



## VMStorage容量規劃與預留



我想要理解35%怎麼計算出來的用法，為了規劃vmstorage容量大小，你能教我嗎，或是你能給更簡單的範例：

### Capacity planning #

VictoriaMetrics uses lower amounts of CPU, RAM and storage space on production workloads compared to competing solutions (Prometheus, Thanos, Cortex, TimescaleDB, InfluxDB, QuestDB, M3DB) according to our case studies.

Each node type - vminsert, vmselect and vmstorage - can run on the most suitable hardware. Cluster capacity scales linearly with the available resources. The needed amounts of CPU and RAM per each node type highly depends on the workload - the number of active time series, series churn rate, query types, query qps, etc. It is recommended setting up a test VictoriaMetrics cluster for your production workload and iteratively scaling per-node resources and the number of nodes per node type until the cluster becomes stable. It is recommended setting up monitoring for the cluster. It helps to determine bottlenecks in cluster setup. It is also recommended following the troubleshooting docs.

The needed storage space for the given retention (the retention is set via `-retentionPeriod` command-line flag at vmstorage) can be extrapolated from disk space usage in a test run. For example, if the storage space usage is 10GB after a day-long test run on a production workload, then it will need at least  $10\text{GB} \times 100 = 1\text{TB}$  of disk space for `-retentionPeriod=100d` (100-days retention period). Storage space usage can be monitored with the official Grafana dashboard for VictoriaMetrics cluster.



It is recommended leaving the following amounts of spare resources:

50% of free RAM across all the node types for reducing the probability of OOM (out of memory) crashes and slowdowns during temporary spikes in workload.

50% of spare CPU across all the node types for reducing the probability of slowdowns during temporary spikes in workload.

At least 20% of free storage space at the directory pointed by `-storageDataPath` command-line flag at `vmstorage` nodes. See also -

`storage.minFreeDiskSpaceBytes` command-line flag description for `vmstorage`.

Increase free storage space and -

`storage.minFreeDiskSpaceBytes` to match at least the amount of data you plan to ingest in a calendar month: on each `vmstorage` pod, the monthly final deduplication process will temporarily need as much space as is used for the previous month's data, before it can free up space. For example, if you have a 3 month retention period and you want to keep at least 10 % space free at all times, you could pick 35 % of your total space as value. When some of your `vmstorage` pods are in read-only mode, the remaining pods will have a higher share of the total data ingestion, and will therefore need more free space the next month.

Some capacity planning tips for VictoriaMetrics cluster:

The replication increases the amounts of needed resources for the cluster by up to  $N$  times where  $N$  is replication factor. This is because `vminsert` stores  $N$  copies of every ingested sample on distinct `vmstorage` nodes. These copies are de-duplicated by `vmselect` during querying. The most cost-efficient and performant solution for data durability is to rely on replicated durable persistent disks such as Google Compute persistent disks instead of using the



replication at VictoriaMetrics level.

It is recommended to run a cluster with big number of small vmstorage nodes instead of a cluster with small number of big vmstorage nodes. This increases chances that the cluster remains available and stable when some of vmstorage nodes are temporarily unavailable during maintenance events such as upgrades, configuration changes or migrations. For example, when a cluster contains 10 vmstorage nodes and a single node becomes temporarily unavailable, then the workload on the remaining 9 nodes increases by  $1/9=11\%$ . When a cluster contains 3 vmstorage nodes and a single node becomes temporarily unavailable, then the workload on the remaining 2 nodes increases by  $1/2=50\%$ . The remaining vmstorage nodes may have no enough free capacity for handling the increased workload. In this case the cluster may become overloaded, which may result to decreased availability and stability.

Cluster capacity for active time series can be increased by increasing RAM and CPU resources per each vmstorage node or by adding new vmstorage nodes. Query latency can be reduced by increasing CPU resources per each vmselect node, since each incoming query is processed by a single vmselect node. Performance for heavy queries scales with the number of available CPU cores at vmselect node, since vmselect processes time series referred by the query on all the available CPU cores.

If the cluster needs to process incoming queries at a high rate, then its capacity can be increased by adding more vmselect nodes, so incoming queries could be spread among bigger number of vmselect nodes.

By default vminsert compresses the data it sends to vmstorage in order to reduce network bandwidth usage. The compression takes additional CPU resources at vminsert. If vminsert nodes have limited CPU, then the compression can be disabled by passing -rpc.disableCompression command-line flag at vminsert nodes.



By default vmstorage compresses the data it sends to vmselect during queries in order to reduce network bandwidth usage. The compression takes additional CPU resources at vmstorage. If vmstorage nodes have limited CPU, then the compression can be disabled by passing `-rpc.disableCompression` command-line flag at vmstorage nodes.  
See also resource usage limits docs.



這段文件中提到的「可以選擇設定為總空間的 **35%**」，是為了確保你在使用 `vmstorage` 時有足夠的「臨時可用空間」來處理每月一次的資料清除與壓縮（deduplication）過程。

## ✓ 怎麼推導出「35%」這個數字？

舉例來說，如果你：

- 資料保留（retention）設定為 3 個月（=90 天）
- 希望 **至少保留 10% 空間是永遠空的**（避免磁碟用滿）
- 每個月的資料大小差不多，例如：
  - 每月約用掉 30% 空間（因為 3 個月總共是 100%）

那麼你要預留的空間至少是：

10%（永遠保留） + 30%（本月將被清掉的資料，但清除前會先暫存在一個地方）  
= 40%

但因為壓縮、碎片化、read-only pod、資料傾斜等實際情況，官方建議 **35%** 是一個相對保守且合理的預留值。



## 💡 用更簡單的方式來理解

假設你有一台 `vmstorage` 節點，設定如下：

- 你打算保留資料 3 個月
- 每個月會寫入約 100GB 的資料
- 所以三個月大約會佔用 **300GB**

這時你該怎麼設定整體的磁碟大小呢？

## ✅ 正確做法：

你至少需要：

- **300GB (資料)**
- **+ 100GB (當月清理過程需要的暫存空間)**
- **+ 一點額外緩衝 (比如 10%)**

所以你應該準備大約：

**300 + 100 + 40 = 440GB**，也就是 **預留空間 140GB / 440GB ≈ 32%**

這個比例就非常接近官方建議的 **35%**。

## 📌 為什麼預留空間很重要？

因為當 `vmstorage` 清除資料時，它會：

1. 將要刪除的資料標記為「舊」
2. 產生新的壓縮檔案（同一時間還沒刪除舊的）
3. 再刪除原始的資料



這就意味著：在清除過程中，你會暫時使用兩倍的空間

## ✓ 小結：怎麼簡單估出你需要的空間？

你可以這樣算：

$$\text{總磁碟大小} = \text{保留期的資料大小} \times 1.35$$

例如：

若每月資料為 200GB，保留 3 個月：  
=>  $200\text{GB} \times 3 = 600\text{GB}$ （資料）  
=>  $600\text{GB} \times 1.35 \approx 810\text{GB}$ （磁碟總空間）

需要我幫你寫成一個小工具（Python script 或 Excel 計算表）來自動算嗎？或你想根據你現在的使用量來估算磁碟空間？



保留資料一年，每分鐘去重，這樣要留多少%空間，我想要理解%怎麼計算出來的用法，為了規劃vmstorage容量大小，你能教我嗎，或是你能給更簡單的範例：



當然可以！讓我們用 **更簡單的例子** 來拆解怎麼計算 **需要留多少%空間**，並且幫助你理解這個「%」是怎麼來的，進一步幫你估算 `vmstorage` 的總容量大小。



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## ✓ 你的條件

- 保留資料：一年（365天）
- 每分鐘資料會進行一次去重（= 會產生最終壓縮檔案）
- 想要知道：要留多少「額外磁碟空間」百分比 來處理 每月的去重、清理過程

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## ✓ 為什麼要預留磁碟空間？

VictoriaMetrics 在清理（去重）舊資料時會：

1. 暫時產生新的壓縮資料檔案（暫時多佔空間）
2. 清除原本的舊資料檔案（空間才會釋放出來）

所以它會需要一段時間「同時佔用兩份資料空間」。

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## ✓ 簡化範例：讓你更容易理解的「%怎麼來的」

假設：

- 一年總資料量 = **1TB**
- 每個月寫入資料量 =  $1\text{TB} \div 12 \approx \mathbf{83\text{GB}}$
- 保證「10% 空間永遠不使用」 → 100GB

那麼：



## 去重清理時，每月會這樣：

- 要處理並重新壓縮「上個月」的資料（83GB）
- 那這段期間，你會「暫時」多佔 83GB 空間
- 加上預留的 10% 空間（100GB）

## 所以你至少要保留：

100GB（永遠不動） + 83GB（每月清理時的暫存）  
= 183GB（額外空間）

換算成百分比：

$183\text{GB} \div 1000\text{GB} = 0.183 = \textbf{**18.3%**}$

## ✅ 那官方說的「35%」是怎麼來的？

這個是加上 **風險緩衝值**，比如：

- 某些 `vmstorage` pods 進入 read-only，其他 pod 得吃下更多寫入量
- 有些月資料暴增（節日、異常等）
- 檔案碎片化導致實際磁碟使用不均
- 多個月去重同時進行（像你說的：每分鐘都去重）

所以他們建議：

**一年資料使用空間 × 1.35 = 最保險的磁碟空間**





例如你寫入：

每天產生  $3\text{GB} \times 365 \approx 1.1\text{TB}$   
→ 建議磁碟容量： $1.1\text{TB} \times 1.35 \approx 1.5\text{TB}$   
→ 預留空間比率： $0.4\text{TB} / 1.5\text{TB} \approx 26.6\%$

所以這個「%」的計算方式就是這樣來的：

## ✅ 給你一個「公式」來套用（簡單記）

建議磁碟總容量 = 每月寫入量 × 保留月數 × 1.35

其中「1.35」是：

- 100% 為資料本身空間
- 10%~15% 預留 buffer
- 去重暫存空間（最多一個月的資料）

## 📌 結論整理

項目	意義
原始資料空間	寫入資料 × 保留月數
去重暫存空間	每月資料量（最多可能重複一份）



項目	意義
預留空間 %	約 10%~15% 作為 buffer
總空間需求 %	100% (資料) + 8% (去重) + 10% buffer $\approx$ <b>120%~135%</b>

## 要不要我幫你做一份 Excel 或 Python 計算工具？

你只要輸入「每天資料量」和「保留幾天」，我可以幫你自動算出建議的 vmstorage 容量和預留空間比例。這樣會更直覺！要的話我可以馬上做 👍