

An Analytical Model for Kafka Sizing

Factors Influencing Sizing

- Message rate and size
- Number of topics and partitions
- Replication factor
- Effectiveness of caching
- Numbers of producers, consumers and consumer groups
- Planned data retention period
- Network adapter speed
- Disk speed

Network and Disk Throughput Calculations

Let

- W = data rate(MB/s): Message rate (msgs/s) * Avg. message size (MB/msg)
- R = replication factor
- C = number of consumer groups
- L = lagging readers (data is no longer in the in-memory cache when they read; incur reading from disk penalty)

Network Write throughput (MB/s) = $W * R$

Network Read throughput (MB/s) = $((R - 1) + C) * W$

Disk read/write throughput (MB/s) = $W * (R + L)$

Network Adapter Utilisation

Network adapters (Gigabit or even higher speed) are full-duplex ie, able to transmit and receive at the same time, hence network adapter utilisation is calculated as:

Let

- T_r = Network Read throughput (MB/s)
- T_w = Network Write throughput (MB/s)
- N_s = network adapter speed (MB/s)

Network adapter utilisation = $\text{Max}(T_r, T_w) / N_s$

Disk Utilisation

Similarly, disk utilisation can be calculated as:

Let

- T_d = Disk read/write throughput (MB/s)
- D_s = disk speed (MB/s)

Disk utilisation = T_d / D_s

Storage Requirements

Let

- S_d = Daily storage required (MB/day):
 - Message rate (msgs/s) * Avg. message size (MB/msg) * 60 * 60 * 24 * replicas
- P_d = retention period (days)

Storage required = $S_d * P_d$

Facts, Simplifications and Safeguards

Fact: Subscriptions Required

Counted in Subscription	Not counted in Subscription
Kafka Broker	Strimzi Operators (cluster, entity, user and topic)
Kafka Connect Clusters	ZooKeeper
MirrorMaker	
Kafka Exporter	
Cruise Control	

Simplifications

- Partitions are balanced
- Load spread equally across all brokers
- No protocol overhead
- No rebalancing needed
- No memory bottleneck
- No compute bottleneck
- No re-configuration needed
- No disk failure

Safeguards

We know that the simplifications are not entirely realistic and that underestimating the cluster size and expanding it after going production will be costly. We, therefore, multiply the outcome based on our analytical mode by an **arbitrary** safety factor of:

1.6

Thank You!