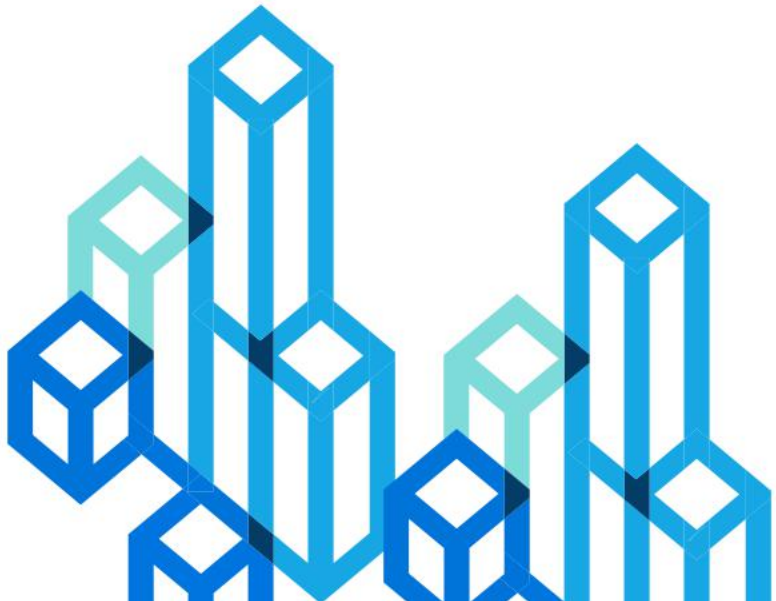
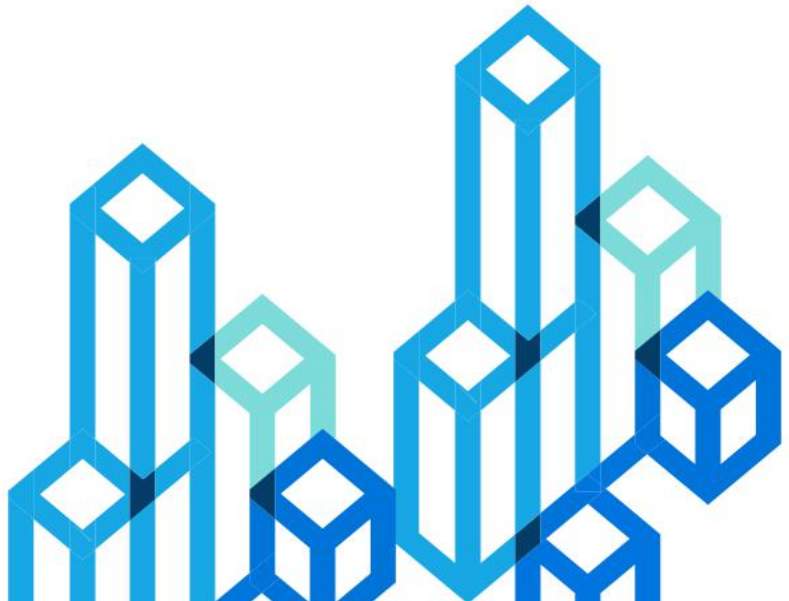
图数据库 Nebula Graph 的架构演进及典型应用





About Me

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Nebula Graph Maintainer

NebulaGraph

vesoft

欧 若 数 网

Contents

- Nebula Graph 2.0 Architecture
  - nebula-graphd
  - nebula-metad
  - nebula-storaged
- Nebula Graph use cases
- Future

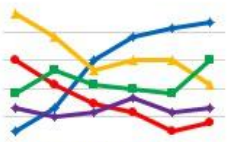
Nebula Graph

DB-Engines Ranking of Graph DBMS

The DB-Engines Ranking ranks database management systems according to their popularity. The ranking is updated monthly.

This is a partial list of the complete ranking showing only graph DBMS.

Read more about the method of calculating the scores.



trend chart

https://nebula-graph.com.cn

Since 2019

☐ include secondary database models — 32 systems in ranking, July 2021

Rank Jul 2021	Rank Jun 2021	Rank Jul 2020	DBMS	Database Model	Score Jul 2021	Score Jun 2021	Score Jul 2020
1.	1.	1.	Neo4j	Graph	57.16	+1.41	+8.24
2.	2.	2.	Microsoft Azure Cosmos DB	Multi-model	36.70	+0.23	+6.30
3.	3.	3.	ArangoDB	Multi-model	4.73	-0.18	-1.12
4.	4.	4.	OrientDB	Multi-model	4.16	-0.30	-0.72
5.	5.	5.	Virtuoso	Multi-model	4.01	+0.32	+1.57
6.	↑ 7.	↑ 10.	GraphDB	Multi-model	2.44	+0.13	+1.13
7.	↓ 6.	7.	JanusGraph	Graph	2.36	-0.13	+0.34
8.	8.	↓ 6.	Amazon Neptune	Multi-model	2.13	-0.07	-0.08
9.	9.	↑ 13.	TigerGraph	Graph	1.91	+0.03	+0.98
10.	10.	↑ 11.	Stardog	Multi-model	1.79	+0.06	+0.53
11.	11.	↓ 8.	Dgraph	Graph	1.76	+0.05	+0.21
12.	12.	↓ 9.	Fauna	Multi-model	1.74	+0.07	+0.27
13.	13.	↑ 14.	AllegroGraph	Multi-model	1.33	0.00	+0.41
14.	14.	↓ 12.	Giraph	Graph	1.21	+0.01	+0.19
15.	15.	↑ 20.	Nebula Graph	Graph	1.10	+0.05	+0.79
16.	↑ 17.	↑ 17.	TypeDB	Multi-model	0.84	+0.03	+0.24
17.	↓ 16.	↓ 15.	Blazegraph	Multi-model	0.84	+0.02	+0.14
18.	18.	↓ 16.	Graph Engine	Multi-model	0.74	+0.00	+0.12

NebulaGraph

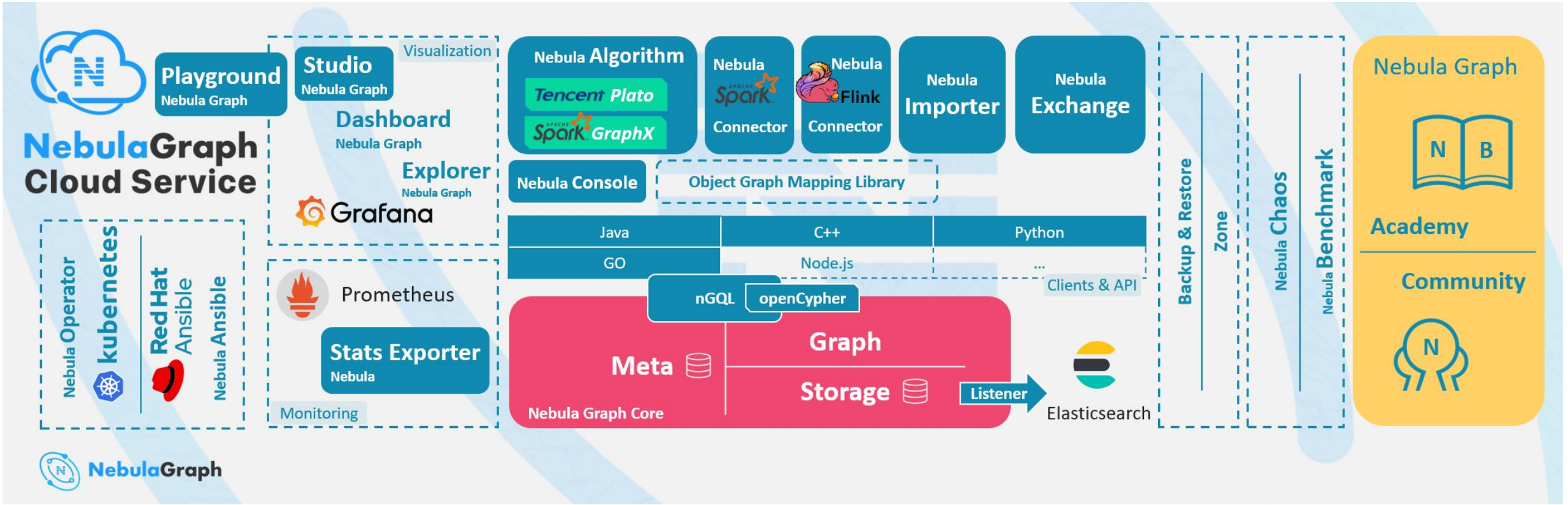
English | 中文

A distributed, scalable, lightning-fast graph database

Neo4j Announces $325 Million Series F Investment, the Largest in Database History

SAN MATEO, Calif. – June 17, 2021

Nebula Graph



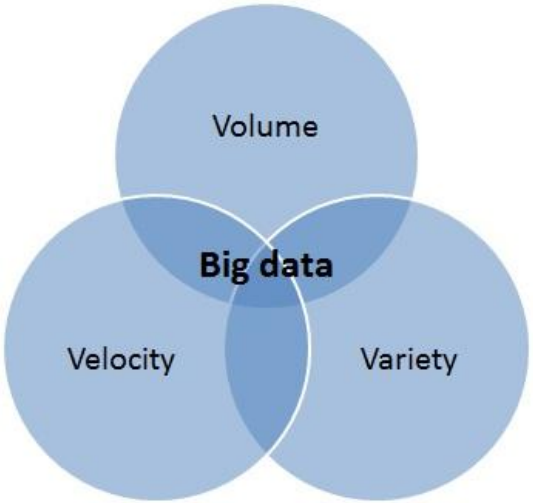
zhihu / norm

An ORM library support nGQL for Golang.

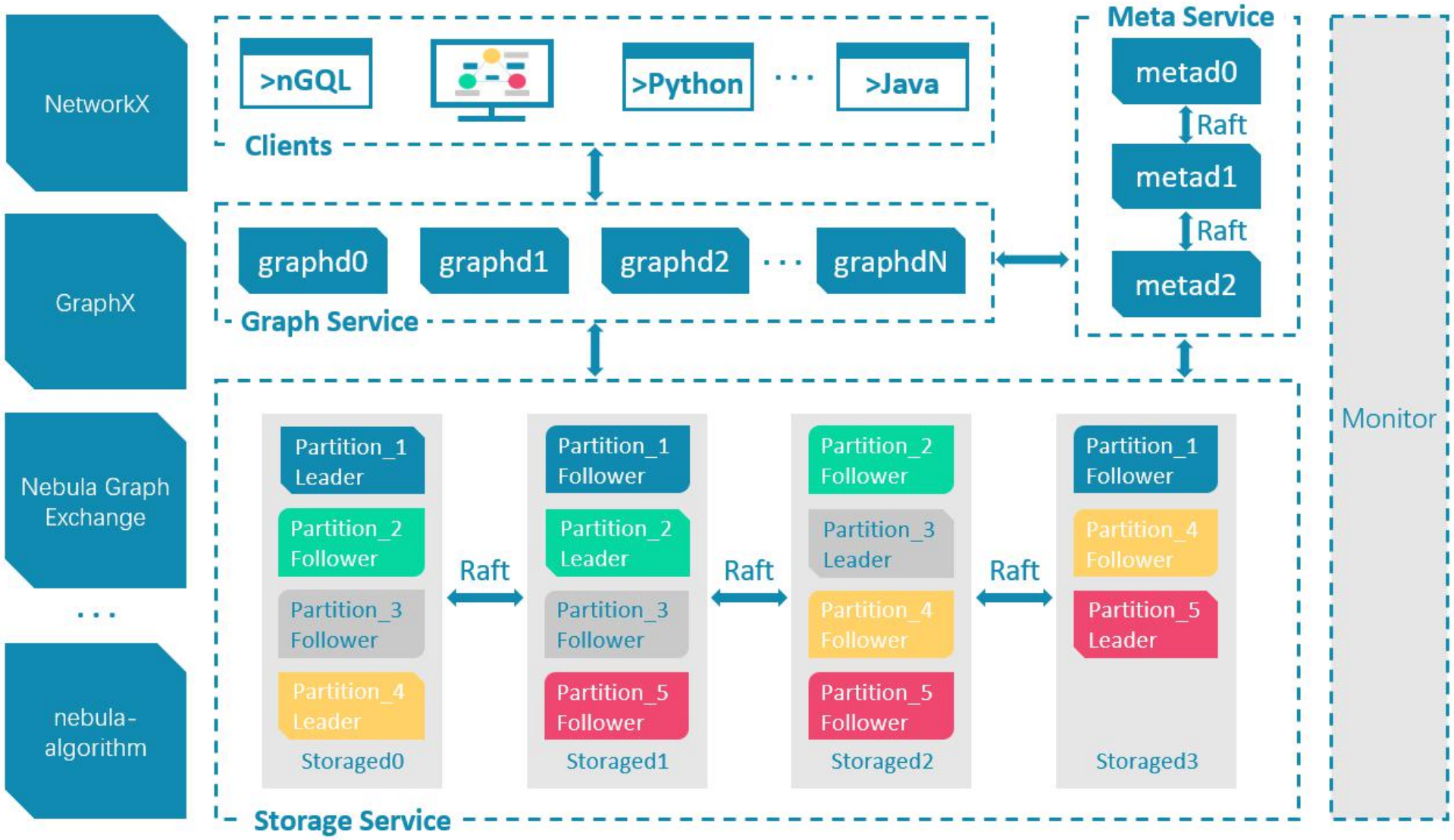
go report A+ | Go passing | license MIT | go.dev reference

Nebula Graph

- Distributed Graph Database (HA, Scale in/out)
- Schema-based, Property Graph
- Low latency
- Shared-nothing
- Cloud Native(nebula on K8s)
- Open Source (Open Core)



Nebula Graph Architecture



Nebula Graph Service

How to query graph data?

Graph Query Language

nGQL: SQL-like

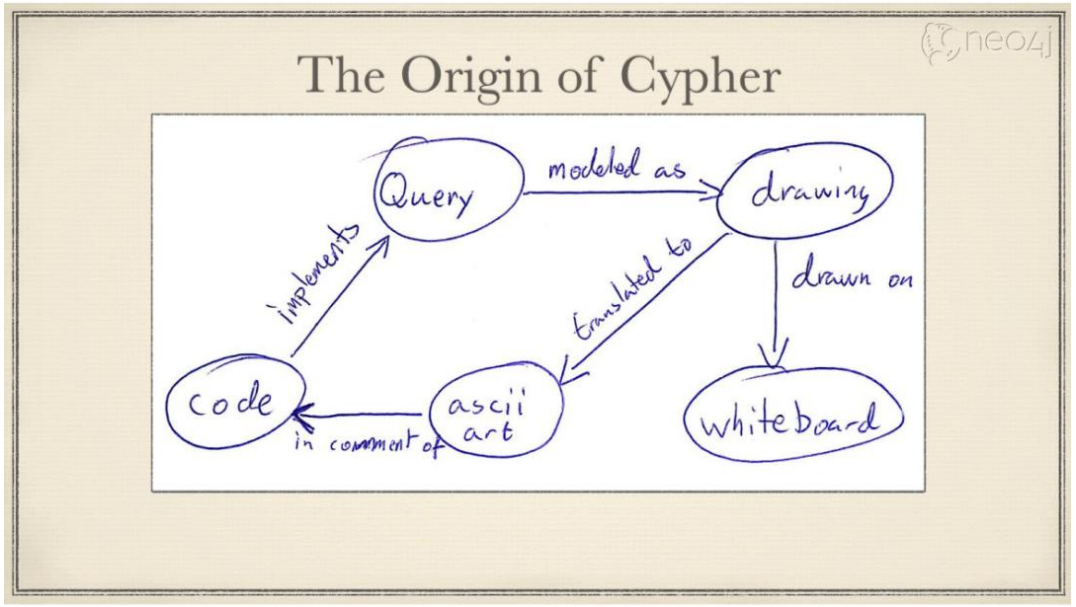
```
nebula> GO FROM "player100" \
        OVER follow BIDIRECT \
        YIELD $$.player.name as Name | \
        GROUP BY $-.Name \
        YIELD $-.Name as Player, count(*) AS Name_Count;
+--------------------+------------+
| Player             | Name_Count |
+--------------------+------------+
| "Tiago Splitter"   | 1          |
+--------------------+------------+
| "Aron Baynes"      | 1          |
+--------------------+------------+
| "Boris Diaw"       | 1          |
+--------------------+------------+
| "Manu Ginobili"    | 2          |
+--------------------+------------+
| "Dejounte Murray"  | 1          |
+--------------------+------------+
| "Danny Green"      | 1          |
+--------------------+------------+
| "Tony Parker"      | 2          |
+--------------------+------------+
| "Shaquille O'Neal"   | 1        |
+--------------------+------------+
| "LaMarcus Aldridge" | 1         |
+--------------------+------------+
| "Marco Belinelli"  | 1          |
+--------------------+------------+
Got 10 rows (time spent 3527/4423 us)
```

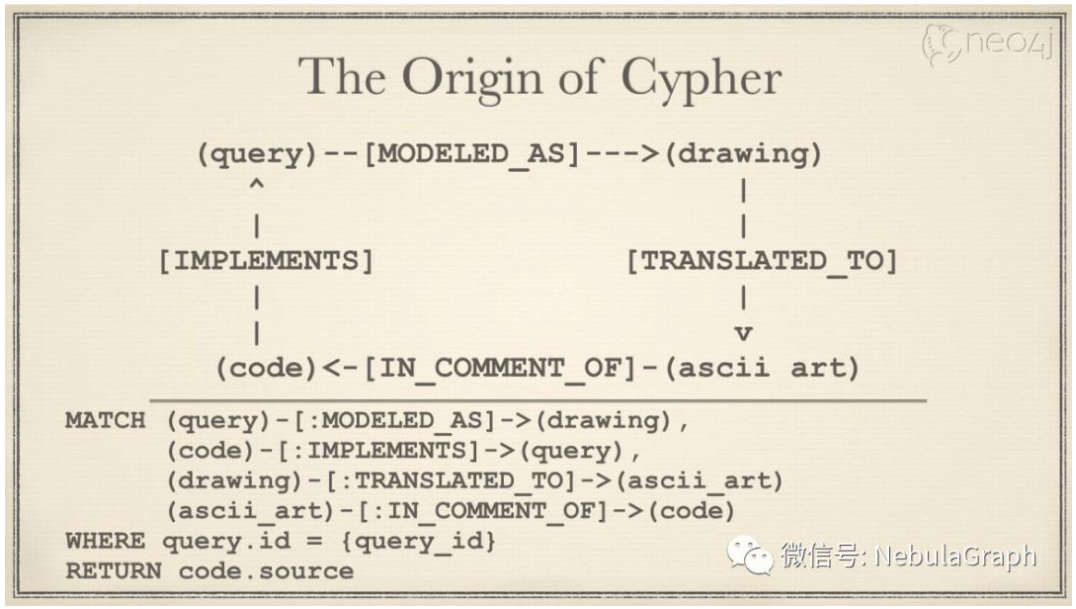
```
LOOKUP ON ME WHERE ME.code == "1234" | \
YIELD $-.VertexID AS dst | \
GO FROM $-.dst OVER P YIELD P._dst AS dst | \

GO FROM $-.dst OVER T \
WHERE any(cur IN split($^.HB.curr, ",") WHERE cur == "CNY") \
YIELD T._dst AS dst, $^.HB.bn as bn0, $^.HB.c as c0 | \

GO FROM $-.dst OVER T \
WHERE any(cur IN split($^.HB.curr, ",") WHERE cur == "CNY") \
YIELD T._dst AS dst, $-.bn0 AS bn0, $-.c0 AS c0 | \

GO FROM $-.dst OVER T \
WHERE any(cur IN split($^.HB.curr, ",") WHERE cur == "CNY") \
YIELD T._dst AS dst, $-.bn0 AS bn0, $-.c0 AS c0 | \

GO FROM $-.dst OVER P REVERSELY \
WHERE any(cur IN split($^.HB.curr, ",") WHERE cur == "CNY") \
  AND $$.ME.code=="4321" AND $$.ME.name=="Global" \
YIELD $^.HB.bn as bn3, $^.HB.c as c3,  $-.bn0 AS bn0, $-.c0 AS c0 | \

ORDER BY $-.bn3 | \
LIMIT 100;
```

Graph Query Language

openCypher: Declarative language

```
MATCH (:ME{code:“4321”})-[:P]->(t0:HB)-[:T]-(t1:HB)-[:T]-(t2:HB)-[:T]-(t3:HB)<-[:P]-(:ME{code:”1234”,name:”Global”})
WHERE
  any(cur IN split(t0.curr, “,”) WHERE cur==“CNY”) AND
  any(cur IN split(t3.curr, “,”) WHERE cur==“CNY”)
RETURN t0.bn, t3.bn, t0.c, t3.c
ORDER BY t3.bn
LIMIT 100
```





Graph Query Language

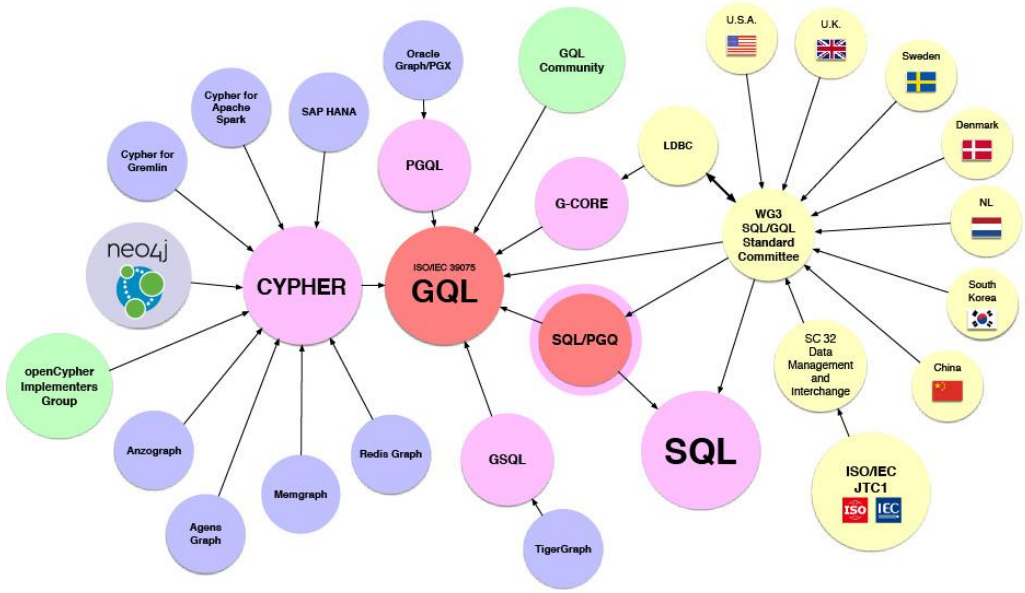
Nebula Graph 2.0: compatible with openCypher (MATCH)

Possible Timeline for a GQL Standard

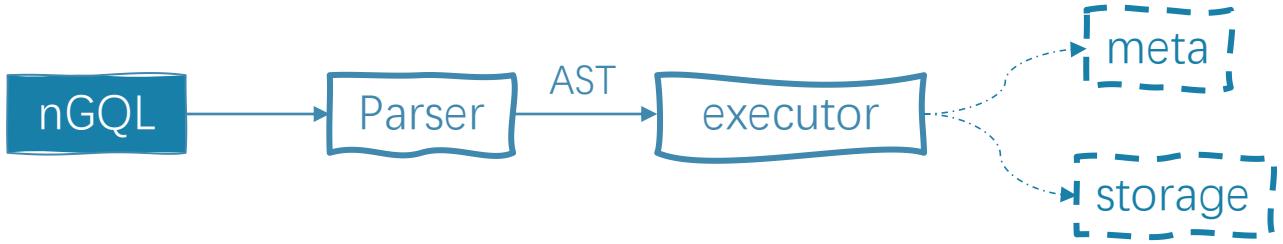
The following is a speculative, optimistic timeline for the progression of a formal Graph Query Language Standard

- 2019-09 – 39075 Database Language GQL project approved - this is the start
- 2021-03 – CD Ballot starts
- 2021-06 – CD Ballot comment resolution
- 2021-09 – DIS (Draft International Standard) Ballot
- 2022-02 – Comment resolution
- 2022-05 – FDIS (Final DIS) Ballot
- 2022-08 – International Standard

This timeline depends on work that has not yet been done.

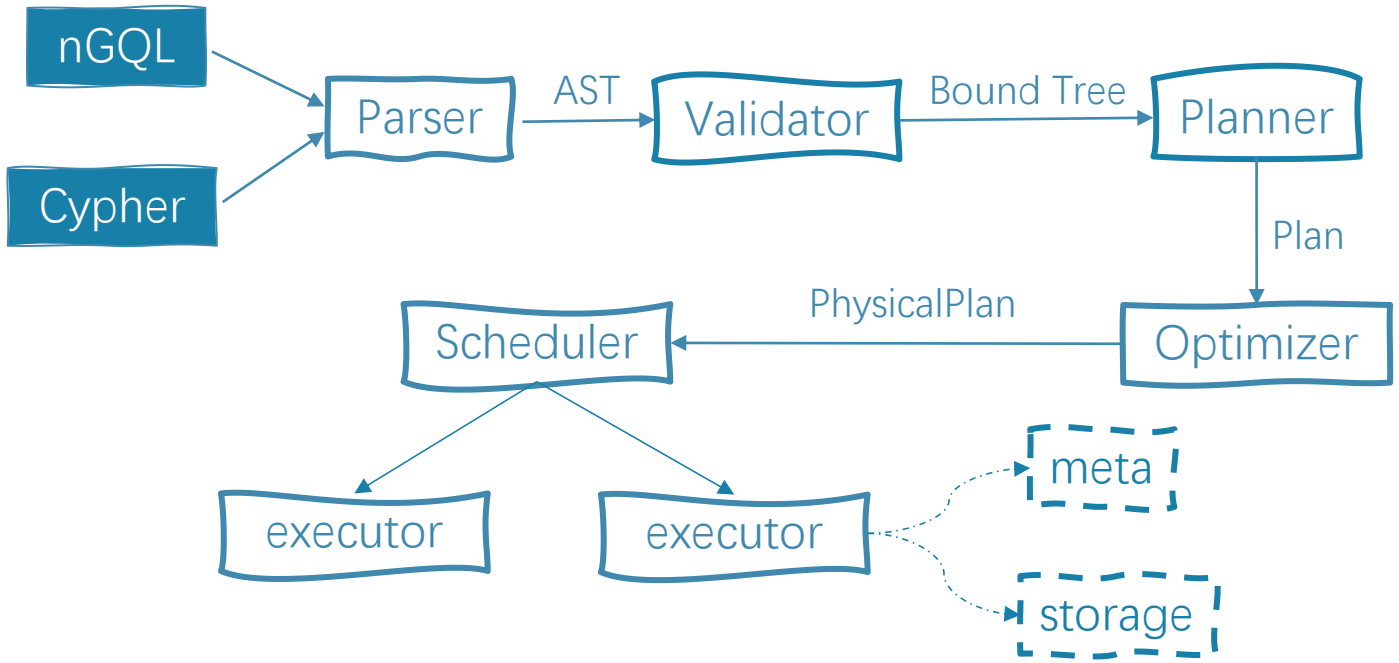


nebula-graphd (1.0)



- Fast, no scheduling overhead
- Simple but each executor class is huge
- Hard to support new operations

nebula-graphd (2.0)



- Validator: Semantic Checking
- Optimizer: RBO, PushFilterDownXRules, TopNRule etc.
- Scheduler: Asynchronous execution framework
- Share Physical Operators for nGQL and openCypher (MATCH)

Operators

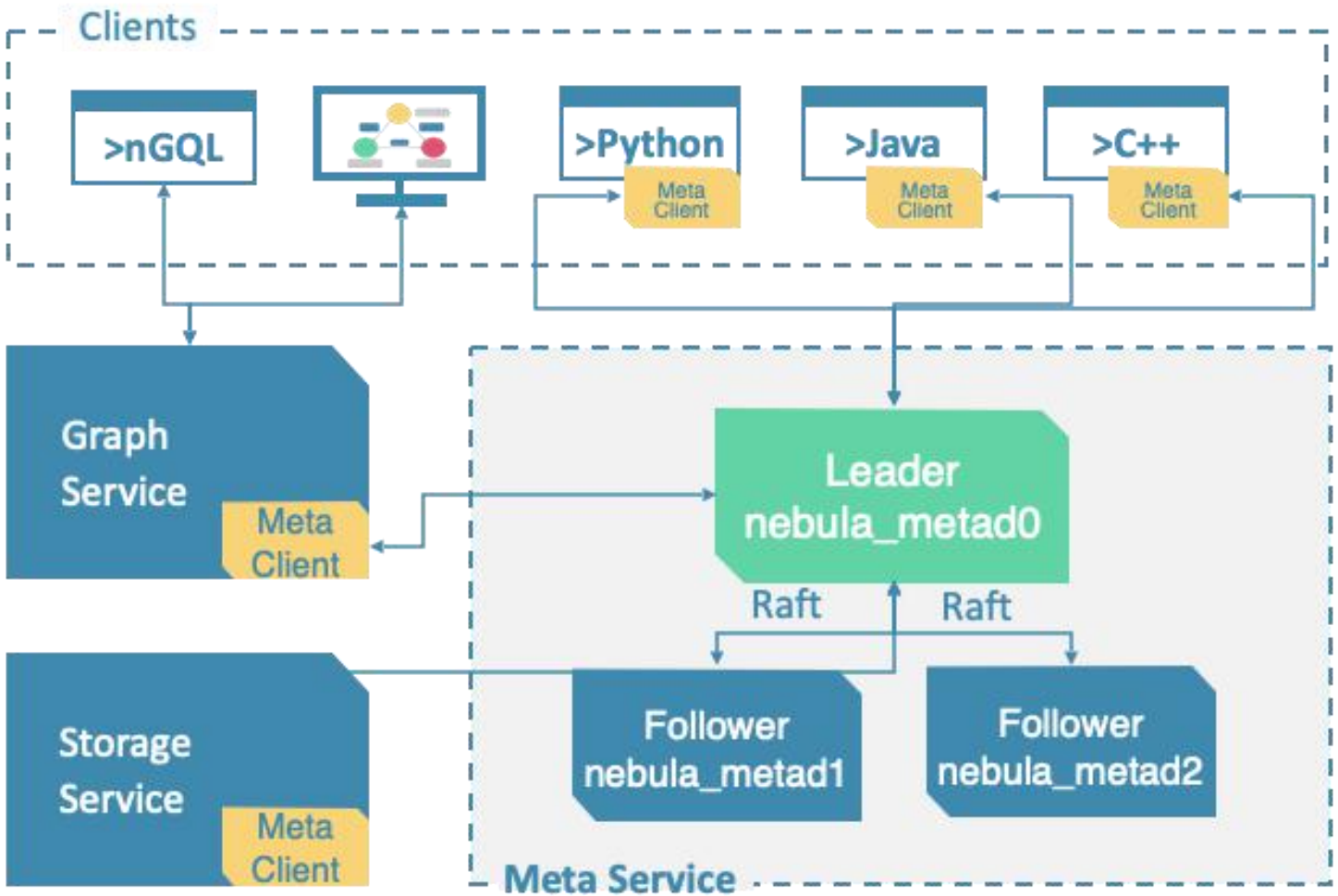
GetNeighbors
GetVertices
GetProps
Project
Join
Filter
Union
Dedup
EdgeIndexFullScan
EdgeIndexPrefixScan
EdgeIndexRangeScan
VertexIndexFullScan
VertexIndexPrefixScan
VertexIndexRangeScan
Loop
Select
...

Nebula Storage Service

How to store graph data?

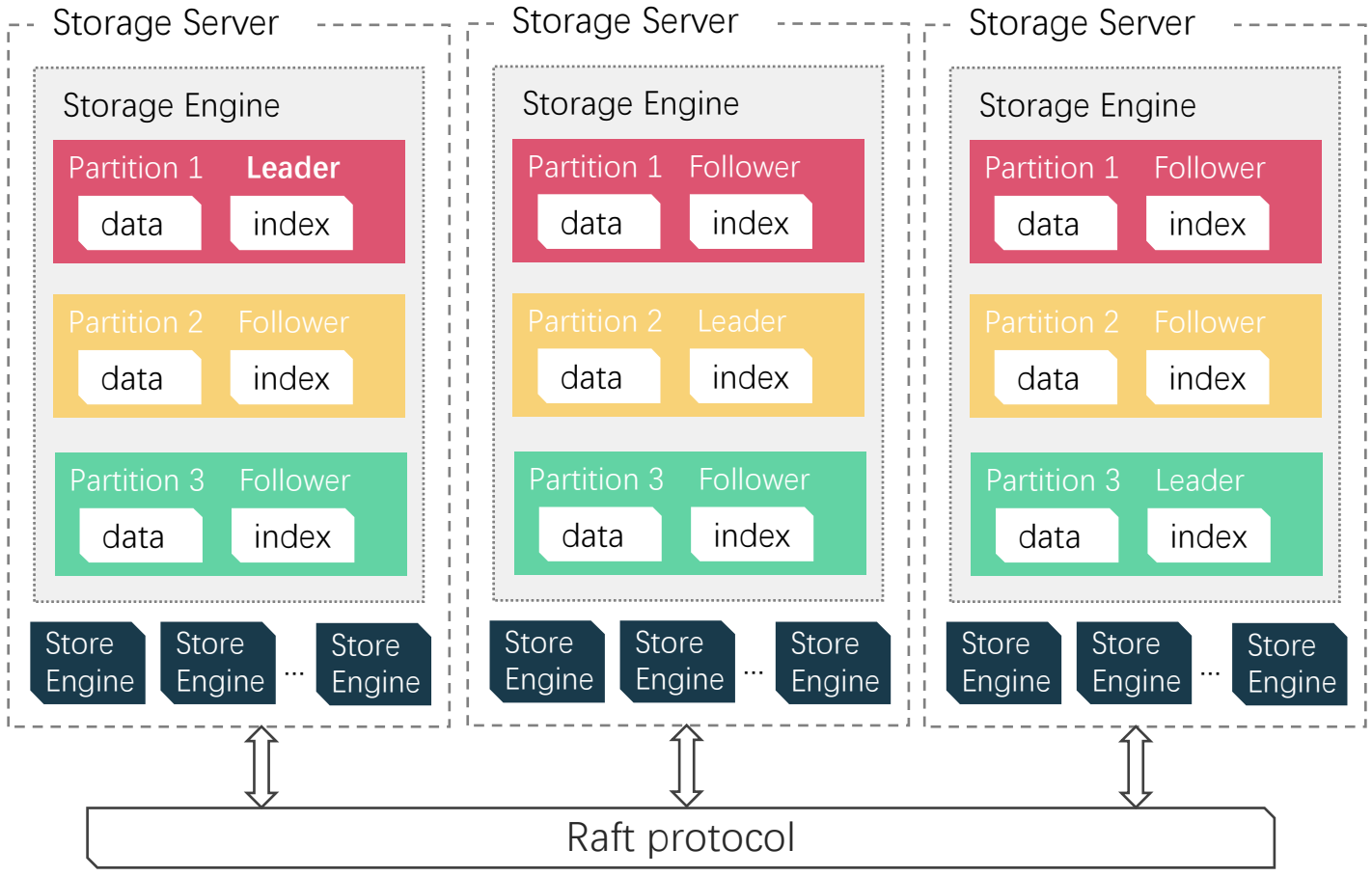
nebula-metad

- User accounts
- Partitions
- Graph spaces
- Schema information
- TTL-based data eviction
- Jobs
- Sessions
- Slow queries

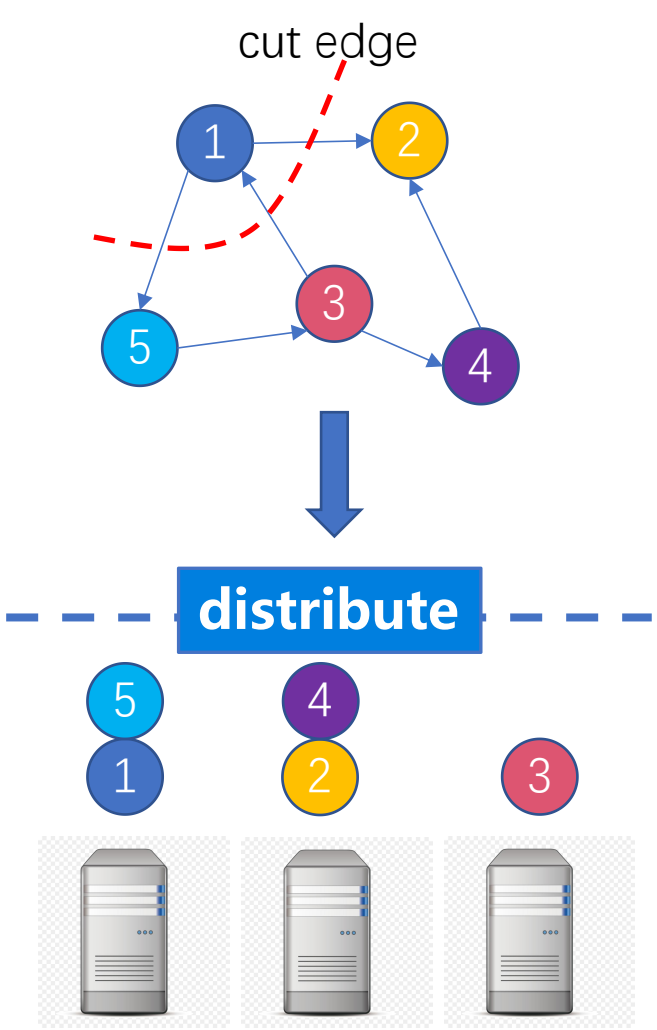


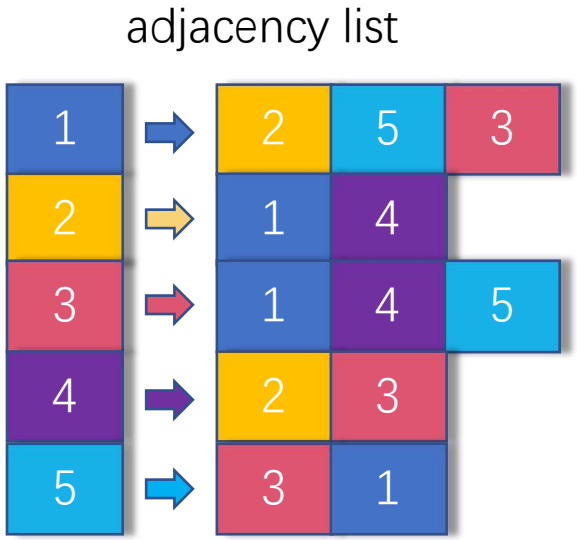
nebula-storaged

- Graph Interface(Vertex/Edge)
- Move compute to data
- Strong Consistency (Raft)
- Learner for 3rd-party Systems
- Backup & Restore
- Zone



Graph on KV store

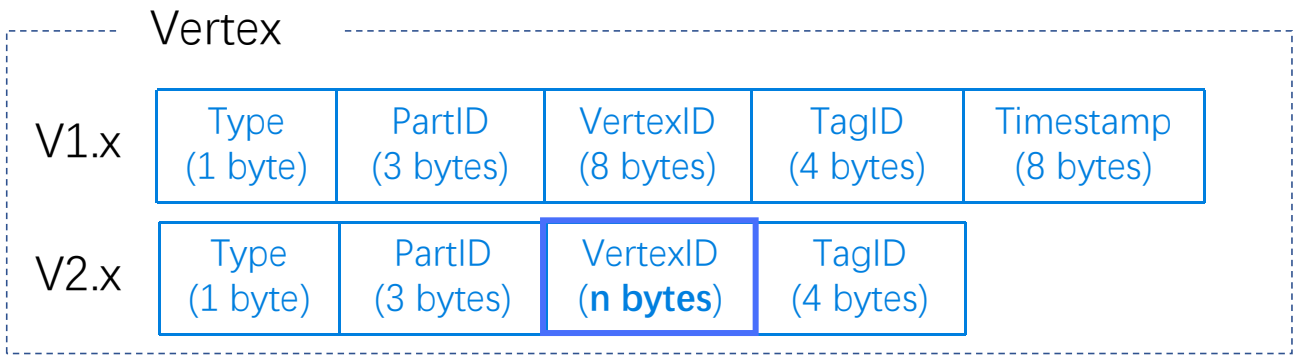


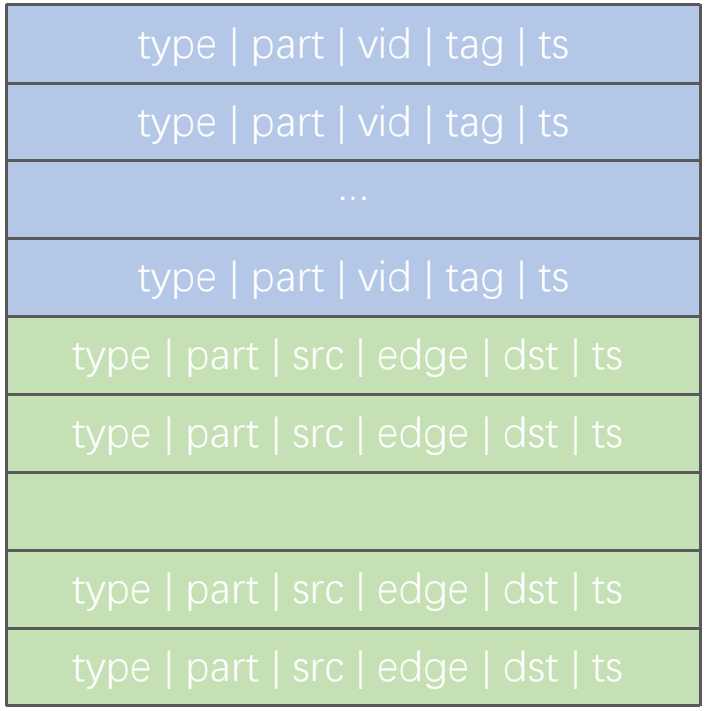


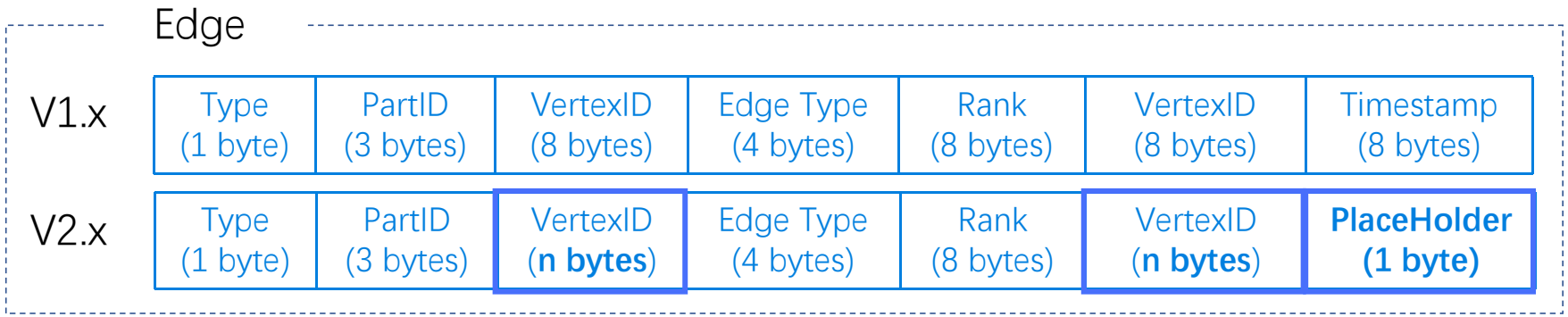
- Cut edge
- Hash partition
- Adjacency list

Graph on KV store

- Directed Graph
- Insert flip edge automatically (TOSS)
- Split vertex/edge by type





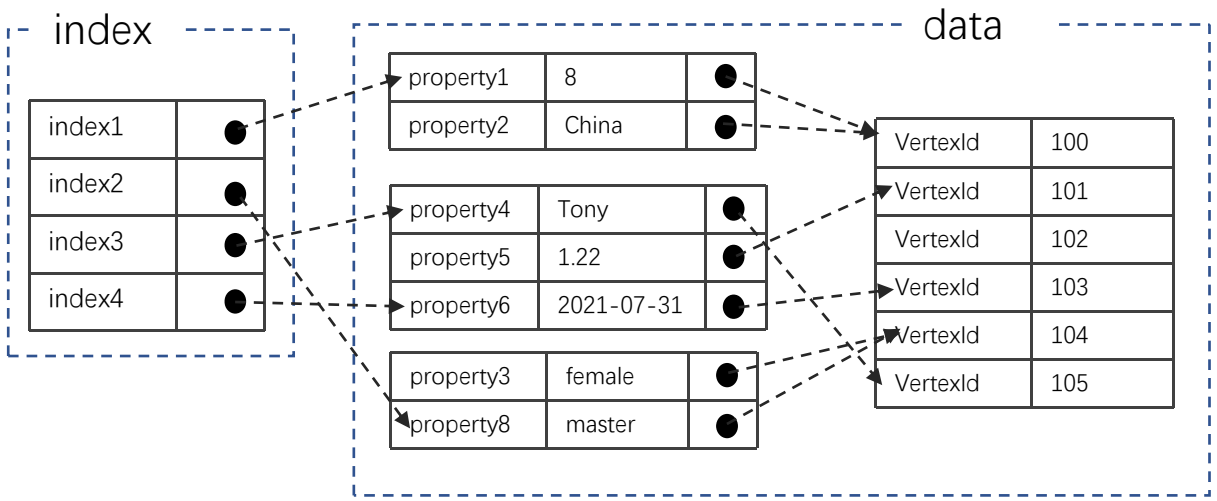


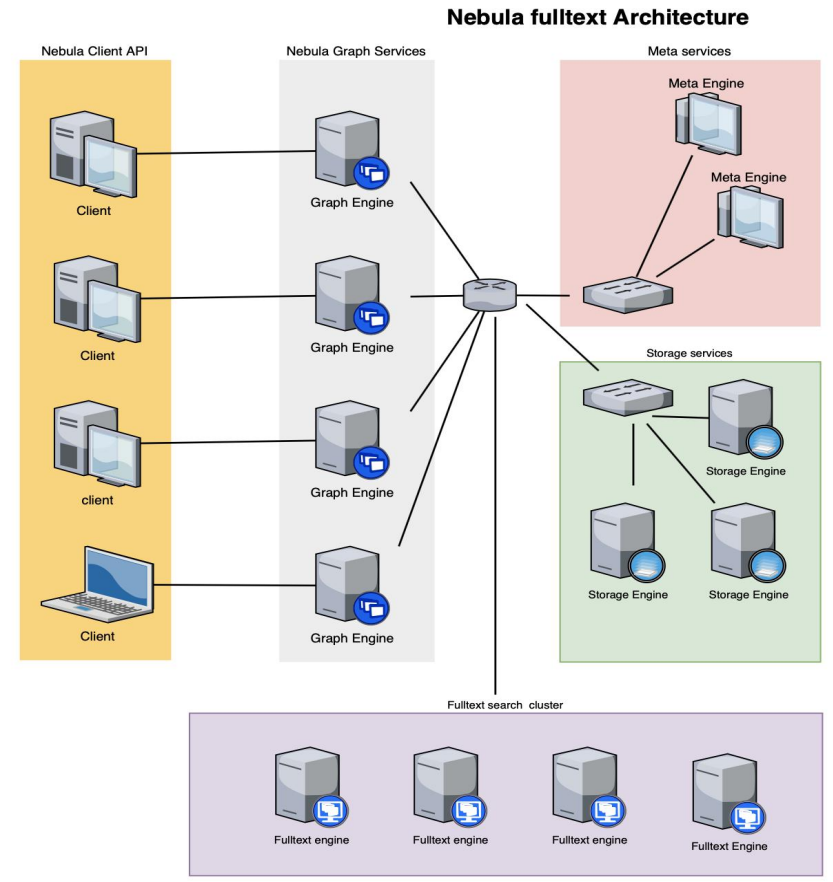
Index

- Stored in same partition with vertex/edge
- Support MATCH/LOOKUP functionality, not speed up query
- Fulltext Index powered by Elastic Search

Key				Value
PartitionId	IndexId	Index binary	VertexId	

Key						Value
PartitionId	IndexId	Index binary	SrcVertexId	EdgeRank	DstVertexId	

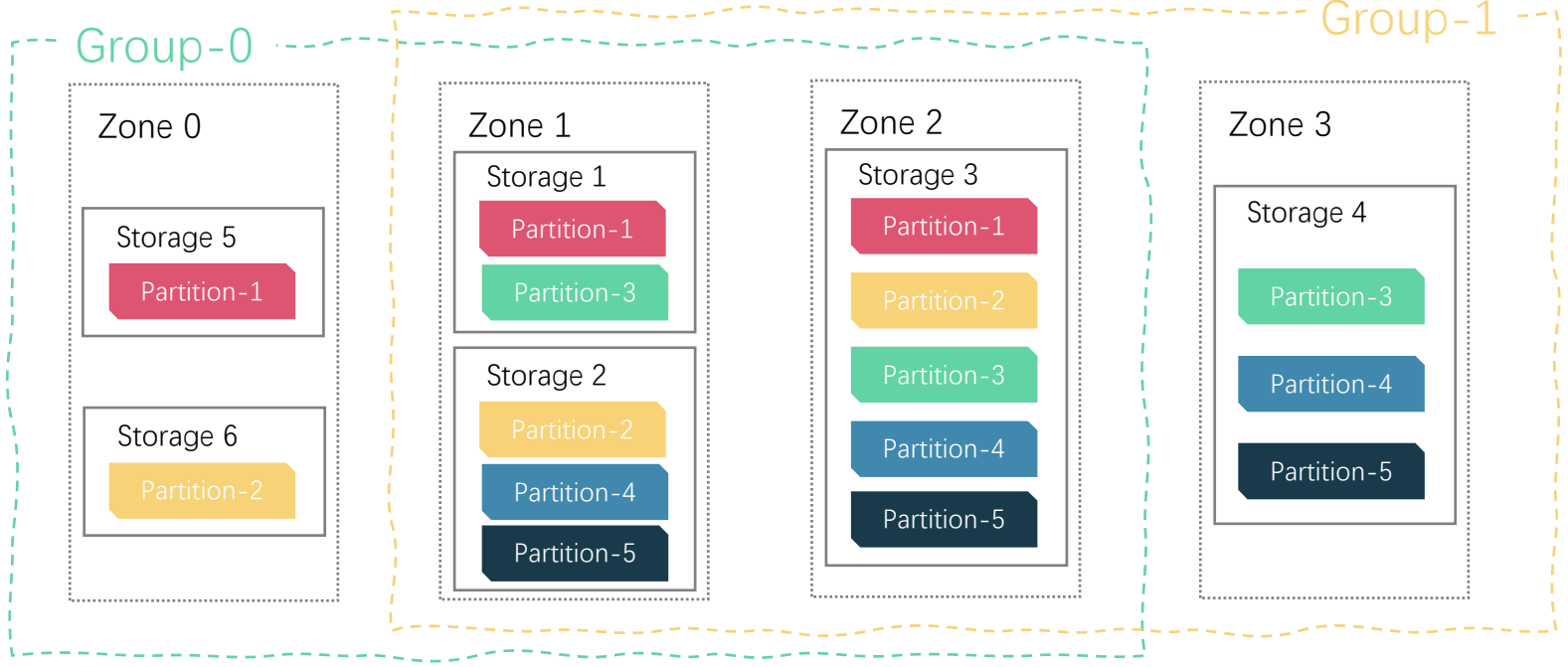




Zone

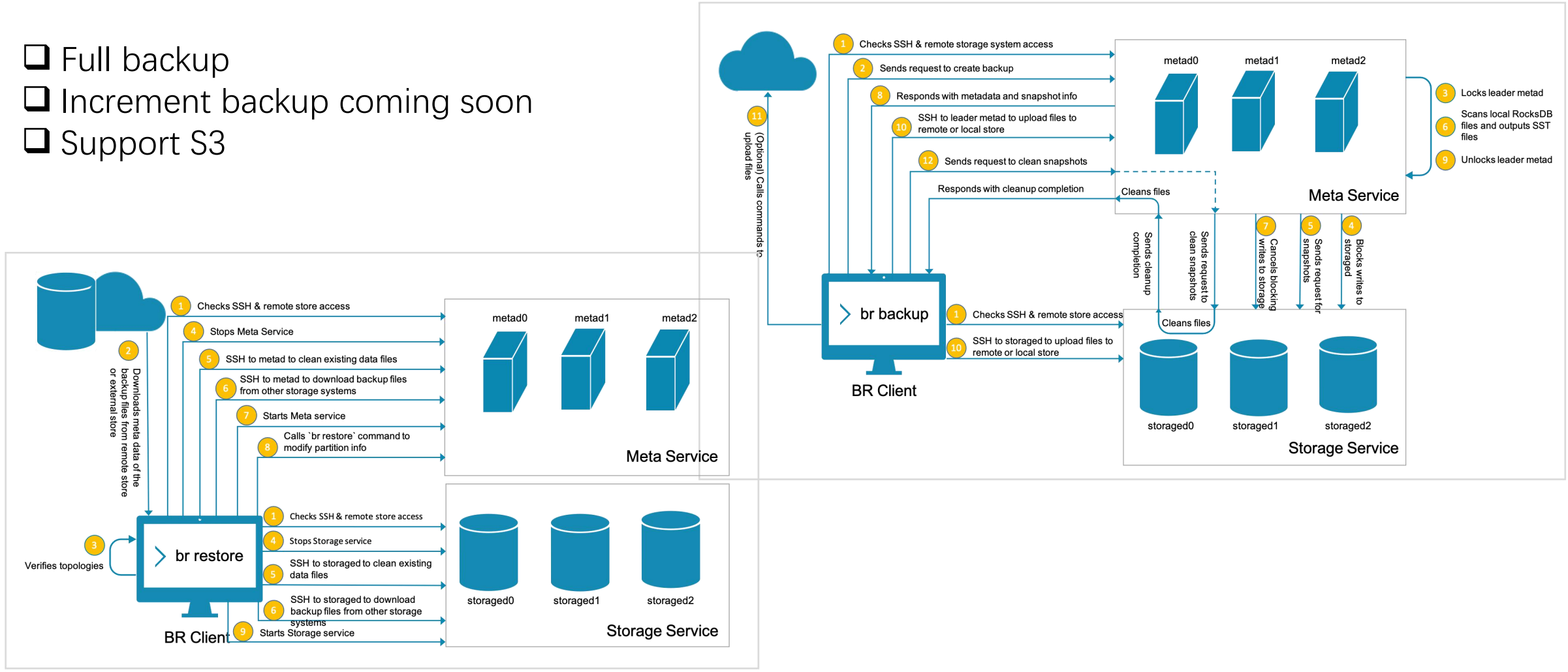
Disaster Recovery

- ❑ Space
- ❑ Group
- ❑ Zone
- ❑ Host



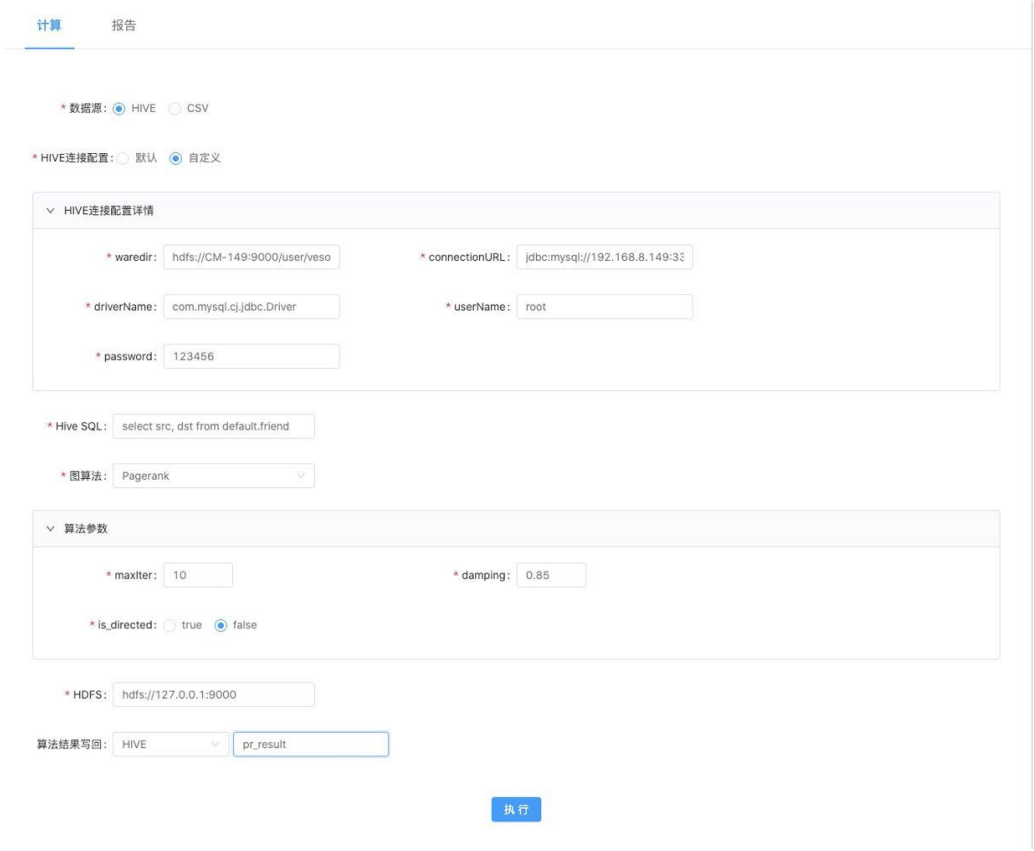
Backup & Restore

- Full backup
- Increment backup coming soon
- Support S3



Graph Computing

- Point queries
- Whole Graph Computing
- Think like a vertex(Vertex-Centric)



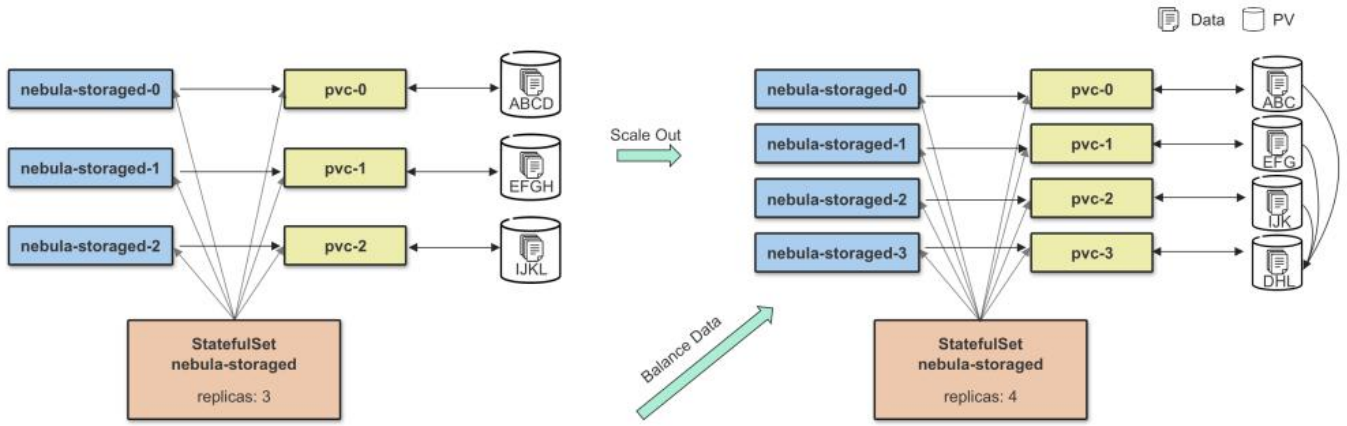
Plato
Tencent Open

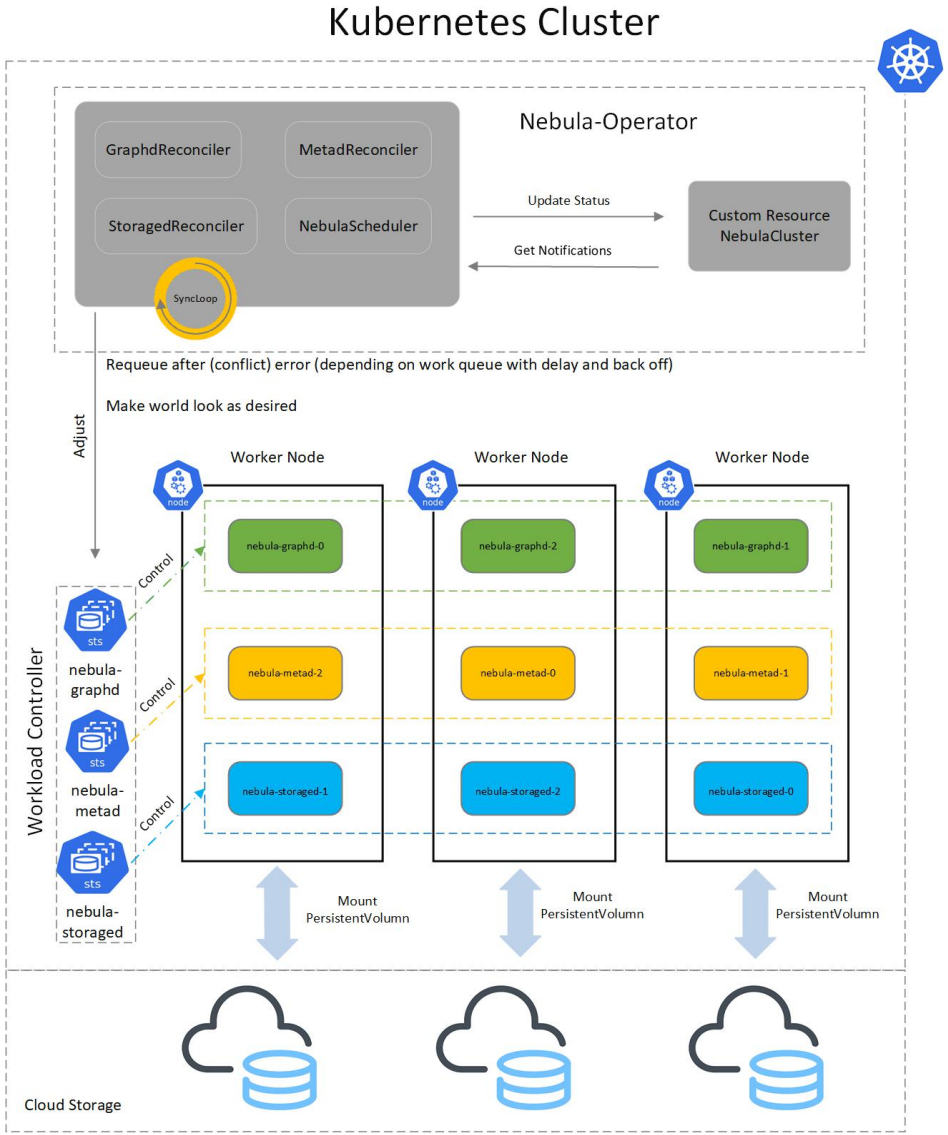
GraphX

APACHE Spark™

Cloud Native

- nebula-operator: CRD nebulacluster
- nebula-stats-exporter: Grafana/Prometheus

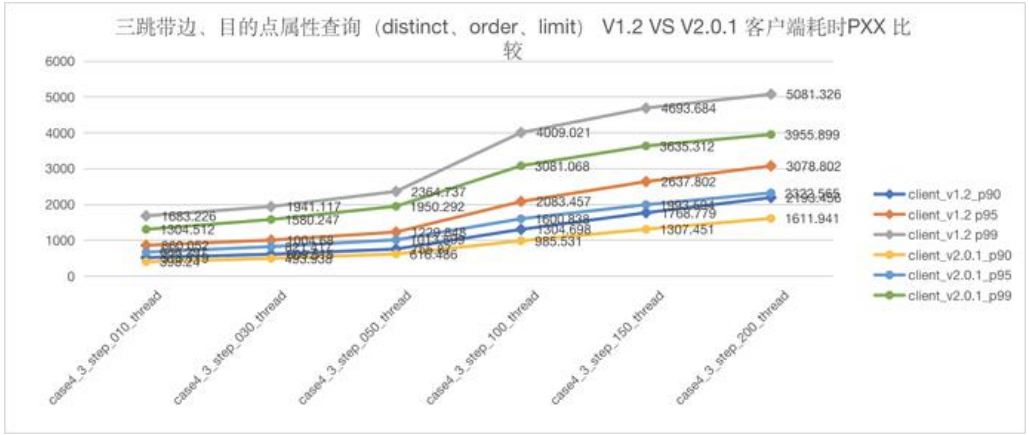




Nebula Benchmark (1.0 vs 2.0)

- Data: ldbc_snb_sf100
- Query:

GO {x} STEP FROM {id} OVER knows \
YIELD DISTINCT knows.`time` as t, $$.person.first_name, $$.person.last_name, $$.person.birthday as birth | \
order by $-.t,$-.birth | limit 10



More Infos: https://discuss.nebula-graph.com.cn/search?q=benchmark

Nebula Graph Use Cases

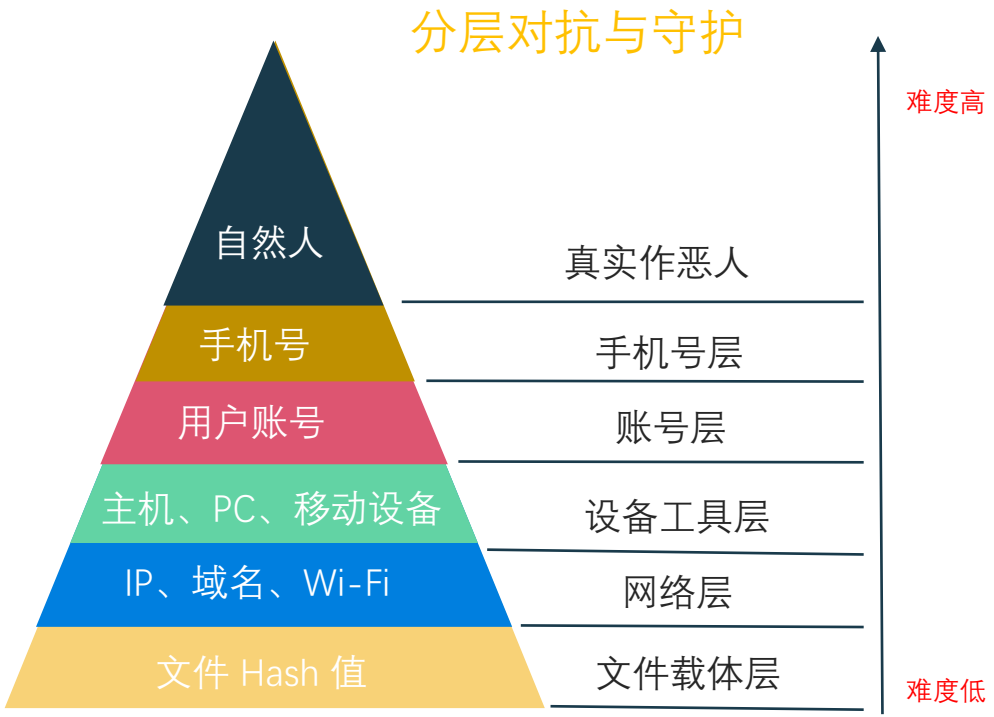
Nebula Graph Adopters

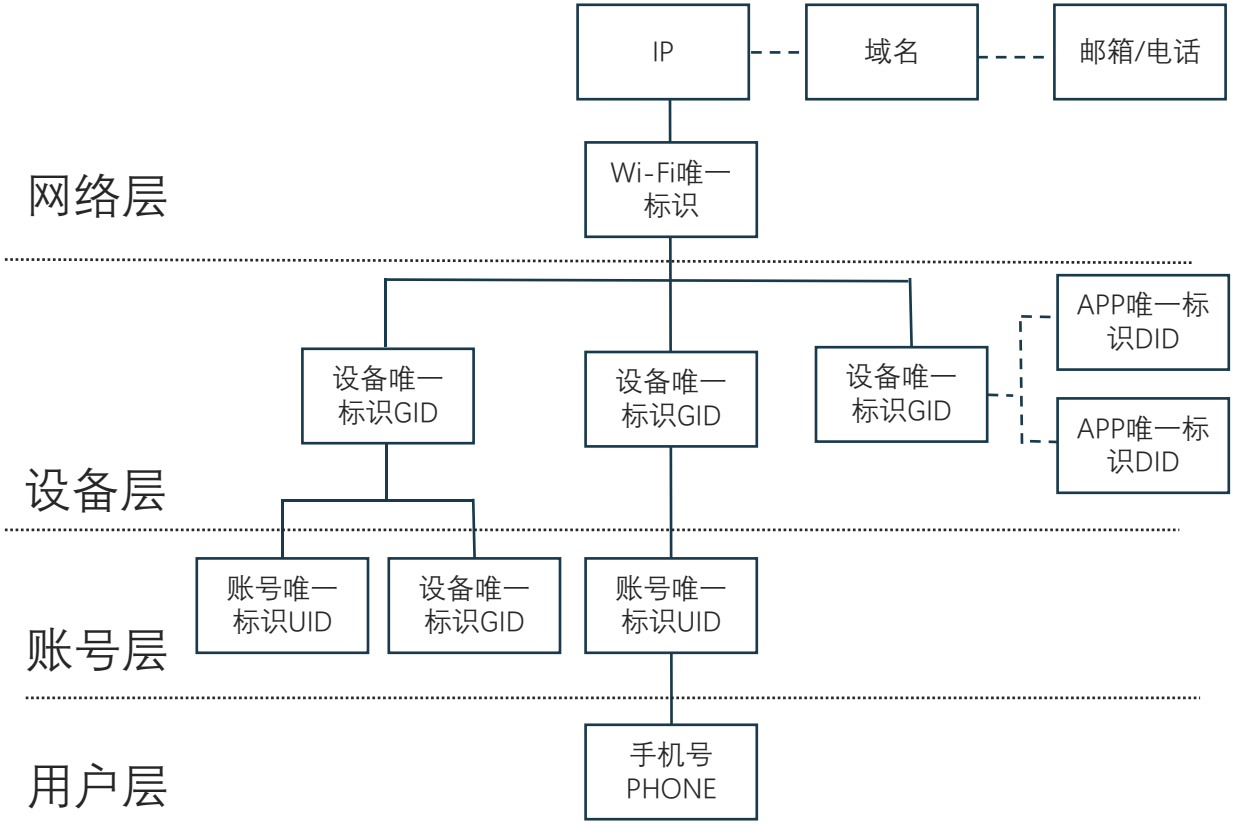
Use case

Knowledge Graph

Use case

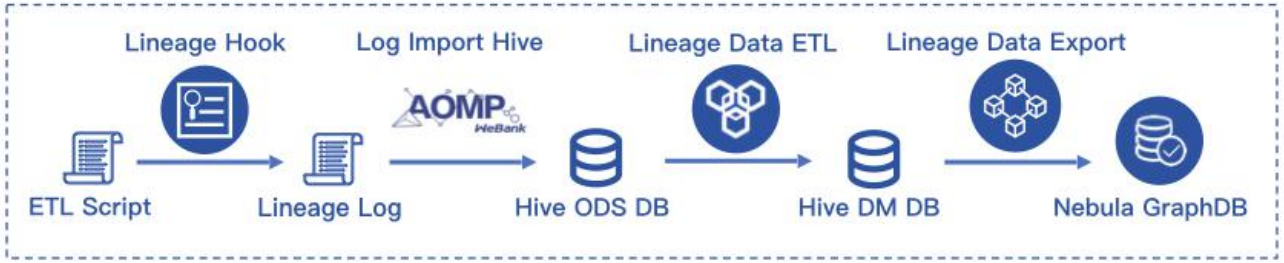
security information

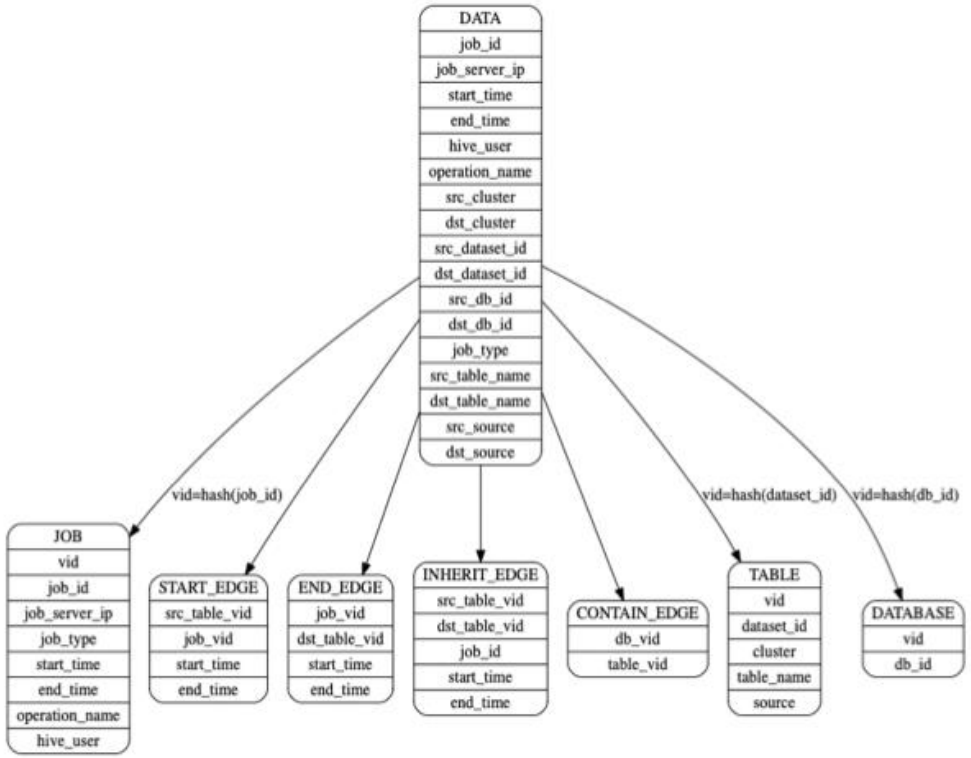


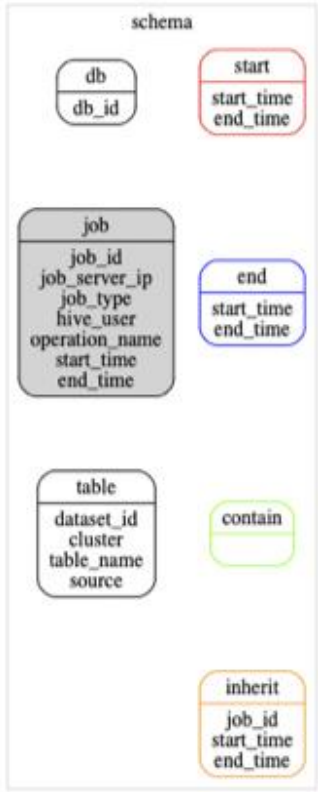


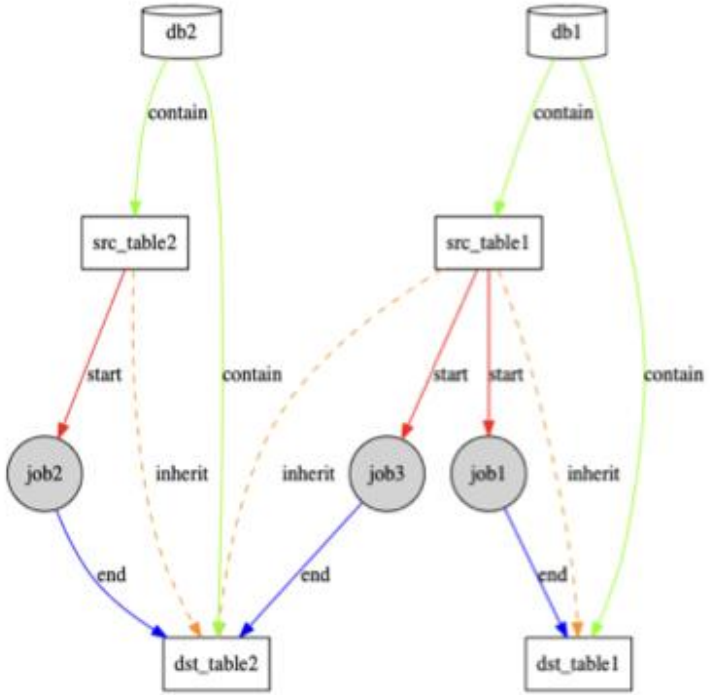
Use case

Data lineage Analysis









Future

- Support more openCypher(MATCH) features
- Performance tuning (memory, plan, expression...)
- Ease of use (Studio, Dashboard and more tools)
- Transaction
- HTAP
- ...

https://nebula-graph.com.cn/nuc2021/

NUC 2021

Nebula User Conference

2021.08.08　　北京北辰洲际酒店

Nebula Graph 用户大会（NUC）是欧若数网旗下开源分布式图数据库 Nebula Graph 举办的一年一度的图数据库大会盛宴，它面向所有 Nebula 社区用户及对图数据库有兴趣的架构师、技术负责人和技术从业人员。大会旨在帮助企业和研发人员快速了解图数据库的应用场景和技术趋势。期间，来自多家一线互联网科技公司的技术人员将会参与分享和讨论。

我要报名

麦思博(msup)有限公司是一家面向技术型企业的培训咨询机构，携手2000余位中外客座导师，服务于技术团队的能力提升、软件工程效能和产品创新迭代，超过3000余家企业续约学习，是科技领域占有率第1的客座导师品牌，msup以整合全球领先经验实践为己任，为中国产业快速发展提供智库。

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