	amazon REDSHIFT	amazon ATHENA	BigQuery	snowflake	FIREBOLT
	1st generation	2nd generation	2nd generation	2nd generation	3rd generation
ARCHITECTURE					
Elasticity - separation of storage and compute	🟠 Redshift RA3, Spectrum only	🟢 Yes (query engine, no storage)	🟢 Yes	🟢 Yes	🟢 Yes
Supported cloud infrastructure	🟠 AWS only	🟠 AWS only	🟠 Google Cloud only	🟢 AWS, Azure, Google Cloud	🟠 AWS only
Isolated tenancy - option for dedicated resources	🟢 Isolated tenant, use own VPC	🔴 Multi-tenant pooled resources	🟠 Multi-tenant on demand and reserved resources only	🟠 Multi-tenant resources (Only VPS dedicated on isolated Snowflake account)	🟠 Multi-tenant dedicated resources
Compute - node types	🟢 Any size, and types	🔴 N/A no choice	🟠 No choice over (fixed) slot size	🟠 1-128 nodes, unknown types	🟢 1-128 choice of any types
Data - internal/external, writable storage	🟢 Internal writable, external (Spectrum)	🟠 External only	🟢 External tables supported - 4 concurrent queries by default*	🟢 External tables supported	🟢 External tables (used for ingestion)
Security - data	🟢 Isolated/VPC tenant for storage and compute Encryption at rest, RBAC	🟠 Shared resources	🟢 Separate customer keys, column-level encryption, encryption at rest, AEAD individual value encryption, RBAC	🟢 Separate customer keys (only VPS is isolated tenant) Encryption at rest, RBAC	🟢 Dedicated resources for storage and compute Encryption at rest, RBAC
Security - network	🟢 Firewall, SSL, PrivateLink whitelist/ blacklist control, isolated/VPC tenancy	🟢 Shared resources	🟢 TLS, Firewall (Google Cloud), TLS, VPN, whitelist/ blacklist control part of GCP	🟢 Firewall, SSL, PrivateLink whitelist/ blacklist control, isolated for VPS only	🟢 Firewall and WAF, SSL, PrivateLink whitelist/ blacklist control

SCALABILITY					
Elasticity - (individual) query scalability	🟠 Manual	🟠 Automatic (but shared resources)	🟢 Automatic allocation of each query to on demand, or reserved and flex slots	🟢 1-click cluster resize, no choice of node size	🟢 1-click cluster resize of node type, number of nodes
Elasticity - user (concurrent query) scalability	🟠 Autoscale up to 10 clusters, 15 queries per cluster, 50 queued queries total, max.	🔴 Limited - 20 concurrent queries by default	🟢 Limited to 100 concurrent users by default*	🟢 Autoscale up to 10 warehouses. Limited to 20 DML writes in queue per table	🟢 Unlimited manual scaling
Write scalability - batch	🟢 1 master cluster	🟢 N/A	🟢 1,500 load jobs/day (~1 per minute), 100,000 per project, 15TB per job, 6 hour max time*	🟢 Strong	🟢 Strong. Multi-master parallel batch
Write scalability - continuous	🔴 Limited (table-level locking)	🔴 N/A (mostly batch-centric storage)	🟢 1GB/sec w/ no dedup, 100MB./sec w/ dedup, 100K rows per second per table, 100K-500K per project by default*	🟠 Limited to 20 DML writes in queue per table. 1 minute or greater ingestion latency recommended	🟢 Multi-master continuous writes
Data scalability	🟠 Only with RA3: 128 RA3 nodes, 8PB of data.	🟢 Up to 100 partitions per table, 100 buckets (default)	🟢 No real limit	🟢 No specified storage limit. 4XL data warehouse (128 nodes)	🟢 No limit

PERFORMANCE	(Redshift)	(Athena)	(BigQuery)	(Snowflake)	(Firebolt)
Indexes	🔴 None	🔴 None	🔴 None	🔴 None	🟢 Indices for data access, joins, aggregation, search
Query optimization - performance	🟠 Limited cost-based optimization	🔴 Limited cost-based optimization	🟠 Cost-based optimization	🟠 Cost-based optimization, vectorization	🟢 Index- and cost-based optimization, vectorization JIT, pushdown optimization
Tuning	🟠 Choice of (limited) node types	🔴 No choice of resources	🟠 Can only purchase reserved or flex slots	🟠 Can only choose warehouse size not node types	🟢 Choice of node types, Indexing
Storage format	🟠 Native Redshift storage (not Spectrum)	🔴 S3	🟢 Optimized (capacitor) on Colossus	🟠 Optimized micro-partition storage (S3), separate RAM	🟢 Optimized F3 storage (on S3). Data access integrated across disk, SSD, RAM)
Ingestion performance	🟠 Batch-centric (table-level locking)	🟢 N/A (storage and ingestion separate)	🟢 Writes 1 row at a time. Limits of 100K messages/sec by default*	🟠 Batch-centric (micro-partition level locking, limit of 20 queued writes per table)	🟢 Multi-master, lock-free high performance ingestion with unlimited scale for batch or continuous ingestion
Ingestion latency	🟠 Batch-centric (minute-level)	🔴 Not well suited for low latency visibility since unable to see as new values during ingestion	🟢 Immediately visible during ingestion	🟠 Batch write preferred (1+ minute interval). Requires rewrite of entire micro-partition	🟢 Immediately visible during ingestion
Partitioning	🟠 Distribution, sort keys	🟠 Partition pruning	🟢 Partitions, pruning	🟢 Micro-partition / pruning, cluster keys	🟢 F3 with sparse indexing
Caching	🟢 Result cache	🟠 None	🟢 Result cache (24 hours), shared memory	🟢 Result cache, materialized view	🟢 F3 (cache) with aggregating, join, and search indexes
Semi-structured data - native JSON functions within SQL	🔴 Limited	🟢 Yes (Lambda)	🟢 Yes	🟢 Yes	🟢 Yes (Lambda)
Semi-structured data - native JSON storage type	🔴 No	🔴 No	🟠 Can store as strings or STRUCT. But requires UDFs for compute	🟠 Limited VARIANT (single field)	🟢 Yes (Nested array type, compact)
Semi-structured data - performance	🔴 Slow (flattens JSON into table)	🔴 Slow (full load into RAM, full scan)	🟠 JSON strings slow. Can store as STRUCT and use UDF (JS)	🟠 Slow (can require full load into RAM, full scan)	🟢 Fast (array operations without full scans)

USE CASES	Redshift	AWS	BigQuery	Snowflake	Firebolt
Reporting	🟢 Yes	🟢 Yes	🟢 Yes	🟢 Yes	🟢 Yes
Dashboards	🟠 Fixed view	🟠 Fixed view	🟠 Fixed view	🟠 Fixed view	🟢 Fixed view, dynamic / changing data
Ad hoc, interactive analytics	🔴 Seconds-minutes first-time query performance	🔴 Seconds-minutes first-time query performance	🔴 Seconds-minutes first-time query performance	🔴 Seconds-minutes first-time query performance	🟢 Sub-second to seconds first-time query performance
Operational or customer-facing analytics (high concurrency, continuously updating / streaming data)	🟠 Slower query performance. Limited continuous writes and concurrency, limited semi-structured data support	🔴 Slow query performance and limited scale. Limited continuous writes and concurrency, slow semi-structured data performance	🟠 Slower query performance. Limited to 100K continuous writes/table, 100 concurrent users by default*	🟠 Slower query performance. Limited continuous writes and concurrency, slow semi-structured data performance	🟢 Yes. Support continuous writes at scale, fast semi-structured performance
Data processing engine (Exports or publishes data)	🟢 Unload data as Parquet	🟢 Exports query results	🟢 1GB max export file size, exports to Google cloud only*	🟢 Export query results or table	🟢 Export query results
Data science/ML	🟢 Invoke ML (SageMaker) in SQL	🟠 Export query results	🟢 BigQuery ML	🟢 Spark, Arrow, Python connectors, integration with ML tools, export query results	🟠 Export query results

COST					
Administration - deployment, management	🟠 Easy to provision, harder to configure and manage	🟢 No administration or tuning	🟢 No administration or tuning	🟢 Easy to deploy and resize Strong performance visibility limited tuning	🟢 Easy to deploy and resize Easy to add indexing, change node types
Choice - provision different cluster types on same data	🔴 No	🔴 No	🟢 Yes	🟢 Choice of fixed size warehouses	🟢 Choice of node types, engine sizes
Choice - provision different number of nodes	🟢 Yes	🟠 No	🟢 Up to 2000 flex (on demand) slots, Purchase reserved or flex slots 100 at a time with no limits	🟢 Yes	🟢 Yes
Choice - provision different node types	🟠 Yes (Limited)	🔴 No	🔴 No	🔴 No	🟢 Yes
Pricing - compute	🔴 $0.25-13 per node on demand <40% less when up front	🟢 None	🔴 On demand - $5/TB data processed, Flex slots $4 for 100 slots per hour $1700/month per 100 slots	🔴 $2-$4+ per node. Fast analytics need large cluster ($16-32+/hour) or greater	🟢 Choose any any node. Compute costs range $1-10/hour with 10x price-performance advantage
Pricing - storage	🟢 Stored data only. RA3: $24 per TB per monthS3: AWS S3 costs	🟢 N/A (not part of Athena)	🟢 $20/TB active storage, $10/TB inactive	🟢 All storage. $23/40 per TB per month on demand/up front	🟢 All storage. $23/40 per TB per month on demand/up front
Pricing - transferred data	🟢 Spectrum: $5 per TB scanned (10MB min per query)	🟢 $5 per TB scanned (10MB per query)	🟢 Batch is free.Streaming ingest $0.01 per 200MB ($50/TB), streaming reads $1.1/TB	🟢 None	🟢 None