

Physical streaming replication compression test

Test configuration

3 host: PostgreSQL master, PostgreSQL standby replica, pg_restore client host

PostgreSQL master host specs

24 CPU cores / 72 GB RAM / 1.2 TB SSD storage / Ubuntu 20.04.2 LTS

PostgreSQL replica host specs

8 CPU cores / 16 GB RAM / 1.2 TB SSD storage / Ubuntu 20.04.2 LTS

pg_restore client host

8 CPU cores / 16 GB RAM / 1.2 TB SSD storage / Ubuntu 20.04.2 LTS

PostgreSQL additional settings

max_connections = 1000
shared_buffers = 4GB
effective_cache_size = 12GB
maintenance_work_mem = 1GB
checkpoint_completion_target = 0.7
wal_buffers = 16MB
default_statistics_target = 100
random_page_cost = 1.1
effective_io_concurrency = 200
work_mem = 1048kB
min_wal_size = 1GB
max_wal_size = 4GB
max_worker_processes = 8
max_parallel_workers_per_gather = 4
max_parallel_workers = 8
max_parallel_maintenance_workers = 4

pg_restore configuration

pg_restore -j16 -d \ "host=**master host** dbname=testdb port=5432 user=testuser\" dump

dump: <https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/2QYZBT>

Tested scenarios

Compression approaches

uncompressed

no compression used for replication connection between master and replica

chunked

use streaming compression, wrap compressed data into CompressedData messages and preserve compression context between multiple CompressedData messages.

chunked-reset

use streaming compression, wrap compressed data into CompressedData messages and reset compression context on each CompressedData message.

permanent

use streaming compression, send raw compressed stream without any wrapping

Tested compression levels

ZSTD, level 1

ZSTD, level 5

ZSTD, level 9

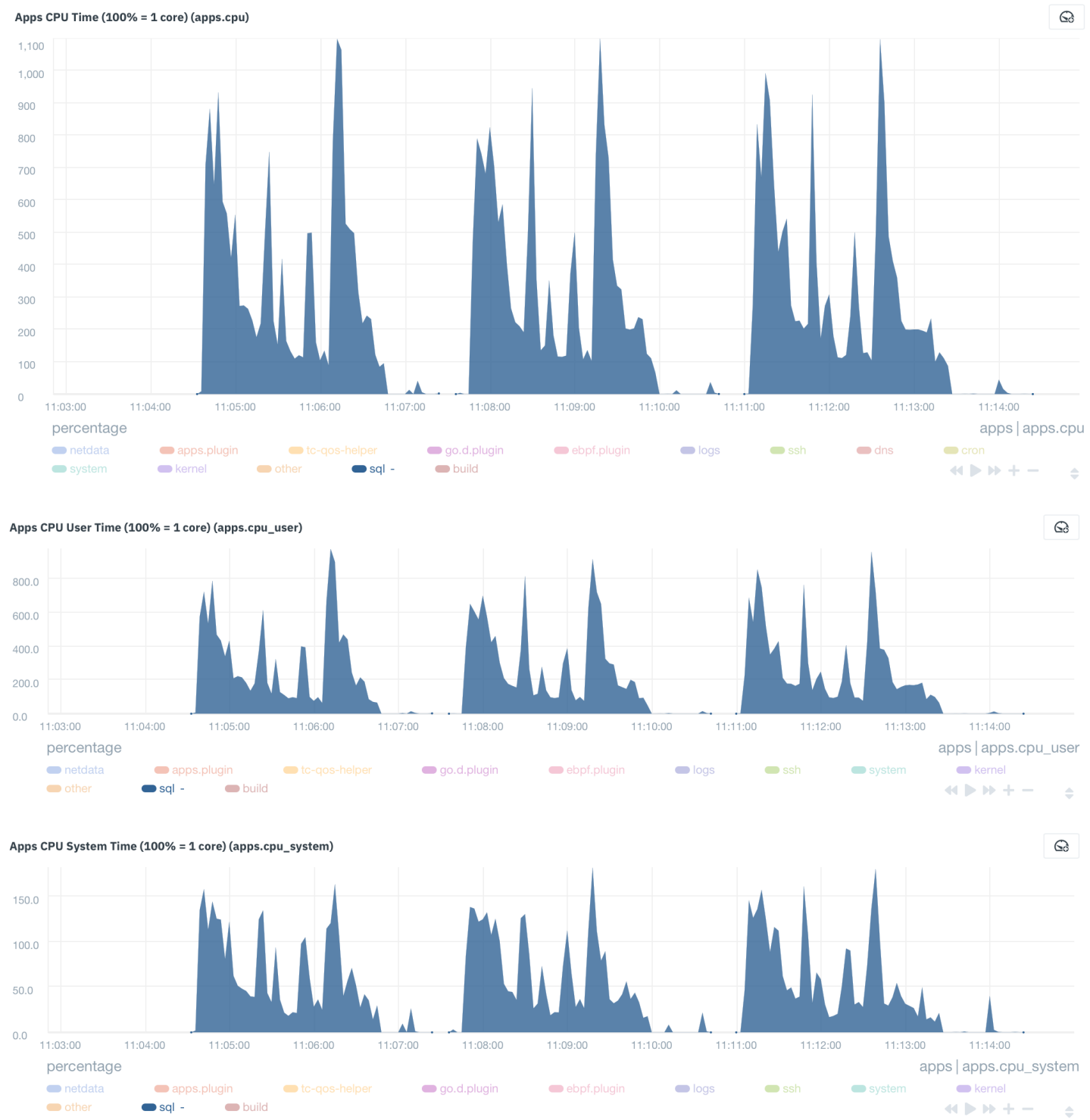
Test results (summary)

scenario	replica rx, MB	replica rx, mean, MB	replica rx, sample standard deviation, MB	CompressedData messages sent, count	estimated message header overhead, MB
uncompressed	6681 6688 6682	6683.6	3.78	n/a	n/a
ZSTD, level 1					
chunked-reset	2725 2718 2735	2726	8.54	53328 53366 53281	0.25
chunked	2691 2695 2696	2694	2.64	53296 53361 53317	0.25
permanent	2691 2697 2695	2694.3	3.05	n/a	n/a
ZSTD, level 5					
chunked-reset	2232 2238 2233	2234.3	3.2	53189 53200 53277	0.25
chunked	2126 2119 2124	2123	3.6	53268 53189 53261	0.25
permanent	2113 2118 2115	2115.3	2.5	n/a	n/a
ZSTD, level 9					
chunked-reset	2150 2152 2159	2153.6	4.7	53301 53223 53279	0.25
chunked	1942 1942 1945	1943	1.7	53256 53256 53206	0.25
permanent	1942 1936 1947	1941.6	5.5	n/a	n/a

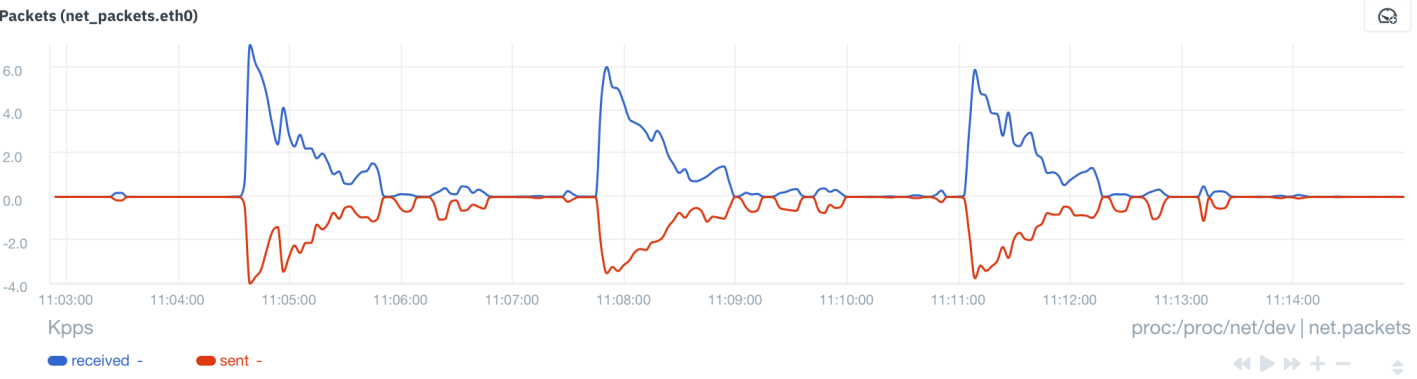
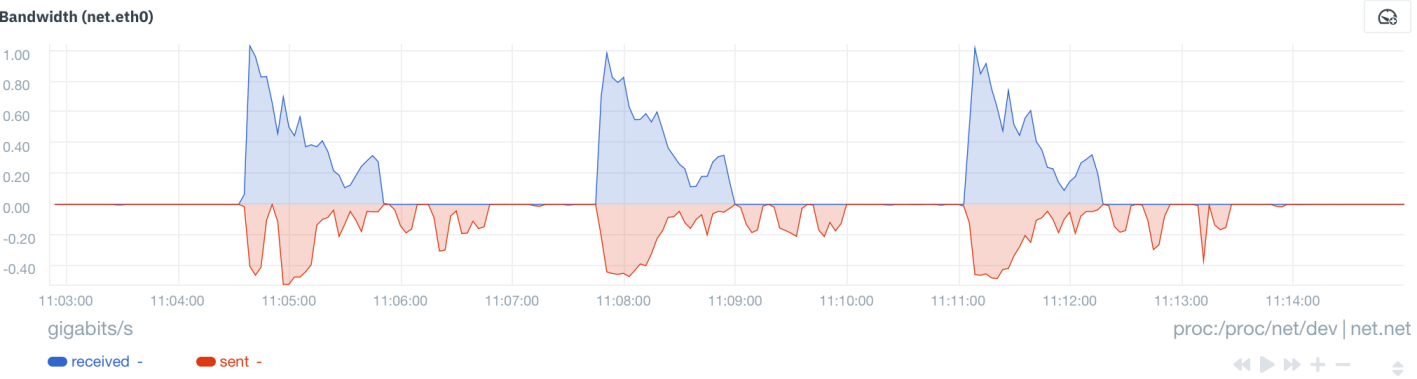
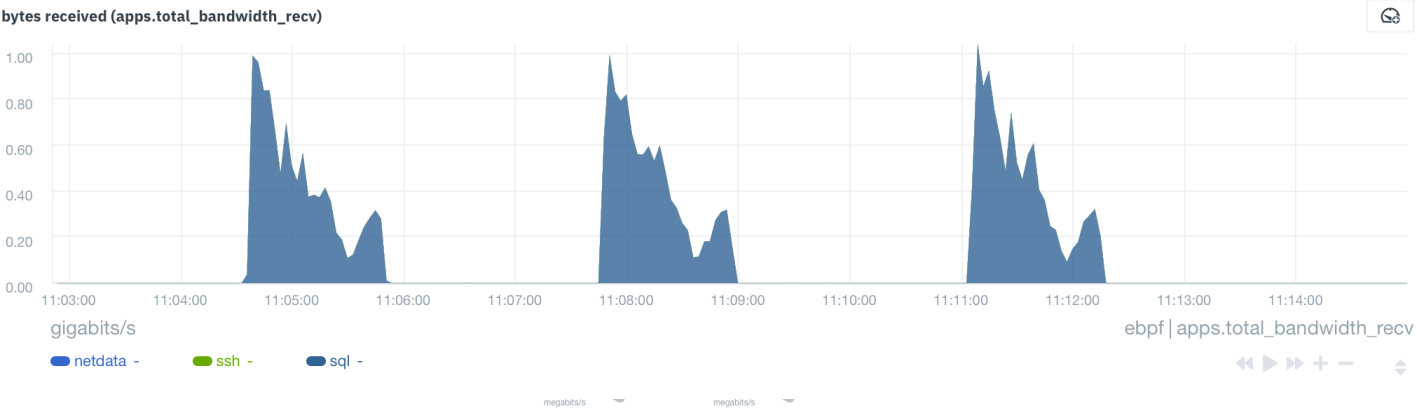
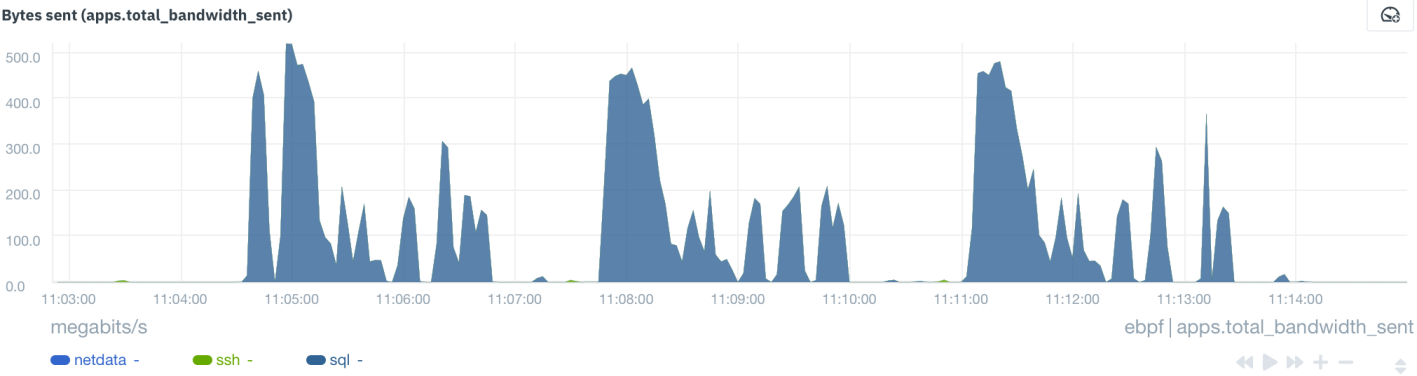
Resource consumption graphs

ZSTD, level 1

master



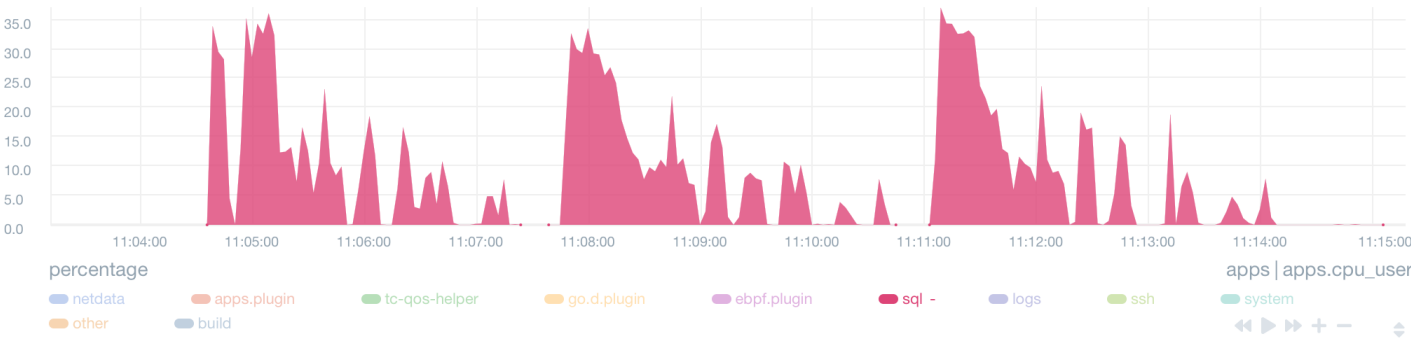
ebpf net



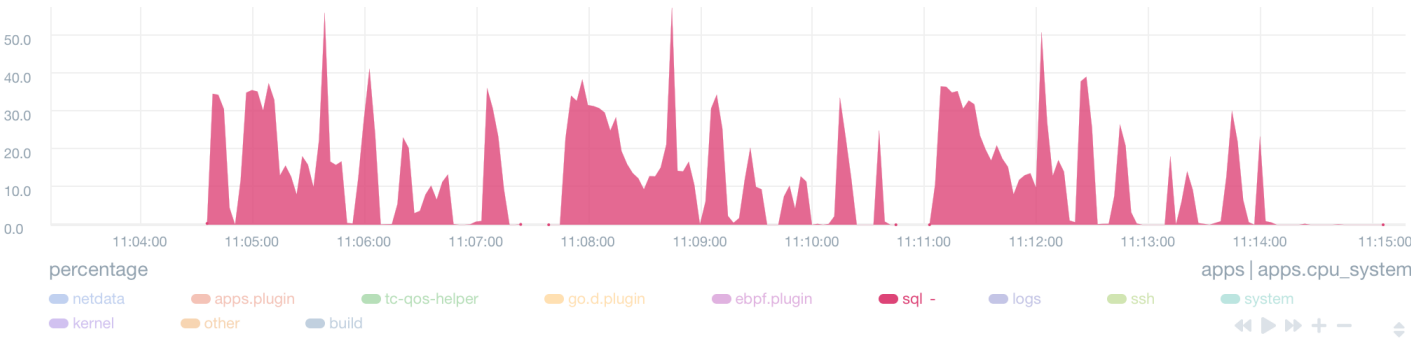
Apps CPU Time (100% = 1 core) (apps.cpu)

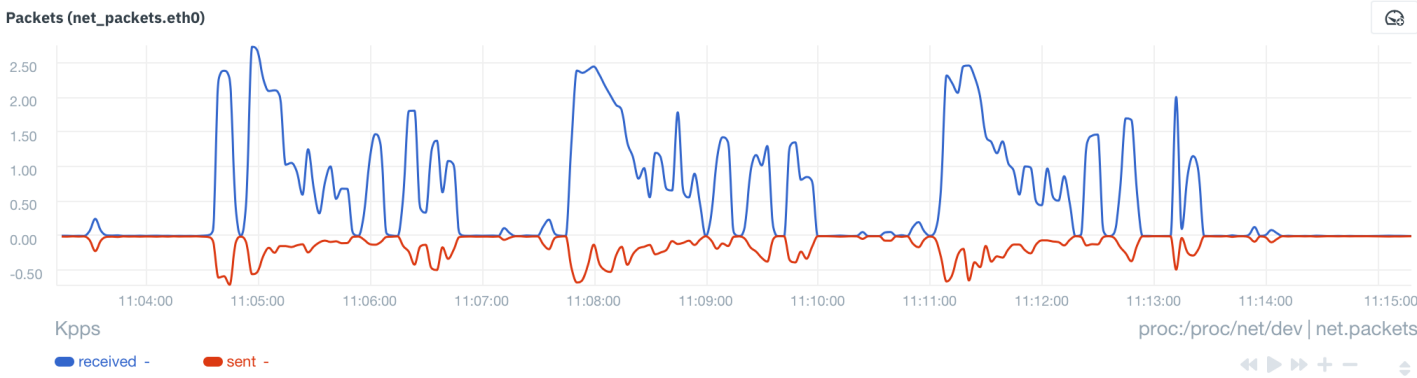
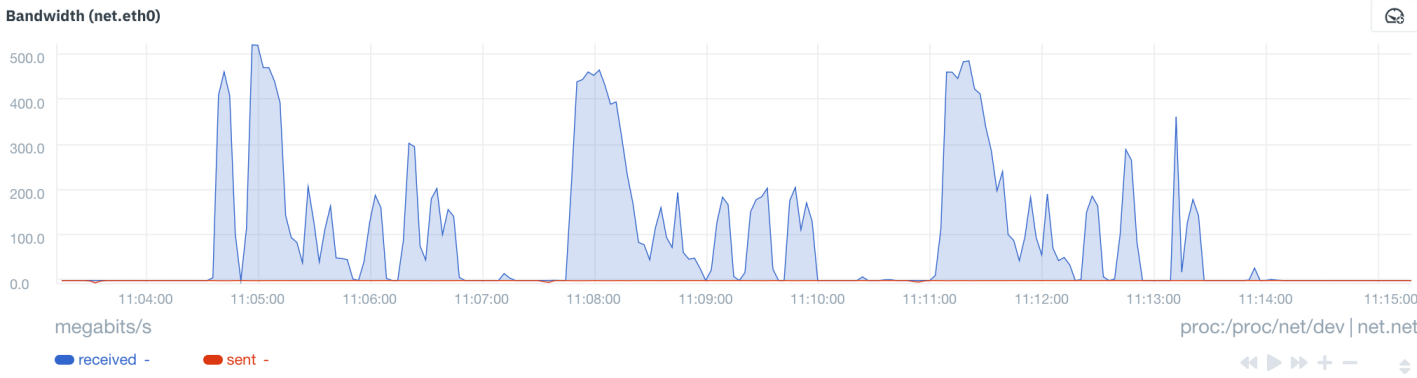
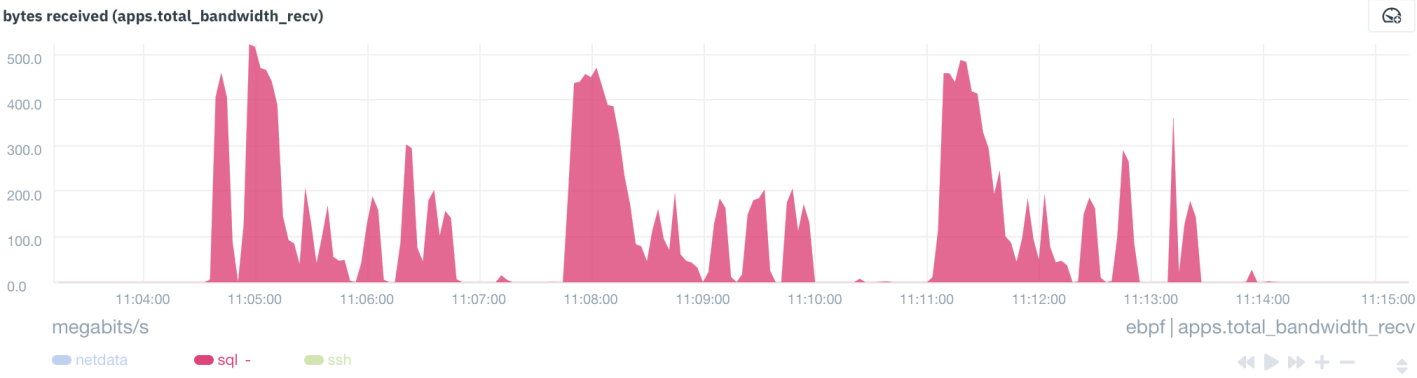
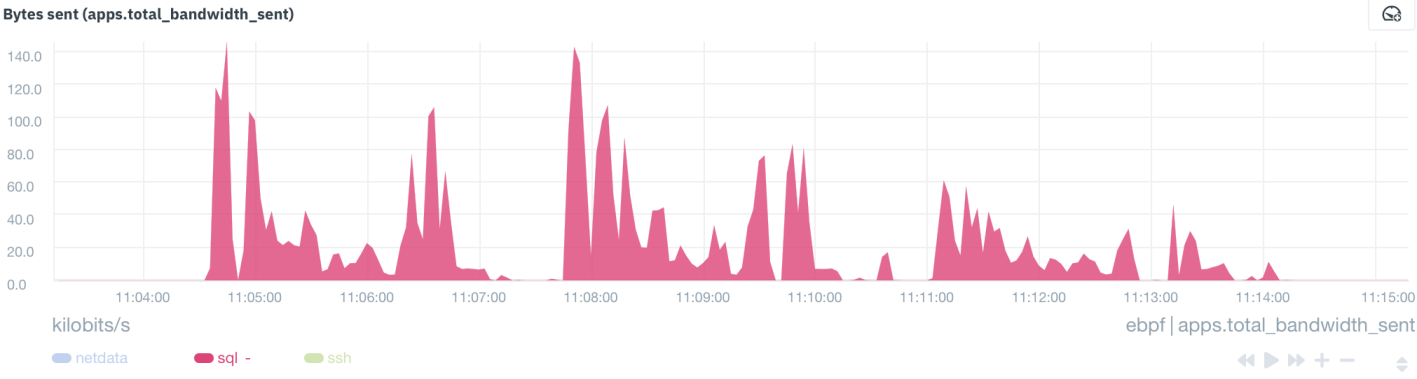


Apps CPU User Time (100% = 1 core) (apps.cpu_user)



Apps CPU System Time (100% = 1 core) (apps.cpu_system)

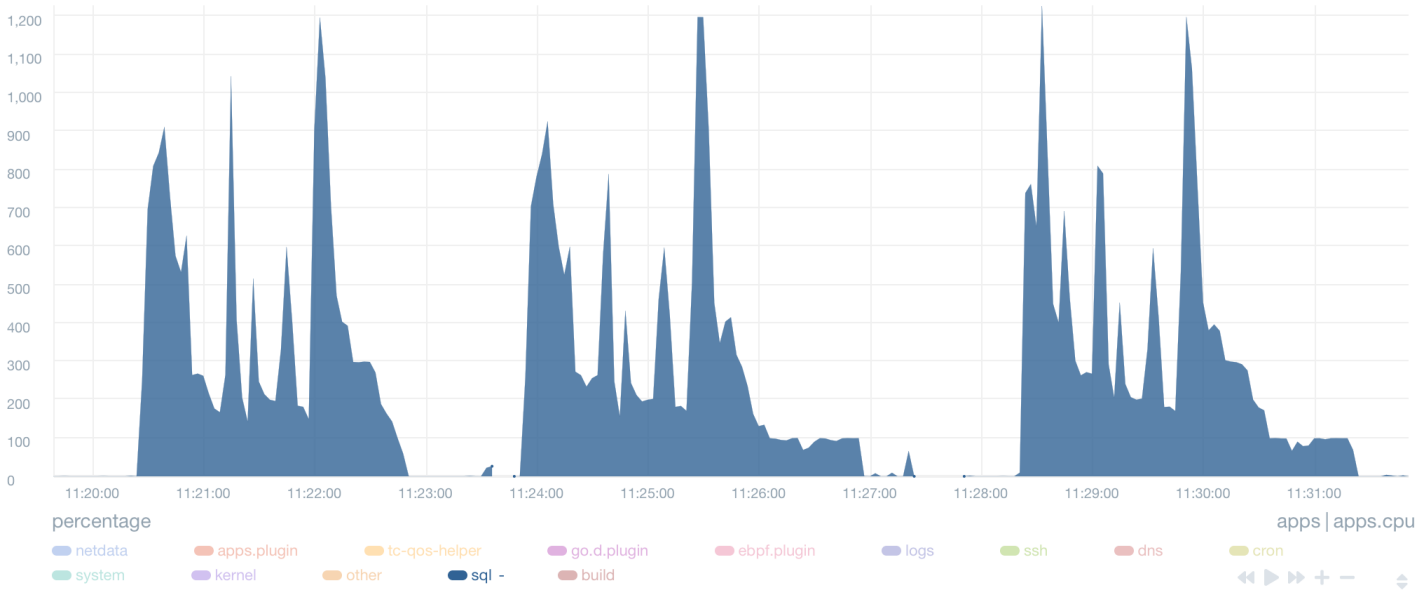




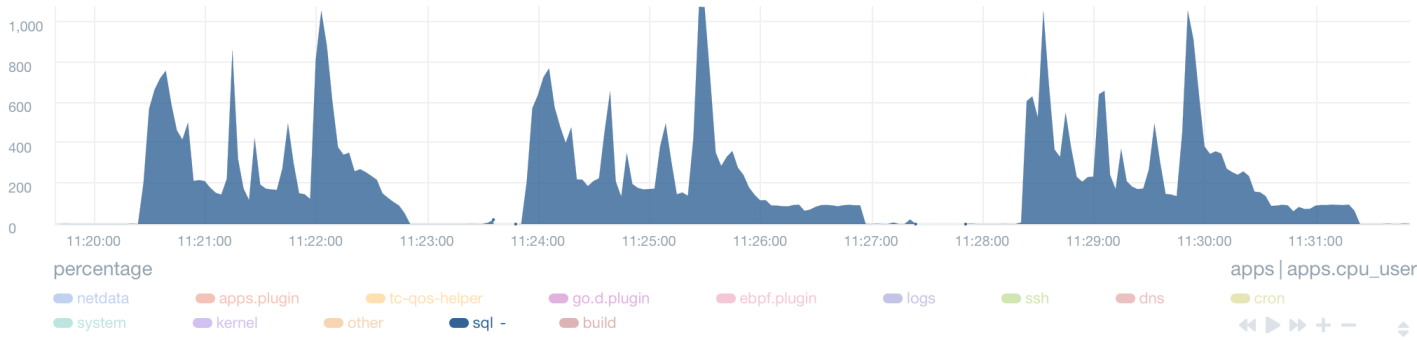
ZSTD, level 5

master

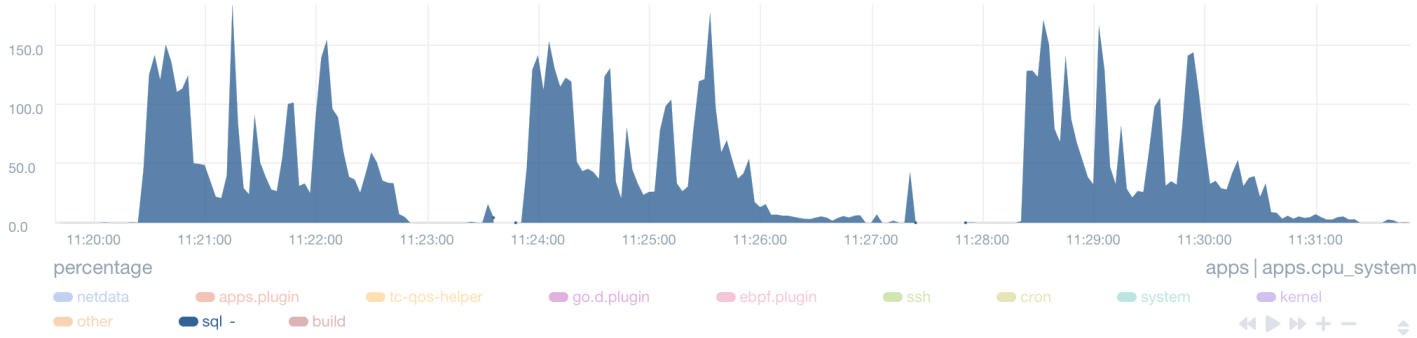
Apps CPU Time (100% = 1 core) (apps.cpu)



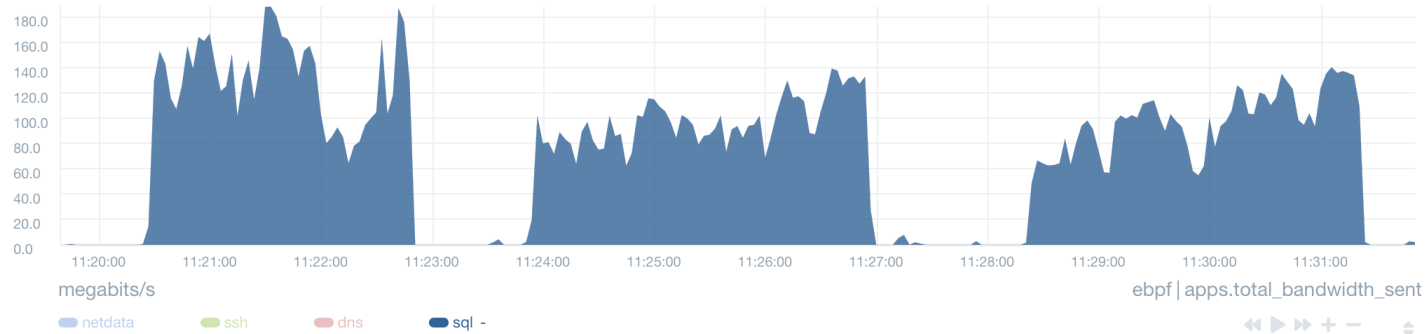
Apps CPU User Time (100% = 1 core) (apps.cpu_user)



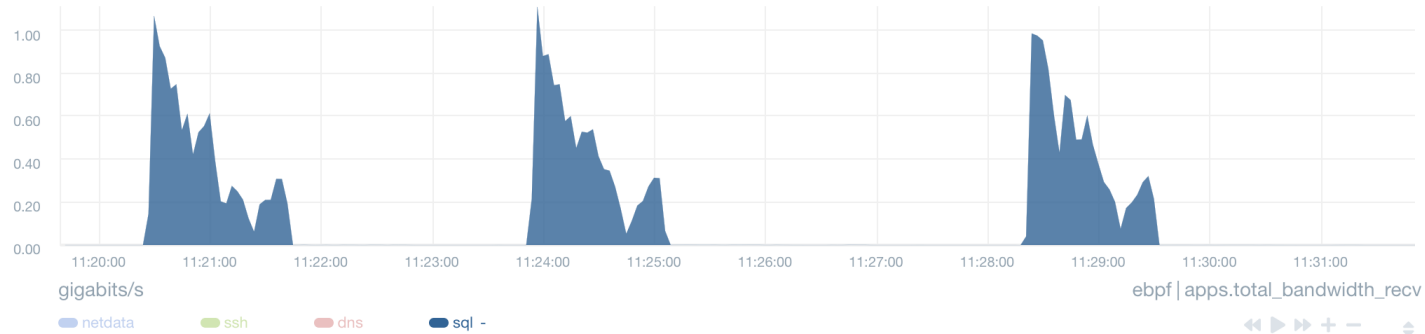
Apps CPU System Time (100% = 1 core) (apps.cpu_system)



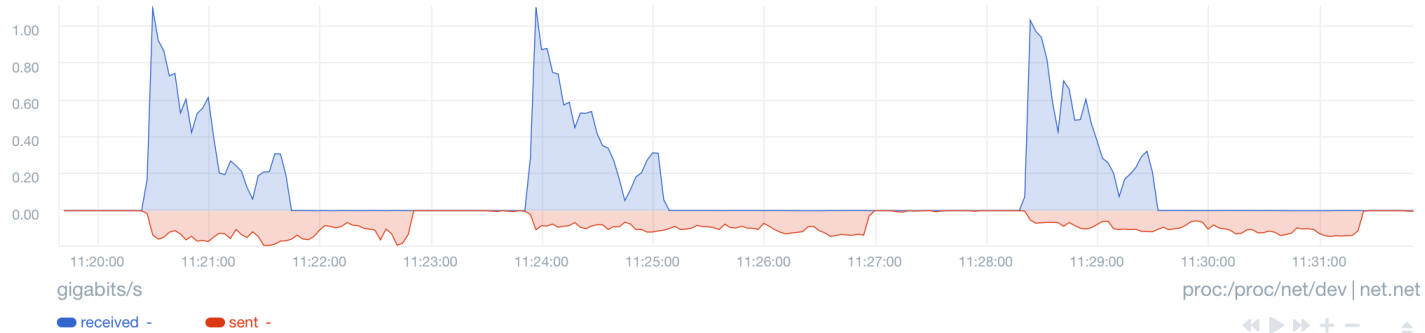
Bytes sent (apps.total_bandwidth_sent)



bytes received (apps.total_bandwidth_rcv)



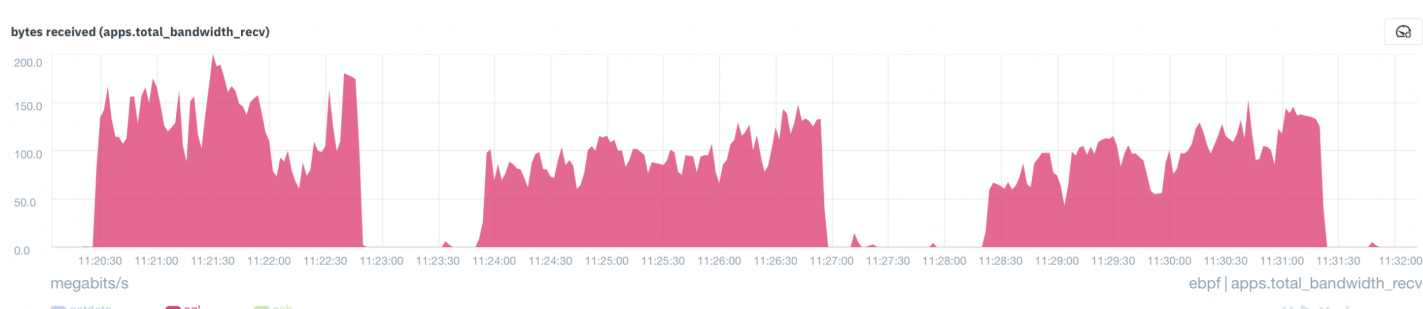
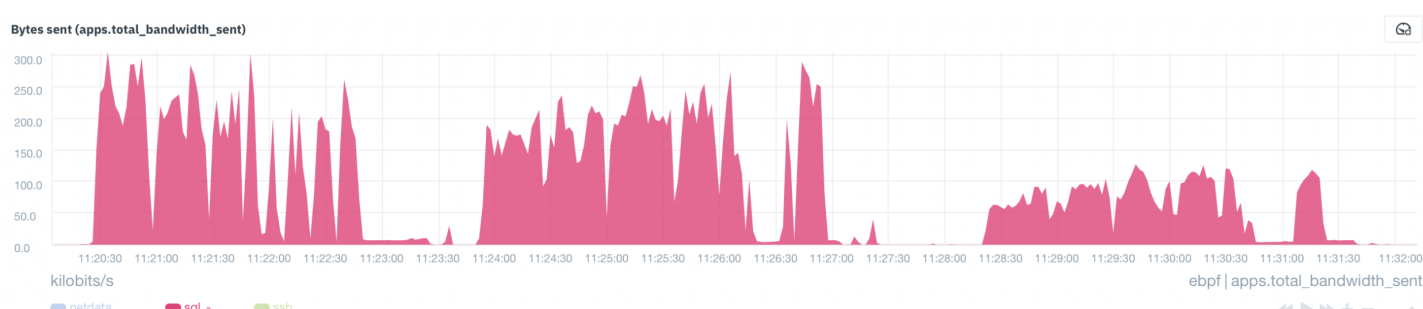
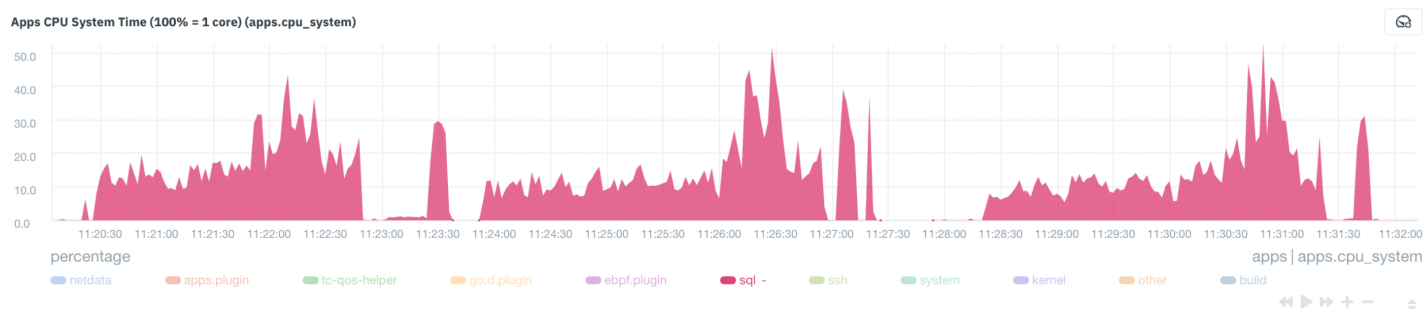
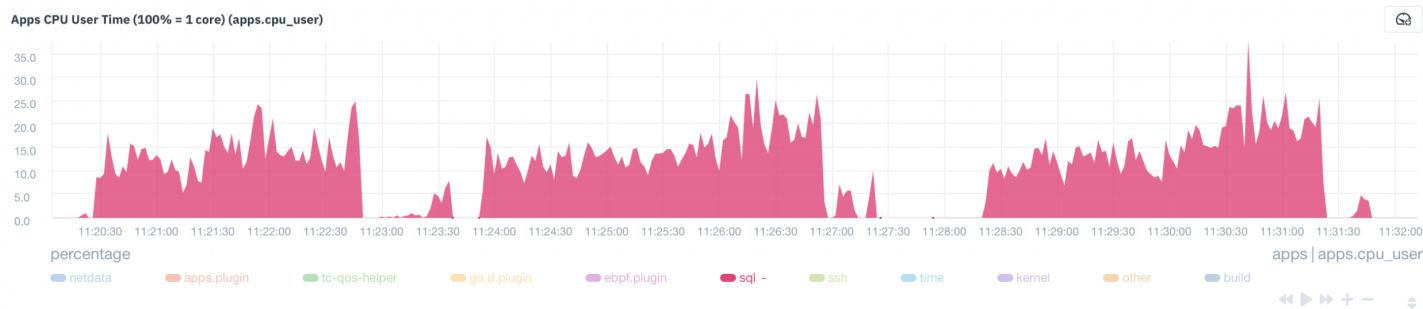
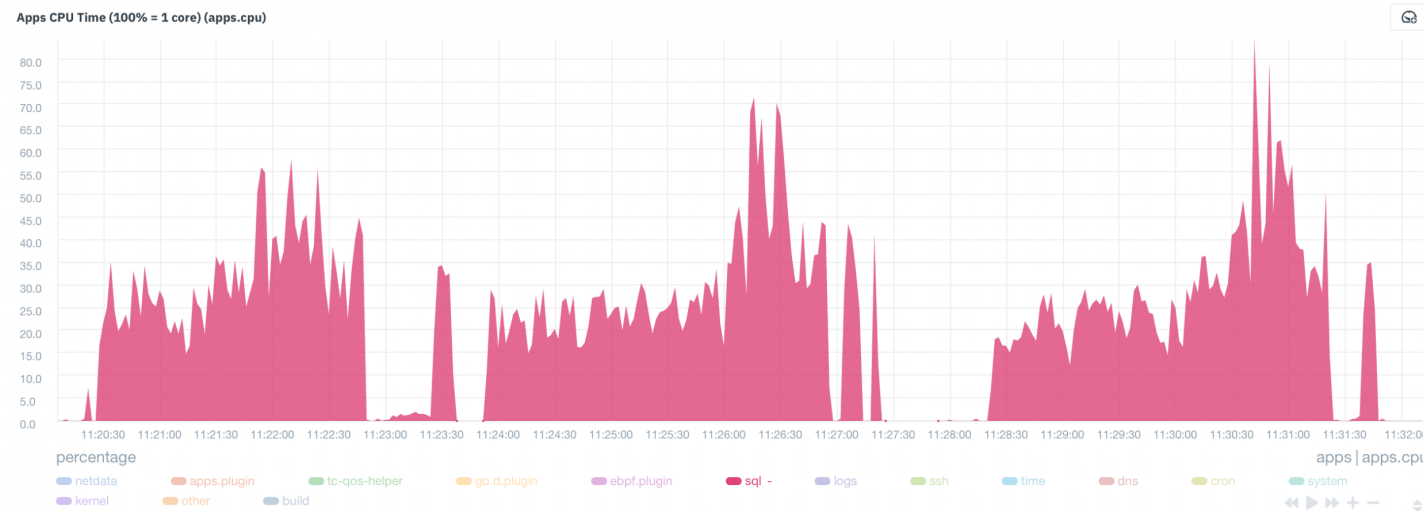
Bandwidth (net.eth0)



Packets (net_packets.eth0)



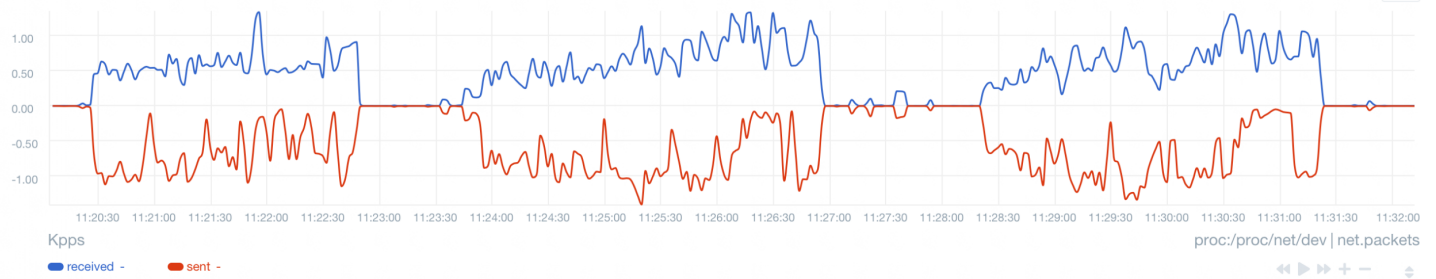
replica



Bandwidth (net.eth0)



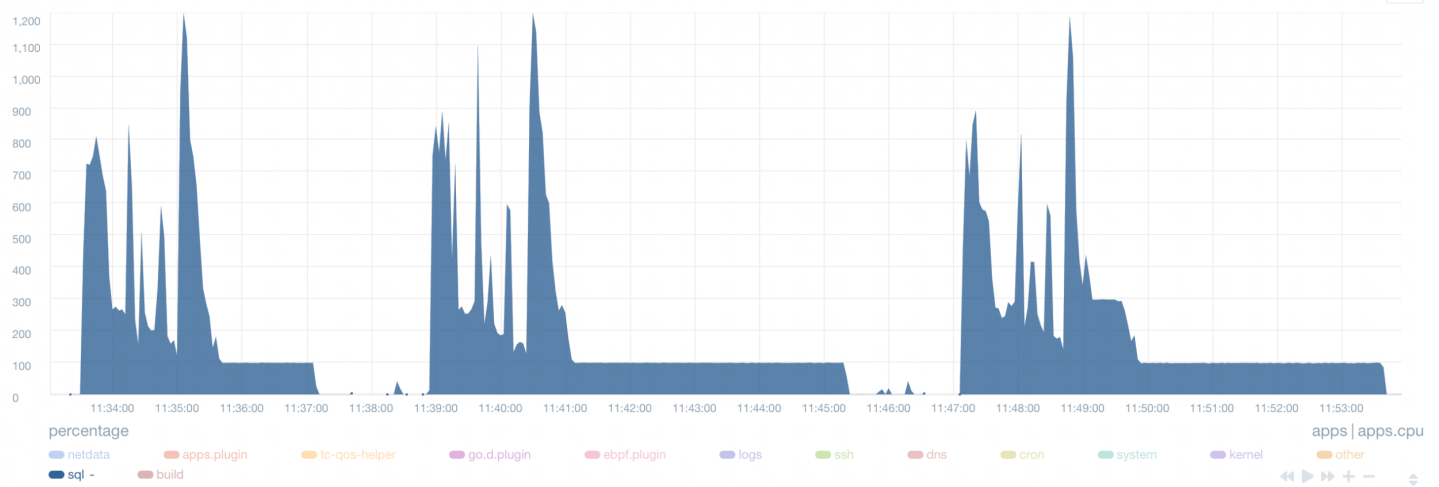
Packets (net_packets.eth0)

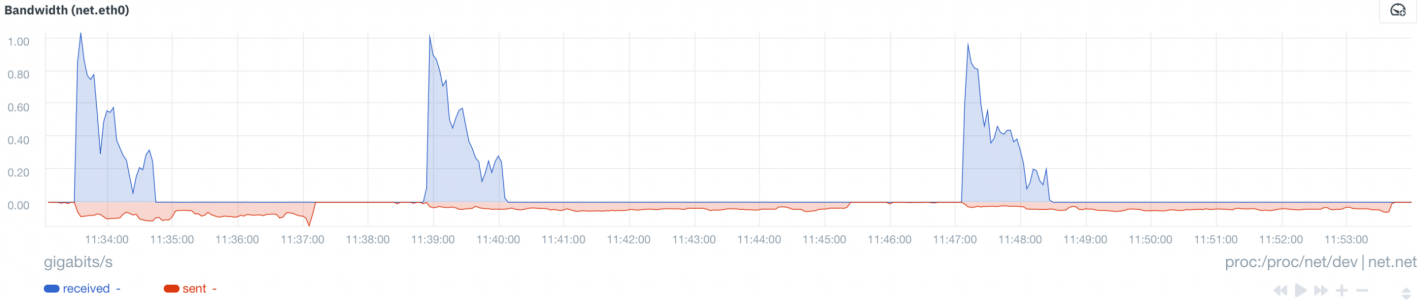
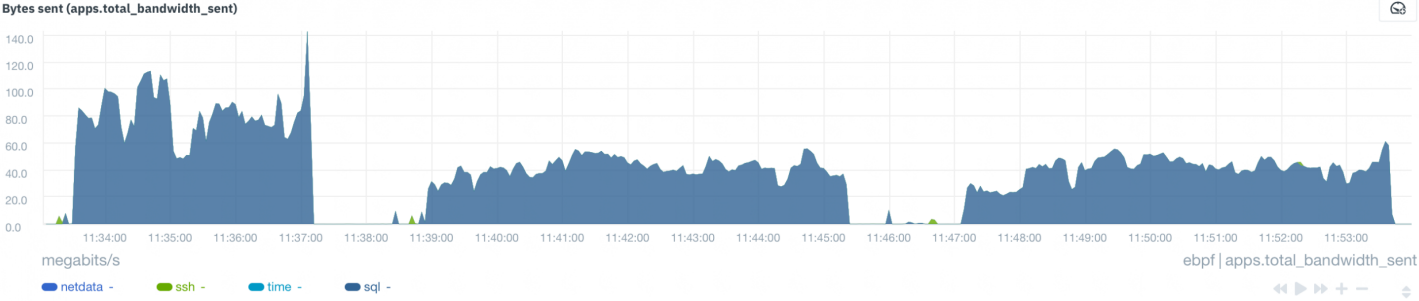
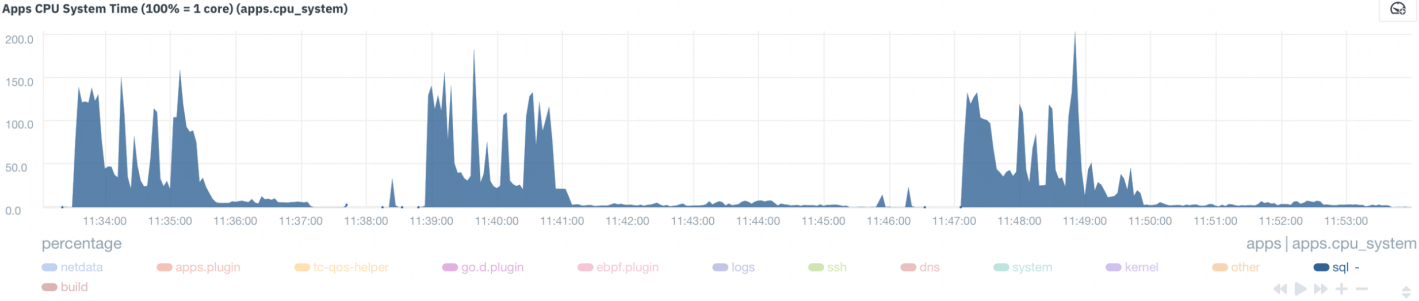
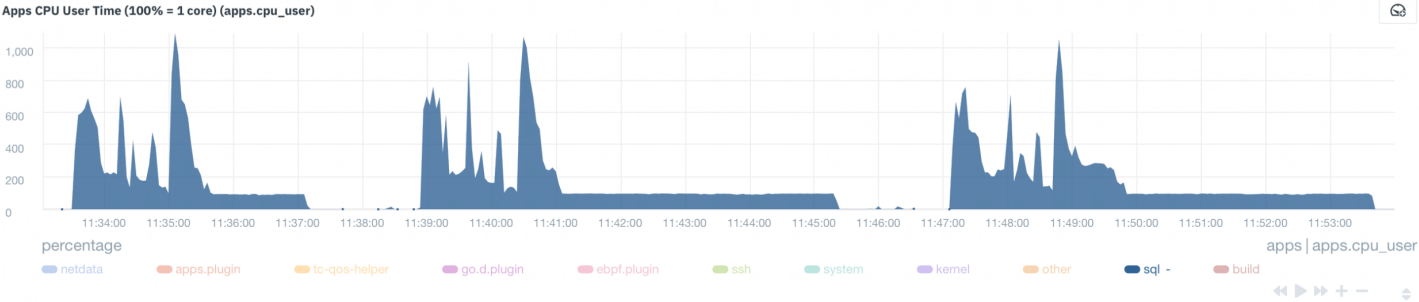


ZSTD, level 9

master

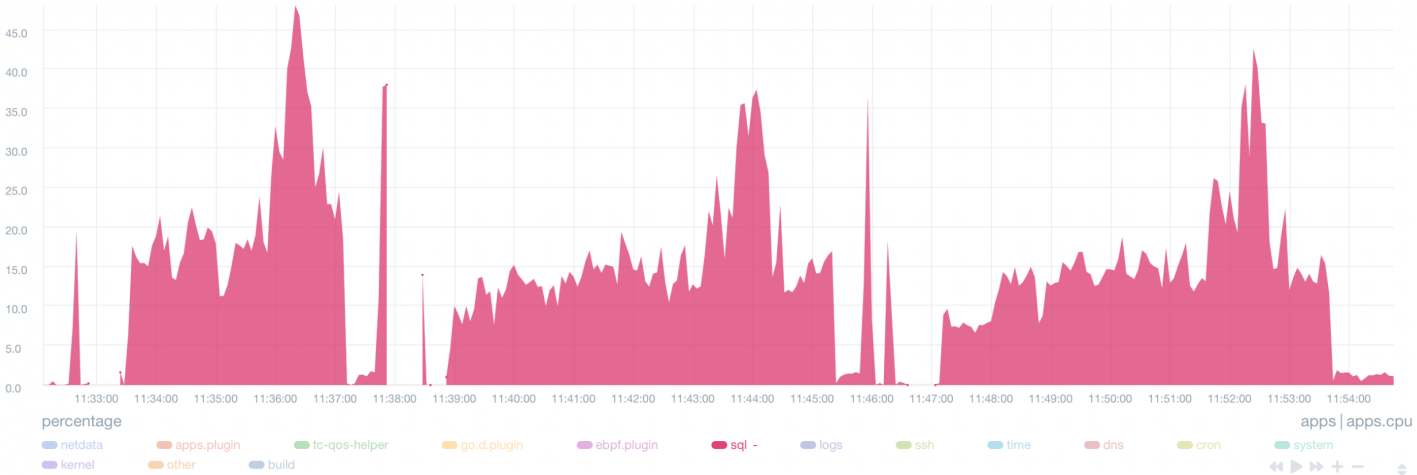
Apps CPU Time (100% = 1 core) (apps.cpu)



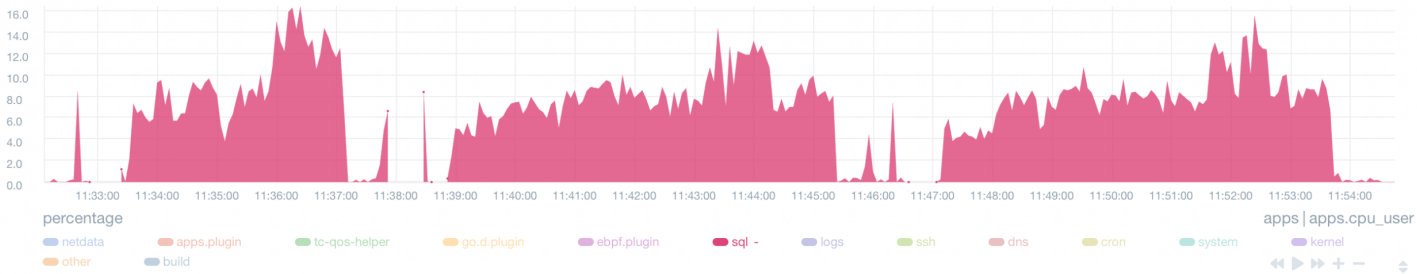


replica

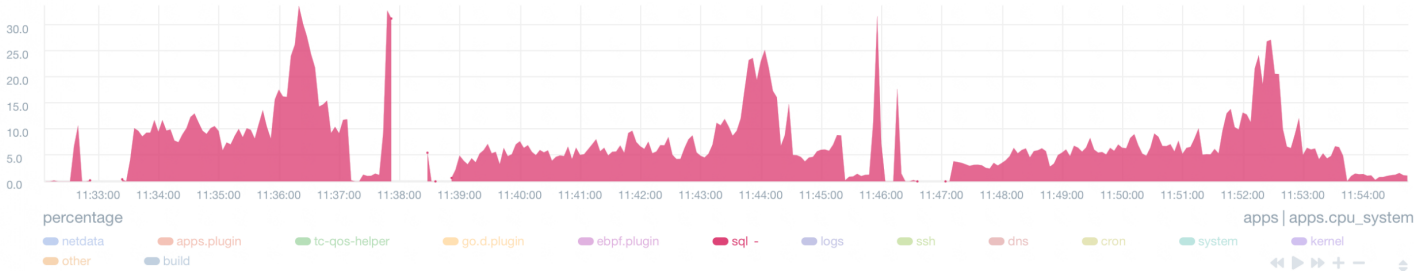
Apps CPU Time (100% = 1 core) (apps.cpu)



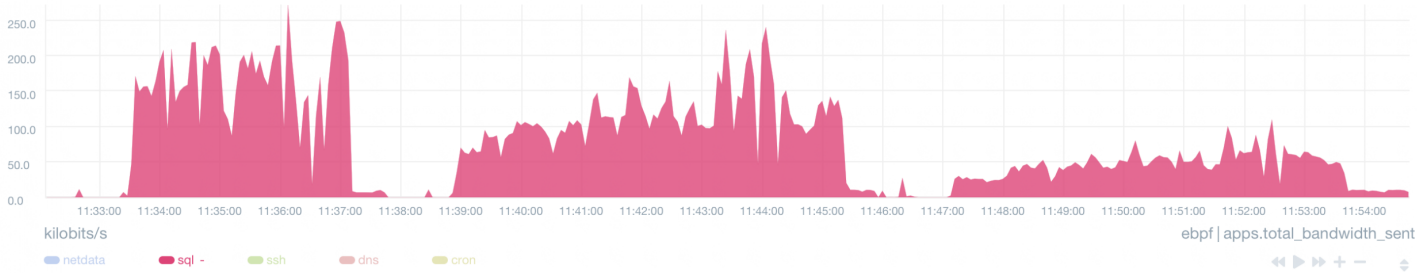
Apps CPU User Time (100% = 1 core) (apps.cpu_user)



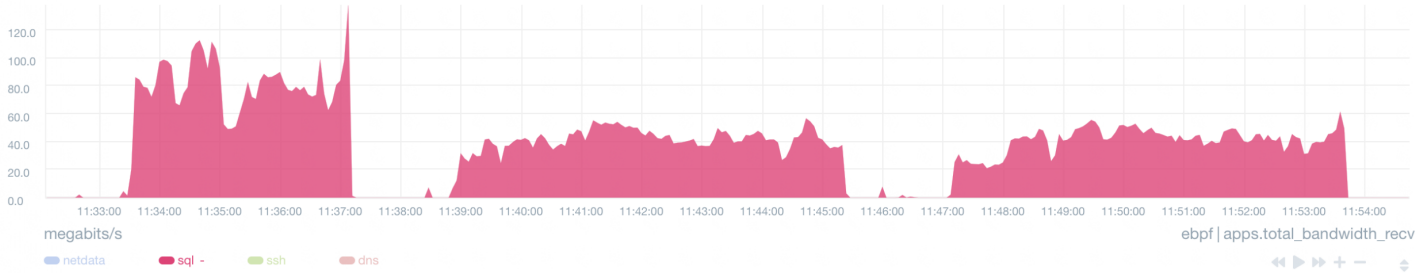
Apps CPU System Time (100% = 1 core) (apps.cpu_system)

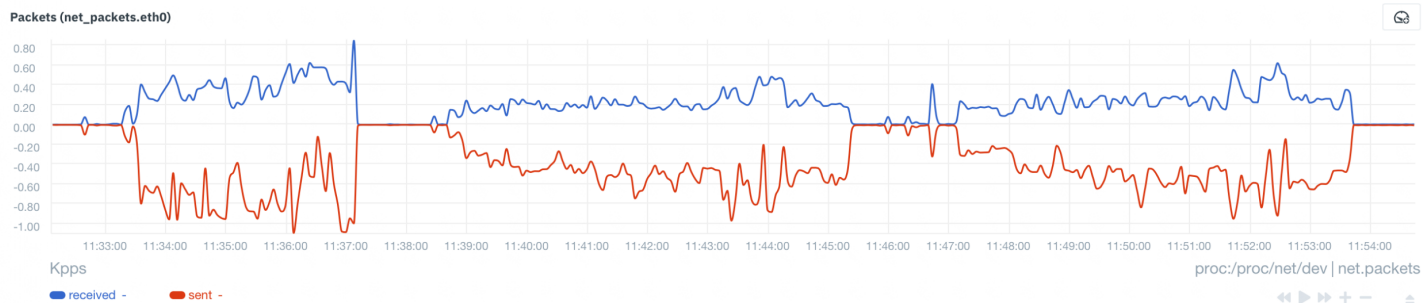


Bytes sent (apps.total_bandwidth_sent)



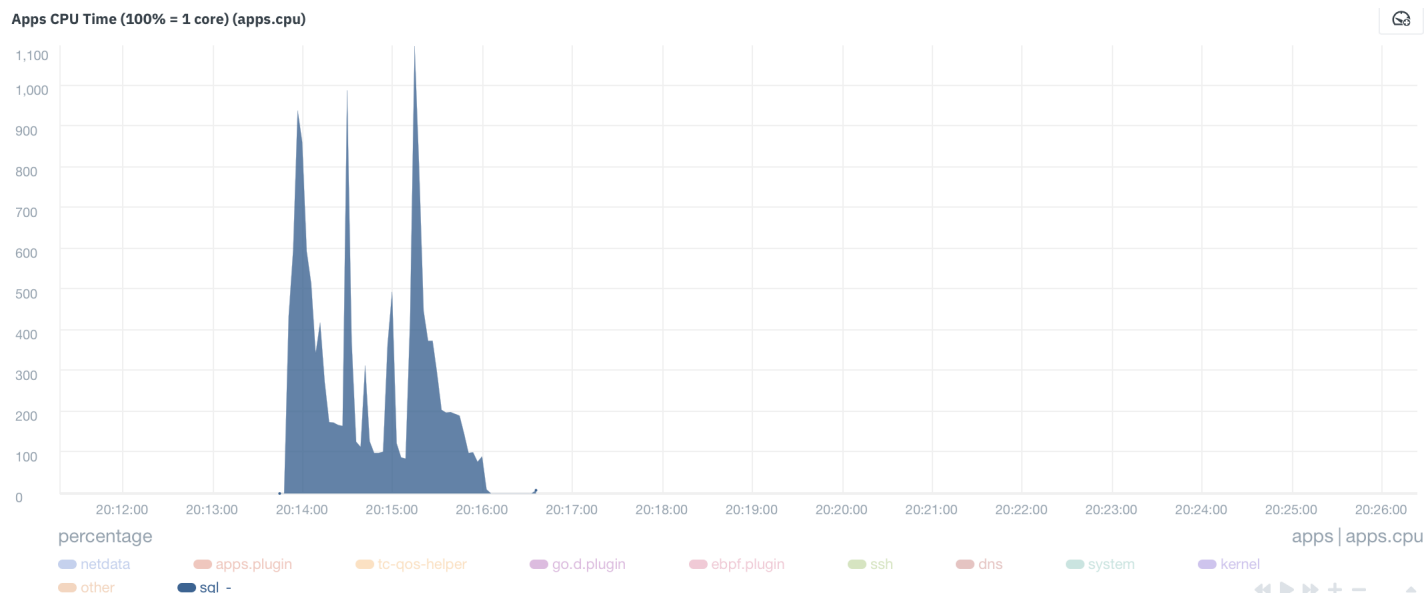
bytes received (apps.total_bandwidth_rcv)

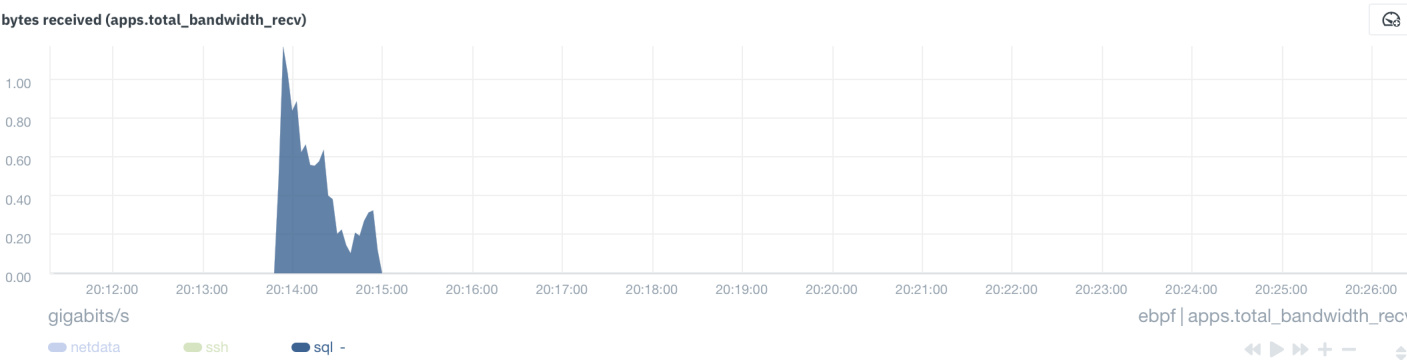
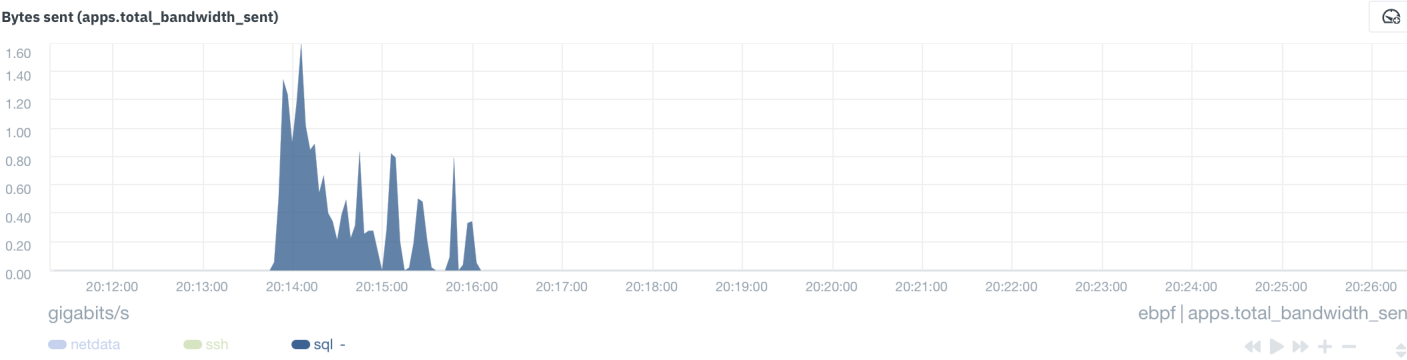
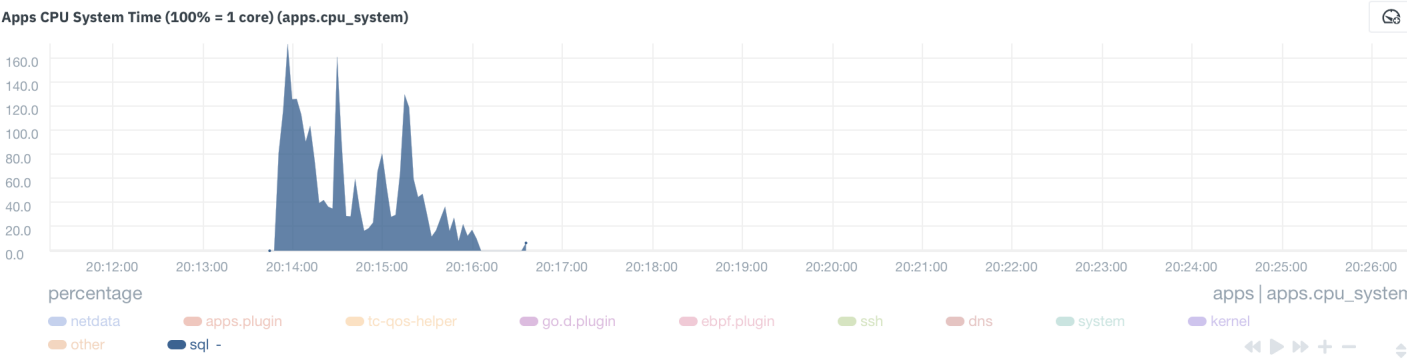
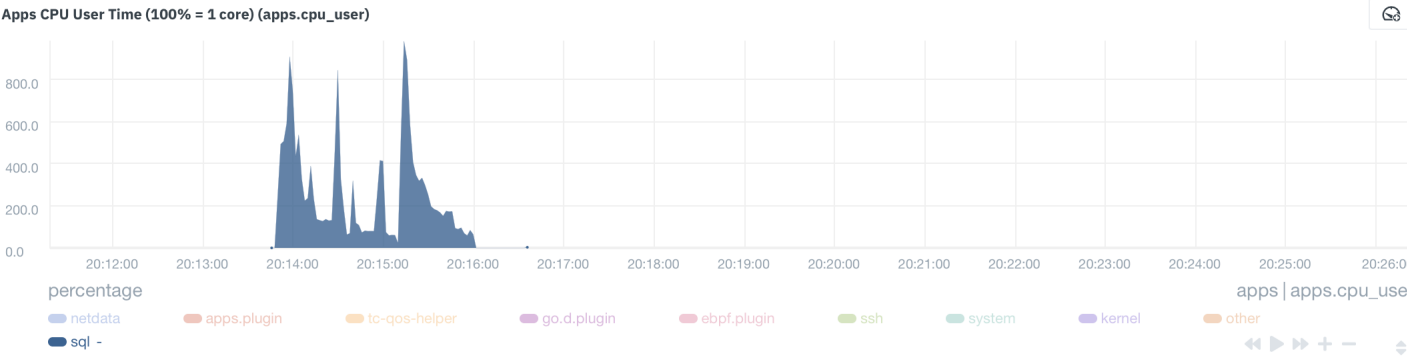




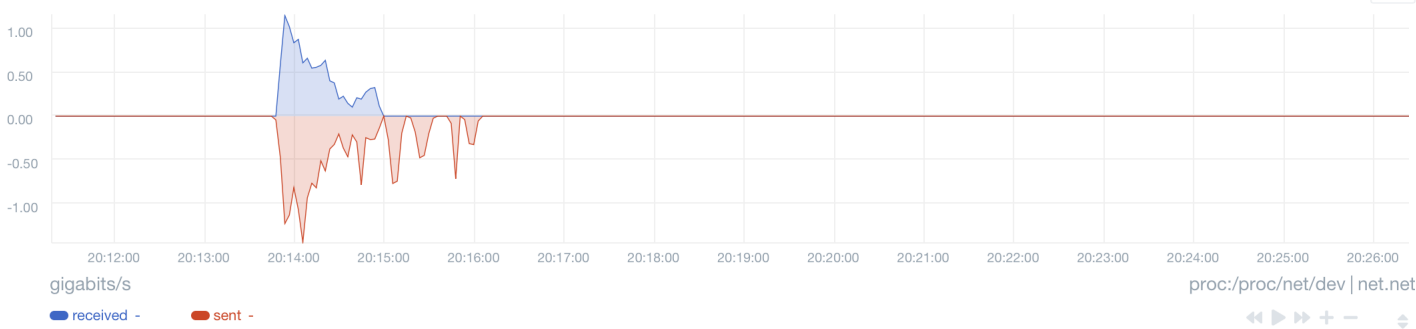
uncompressed

master

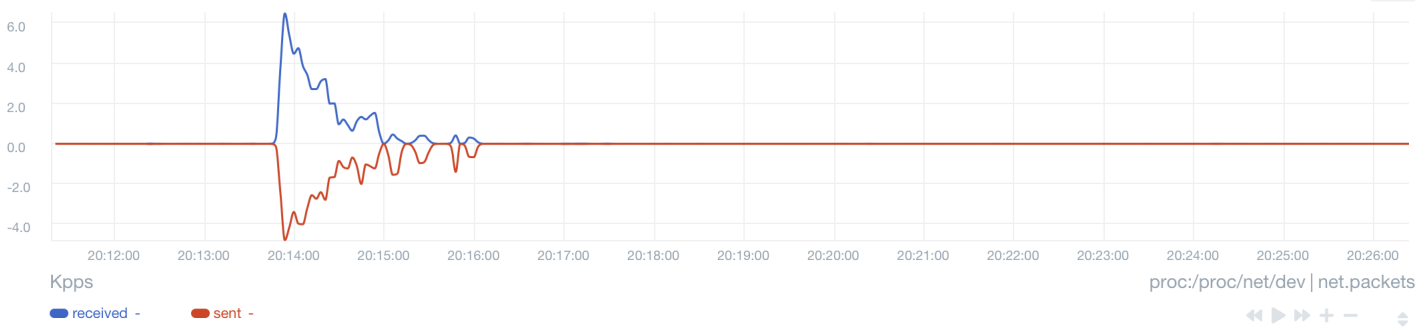




Bandwidth (net.eth0)

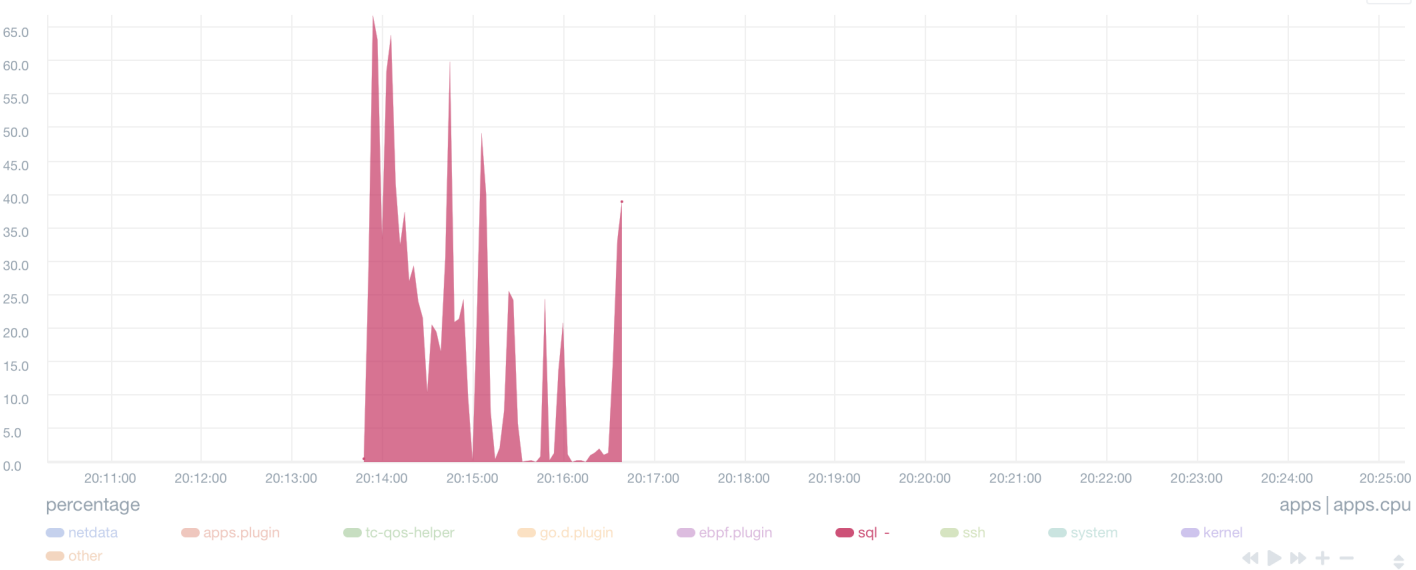


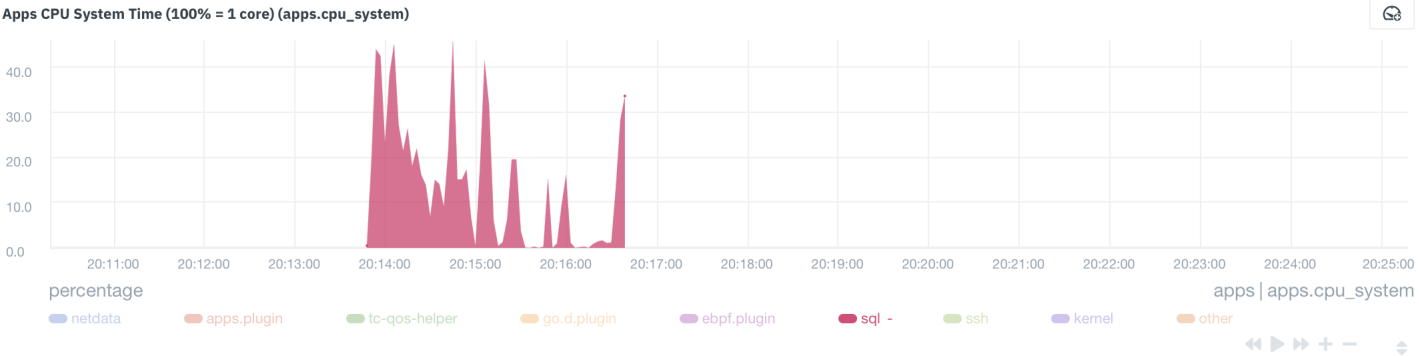
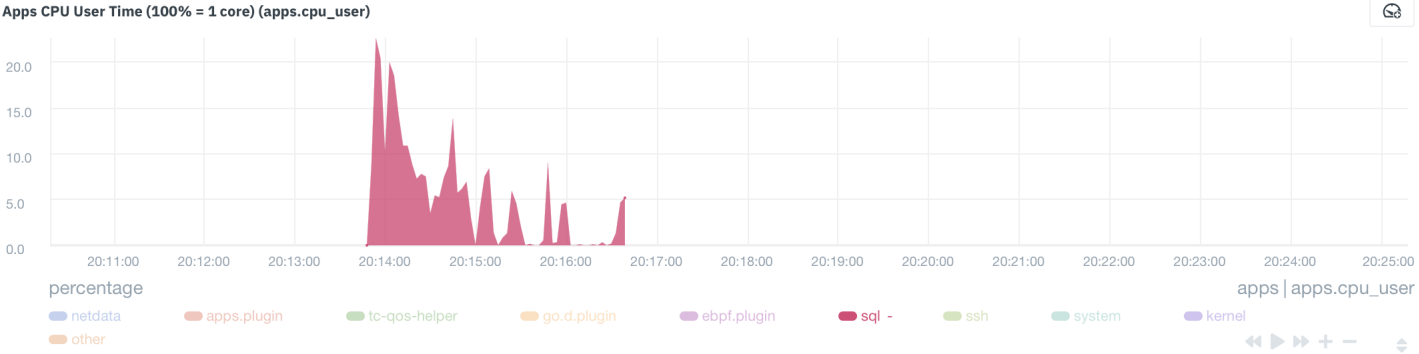
Packets (net_packets.eth0)



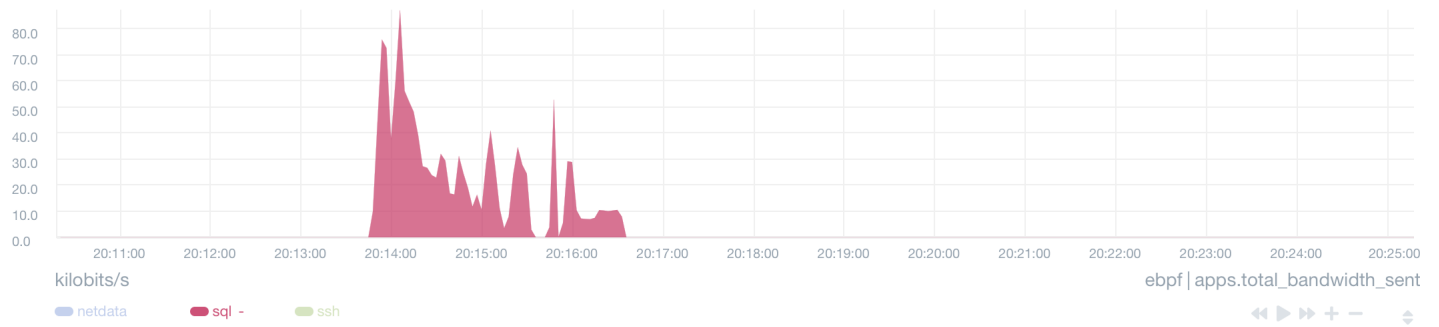
replica

Apps CPU Time (100% = 1 core) (apps.cpu)

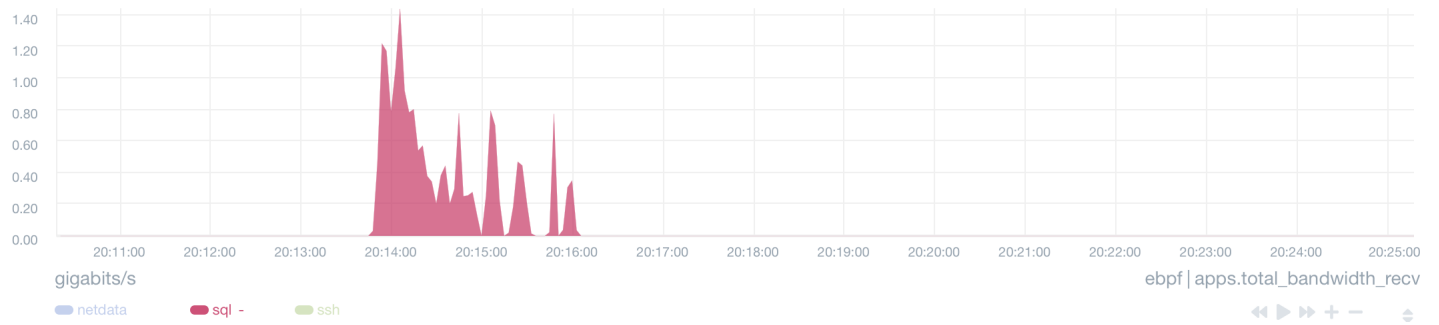




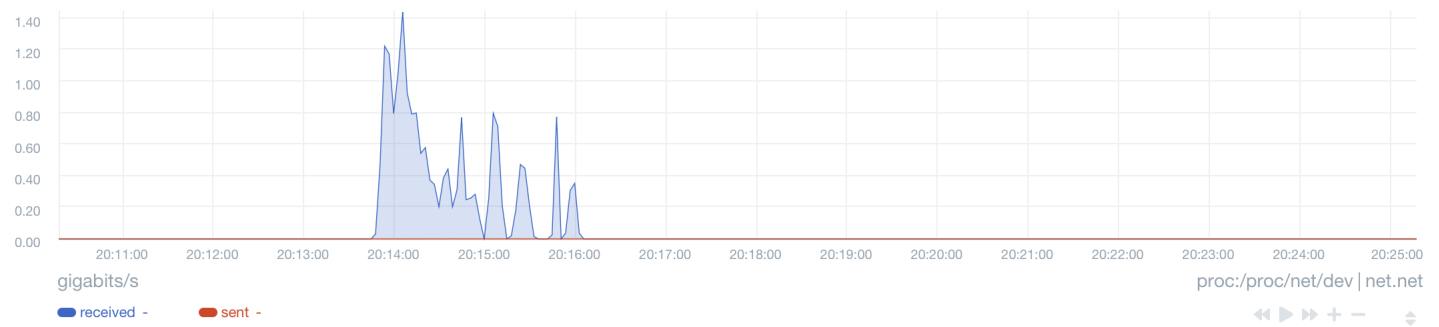
Bytes sent (apps.total_bandwidth_sent)



bytes received (apps.total_bandwidth_recv)



Bandwidth (net.eth0)



Packets (net_packets.eth0)

