The Performance Paradox:
When Slower Code Doesn't Slow You Down

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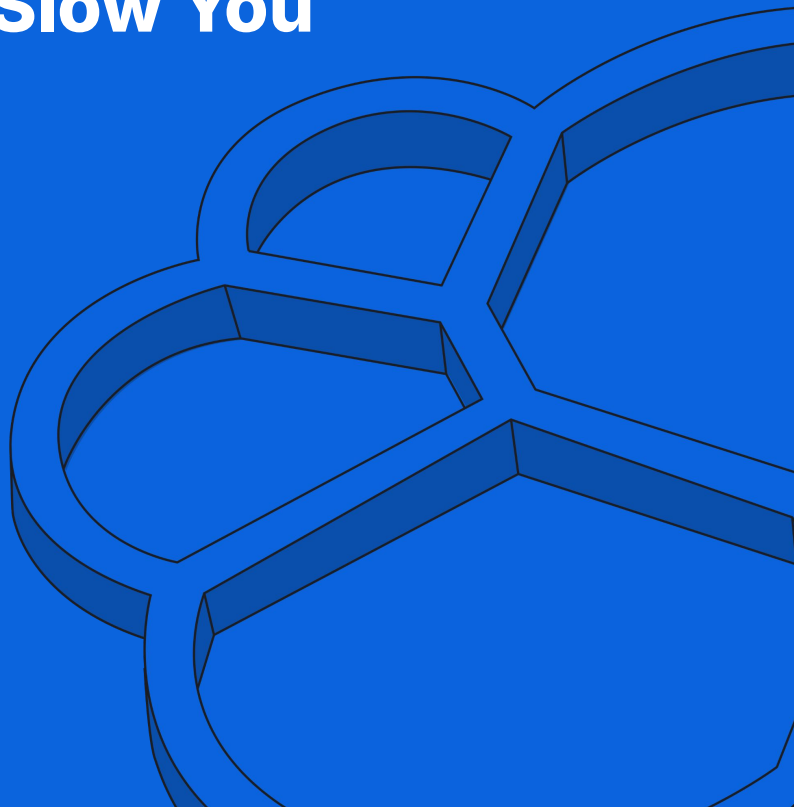
elastic | The Search AI Company



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Ingest GZIP-compressed logs

"The concatenation of a sequence of gzipped files is equivalent to the gzip of the concatenation of the sequence."

Go's compress/gzip docs

Ingest GZIP-compressed logs

in other words, read a GZIP files, decompress it and ingest the plain data

On-the-fly decompression: no need for extra storage or loading the whole file into memory

Supports offset tracking / partial reading: can resume if the file wasn't fully read. Only one in the market ;)

Identifies files by fingerprint of the decompressed data - can identify a file 1st seem as plain, then seem as a GZIP file

Integrity Check, checksum (CRC32) and size verification, happens at the end and just logs an error

Filebeat and Elastic Agent

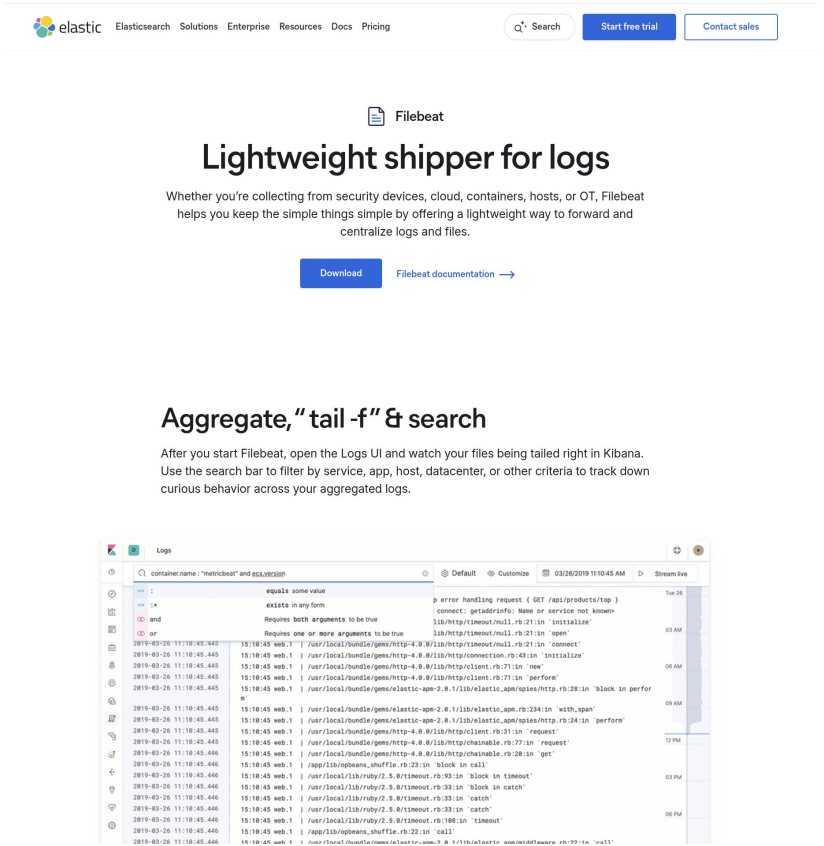
Filebeat

Filebeat is a lightweight shipper for logs

“Whether you’re collecting from security devices, cloud, containers, hosts, or OT, Filebeat helps you keep the simple things simple by offering a lightweight way to forward and centralize logs and files.”

It’s the application which actually does the heavy lifting: reading, processing and shipping the logs to Elasticsearch or to other storages ot for further processing.

The Elastic Agent configures and runs a filebeat under the hood. So new features for log collection are, mostly, developed on Filebeat and the agent just needs to configure/enable them.

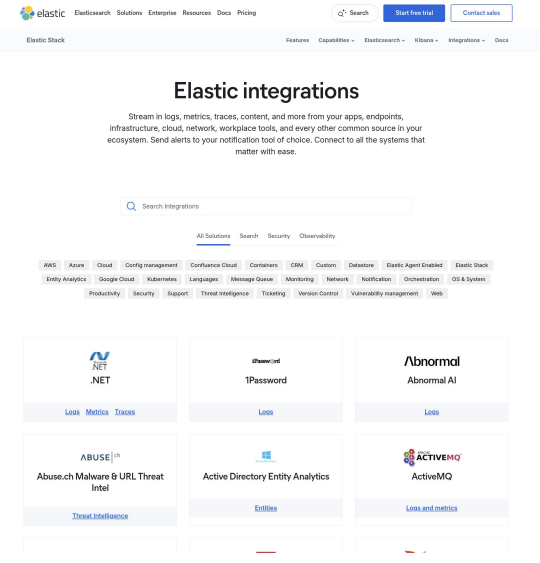


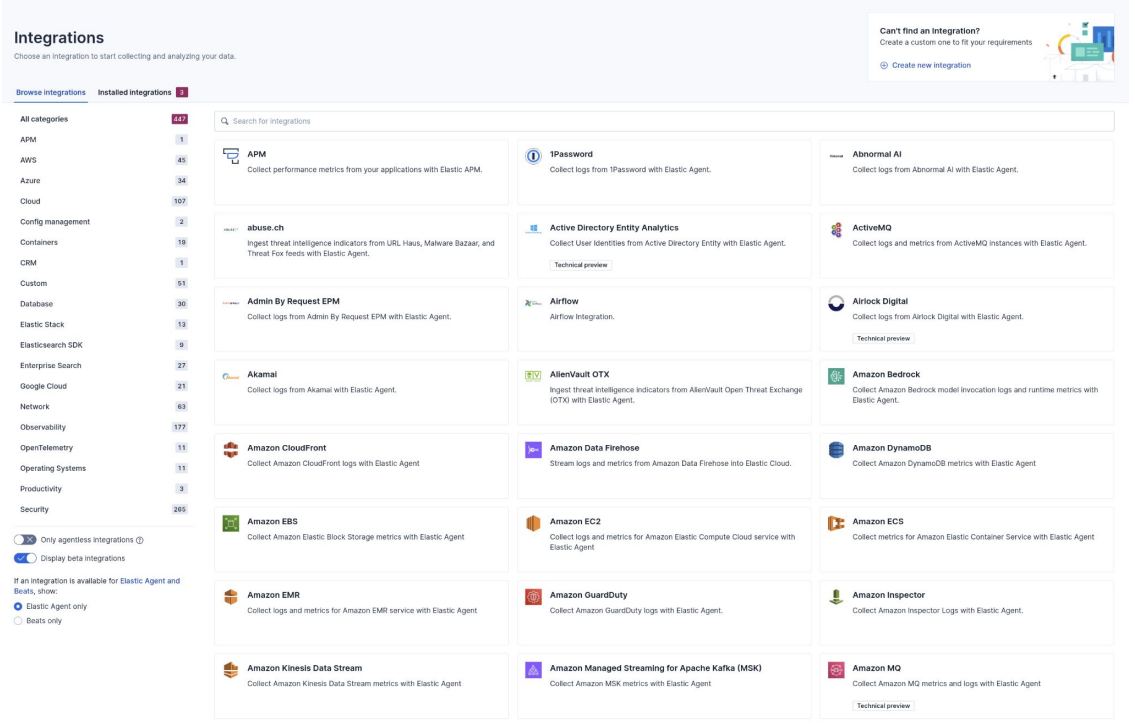
Elastic Agent: all in “one”

*“**Elastic Agent** is a single, unified way to add monitoring for logs, metrics, and other types of data to a host.”*

The Elastic Agent, or “agent” as we say, is a centrally managed, easy to deploy and configure solution.

Users use integrations to configure it to observe and protect all sorts of endpoints.





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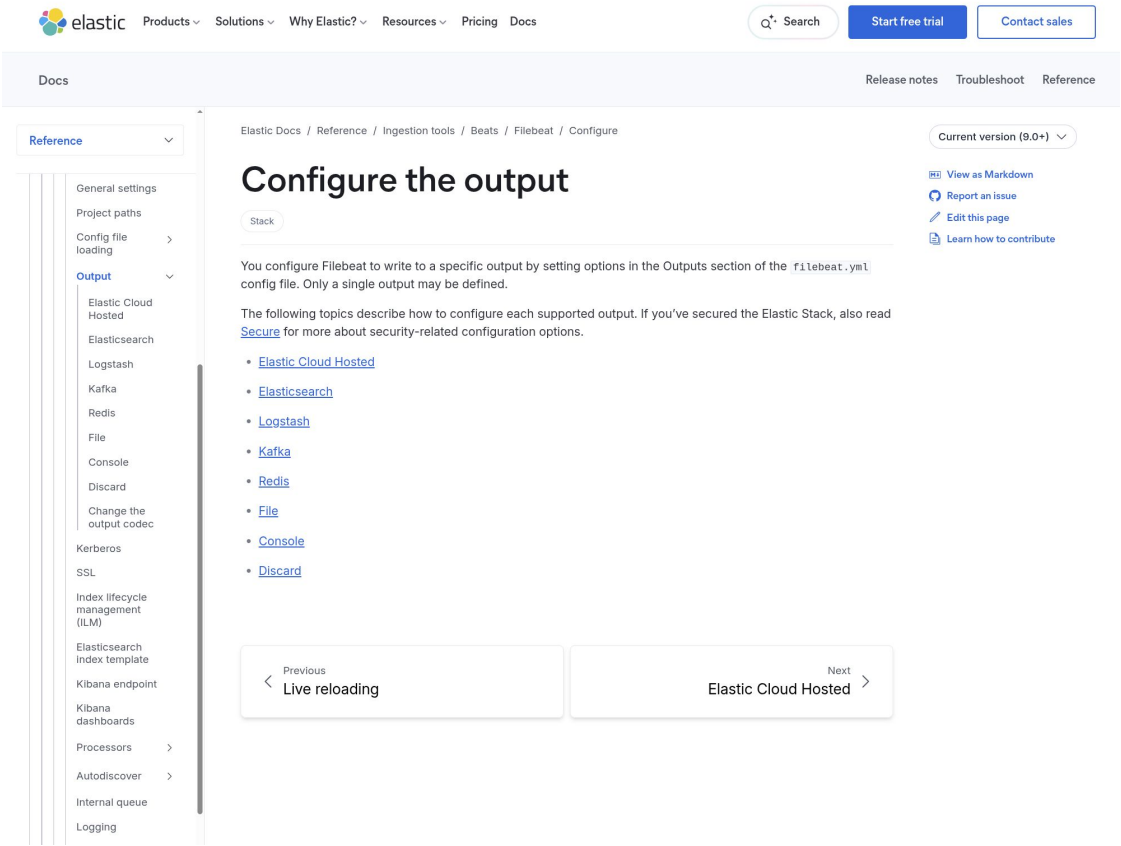
Filebeat inputs: it reads data from

- AWS CloudWatch
- AWS S3
- Azure Event Hub
- Azure Blob Storage
- Benchmark
- CEL
- Cloud Foundry
- CometD
- Container
- Entity Analytics
- ETW
- ***filestream***
- GCP Pub/Sub
- Google Cloud Storage
- HTTP Endpoint
- HTTP JSON
- journald
- Kafka
- Log (deprecated in 7.16.0, use filestream)
- MQTT
- NetFlow
- Office 365 Management Activity API
- Redis
- Salesforce
- Stdin
- Streaming
- Syslog
- TCP
- UDP
- Unified Logs
- Unix
- winlog

Filebeat outputs: it sends data to

- Elastic Cloud Hosted
- Elasticsearch
- Logstash
- Kafka
- Redis
- File
- Console
- Discard



Development process

Reading GZIP files

Development workflow

```
filebeat.inputs:
  - type: filestream
    id: "test-filestream"
    paths:
      - /var/some-app/app.log*
    gzip_experimental: true
```

RFC + PoC: ensure it’s viable

Development, testing and review

Merge → Further tests on CI

Benchmark and final review

Benchmarks

We have two different types of benchmark

End-to-end

We have a internal too called “benchbuilder” to perform end-to-end test of the beats (filebeat, metricbeat, and so on) and the Elastic Agent.

It focus on user experience, using events per second (EPS) as its key metric

More complex and requires extensive setup

Go / micro-benchmarks

Regular Go benchmarks, testing a function or small component to access a new implementation is indeed better or we aren’t degrading performance with new features or refactors

Easy and cheap to develop and run

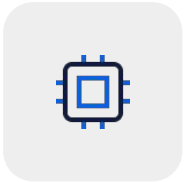
What we want to measure?

- many small files 1000s of 10MB files (Kubernetes log rotation)

- 1 huge file, several GBs (ensure it can work with files larger than the memory available)

Is is slower, the same or faster?

EPS:
Events per second



How much does this increase the system load:

CPU usage

What's the new memory footprint?

Memory usage

Common sense: A Clear Trade-Of

Decompression = CPU Work

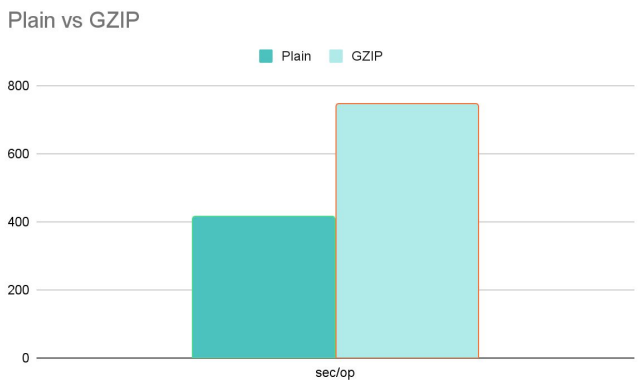
More CPU Work = Slower Performance

Slower reading ⇒ Events Per Second (EPS) will be reduced

PoC benchmarks

Before starting developing the feature we wanted to make sure it was viable

```
❯ benchstat plain.mac.out gzip.mac.out
goos: darwin
goarch: arm64
pkg: github.com/elastic/beats/v7/filebeat/input/filestream
cpu: Apple M1 Max
                           | plain.mac.out |             gzip.mac.out              |
                           |    sec/op     |    sec/op     vs base                 |
Gzip/static-line/1.0_MB-10     12.27m ± 1%    14.78m ± 0%   +20.54% (p=0.000 n=10)
Gzip/static-line/5.2_MB-10     60.05m ± 1%    72.95m ± 0%   +21.48% (p=0.000 n=10)
Gzip/static-line/26_MB-10      300.0m ± 0%    362.5m ± 0%   +20.82% (p=0.000 n=10)
Gzip/static-line/52_MB-10      598.0m ± 0%    723.1m ± 0%   +20.92% (p=0.000 n=10)
Gzip/static-line/105_MB-10      1.199 ± 0%     1.450 ± 2%   +20.90% (p=0.000 n=10)
Gzip/static-line/262_MB-10      3.010 ± 0%     3.616 ± 1%   +20.15% (p=0.000 n=10)
Gzip/static-line/524_MB-10      6.162 ± 0%     7.236 ± 0%   +17.42% (p=0.000 n=10)
Gzip/static-line/1.0_GB-10      12.05 ± 0%     14.53 ± 0%   +20.53% (p=0.000 n=10)
Gzip/random-line/1.0_MB-10     4.890m ± 0%   13.017m ± 0%  +166.18% (p=0.000 n=10)
Gzip/random-line/5.2_MB-10     23.86m ± 0%    63.93m ± 0%  +167.94% (p=0.000 n=10)
Gzip/random-line/26_MB-10      119.7m ± 0%    321.3m ± 0%  +168.47% (p=0.000 n=10)
Gzip/random-line/52_MB-10      240.5m ± 0%    643.9m ± 0%  +167.69% (p=0.000 n=10)
Gzip/random-line/105_MB-10     481.5m ± 0%   1287.3m ± 0%  +167.38% (p=0.000 n=10)
Gzip/random-line/262_MB-10      1.204 ± 0%     3.220 ± 0%  +167.50% (p=0.000 n=10)
Gzip/random-line/524_MB-10      2.411 ± 0%     6.423 ± 0%  +166.46% (p=0.000 n=10)
Gzip/random-line/1.0_GB-10      4.828 ± 0%    13.047 ± 2%  +170.21% (p=0.000 n=10)
geomean                        415.9m         746.6m        +79.49%
```



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Reading GZIP files
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    gzip_experimental: true
```

~~RFC + PoC: ensure it's viable~~

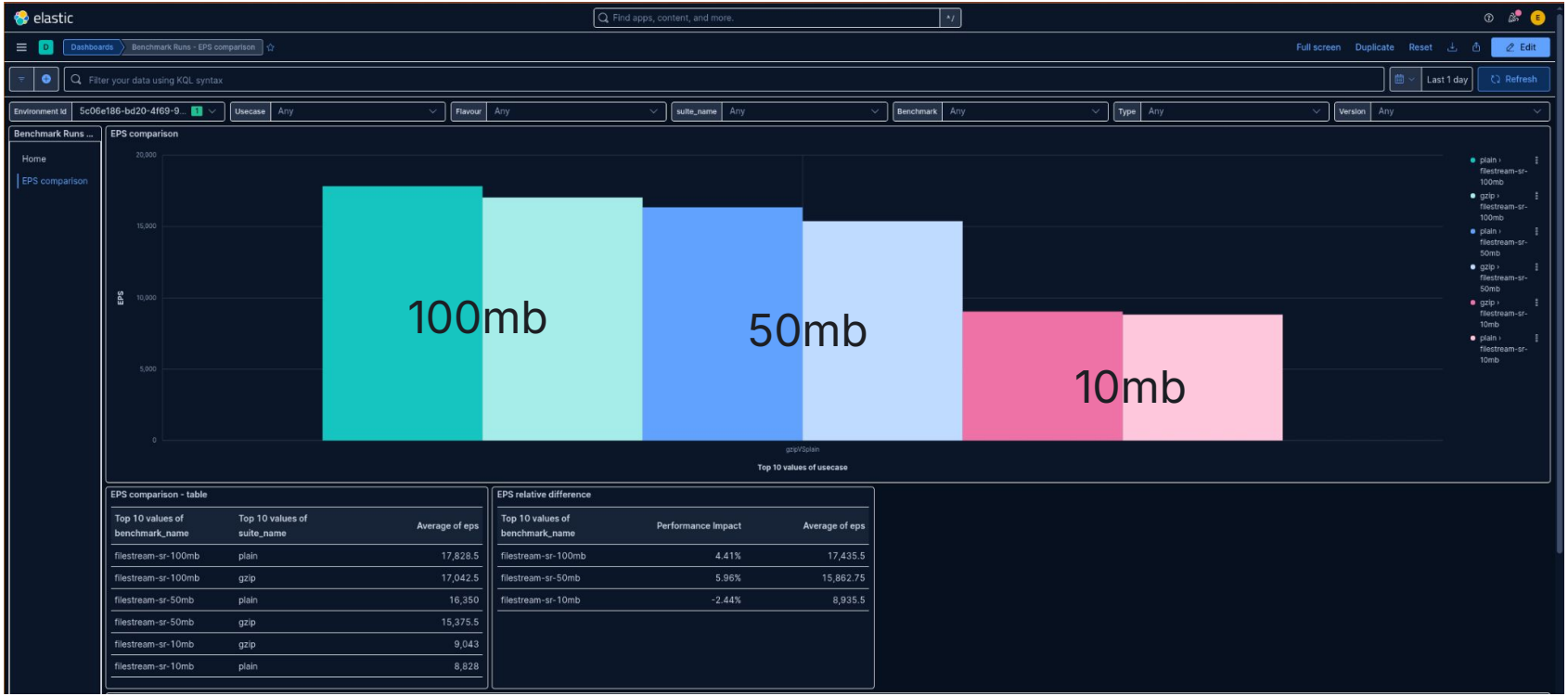
~~Development, testing and review~~

~~Merge -> Further tests on CI~~

Benchmark and final review

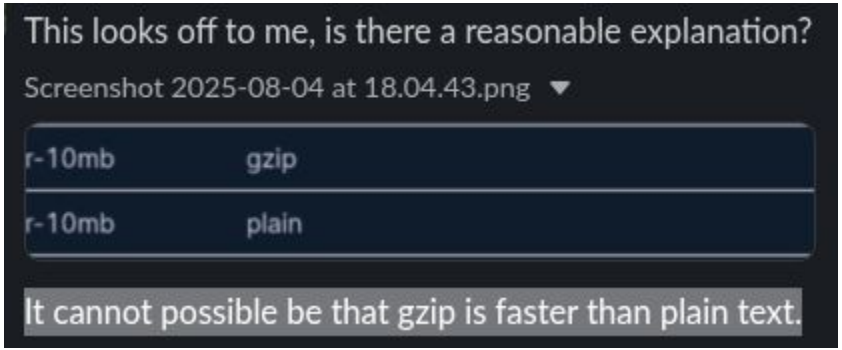
Benchmarks

1st EPS comparison



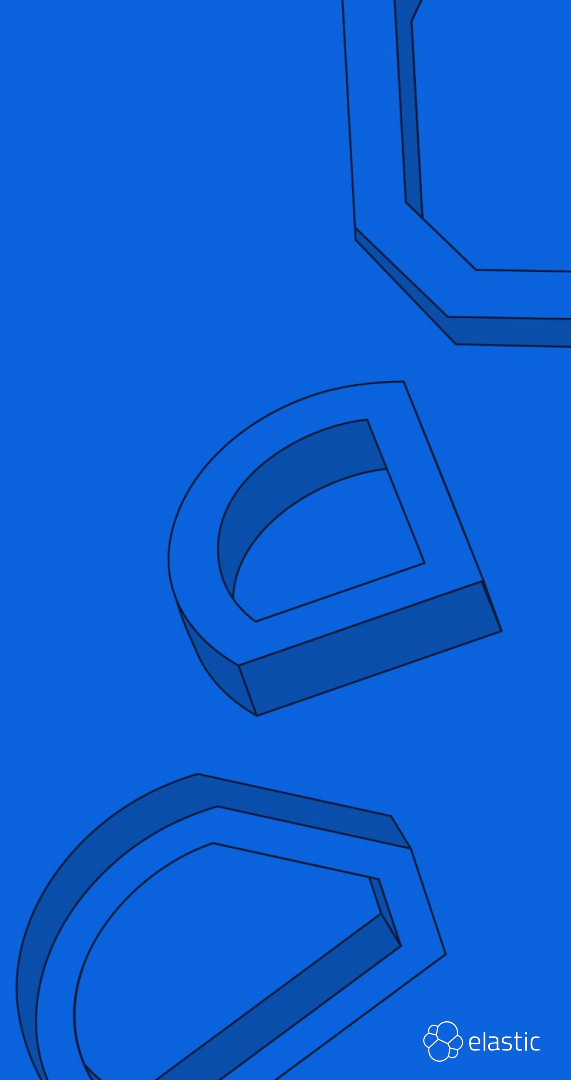
Small difference between EPS output

Odd, GZIP was faster. WHY?!

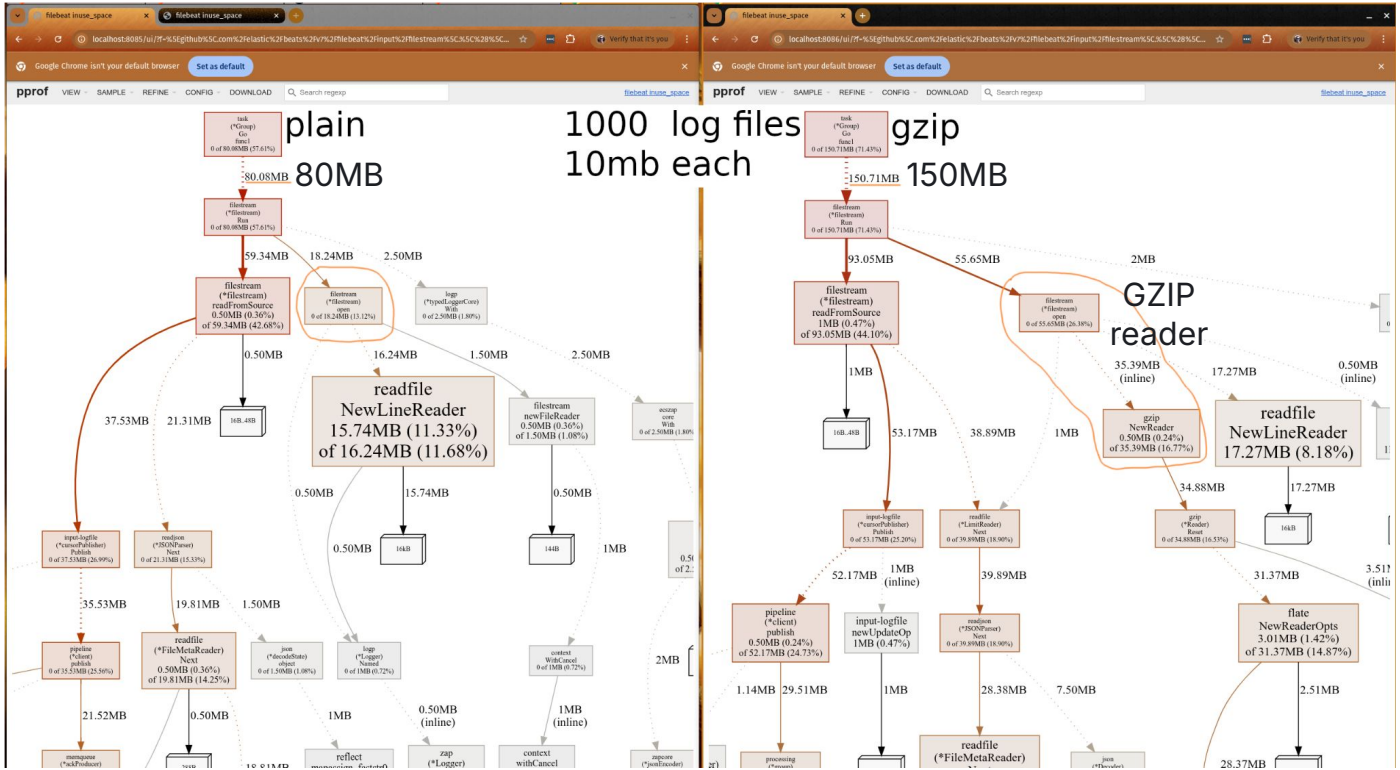


filestream-sr-10mb	gzip	9,043
filestream-sr-10mb	plain	8,828

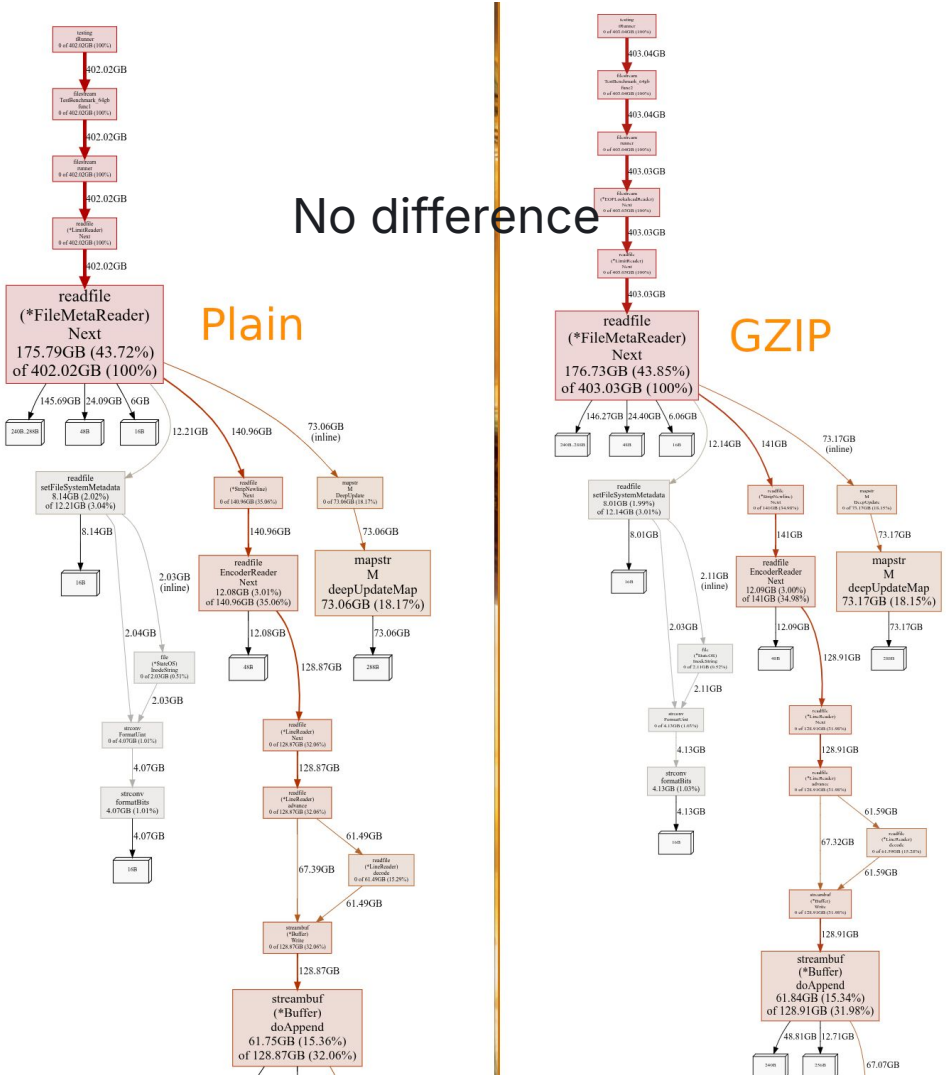
Memory analysis:
Go benchmark



Memory usage: 1000×10MB file



Memory usage: 1×64GB file



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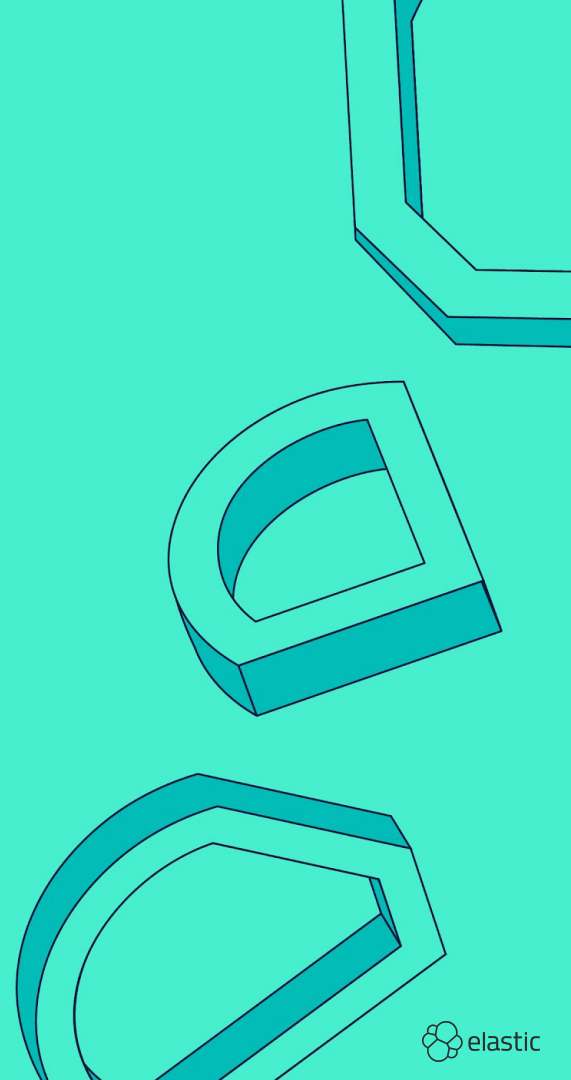
Memory usage: conclusion

- 100Kb increase in memory usage per file.

Mitigation:

- **limiting the number of files read concurrently**. On Filebeat terms, limit the number of *harvesters*.
- **closing files as soon as then end is reached**. It's the behaviour for GZIP files as no data should be appended to them.

CPU usage:
Go benchmark



CPU usage

Just as for the memory benchmarks:

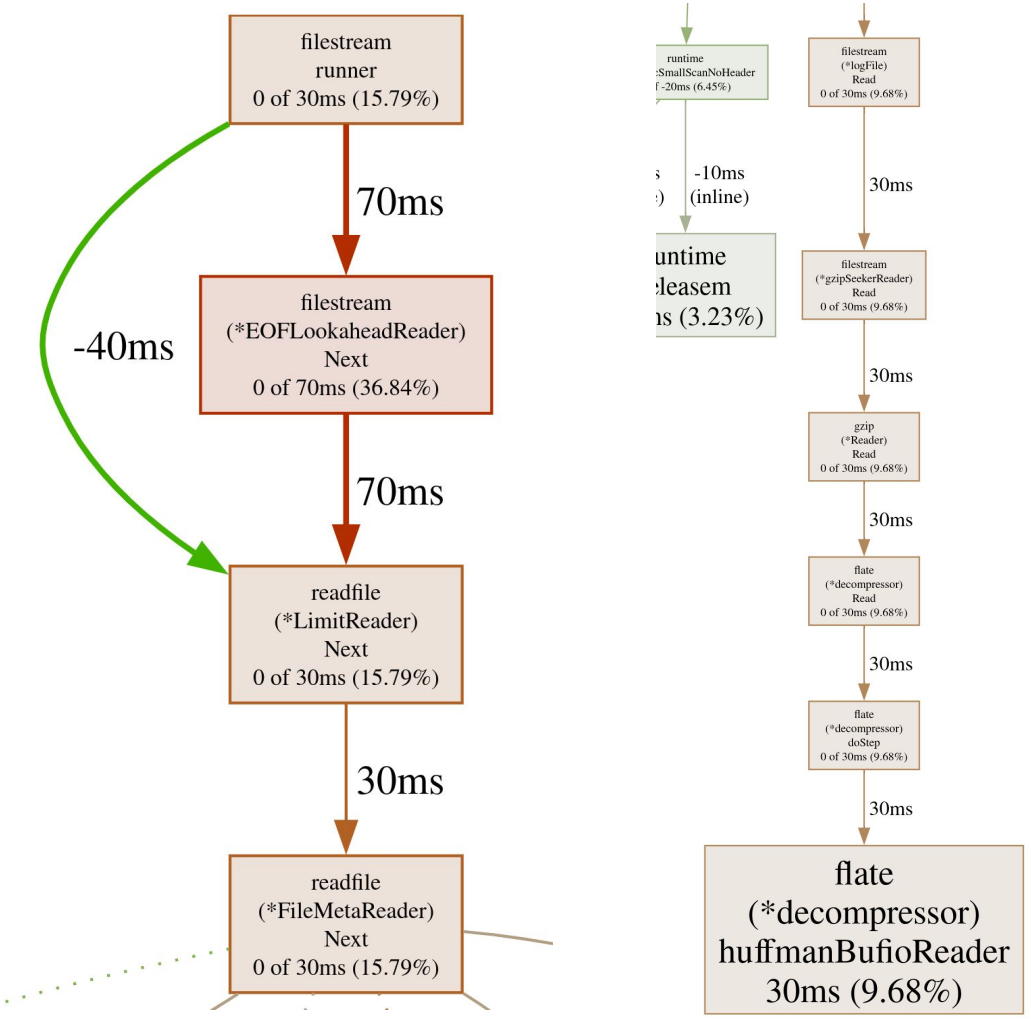
A local benchmark was conducted to evaluate the file reading process in isolation.

This test instantiated the reader abstraction used by filestream, excluding overhead from other Filebeat components like processors and outputs.

We see a increase in CPU usage if we look only at reading the files.

```
go test -v -run TestBenchmark_64gb -timeout=0
=== RUN   TestBenchmark_64gb
=== RUN   TestBenchmark_64gb/plain
=== RUN   TestBenchmark_64gb/gzip
--- PASS: TestBenchmark_64gb (1130.28s)
    --- PASS: TestBenchmark_64gb/plain (251.57s)
    --- PASS: TestBenchmark_64gb/gzip (329.39s)
PASS
```

CPU profile



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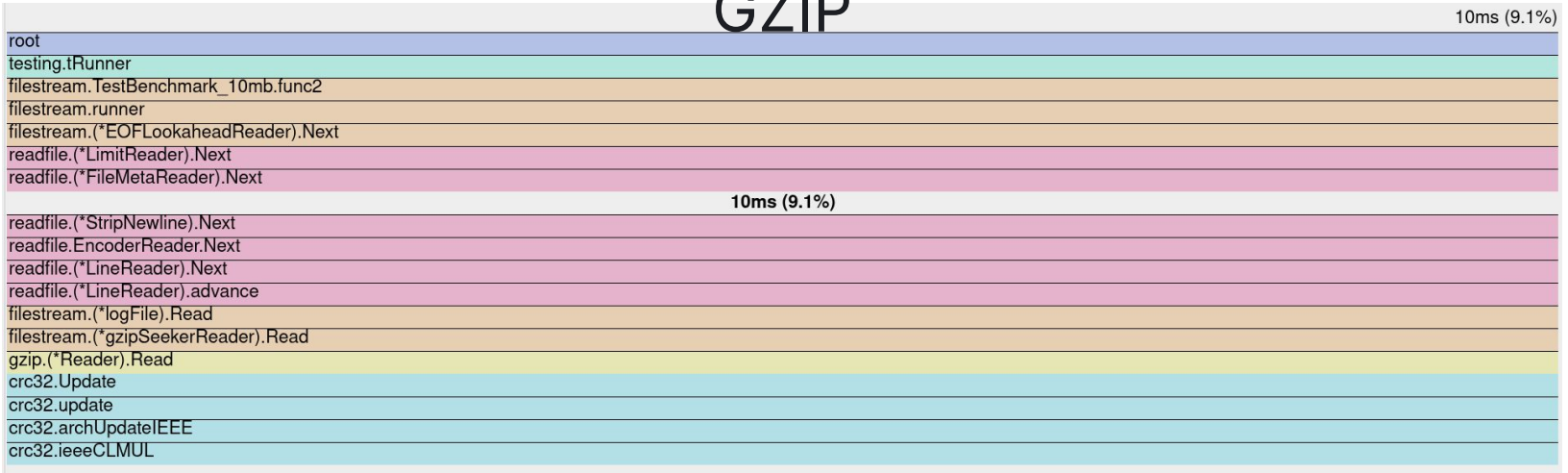
CPU profile

Plain

GZIP



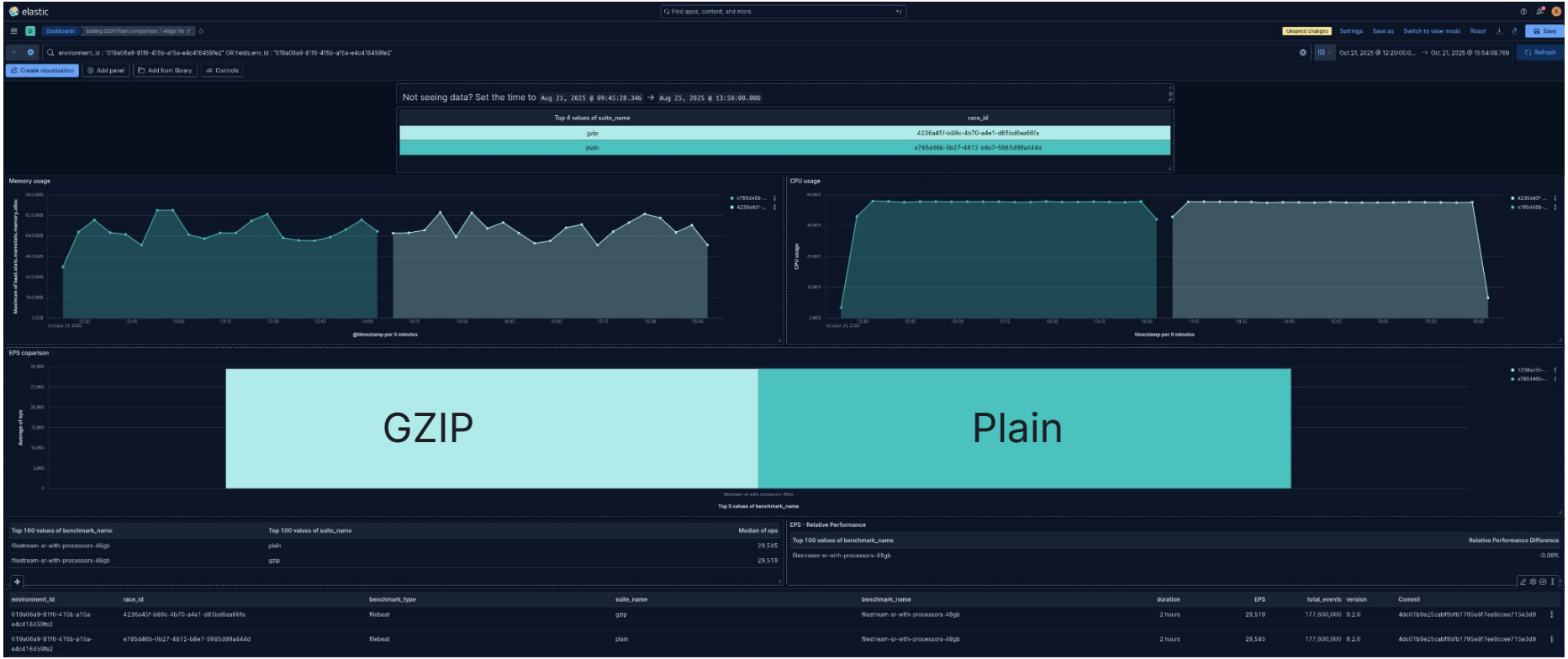
CPU usage: conclusion

- Increase due to the *EOFLookaheadReader* - signals EOF for GZIP files

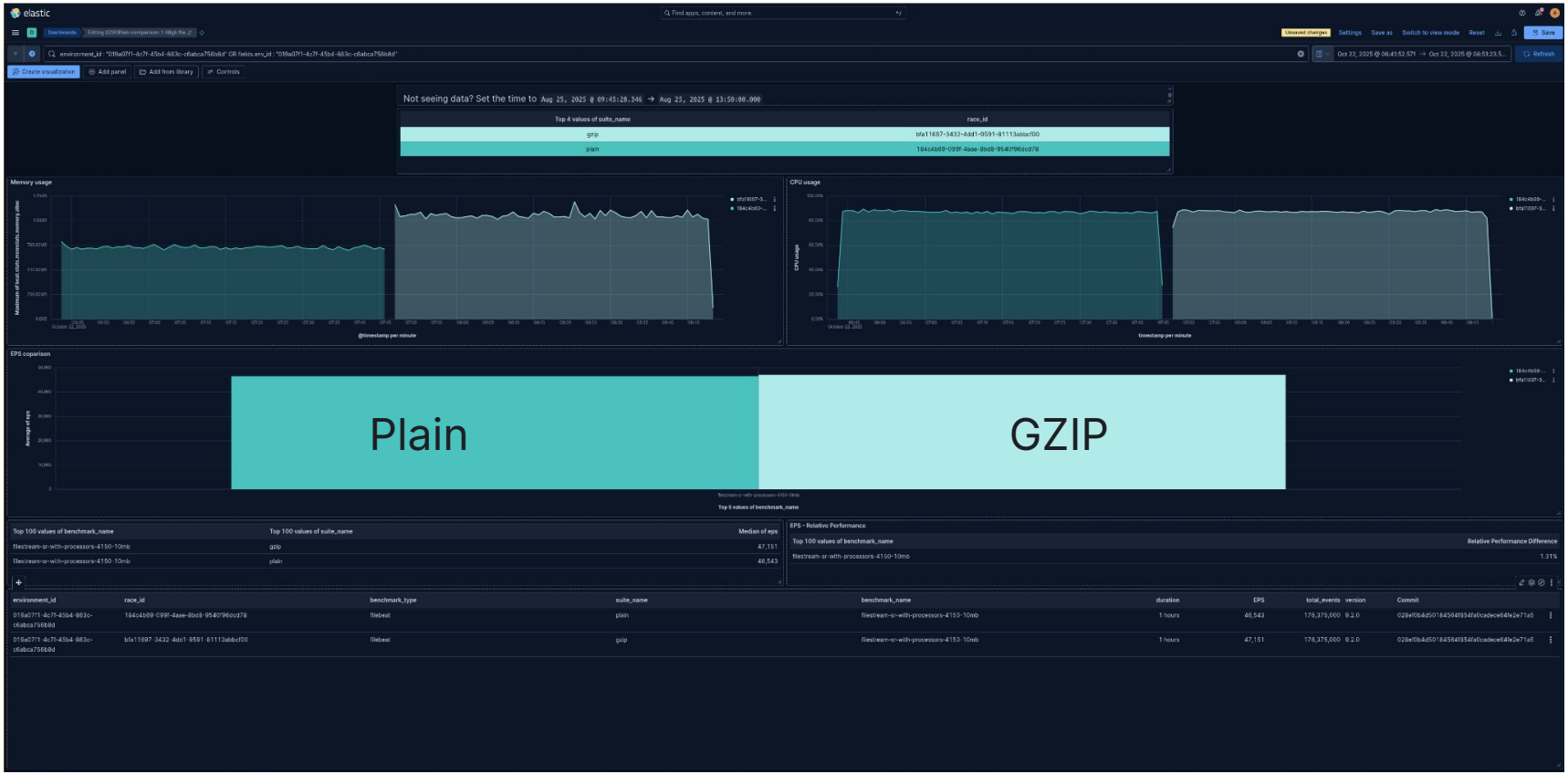
- Decompression also increases CPU usage what a surprise!
- Decompression isn’t really expensive

Final end-to-end benchmarks

1 × 48GB file


elastic
Not seeing data? Set the time to Aug 25, 2025 @ 09:45:28.346 → Aug 25, 2025 @ 13:50:00.000
Top 4 values of suite_name
race_id
gzip
4236a45f-b89c-4b70-a4e1-d85bd6ea66fa
plain
e785d46b-0b27-4812-b8e7-5985d99a444d
Memory usage
CPU usage
@timestamp per 5 minutes
timestamp per 5 minutes
EPS coparison
GZIP
Plain
Top 5 values of benchmark_name
Top 100 values of benchmark_name
Top 100 values of suite_name
Median of eps
filestream-sr-with-processors-48gb
plain
29,545
filestream-sr-with-processors-48gb
gzip
29,519
EPS - Relative Performance
Top 100 values of benchmark_name
Relative Performance Difference
filestream-sr-with-processors-48gb
-0.09%
environment_id
race_id
benchmark_type
suite_name
benchmark_name
duration
EPS
total_events
version
Commit
019a06a9-81f6-415b-a15a-e4c416459fe2
4236a45f-b89c-4b70-a4e1-d85bd6ea66fa
filebeat
gzip
filestream-sr-with-processors-48gb
2 hours
29,519
177,600,000
9.2.0
4dc01b9e25cabf9bfb1795e8f7ee8ccae715e3d9
019a06a9-81f6-415b-a15a-e4c416459fe2
e785d46b-0b27-4812-b8e7-5985d99a444d
filebeat
plain
filestream-sr-with-processors-48gb
2 hours
29,545
177,600,000
9.2.0
4dc01b9e25cabf9bfb1795e8f7ee8ccae715e3d9

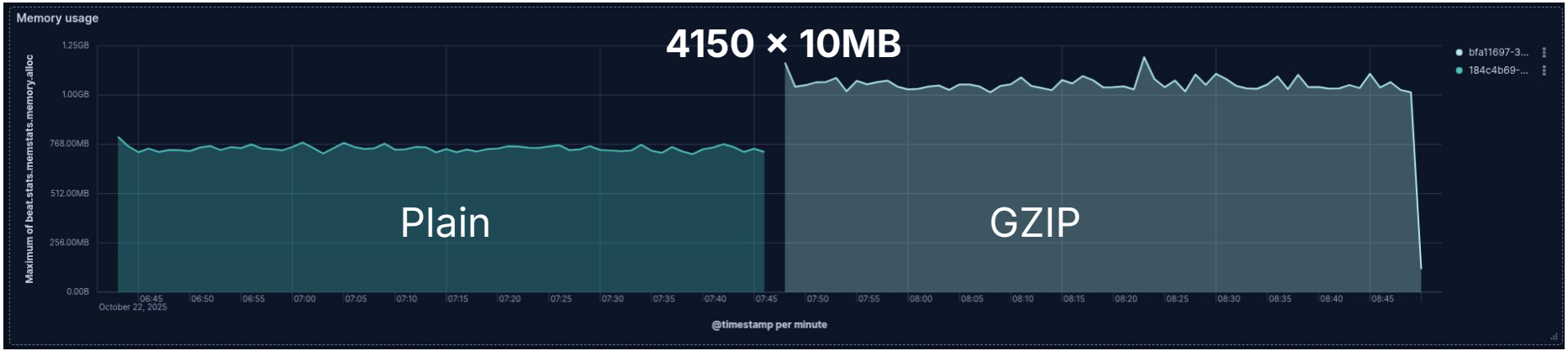
4150 × 10MB files



CPU usage

elastic

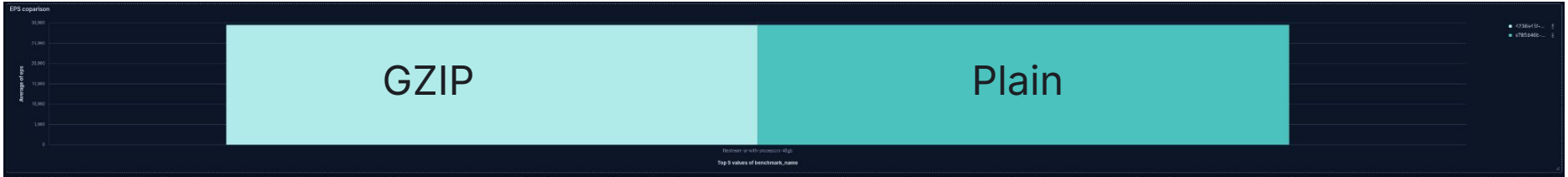
Memory usage



elastic

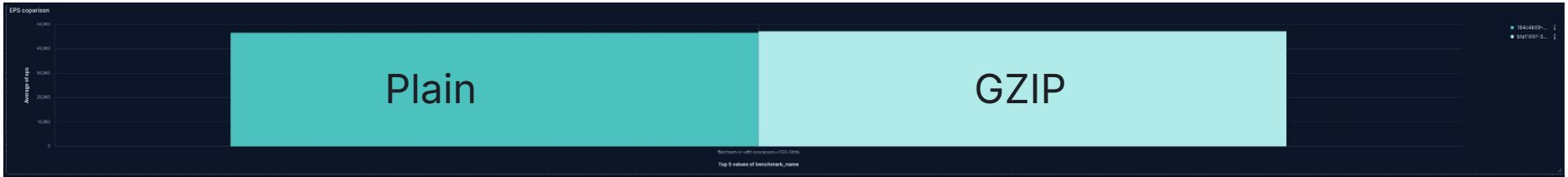
EPS comparison

1 × 48 GB



Top 100 values of benchmark_name	Top 100 values of suite_name	Median of eps
filestream-sr-with-processors-48gb	plain	29,545
filestream-sr-with-processors-48gb	gzip	29,519

4150 × 10MB



Top 100 values of benchmark_name	Top 100 values of suite_name	Median of eps
filestream-sr-with-processors-4150-10mb	gzip	47,151
filestream-sr-with-processors-4150-10mb	plain	46,543

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EPS comparison

1 × 48 GB

EPS - Relative Performance

Top 100 values of benchmark_name	Relative Performance Difference
filestream-sr-with-processors-48gb	-0.09%

environment_id	race_id	benchmark_type	suite_name	benchmark_name	duration	EPS	total_events	version	Commit
019a06a6-61f6-415b-a15a-e4c416459fe2	4236a45f-b80c-4b70-a4e1-d85bd6ea66fa	filebeat	gzip	filestream-sr-with-processors-48gb	2 hours	29,519	177,600,000	9.2.0	4dc01bf6e25cabf8bfb1795a8f7ee6ccee715e3d9
019a06a6-61f6-415b-a15a-e4c416459fe2	e785d6fb-0b27-4812-b8a7-5985d99a444d	filebeat	plain	filestream-sr-with-processors-48gb	2 hours	29,545	177,600,000	9.2.0	4dc01bf6e25cabf8bfb1795a8f7ee6ccee715e3d9

4150 × 10MB

EPS - Relative Performance

Top 100 values of benchmark_name	Relative Performance Difference
filestream-sr-with-processors-4150-10mb	1.31%

environment_id	race_id	benchmark_type	suite_name	benchmark_name	duration	EPS	total_events	version	Commit
019a07f1-4c7f-45b4-863c-c8aaca756b8d	184c4b69-099f-4aae-8bd8-9540f9fdcd78	filebeat	plain	filestream-sr-with-processors-4150-10mb	1 hours	46,543	176,375,000	9.2.0	028ef0b4e50184564f854fa0cadece64fa2e71a5
019a07f1-4c7f-45b4-863c-c8aaca756b8d	bfa11697-3432-4dd1-9591-81113abbcf00	filebeat	gzip	filestream-sr-with-processors-4150-10mb	1 hours	47,151	176,375,000	9.2.0	028ef0b4e50184564f854fa0cadece64fa2e71a5

Understanding Filebeat

In a nutshell: How Filebeat works?

Filebeat, reads the data (the logs), process it, then ships it away

Input: filestream

Monitor the file system, find log files, read the files, keep track of current offset for each file, transform each log into filebeat's internal model

Pipeline / Queue

Apply configurable processors which can do all sorts of transformations such as add, remove fields, JSON parsing and field expansion and so on.

Output

Send out the events (the logs). Usually Elasticsearch, but also Logstash, Kafka, Redis and so on.

In a nutshell: How filestream works?

How logs are ingested

File watcher

The file watcher scans the file system every 10s (configurable) to detect:

- new files
- data appended to a file
- a file is truncated
- a file is deleted

For each, an event is sent

Prospector

For each event, it decides if a harvester should:

- start
- stop
- continue
- restart (reset the offset to 0 and start from the beginning)

Harvester

Actually reads the files.

Reads one line at a time and can produce a single event (log) from multiple lines

Publisher

Sends the event to the Pipeline for further processing

In a nutshell: How filestream works?

How logs are ingested

Pipeline

Passes the events through the processor list in order.

Output

Sends out the event to permanent storage or for further processing

Ack

The output acknowledges the event was published (or dropped). The input updates its offset. So when filebeat restarts, it knows the last line it read and picks up from there.

Registry

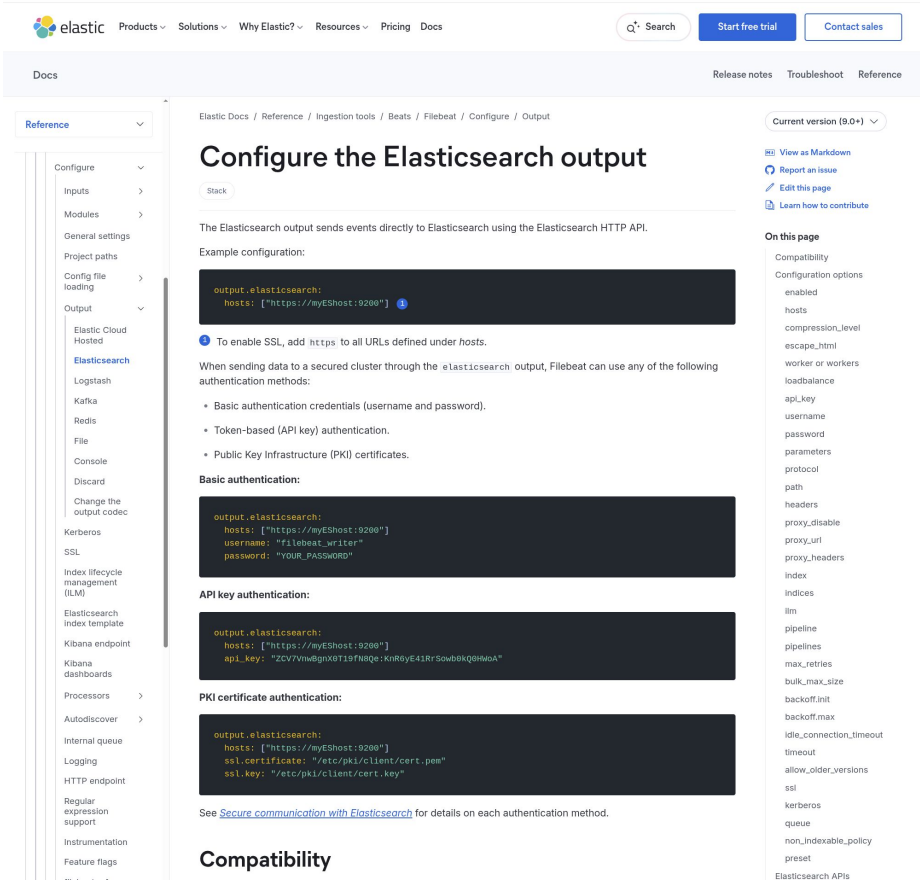
Updates the on the persistent store the current state for each file

Output: shipping data over the network

Sending data over the network adds overhead for sure. Also the Elastic Agent and beats support different output which each one will have its own performance and limitations.

We have a discard output, which, immediately discards any data it receives, allowing us to minimise the impact of sending data and develop without any extra setup.

Benchbuilder does not supports it, but local tests showed it did not affect the performance of ingesting *plain* or *gzip* files.

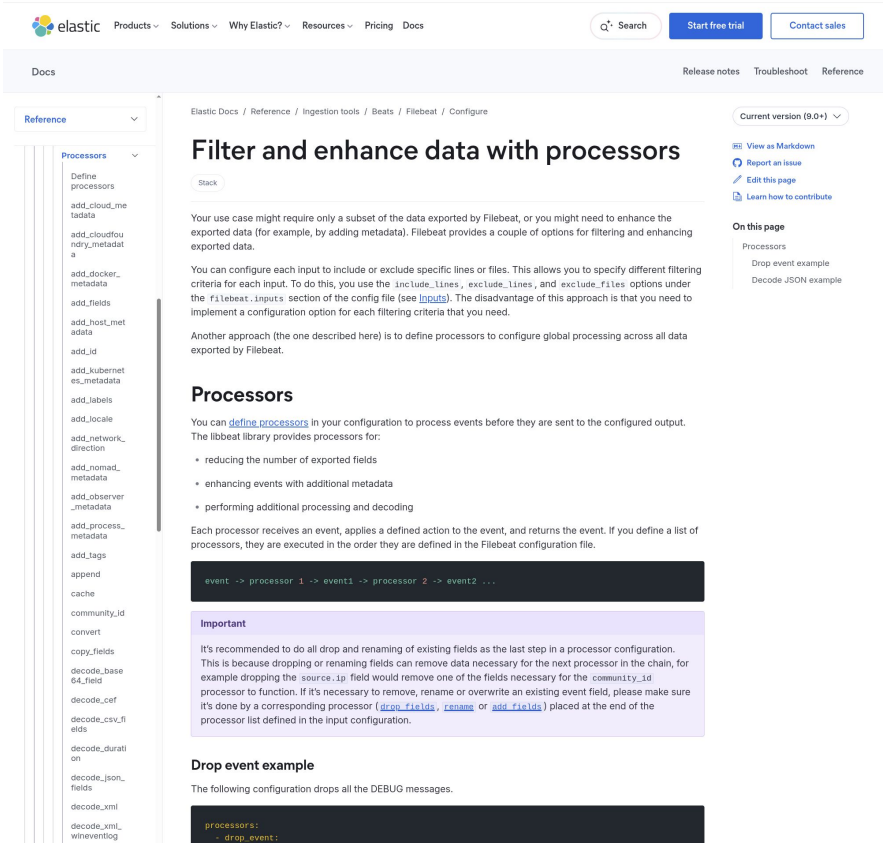


Processors: impact on overall performance

Logs, or events as we call them, go one by one from the input to the pipeline. Passing by each processor in sequence.

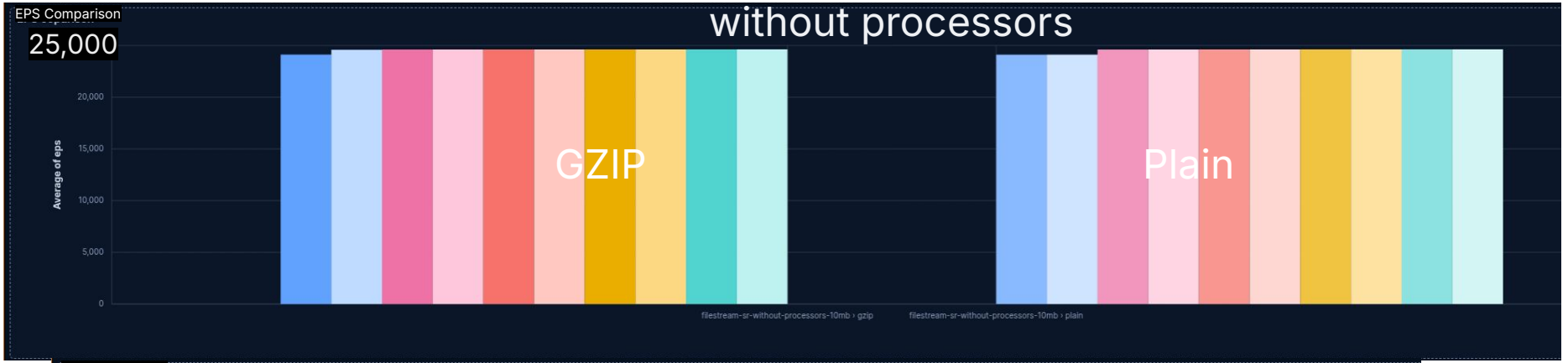
One guarantee we give is if a processor fails, we can still deliver the original event this processor received. All further processors are ignored.

Processors which perform destructive actions must work on a copy of the event, allowing to “rollback” on error.



Remove the processors

EPS comparison



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Remove the processors

Top 100 values of benchmark_name	Top 100 values of suite_name	Median of eps
filestream-sr-without-processors-100mb	plain	35,448
filestream-sr-without-processors-100mb	gzip	35,240
filestream-sr-without-processors-10mb	plain	24,618.5
filestream-sr-without-processors-10mb	gzip	24,615.5
filestream-sr-with-processors-10mb	plain	19,679
filestream-sr-with-processors-10mb	gzip	19,657.5
filestream-sr-with-processors-100mb	plain	19,438
filestream-sr-with-processors-100mb	gzip	19,414

EPS - Relative Performance

Top 100 values of benchmark_name	Relative Performance Difference
filestream-sr-with-processors-100mb	0.03%
filestream-sr-with-processors-10mb	-0.39%
filestream-sr-without-processors-100mb	-0.43%
filestream-sr-without-processors-10mb	0.19%

Conclusion

- Reading GZIP files is slower than reading plain files
- However, it does not affect Filebeat/Elastic Agent performance
- The bottleneck is the queue/pipeline
- There is a ~100KB memory increase per file read
- No CPU increase in the overall performance

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Questions?

Thank you!

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