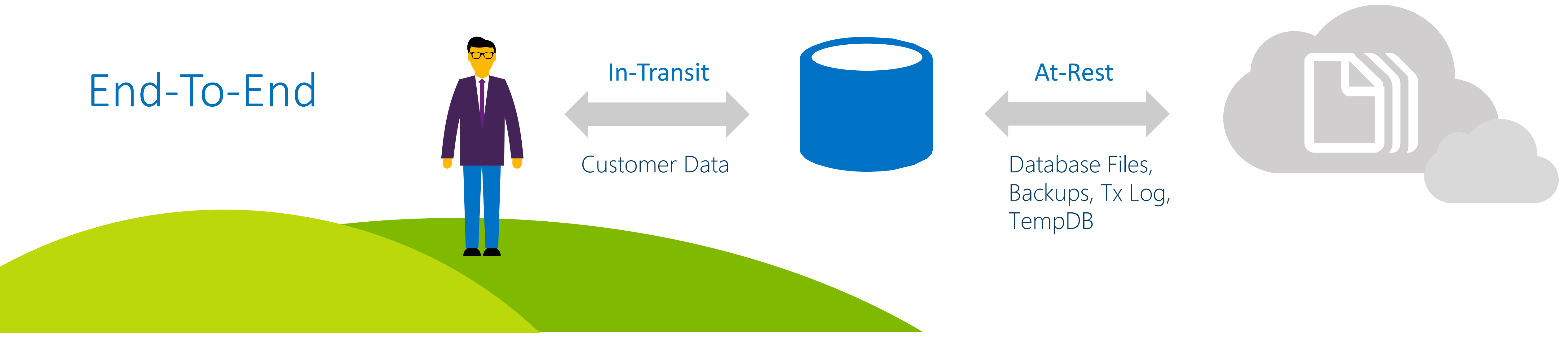
Transparent Data Encryption

Protect sensitive data stored in a SQL database from unauthorized access

- Encrypted at rest, in flight, and while in use
- SQL Server does not have the keys (nor does it need the keys)
- Keep application changes to a minimum
- Encryption/decryption of data done transparently in TCE-enabled client driver
- Support for equality operations (include joins) on encrypted data
- Azure manages encryption keys
- V12 databases only

Encryption Overview

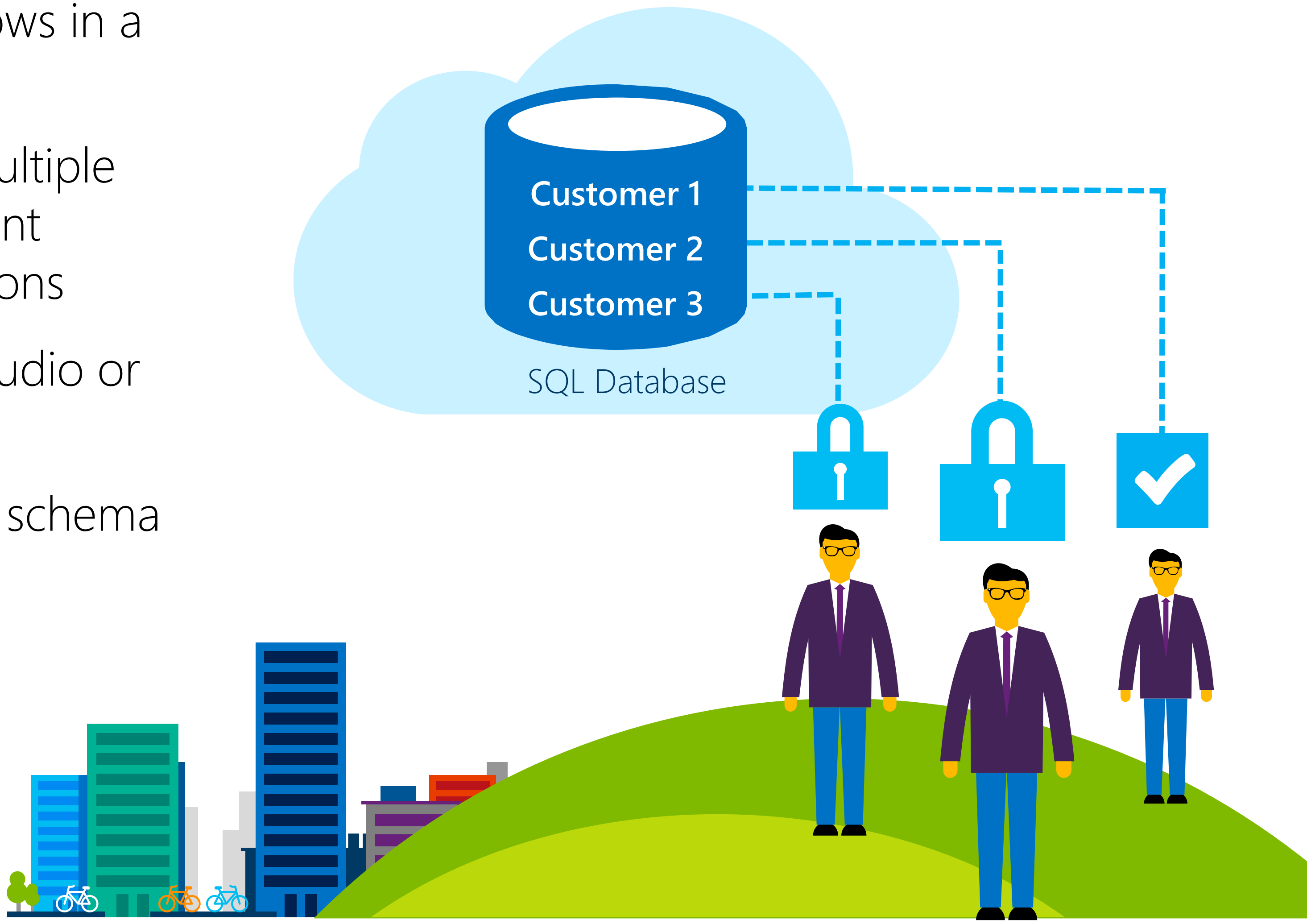
Encryption Type	Type	Customer Value
Encryption-In-Transit	TLS from Client to Server TLS = Transport Layer Security	Protects data between client and server against snooping & man-in-the-middle attacks. SQL DB is phasing out SSL 3.0 and TLS 1.0 in favor of TLS 1.2.
Encryption-At-Rest	TDE for SQL DB TDE = Transparent Data Encryption	Protects data on disk. Key management done by Azure. **Makes it easier to obtain compliance.**
Encryption-End-To-End	Client-side column encryption for SQL DB (library available for download)	Data protected end-to-end but application is aware of encrypted columns. **Used in the absence of data masking and TDE for compliance related scenarios.**



Row-level security

Protect data privacy by ensuring the right access across rows

- Fine-grained access control over specific rows in a database table
- Help prevent unauthorized access when multiple users share the same tables, or to implement connection filtering in multitenant applications
- Administer via SQL Server Management Studio or SQL Server Data Tools
- Enforcement logic inside the database and schema bound to the table.



Dynamic Data Masking

Prevent the abuse of sensitive data by hiding it from users

- Configuration made easy in the new Azure portal
- Policy-driven at the table and column level, for a defined set of users
- Data masking applied in real-time to query results based on policy
- Multiple masking functions available (e.g. full, partial) for various sensitive data categories (e.g. Credit Card Numbers, SSN, etc.)

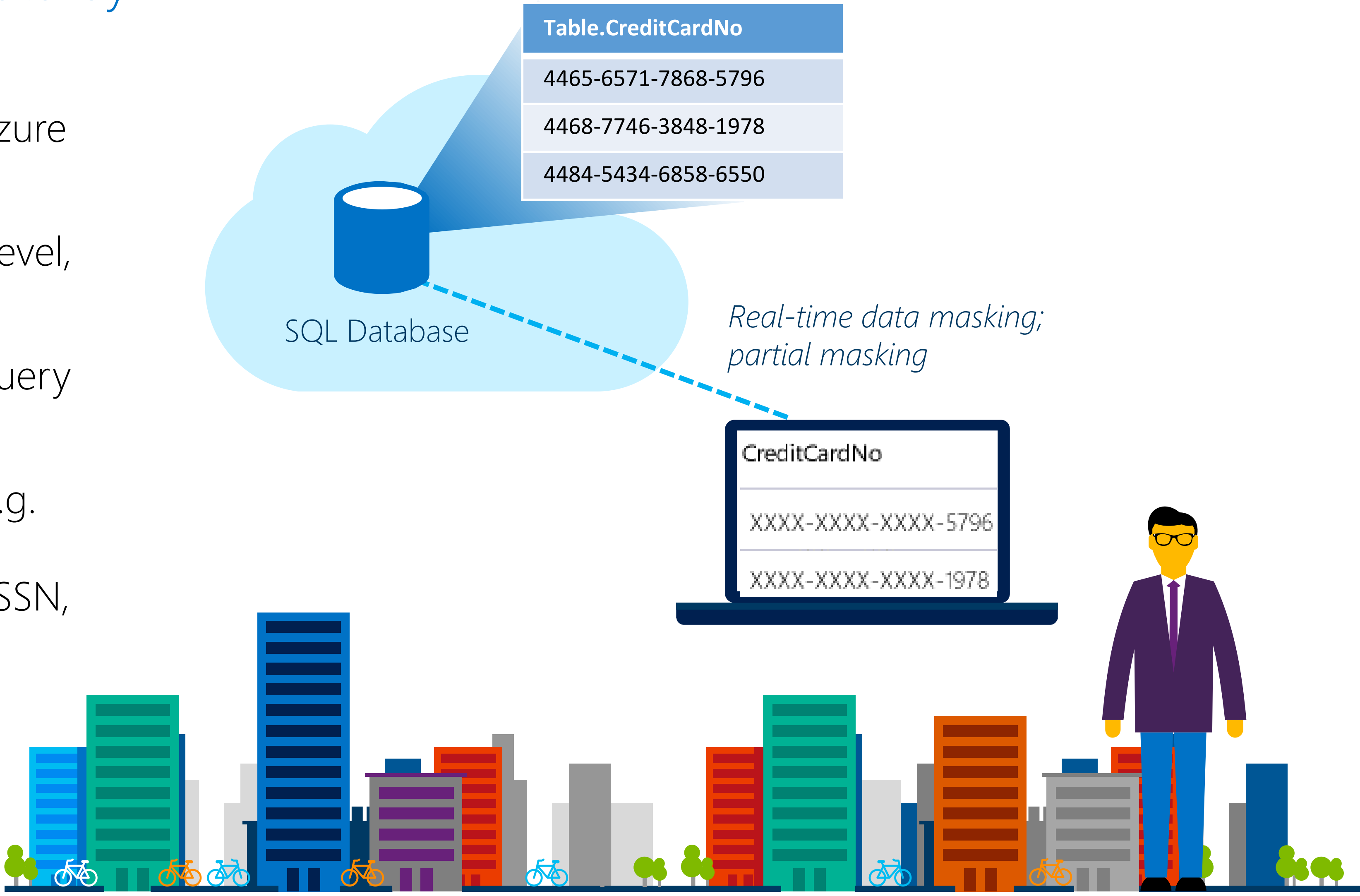


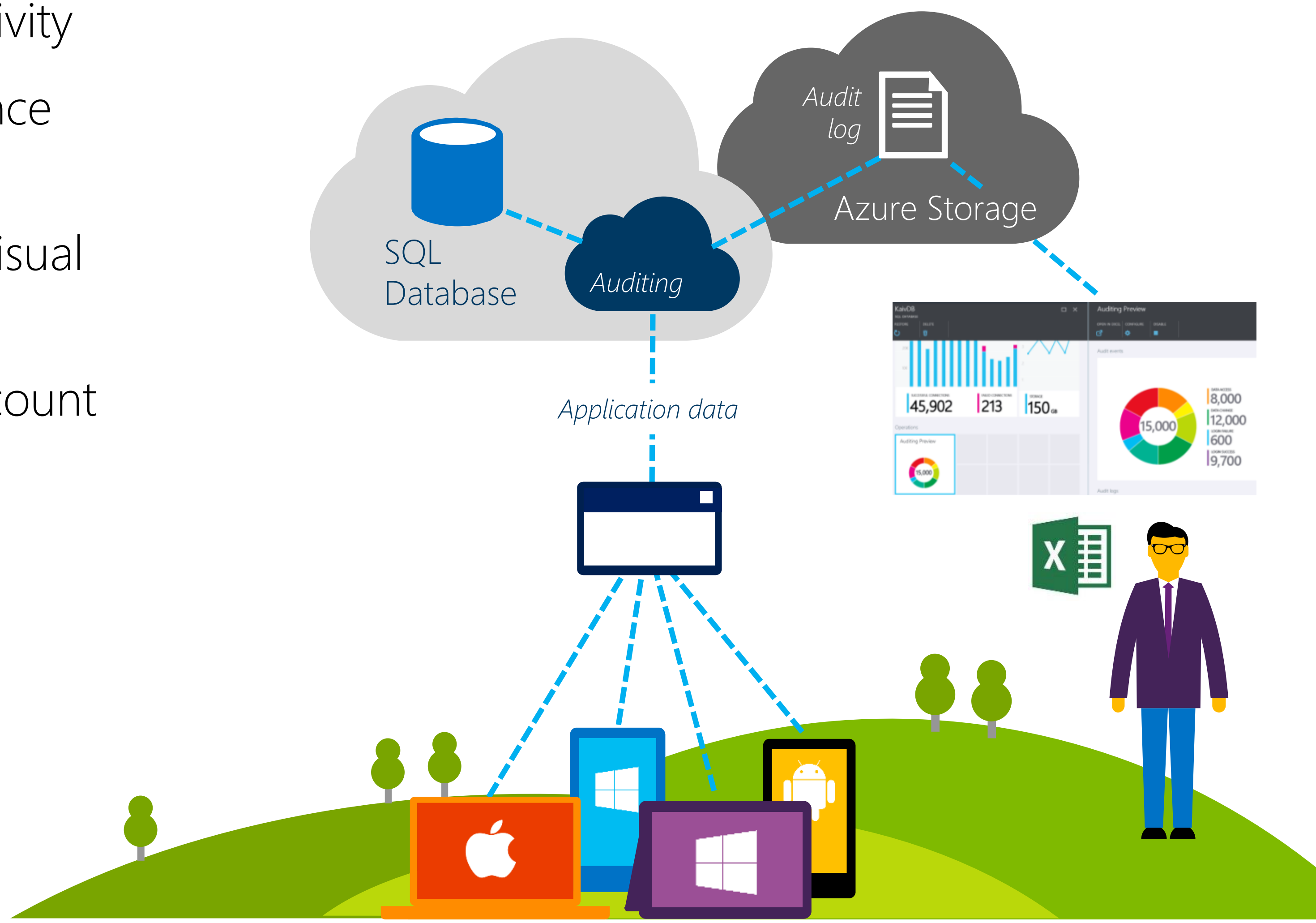
Table.CreditCardNo
4465-6571-7868-5796
4468-7746-3848-1978
4484-5434-6858-6550

CreditCardNo
XXXX-XXXX-XXXX-5796
XXXX-XXXX-XXXX-1978

Auditing

Gain insight into database events and streamline compliance-related tasks

- Configurable to track and log database activity
- Dashboard views in the portal for at-a-glance insights
- Pre-defined Power View reports for deep visual analysis on Audit log data
- Audit logs reside in your Azure Storage account
- Available in Basic, Standard, and Premium
- Access via the Azure portal (https://portal.azure.com)



Microsoft

Thank you!