Replicated log task

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Iteration 0.

Choose a desirable language for implementation and try to implement (or find the implementation) a simple *Echo Client-Server* application.

Server:

```
PS C:\Users\dmytr\Desktop\5_2\dsd\project> python .\iteration0\echo_server.py
2025-06-04 16:46:55,358 - SERVER - INFO - Echo server listening on 0.0.0.0:65432
2025-06-04 16:46:57,753 - SERVER - INFO - Connected by ('127.0.0.1', 62419)
2025-06-04 16:46:57,753 - SERVER - INFO - Received from ('127.0.0.1', 62419): Test Message 1 from client
2025-06-04 16:46:57,753 - SERVER - INFO - Echoed to ('127.0.0.1', 62419): Test Message 1 from client
2025-06-04 16:46:57,753 - SERVER - INFO - Connection closed by ('127.0.0.1', 62419)
2025-06-04 16:46:58,753 - SERVER - INFO - Connected by ('127.0.0.1', 62420)
2025-06-04 16:46:58,753 - SERVER - INFO - Received from ('127.0.0.1', 62420): Another Message from client
2025-06-04 16:46:58,753 - SERVER - INFO - Echoed to ('127.0.0.1', 62420): Another Message from client
2025-06-04 16:46:58,753 - SERVER - INFO - Connection closed by ('127.0.0.1', 62420)
```

Client:

```
PS C:\Users\dmytr\Desktop\5_2\dsd\project> python .\iteration0\echo_client.py
2025-06-04 16:46:57,752 - CLIENT - INFO - Sending: 'Test Message 1 from client'
2025-06-04 16:46:57,753 - CLIENT - INFO - Received echo: 'Test Message 1 from client'
2025-06-04 16:46:58,753 - CLIENT - INFO - Sending: 'Another Message from client'
2025-06-04 16:46:58,753 - CLIENT - INFO - Received echo: 'Another Message from client'
PS C:\Users\dmytr\Desktop\5_2\dsd\project>
```

Iteration 1.

Task

The Replicated Log should have the following deployment architecture: one ***Master*** and any number of ***Secondaries***.

Master should expose a simple HTTP server (or alternative service with a similar API) with:

- *POST method* - appends a message into the in-memory list
- *GET method* - returns all messages from the in-memory list

Secondary should expose a simple HTTP server(or alternative service with a similar API) with:

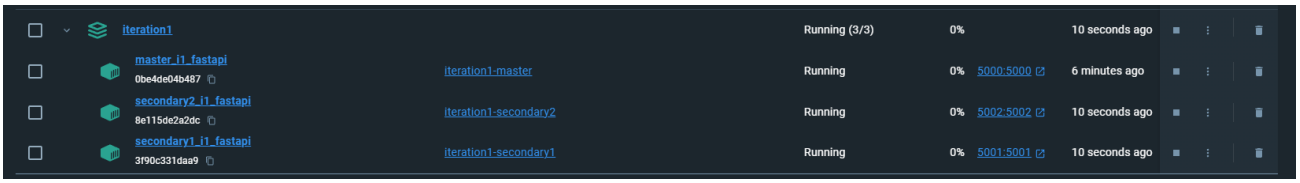
- *GET method* - returns all replicated messages from the in-memory list

Properties and assumptions:

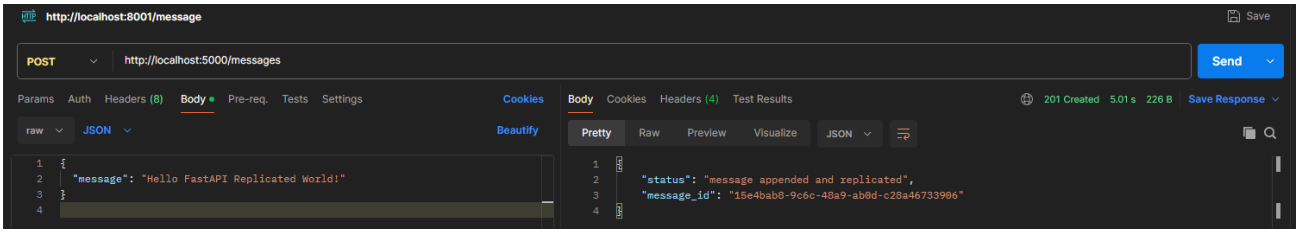
- after each POST request, the message should be replicated on every *Secondary* server
- *Master* should ensure that *Secondaries* have received a message via *ACK*
- *Master's POST request* should be finished only after receiving *ACKs* from all *Secondaries* (blocking replication approach)
- to test that the replication is blocking, introduce the delay/sleep on the *Secondary*
- at this stage assume that the communication channel is a perfect link (no failures and messages lost)
- any RPC framework can be used for *Master-Secondary* communication (Sockets, language-specific RPC, HTTP, Rest, gRPC, …)
- your implementation should support logging
- *Master* and *Secondaries* should run in Docker

Demonstration:

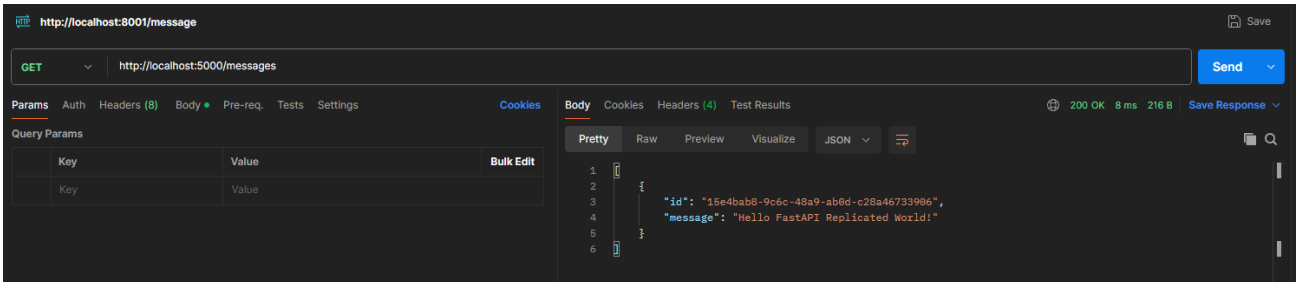
Запустимо наші ноди:



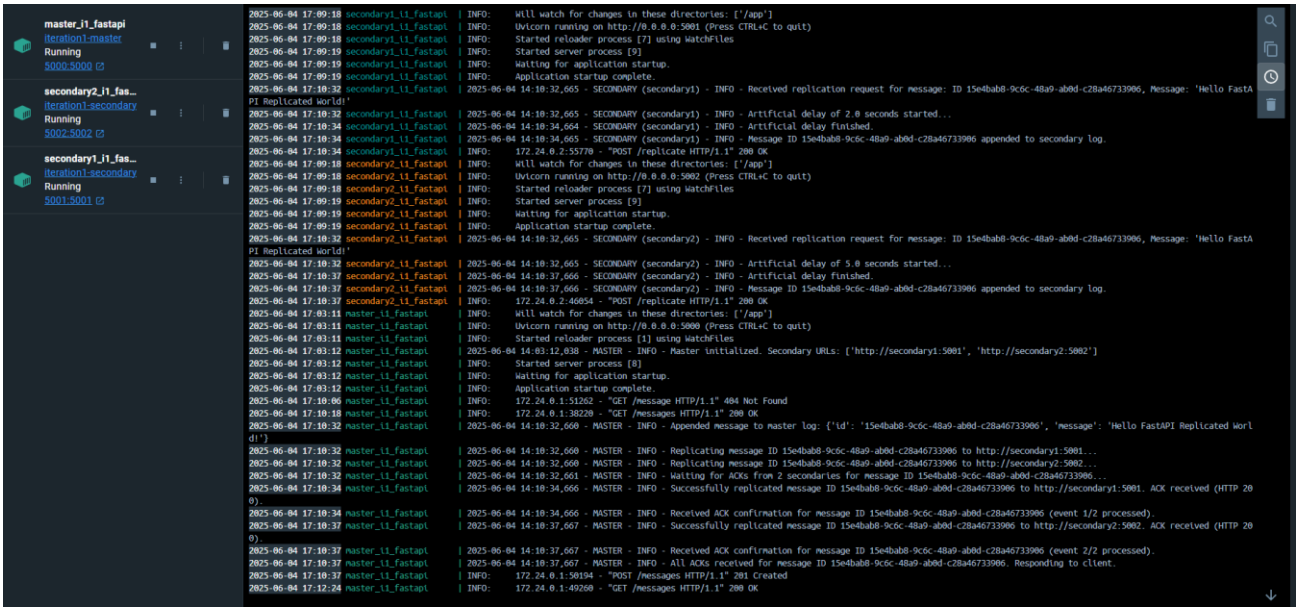
Додамо перше повідомлення:



Виведемо список усіх повідомлень:



Логи:



Iteration 2.

Task

In the previous iteration, the replication was blocking for all secondaries, i.e. to return a response to the client we should receive acknowledgements (ACK) from all secondaries.

Current iteration should provide tunable semi-synchronicity for replication, by defining *write concern* parameters.

- client POST request in addition to the message should also contain *write concern* parameter *w=1,2,3,..,n*
- *w* value specifies how many ACKs the master should receive from secondaries before responding to the client

w = 1 - only from master

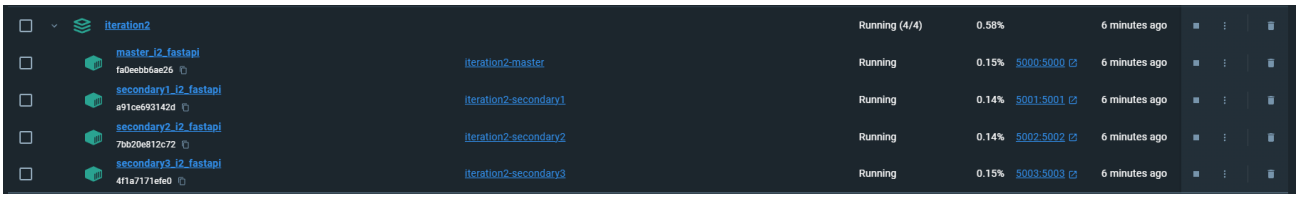
w = 2 - from master and one secondary

w = 3 - from master and two secondaries

Please emulate the replica's inconsistency (and eventual consistency) with the master by introducing the artificial delay on the secondary node. In this case, the master and secondary should temporarily return different lists of messages.

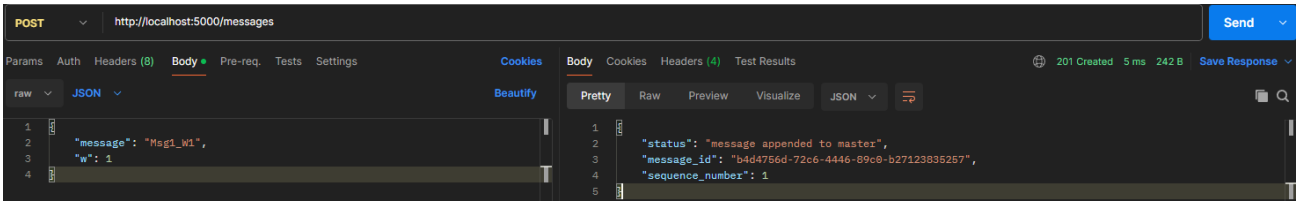
Add logic for messages deduplication and to guarantee the total ordering of messages.

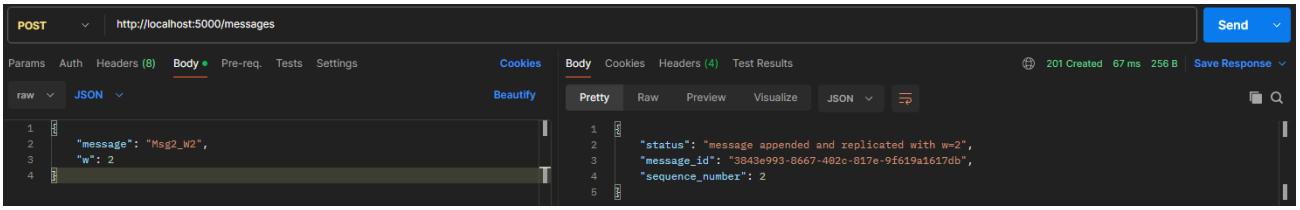
Demonstration:

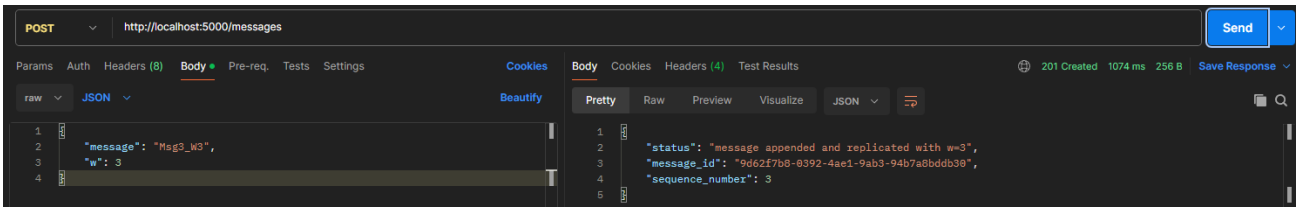


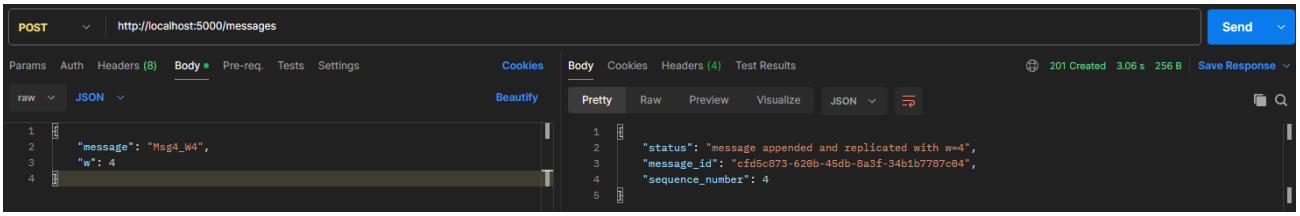

```
2025-06-04 17:18:43 secondary3_i2_fastapi  | INFO:     Will watch for changes in these directories: ['/app']
2025-06-04 17:18:43 secondary3_i2_fastapi  | INFO:     Uvicorn running on http://0.0.0.0:5003 (Press CTRL+C to quit)
2025-06-04 17:18:43 secondary3_i2_fastapi  | INFO:     Started reloader process [7] using WatchFiles
2025-06-04 17:18:44 secondary3_i2_fastapi  | INFO:     Started server process [9]
2025-06-04 17:18:44 secondary3_i2_fastapi  | INFO:     Waiting for application startup.
2025-06-04 17:18:44 secondary3_i2_fastapi  | INFO:     Application startup complete.
2025-06-04 17:18:42 master_i2_fastapi      | INFO:     Will watch for changes in these directories: ['/app']
2025-06-04 17:18:42 master_i2_fastapi      | INFO:     Uvicorn running on http://0.0.0.0:5000 (Press CTRL+C to quit)
2025-06-04 17:18:42 master_i2_fastapi      | INFO:     Started reloader process [1] using WatchFiles
2025-06-04 17:18:43 master_i2_fastapi      | 2025-06-04 14:18:43,747 - MASTER - INFO - Master initialized. Secondary URLs: ['http://secondary1:5001', 'http://secondary2:5002', 'http://secondary3:5003']
2025-06-04 17:18:43 master_i2_fastapi      | INFO:     Started server process [8]
2025-06-04 17:18:43 master_i2_fastapi      | INFO:     Waiting for application startup.
2025-06-04 17:18:43 master_i2_fastapi      | INFO:     Application startup complete.
2025-06-04 17:18:43 secondary2_i2_fastapi  | INFO:     Will watch for changes in these directories: ['/app']
2025-06-04 17:18:43 secondary2_i2_fastapi  | INFO:     Uvicorn running on http://0.0.0.0:5002 (Press CTRL+C to quit)
2025-06-04 17:18:43 secondary2_i2_fastapi  | INFO:     Started reloader process [7] using WatchFiles
2025-06-04 17:18:44 secondary2_i2_fastapi  | INFO:     Started server process [9]
2025-06-04 17:18:44 secondary2_i2_fastapi  | INFO:     Waiting for application startup.
2025-06-04 17:18:44 secondary2_i2_fastapi  | INFO:     Application startup complete.
2025-06-04 17:18:43 secondary1_i2_fastapi  | INFO:     Will watch for changes in these directories: ['/app']
2025-06-04 17:18:43 secondary1_i2_fastapi  | INFO:     Uvicorn running on http://0.0.0.0:5001 (Press CTRL+C to quit)
2025-06-04 17:18:43 secondary1_i2_fastapi  | INFO:     Started reloader process [7] using WatchFiles
2025-06-04 17:18:44 secondary1_i2_fastapi  | INFO:     Started server process [9]
2025-06-04 17:18:44 secondary1_i2_fastapi  | INFO:     Waiting for application startup.
2025-06-04 17:18:44 secondary1_i2_fastapi  | INFO:     Application startup complete.
```

Зальємо повідомлення з різними W, при створенні секондарі нод у них були різні таймаути.

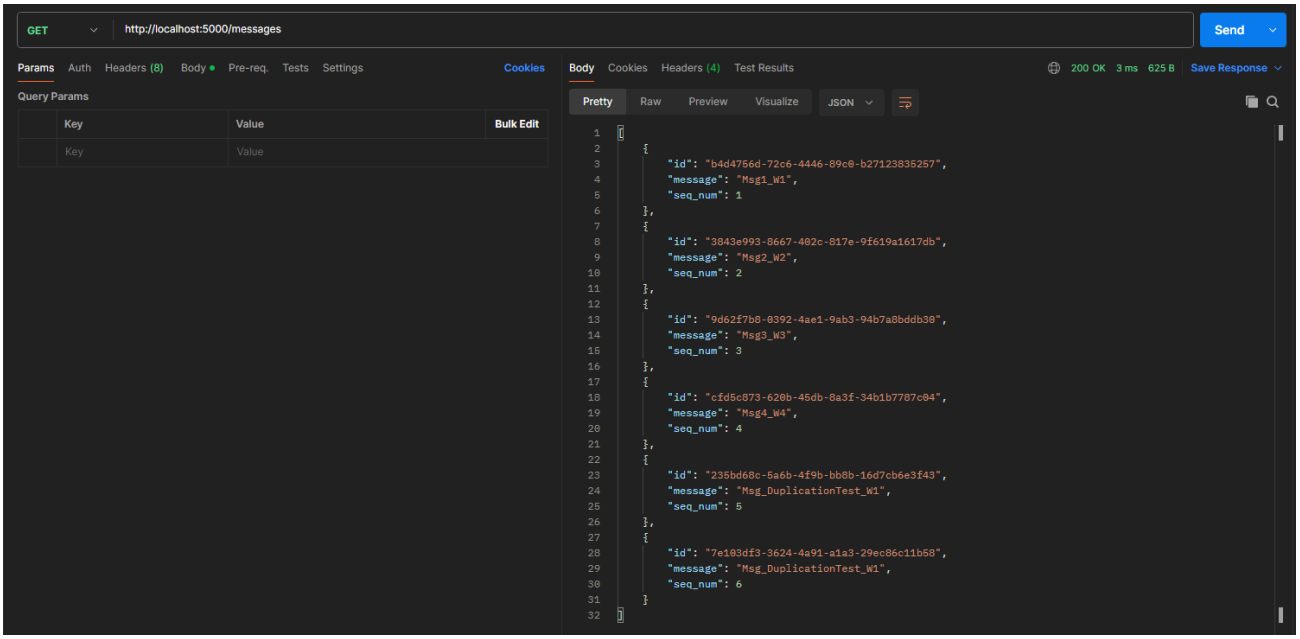




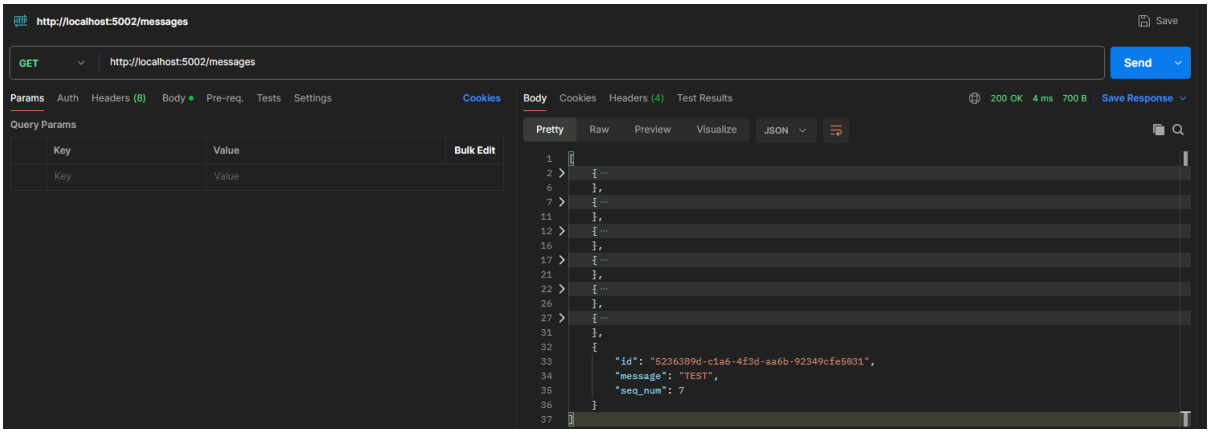


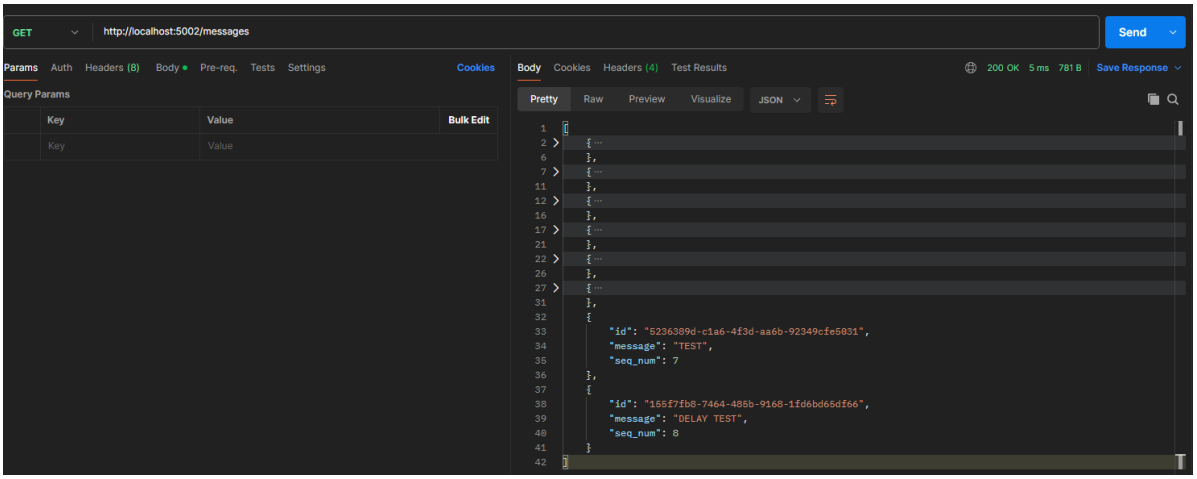


Нижче бачимо результат, успішна дедуплікація.

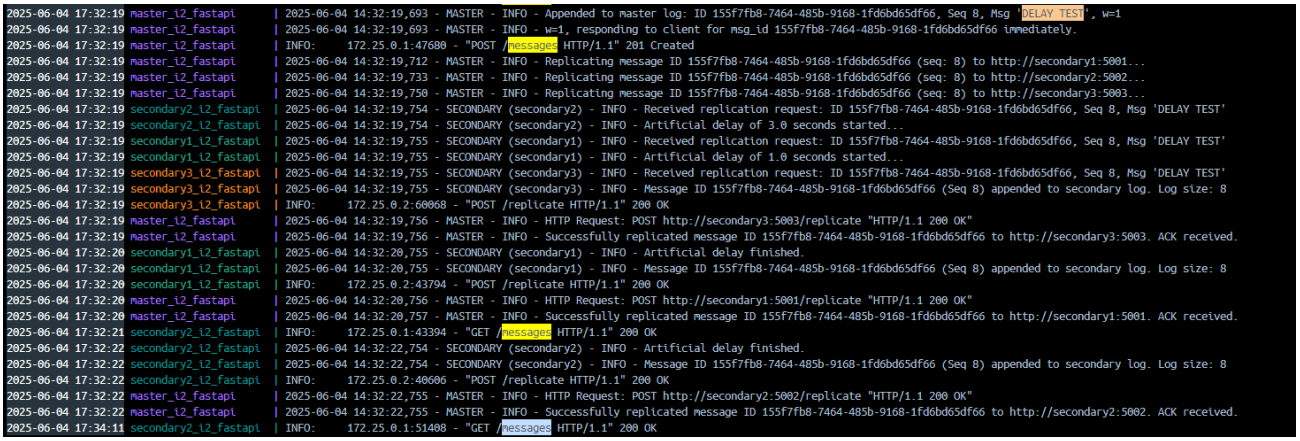


Спробуємо отримати ситуацію коли у secondary через delay не відображаються всі messages. Спочатку додам повідомлення, а після одразу ж зроблю запит на секондарі з затримкою а потім через деякий час знову зроблю запит:



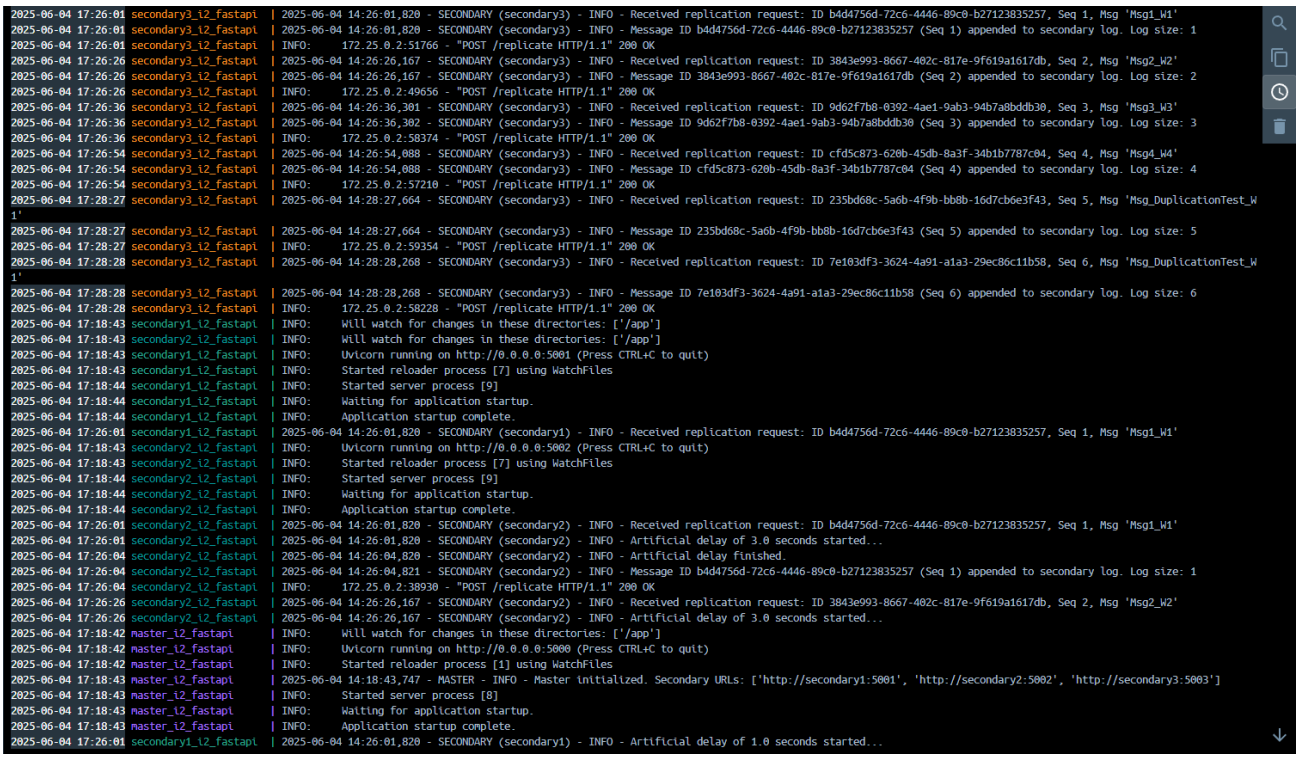


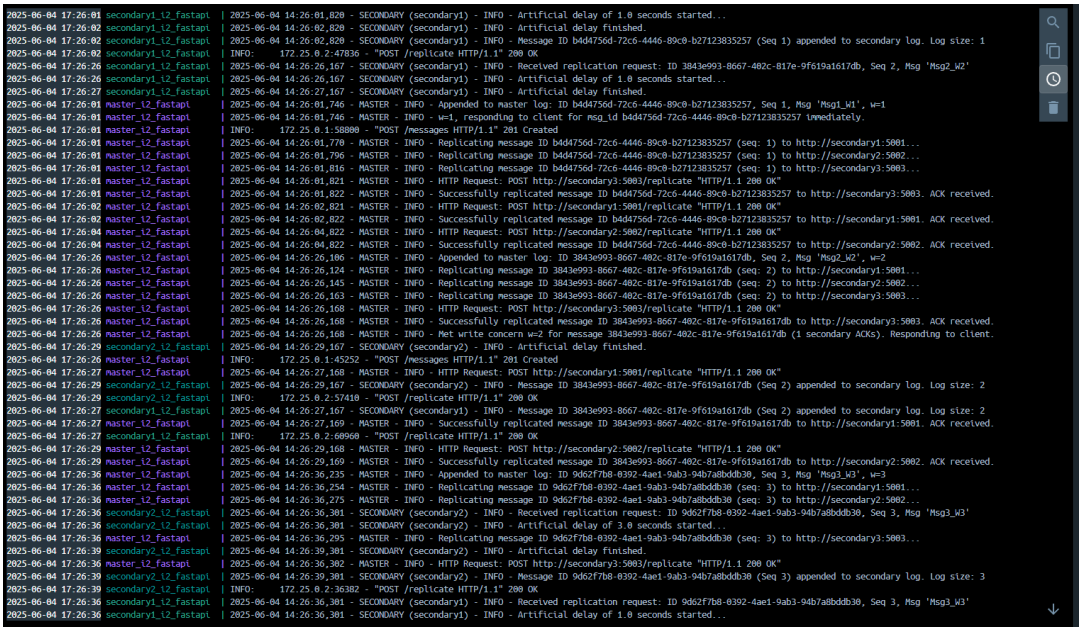
Як бачимо спрацювало, подивимося лог:



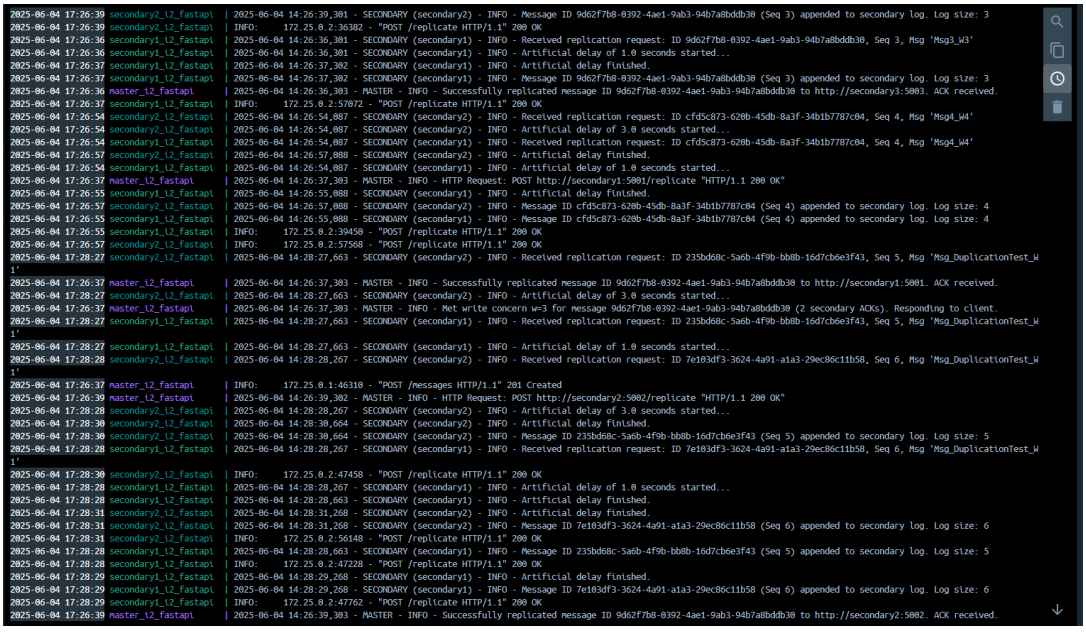
Тут бачимо що спочатку користувач запросив список повідомлень, а вже після відбулася реплікація.

Інші логи:

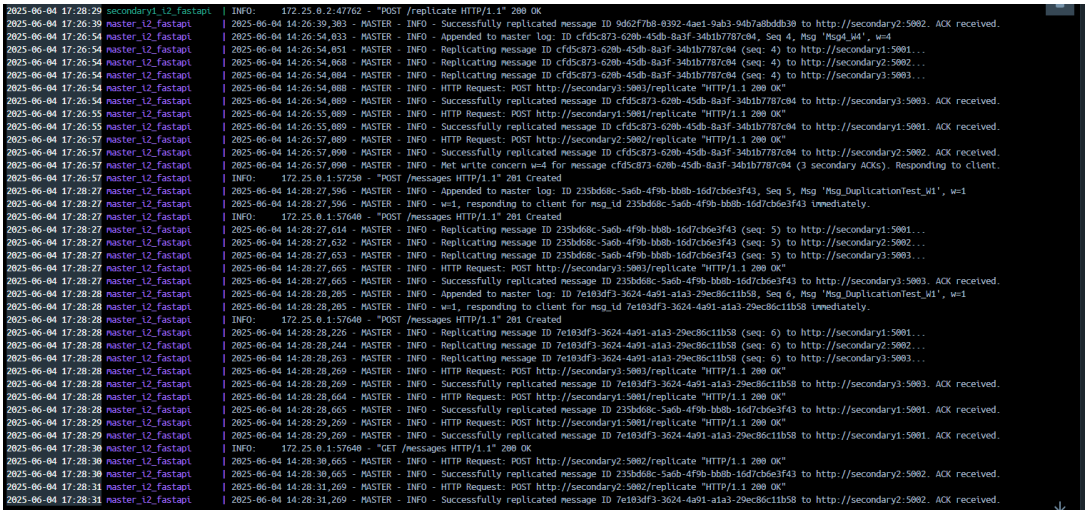




```
2025-06-04 17:26:01 secondary1_l2_fastapi  | 2025-06-04 14:26:01,820 - SECONDARY (secondary1) - INFO - Artificial delay of 1.0 seconds started...
2025-06-04 17:26:02 secondary1_l2_fastapi  | 2025-06-04 14:26:02,820 - SECONDARY (secondary1) - INFO - Artificial delay finished.
2025-06-04 17:26:02 secondary1_l2_fastapi  | 2025-06-04 14:26:02,820 - SECONDARY (secondary1) - INFO - Message ID b4d4756d-72c6-4446-89c0-b27123835257 (Seq 1) appended to secondary log. Log size: 1
2025-06-04 17:26:02 secondary1_l2_fastapi  | INFO:     172.25.0.2:47836 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 17:26:26 secondary1_l2_fastapi  | 2025-06-04 14:26:26,167 - SECONDARY (secondary1) - INFO - Received replication request: ID 3843e993-8667-402c-817e-9f619a1617db, Seq 2, Msg 'Msg2_W2'
2025-06-04 17:26:26 secondary1_l2_fastapi  | 2025-06-04 14:26:26,167 - SECONDARY (secondary1) - INFO - Artificial delay of 1.0 seconds started...
2025-06-04 17:26:27 secondary1_l2_fastapi  | 2025-06-04 14:26:27,167 - SECONDARY (secondary1) - INFO - Artificial delay finished.
2025-06-04 17:26:01 master_l2_fastapi      | 2025-06-04 14:26:01,746 - MASTER - INFO - Appended to master log: ID b4d4756d-72c6-4446-89c0-b27123835257, Seq 1, Msg 'Msg1_W1', w=1
2025-06-04 17:26:01 master_l2_fastapi      | 2025-06-04 14:26:01,746 - MASTER - INFO - w=1, responding to client for msg_id b4d4756d-72c6-4446-89c0-b27123835257 immediately.
2025-06-04 17:26:01 master_l2_fastapi      | INFO:     172.25.0.1:58800 - "POST /messages HTTP/1.1" 201 Created
2025-06-04 17:26:01 master_l2_fastapi      | 2025-06-04 14:26:01,770 - MASTER - INFO - Replicating message ID b4d4756d-72c6-4446-89c0-b27123835257 (seq: 1) to http://secondary1:5001...
2025-06-04 17:26:01 master_l2_fastapi      | 2025-06-04 14:26:01,796 - MASTER - INFO - Replicating message ID b4d4756d-72c6-4446-89c0-b27123835257 (seq: 1) to http://secondary2:5002...
2025-06-04 17:26:01 master_l2_fastapi      | 2025-06-04 14:26:01,816 - MASTER - INFO - Replicating message ID b4d4756d-72c6-4446-89c0-b27123835257 (seq: 1) to http://secondary3:5003...
2025-06-04 17:26:01 master_l2_fastapi      | 2025-06-04 14:26:01,821 - MASTER - INFO - HTTP Request: POST http://secondary3:5003/replicate "HTTP/1.1 200 OK"
2025-06-04 17:26:01 master_l2_fastapi      | 2025-06-04 14:26:01,822 - MASTER - INFO - Successfully replicated message ID b4d4756d-72c6-4446-89c0-b27123835257 to http://secondary3:5003. ACK received.
2025-06-04 17:26:02 master_l2_fastapi      | 2025-06-04 14:26:02,821 - MASTER - INFO - HTTP Request: POST http://secondary1:5001/replicate "HTTP/1.1 200 OK"
2025-06-04 17:26:02 master_l2_fastapi      | 2025-06-04 14:26:02,822 - MASTER - INFO - Successfully replicated message ID b4d4756d-72c6-4446-89c0-b27123835257 to http://secondary1:5001. ACK received.
2025-06-04 17:26:04 master_l2_fastapi      | 2025-06-04 14:26:04,822 - MASTER - INFO - HTTP Request: POST http://secondary2:5002/replicate "HTTP/1.1 200 OK"
2025-06-04 17:26:04 master_l2_fastapi      | 2025-06-04 14:26:04,822 - MASTER - INFO - Successfully replicated message ID b4d4756d-72c6-4446-89c0-b27123835257 to http://secondary2:5002. ACK received.
2025-06-04 17:26:26 master_l2_fastapi      | 2025-06-04 14:26:26,106 - MASTER - INFO - Appended to master log: ID 3843e993-8667-402c-817e-9f619a1617db, Seq 2, Msg 'Msg2_W2', w=2
2025-06-04 17:26:26 master_l2_fastapi      | 2025-06-04 14:26:26,124 - MASTER - INFO - Replicating message ID 3843e993-8667-402c-817e-9f619a1617db (seq: 2) to http://secondary1:5001...
2025-06-04 17:26:26 master_l2_fastapi      | 2025-06-04 14:26:26,145 - MASTER - INFO - Replicating message ID 3843e993-8667-402c-817e-9f619a1617db (seq: 2) to http://secondary2:5002...
2025-06-04 17:26:26 master_l2_fastapi      | 2025-06-04 14:26:26,163 - MASTER - INFO - Replicating message ID 3843e993-8667-402c-817e-9f619a1617db (seq: 2) to http://secondary3:5003...
2025-06-04 17:26:26 master_l2_fastapi      | 2025-06-04 14:26:26,168 - MASTER - INFO - HTTP Request: POST http://secondary3:5003/replicate "HTTP/1.1 200 OK"
2025-06-04 17:26:26 master_l2_fastapi      | 2025-06-04 14:26:26,168 - MASTER - INFO - Successfully replicated message ID 3843e993-8667-402c-817e-9f619a1617db to http://secondary3:5003. ACK received.
2025-06-04 17:26:26 master_l2_fastapi      | 2025-06-04 14:26:26,168 - MASTER - INFO - Met write concern w=2 for message 3843e993-8667-402c-817e-9f619a1617db (1 secondary ACKs). Responding to client.
2025-06-04 17:26:29 secondary2_l2_fastapi  | 2025-06-04 14:26:29,167 - SECONDARY (secondary2) - INFO - Artificial delay finished.
2025-06-04 17:26:26 master_l2_fastapi      | INFO:     172.25.0.1:45252 - "POST /messages HTTP/1.1" 201 Created
2025-06-04 17:26:27 master_l2_fastapi      | 2025-06-04 14:26:27,168 - MASTER - INFO - HTTP Request: POST http://secondary1:5001/replicate "HTTP/1.1 200 OK"
2025-06-04 17:26:29 secondary2_l2_fastapi  | 2025-06-04 14:26:29,167 - SECONDARY (secondary2) - INFO - Message ID 3843e993-8667-402c-817e-9f619a1617db (Seq 2) appended to secondary log. Log size: 2
2025-06-04 17:26:29 secondary2_l2_fastapi  | INFO:     172.25.0.2:57410 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 17:26:27 secondary1_l2_fastapi  | 2025-06-04 14:26:27,167 - SECONDARY (secondary1) - INFO - Message ID 3843e993-8667-402c-817e-9f619a1617db (Seq 2) appended to secondary log. Log size: 2
2025-06-04 17:26:27 master_l2_fastapi      | 2025-06-04 14:26:27,169 - MASTER - INFO - Successfully replicated message ID 3843e993-8667-402c-817e-9f619a1617db to http://secondary1:5001. ACK received.
2025-06-04 17:26:27 secondary1_l2_fastapi  | INFO:     172.25.0.2:60960 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 17:26:29 master_l2_fastapi      | 2025-06-04 14:26:29,168 - MASTER - INFO - HTTP Request: POST http://secondary2:5002/replicate "HTTP/1.1 200 OK"
2025-06-04 17:26:29 master_l2_fastapi      | 2025-06-04 14:26:29,169 - MASTER - INFO - Successfully replicated message ID 3843e993-8667-402c-817e-9f619a1617db to http://secondary2:5002. ACK received.
2025-06-04 17:26:36 master_l2_fastapi      | 2025-06-04 14:26:36,235 - MASTER - INFO - Appended to master log: ID 9d62f7b8-0392-4ae1-9ab3-94b7a8bddb30, Seq 3, Msg 'Msg3_W3', w=3
2025-06-04 17:26:36 master_l2_fastapi      | 2025-06-04 14:26:36,254 - MASTER - INFO - Replicating message ID 9d62f7b8-0392-4ae1-9ab3-94b7a8bddb30 (seq: 3) to http://secondary1:5001...
2025-06-04 17:26:36 master_l2_fastapi      | 2025-06-04 14:26:36,275 - MASTER - INFO - Replicating message ID 9d62f7b8-0392-4ae1-9ab3-94b7a8bddb30 (seq: 3) to http://secondary2:5002...
2025-06-04 17:26:36 secondary2_l2_fastapi  | 2025-06-04 14:26:36,301 - SECONDARY (secondary2) - INFO - Received replication request: ID 9d62f7b8-0392-4ae1-9ab3-94b7a8bddb30, Seq 3, Msg 'Msg3_W3'
2025-06-04 17:26:36 secondary2_l2_fastapi  | 2025-06-04 14:26:36,301 - SECONDARY (secondary2) - INFO - Artificial delay of 3.0 seconds started...
2025-06-04 17:26:36 master_l2_fastapi      | 2025-06-04 14:26:36,295 - MASTER - INFO - Replicating message ID 9d62f7b8-0392-4ae1-9ab3-94b7a8bddb30 (seq: 3) to http://secondary3:5003...
2025-06-04 17:26:39 secondary2_l2_fastapi  | 2025-06-04 14:26:39,301 - SECONDARY (secondary2) - INFO - Artificial delay finished.
2025-06-04 17:26:36 master_l2_fastapi      | 2025-06-04 14:26:36,302 - MASTER - INFO - HTTP Request: POST http://secondary3:5003/replicate "HTTP/1.1 200 OK"
2025-06-04 17:26:39 secondary2_l2_fastapi  | 2025-06-04 14:26:39,301 - SECONDARY (secondary2) - INFO - Message ID 9d62f7b8-0392-4ae1-9ab3-94b7a8bddb30 (Seq 3) appended to secondary log. Log size: 3
2025-06-04 17:26:39 secondary2_l2_fastapi  | INFO:     172.25.0.2:36382 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 17:26:36 secondary1_l2_fastapi  | 2025-06-04 14:26:36,301 - SECONDARY (secondary1) - INFO - Received replication request: ID 9d62f7b8-0392-4ae1-9ab3-94b7a8bddb30, Seq 3, Msg 'Msg3_W3'
2025-06-04 17:26:36 secondary1_l2_fastapi  | 2025-06-04 14:26:36,301 - SECONDARY (secondary1) - INFO - Artificial delay of 1.0 seconds started...
```



```
2025-06-04 17:26:39 secondary2_l2_fastapi  | 2025-06-04 14:26:39,301 - SECONDARY (secondary2) - INFO - Message ID 9d62f7b8-0392-4ae1-9ab3-94b7a8bddb30 (Seq 3) appended to secondary log. Log size: 3
2025-06-04 17:26:39 secondary2_l2_fastapi  | INFO:     172.25.0.2:36382 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 17:26:36 secondary1_l2_fastapi  | 2025-06-04 14:26:36,301 - SECONDARY (secondary1) - INFO - Received replication request: ID 9d62f7b8-0392-4ae1-9ab3-94b7a8bddb30, Seq 3, Msg 'Msg3_W3'
2025-06-04 17:26:36 secondary1_l2_fastapi  | 2025-06-04 14:26:36,301 - SECONDARY (secondary1) - INFO - Artificial delay of 1.0 seconds started...
2025-06-04 17:26:37 secondary1_l2_fastapi  | 2025-06-04 14:26:37,302 - SECONDARY (secondary1) - INFO - Artificial delay finished.
2025-06-04 17:26:37 secondary1_l2_fastapi  | 2025-06-04 14:26:37,302 - SECONDARY (secondary1) - INFO - Message ID 9d62f7b8-0392-4ae1-9ab3-94b7a8bddb30 (Seq 3) appended to secondary log. Log size: 3
2025-06-04 17:26:36 master_l2_fastapi      | 2025-06-04 14:26:36,303 - MASTER - INFO - Successfully replicated message ID 9d62f7b8-0392-4ae1-9ab3-94b7a8bddb30 to http://secondary3:5003. ACK received.
2025-06-04 17:26:37 secondary1_l2_fastapi  | INFO:     172.25.0.2:57072 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 17:26:54 secondary2_l2_fastapi  | 2025-06-04 14:26:54,087 - SECONDARY (secondary2) - INFO - Received replication request: ID cfd5c873-620b-45db-8a3f-34b1b7787c04, Seq 4, Msg 'Msg4_W4'
2025-06-04 17:26:54 secondary2_l2_fastapi  | 2025-06-04 14:26:54,087 - SECONDARY (secondary2) - INFO - Artificial delay of 3.0 seconds started...
2025-06-04 17:26:54 secondary1_l2_fastapi  | 2025-06-04 14:26:54,087 - SECONDARY (secondary1) - INFO - Received replication request: ID cfd5c873-620b-45db-8a3f-34b1b7787c04, Seq 4, Msg 'Msg4_W4'
2025-06-04 17:26:57 secondary2_l2_fastapi  | 2025-06-04 14:26:57,088 - SECONDARY (secondary2) - INFO - Artificial delay finished.
2025-06-04 17:26:54 secondary1_l2_fastapi  | 2025-06-04 14:26:54,087 - SECONDARY (secondary1) - INFO - Artificial delay of 1.0 seconds started...
2025-06-04 17:26:37 master_l2_fastapi      | 2025-06-04 14:26:37,303 - MASTER - INFO - HTTP Request: POST http://secondary1:5001/replicate "HTTP/1.1 200 OK"
2025-06-04 17:26:55 secondary1_l2_fastapi  | 2025-06-04 14:26:55,088 - SECONDARY (secondary1) - INFO - Artificial delay finished.
2025-06-04 17:26:57 secondary2_l2_fastapi  | 2025-06-04 14:26:57,088 - SECONDARY (secondary2) - INFO - Message ID cfd5c873-620b-45db-8a3f-34b1b7787c04 (Seq 4) appended to secondary log. Log size: 4
2025-06-04 17:26:55 secondary1_l2_fastapi  | 2025-06-04 14:26:55,088 - SECONDARY (secondary1) - INFO - Message ID cfd5c873-620b-45db-8a3f-34b1b7787c04 (Seq 4) appended to secondary log. Log size: 4
2025-06-04 17:26:55 secondary1_l2_fastapi  | INFO:     172.25.0.2:39450 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 17:26:57 secondary2_l2_fastapi  | INFO:     172.25.0.2:57568 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 17:28:27 secondary2_l2_fastapi  | 2025-06-04 14:28:27,663 - SECONDARY (secondary2) - INFO - Received replication request: ID 235bd68c-5a6b-4f9b-bb8b-16d7cb6e3f43, Seq 5, Msg 'Msg_DuplicationTest_W
1'
2025-06-04 17:26:37 master_l2_fastapi      | 2025-06-04 14:26:37,303 - MASTER - INFO - Successfully replicated message ID 9d62f7b8-0392-4ae1-9ab3-94b7a8bddb30 to http://secondary1:5001. ACK received.
2025-06-04 17:28:27 secondary2_l2_fastapi  | 2025-06-04 14:28:27,663 - SECONDARY (secondary2) - INFO - Artificial delay of 3.0 seconds started...
2025-06-04 17:26:37 master_l2_fastapi      | 2025-06-04 14:26:37,303 - MASTER - INFO - Met write concern w=3 for message 9d62f7b8-0392-4ae1-9ab3-94b7a8bddb30 (2 secondary ACKs). Responding to client.
2025-06-04 17:28:27 secondary1_l2_fastapi  | 2025-06-04 14:28:27,663 - SECONDARY (secondary1) - INFO - Received replication request: ID 235bd68c-5a6b-4f9b-bb8b-16d7cb6e3f43, Seq 5, Msg 'Msg_DuplicationTest_W
1'
2025-06-04 17:28:27 secondary1_l2_fastapi  | 2025-06-04 14:28:27,663 - SECONDARY (secondary1) - INFO - Artificial delay of 1.0 seconds started...
2025-06-04 17:28:28 secondary2_l2_fastapi  | 2025-06-04 14:28:28,267 - SECONDARY (secondary2) - INFO - Received replication request: ID 7e103df3-3624-4a91-a1a3-29ec86c11b58, Seq 6, Msg 'Msg_DuplicationTest_W
1'
2025-06-04 17:26:37 master_l2_fastapi      | INFO:     172.25.0.1:46310 - "POST /messages HTTP/1.1" 201 Created
2025-06-04 17:26:39 master_l2_fastapi      | 2025-06-04 14:26:39,302 - MASTER - INFO - HTTP Request: POST http://secondary2:5002/replicate "HTTP/1.1 200 OK"
2025-06-04 17:28:28 secondary2_l2_fastapi  | 2025-06-04 14:28:28,267 - SECONDARY (secondary2) - INFO - Artificial delay of 3.0 seconds started...
2025-06-04 17:28:30 secondary2_l2_fastapi  | 2025-06-04 14:28:30,664 - SECONDARY (secondary2) - INFO - Artificial delay finished.
2025-06-04 17:28:30 secondary2_l2_fastapi  | 2025-06-04 14:28:30,664 - SECONDARY (secondary2) - INFO - Message ID 235bd68c-5a6b-4f9b-bb8b-16d7cb6e3f43 (Seq 5) appended to secondary log. Log size: 5
2025-06-04 17:28:28 secondary1_l2_fastapi  | 2025-06-04 14:28:28,267 - SECONDARY (secondary1) - INFO - Received replication request: ID 7e103df3-3624-4a91-a1a3-29ec86c11b58, Seq 6, Msg 'Msg_DuplicationTest_W
1'
2025-06-04 17:28:30 secondary2_l2_fastapi  | INFO:     172.25.0.2:47458 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 17:28:28 secondary1_l2_fastapi  | 2025-06-04 14:28:28,267 - SECONDARY (secondary1) - INFO - Artificial delay of 1.0 seconds started...
2025-06-04 17:28:28 secondary1_l2_fastapi  | 2025-06-04 14:28:28,663 - SECONDARY (secondary1) - INFO - Artificial delay finished.
2025-06-04 17:28:31 secondary2_l2_fastapi  | 2025-06-04 14:28:31,268 - SECONDARY (secondary2) - INFO - Artificial delay finished.
2025-06-04 17:28:31 secondary2_l2_fastapi  | 2025-06-04 14:28:31,268 - SECONDARY (secondary2) - INFO - Message ID 7e103df3-3624-4a91-a1a3-29ec86c11b58 (Seq 6) appended to secondary log. Log size: 6
2025-06-04 17:28:31 secondary2_l2_fastapi  | INFO:     172.25.0.2:56148 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 17:28:28 secondary1_l2_fastapi  | 2025-06-04 14:28:28,663 - SECONDARY (secondary1) - INFO - Message ID 235bd68c-5a6b-4f9b-bb8b-16d7cb6e3f43 (Seq 5) appended to secondary log. Log size: 5
2025-06-04 17:28:28 secondary1_l2_fastapi  | INFO:     172.25.0.2:47228 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 17:28:29 secondary1_l2_fastapi  | 2025-06-04 14:28:29,268 - SECONDARY (secondary1) - INFO - Artificial delay finished.
2025-06-04 17:28:29 secondary1_l2_fastapi  | 2025-06-04 14:28:29,268 - SECONDARY (secondary1) - INFO - Message ID 7e103df3-3624-4a91-a1a3-29ec86c11b58 (Seq 6) appended to secondary log. Log size: 6
2025-06-04 17:28:29 secondary1_l2_fastapi  | INFO:     172.25.0.2:47762 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 17:26:39 master_l2_fastapi      | 2025-06-04 14:26:39,303 - MASTER - INFO - Successfully replicated message ID 9d62f7b8-0392-4ae1-9ab3-94b7a8bddb30 to http://secondary2:5002. ACK received.
```



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2025-06-04 17:28:29 secondary1_l2_fastapi  | INFO:     172.25.0.2:47762 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 17:26:39 master_l2_fastapi      | 2025-06-04 14:26:39,303 - MASTER - INFO - Successfully replicated message ID 9d62f7b8-0392-4ae1-9ab3-94b7a8bddb30 to http://secondary2:5002. ACK received.
2025-06-04 17:26:54 master_l2_fastapi      | 2025-06-04 14:26:54,033 - MASTER - INFO - Appended to master log: ID cfd5c873-620b-45db-8a3f-34b1b7787c04, Seq 4, Msg 'Msg4_W4', w=4
2025-06-04 17:26:54 master_l2_fastapi      | 2025-06-04 14:26:54,051 - MASTER - INFO - Replicating message ID cfd5c873-620b-45db-8a3f-34b1b7787c04 (seq: 4) to http://secondary1:5001...
2025-06-04 17:26:54 master_l2_fastapi      | 2025-06-04 14:26:54,068 - MASTER - INFO - Replicating message ID cfd5c873-620b-45db-8a3f-34b1b7787c04 (seq: 4) to http://secondary2:5002...
2025-06-04 17:26:54 master_l2_fastapi      | 2025-06-04 14:26:54,084 - MASTER - INFO - Replicating message ID cfd5c873-620b-45db-8a3f-34b1b7787c04 (seq: 4) to http://secondary3:5003...
2025-06-04 17:26:54 master_l2_fastapi      | 2025-06-04 14:26:54,088 - MASTER - INFO - HTTP Request: POST http://secondary3:5003/replicate "HTTP/1.1 200 OK"
2025-06-04 17:26:54 master_l2_fastapi      | 2025-06-04 14:26:54,089 - MASTER - INFO - Successfully replicated message ID cfd5c873-620b-45db-8a3f-34b1b7787c04 to http://secondary3:5003. ACK received.
2025-06-04 17:26:55 master_l2_fastapi      | 2025-06-04 14:26:55,089 - MASTER - INFO - HTTP Request: POST http://secondary1:5001/replicate "HTTP/1.1 200 OK"
2025-06-04 17:26:55 master_l2_fastapi      | 2025-06-04 14:26:55,089 - MASTER - INFO - Successfully replicated message ID cfd5c873-620b-45db-8a3f-34b1b7787c04 to http://secondary1:5001. ACK received.
2025-06-04 17:26:57 master_l2_fastapi      | 2025-06-04 14:26:57,089 - MASTER - INFO - HTTP Request: POST http://secondary2:5002/replicate "HTTP/1.1 200 OK"
2025-06-04 17:26:57 master_l2_fastapi      | 2025-06-04 14:26:57,090 - MASTER - INFO - Successfully replicated message ID cfd5c873-620b-45db-8a3f-34b1b7787c04 to http://secondary2:5002. ACK received.
2025-06-04 17:26:57 master_l2_fastapi      | 2025-06-04 14:26:57,090 - MASTER - INFO - Met write concern w=4 for message cfd5c873-620b-45db-8a3f-34b1b7787c04 (3 secondary ACKs). Responding to client.
2025-06-04 17:26:57 master_l2_fastapi      | INFO:     172.25.0.1:57250 - "POST /messages HTTP/1.1" 201 Created
2025-06-04 17:28:27 master_l2_fastapi      | 2025-06-04 14:28:27,596 - MASTER - INFO - Appended to master log: ID 235bd68c-5a6b-4f9b-bb8b-16d7cb6e3f43, Seq 5, Msg 'Msg_DuplicationTest_W1', w=1
2025-06-04 17:28:27 master_l2_fastapi      | 2025-06-04 14:28:27,596 - MASTER - INFO - w=1, responding to client for msg_id 235bd68c-5a6b-4f9b-bb8b-16d7cb6e3f43 immediately.
2025-06-04 17:28:27 master_l2_fastapi      | INFO:     172.25.0.1:57640 - "POST /messages HTTP/1.1" 201 Created
2025-06-04 17:28:27 master_l2_fastapi      | 2025-06-04 14:28:27,614 - MASTER - INFO - Replicating message ID 235bd68c-5a6b-4f9b-bb8b-16d7cb6e3f43 (seq: 5) to http://secondary1:5001...
2025-06-04 17:28:27 master_l2_fastapi      | 2025-06-04 14:28:27,632 - MASTER - INFO - Replicating message ID 235bd68c-5a6b-4f9b-bb8b-16d7cb6e3f43 (seq: 5) to http://secondary2:5002...
2025-06-04 17:28:27 master_l2_fastapi      | 2025-06-04 14:28:27,653 - MASTER - INFO - Replicating message ID 235bd68c-5a6b-4f9b-bb8b-16d7cb6e3f43 (seq: 5) to http://secondary3:5003...
2025-06-04 17:28:27 master_l2_fastapi      | 2025-06-04 14:28:27,665 - MASTER - INFO - HTTP Request: POST http://secondary3:5003/replicate "HTTP/1.1 200 OK"
2025-06-04 17:28:27 master_l2_fastapi      | 2025-06-04 14:28:27,665 - MASTER - INFO - Successfully replicated message ID 235bd68c-5a6b-4f9b-bb8b-16d7cb6e3f43 to http://secondary3:5003. ACK received.
2025-06-04 17:28:28 master_l2_fastapi      | 2025-06-04 14:28:28,205 - MASTER - INFO - Appended to master log: ID 7e103df3-3624-4a91-a1a3-29ec86c11b58, Seq 6, Msg 'Msg_DuplicationTest_W1', w=1
2025-06-04 17:28:28 master_l2_fastapi      | 2025-06-04 14:28:28,205 - MASTER - INFO - w=1, responding to client for msg_id 7e103df3-3624-4a91-a1a3-29ec86c11b58 immediately.
2025-06-04 17:28:28 master_l2_fastapi      | INFO:     172.25.0.1:57640 - "POST /messages HTTP/1.1" 201 Created
2025-06-04 17:28:28 master_l2_fastapi      | 2025-06-04 14:28:28,226 - MASTER - INFO - Replicating message ID 7e103df3-3624-4a91-a1a3-29ec86c11b58 (seq: 6) to http://secondary1:5001...
2025-06-04 17:28:28 master_l2_fastapi      | 2025-06-04 14:28:28,244 - MASTER - INFO - Replicating message ID 7e103df3-3624-4a91-a1a3-29ec86c11b58 (seq: 6) to http://secondary2:5002...
2025-06-04 17:28:28 master_l2_fastapi      | 2025-06-04 14:28:28,263 - MASTER - INFO - Replicating message ID 7e103df3-3624-4a91-a1a3-29ec86c11b58 (seq: 6) to http://secondary3:5003...
2025-06-04 17:28:28 master_l2_fastapi      | 2025-06-04 14:28:28,269 - MASTER - INFO - HTTP Request: POST http://secondary3:5003/replicate "HTTP/1.1 200 OK"
2025-06-04 17:28:28 master_l2_fastapi      | 2025-06-04 14:28:28,269 - MASTER - INFO - Successfully replicated message ID 7e103df3-3624-4a91-a1a3-29ec86c11b58 to http://secondary3:5003. ACK received.
2025-06-04 17:28:28 master_l2_fastapi      | 2025-06-04 14:28:28,664 - MASTER - INFO - HTTP Request: POST http://secondary1:5001/replicate "HTTP/1.1 200 OK"
2025-06-04 17:28:28 master_l2_fastapi      | 2025-06-04 14:28:28,665 - MASTER - INFO - Successfully replicated message ID 235bd68c-5a6b-4f9b-bb8b-16d7cb6e3f43 to http://secondary1:5001. ACK received.
2025-06-04 17:28:29 master_l2_fastapi      | 2025-06-04 14:28:29,269 - MASTER - INFO - HTTP Request: POST http://secondary1:5001/replicate "HTTP/1.1 200 OK"
2025-06-04 17:28:29 master_l2_fastapi      | 2025-06-04 14:28:29,269 - MASTER - INFO - Successfully replicated message ID 7e103df3-3624-4a91-a1a3-29ec86c11b58 to http://secondary1:5001. ACK received.
2025-06-04 17:28:30 master_l2_fastapi      | INFO:     172.25.0.1:57640 - "GET /messages HTTP/1.1" 200 OK
2025-06-04 17:28:30 master_l2_fastapi      | 2025-06-04 14:28:30,665 - MASTER - INFO - HTTP Request: POST http://secondary2:5002/replicate "HTTP/1.1 200 OK"
2025-06-04 17:28:30 master_l2_fastapi      | 2025-06-04 14:28:30,665 - MASTER - INFO - Successfully replicated message ID 235bd68c-5a6b-4f9b-bb8b-16d7cb6e3f43 to http://secondary2:5002. ACK received.
2025-06-04 17:28:31 master_l2_fastapi      | 2025-06-04 14:28:31,269 - MASTER - INFO - HTTP Request: POST http://secondary2:5002/replicate "HTTP/1.1 200 OK"
2025-06-04 17:28:31 master_l2_fastapi      | 2025-06-04 14:28:31,269 - MASTER - INFO - Successfully replicated message ID 7e103df3-3624-4a91-a1a3-29ec86c11b58 to http://secondary2:5002. ACK received.
```

Iteration 3.

Task

The current iteration should provide tunable semi-synchronicity for replication with a *retry* mechanism that should deliver all messages *exactly-once* in total order.

Main features:

- If message delivery fails (due to connection, or internal server error, or secondary is unavailable) the delivery attempts should be repeated - *retry*
    - If one of the secondaries is down and *w=3*, the client should be blocked until the node becomes available. Clients running in parallel shouldn't be blocked by the blocked one.
    - If *w>1* the client should be blocked until the message will be delivered to all secondaries required by the write concern level. Clients running in parallel shouldn't be blocked by the blocked one.
    - All messages that secondaries have missed due to unavailability should be replicated after (re)joining the master
    - Retries can be implemented with an unlimited number of attempts but, possibly, with some "smart" delays logic
    - You can specify a *timeout* for the master in case if there is no response from the secondary
- All messages should be present exactly once in the secondary log - *deduplication*
    - To test deduplication you can generate some random internal server error response from the secondary after the message has been added to the log
- The order of messages should be the same in all nodes - *total order*
    - If secondary has received messages *[msg1, msg2, msg4]*, it shouldn't display the message *'msg4'* until the *'msg3'* will be received
    - To test the total order, you can generate some random internal server error response from the secondaries

Self-check acceptance test:

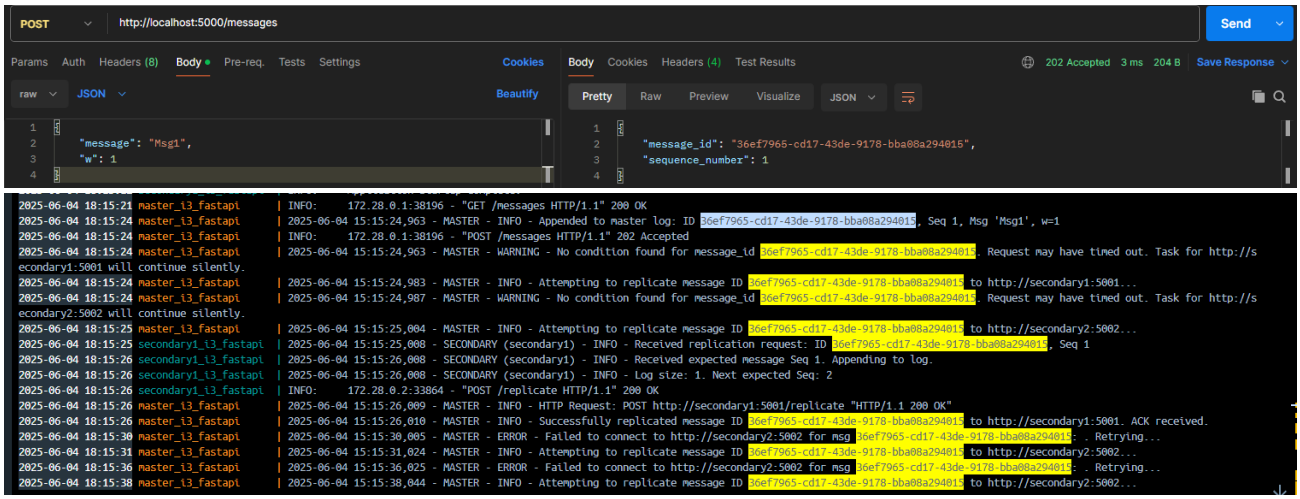
1. Start M + S1
2. send (Msg1, W=1) - Ok

3. send (Msg2, W=2) - Ok
4. send (Msg3, W=3) - Wait
5. send (Msg4, W=1) - Ok
6. Start S2
7. Check messages on S2 - [Msg1, Msg2, Msg3, Msg4]

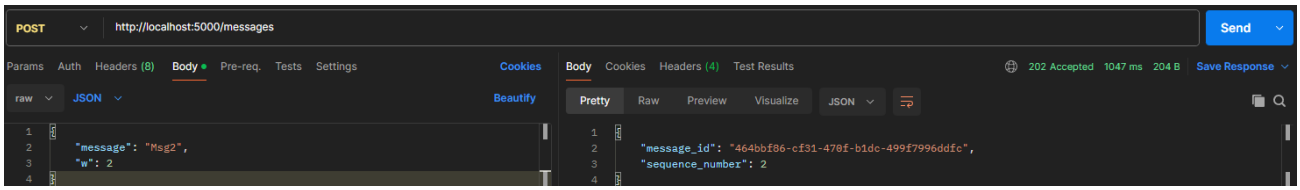
Demonstration:

1. Start M + S1

2. send (Msg1, W=1) - Ok



3. send (Msg2, W=2) – Ok



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2025-06-04 18:15:52 master_i3_fastapi      | 2025-06-04 15:15:52,067 - MASTER - ERROR - Failed to connect to http://secondary2:5002 for msg 36ef7965-cd17-43de-9178-bba08a294015: . Retrying...
2025-06-04 18:15:59 master_i3_fastapi      | 2025-06-04 15:15:59,463 - MASTER - INFO - Appended to master log: ID 464bbf86-cf31-470f-b1dc-499f7996ddfc, Seq 2, Msg 'Msg2', w=2
2025-06-04 18:15:59 master_i3_fastapi      | 2025-06-04 15:15:59,480 - MASTER - INFO - Attempting to replicate message ID 464bbf86-cf31-470f-b1dc-499f7996ddfc to http://secondary1:5001...
2025-06-04 18:15:59 master_i3_fastapi      | 2025-06-04 15:15:59,498 - MASTER - INFO - Attempting to replicate message ID 464bbf86-cf31-470f-b1dc-499f7996ddfc to http://secondary2:5002...
2025-06-04 18:15:59 secondary1_i3_fastapi  | 2025-06-04 15:15:59,501 - SECONDARY (secondary1) - INFO - Received replication request: ID 464bbf86-cf31-470f-b1dc-499f7996ddfc, Seq 2
2025-06-04 18:16:00 master_i3_fastapi      | 2025-06-04 15:16:00,088 - MASTER - INFO - Attempting to replicate message ID 36ef7965-cd17-43de-9178-bba08a294015 to http://secondary2:5002...
2025-06-04 18:16:00 secondary1_i3_fastapi  | 2025-06-04 15:16:00,502 - SECONDARY (secondary1) - INFO - Received expected message Seq 2. Appending to log.
2025-06-04 18:16:00 secondary1_i3_fastapi  | 2025-06-04 15:16:00,502 - SECONDARY (secondary1) - INFO - Log size: 2. Next expected Seq: 3
2025-06-04 18:16:00 secondary1_i3_fastapi  | INFO:     172.28.0.2:44898 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 18:16:00 master_i3_fastapi      | 2025-06-04 15:16:00,503 - MASTER - INFO - HTTP Request: POST http://secondary1:5001/replicate "HTTP/1.1 200 OK"
2025-06-04 18:16:00 master_i3_fastapi      | 2025-06-04 15:16:00,504 - MASTER - INFO - Successfully replicated message ID 464bbf86-cf31-470f-b1dc-499f7996ddfc to http://secondary1:5001. ACK received.
2025-06-04 18:16:00 master_i3_fastapi      | 2025-06-04 15:16:00,504 - MASTER - INFO - Met write concern w=2 for message 464bbf86-cf31-470f-b1dc-499f7996ddfc with 2 ACKs.
2025-06-04 18:16:00 master_i3_fastapi      | INFO:     172.28.0.1:42608 - "POST /messages HTTP/1.1" 202 Accepted
2025-06-04 18:16:04 master_i3_fastapi      | 2025-06-04 15:16:04,500 - MASTER - ERROR - Failed to connect to http://secondary2:5002 for msg 464bbf86-cf31-470f-b1dc-499f7996ddfc: . Retrying...
2025-06-04 18:16:05 master_i3_fastapi      | 2025-06-04 15:16:05,090 - MASTER - ERROR - Failed to connect to http://secondary2:5002 for msg 36ef7965-cd17-43de-9178-bba08a294015: . Retrying...
2025-06-04 18:16:05 master_i3_fastapi      | 2025-06-04 15:16:05,521 - MASTER - INFO - Attempting to replicate message ID 464bbf86-cf31-470f-b1dc-499f7996ddfc to http://secondary2:5002...
2025-06-04 18:16:10 master_i3_fastapi      | 2025-06-04 15:16:10,523 - MASTER - ERROR - Failed to connect to http://secondary2:5002 for msg 464bbf86-cf31-470f-b1dc-499f7996ddfc: . Retrying...
2025-06-04 18:16:12 master_i3_fastapi      | 2025-06-04 15:16:12,541 - MASTER - INFO - Attempting to replicate message ID 464bbf86-cf31-470f-b1dc-499f7996ddfc to http://secondary2:5002...
2025-06-04 18:16:17 master_i3_fastapi      | 2025-06-04 15:16:17,543 - MASTER - ERROR - Failed to connect to http://secondary2:5002 for msg 464bbf86-cf31-470f-b1dc-499f7996ddfc: . Retrying...
2025-06-04 18:16:21 master_i3_fastapi      | 2025-06-04 15:16:21,110 - MASTER - INFO - Attempting to replicate message ID 36ef7965-cd17-43de-9178-bba08a294015 to http://secondary2:5002...
2025-06-04 18:16:21 master_i3_fastapi      | 2025-06-04 15:16:21,560 - MASTER - INFO - Attempting to replicate message ID 464bbf86-cf31-470f-b1dc-499f7996ddfc to http://secondary2:5002...
```
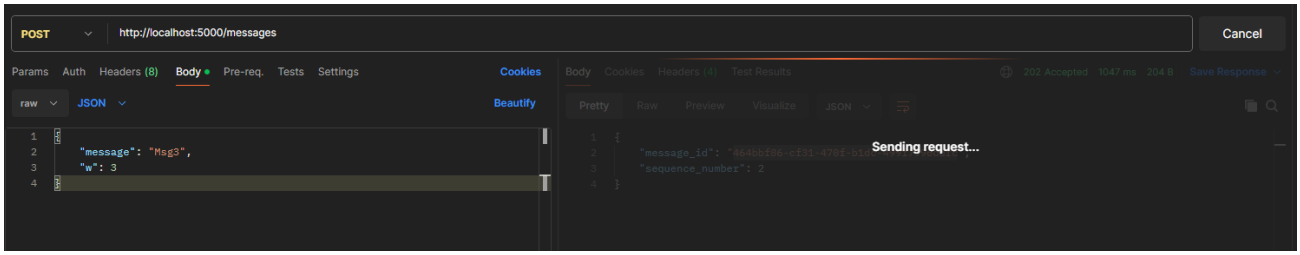
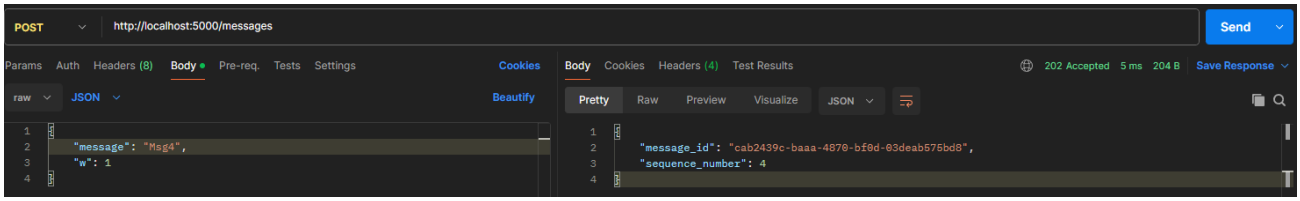

4. send (Msg3, W=3) – Wait



5. send (Msg4, W=1) – Ok




```
2025-06-04 18:17:05 master_i3_fastapi      | 2025-06-04 15:17:05,993 - MASTER - INFO - Appended to master log: ID cab2439c-baaa-4870-bf0d-03deab575bd8, Seq 4, Msg 'Msg4', w=1
2025-06-04 18:17:05 master_i3_fastapi      | INFO:     172.28.0.1:59686 - "POST /messages HTTP/1.1" 202 Accepted
2025-06-04 18:17:05 master_i3_fastapi      | 2025-06-04 15:17:05,994 - MASTER - WARNING - No condition found for message_id cab2439c-baaa-4870-bf0d-03deab575bd8: Request may have timed out. Task for http://s
econdary1:5001 will continue silently.
2025-06-04 18:17:06 master_i3_fastapi      | 2025-06-04 15:17:06,017 - MASTER - INFO - Attempting to replicate message ID cab2439c-baaa-4870-bf0d-03deab575bd8 to http://secondary1:5001...
2025-06-04 18:17:06 master_i3_fastapi      | 2025-06-04 15:17:06,018 - MASTER - WARNING - No condition found for message_id cab2439c-baaa-4870-bf0d-03deab575bd8: Request may have timed out. Task for http://s
econdary2:5002 will continue silently.
2025-06-04 18:17:06 master_i3_fastapi      | 2025-06-04 15:17:06,041 - MASTER - INFO - Attempting to replicate message ID cab2439c-baaa-4870-bf0d-03deab575bd8 to http://secondary2:5002...
2025-06-04 18:17:10 master_i3_fastapi      | 2025-06-04 15:17:10,125 - MASTER - ERROR - Failed to connect to http://secondary2:5002 for msg 7b9a8fcb-23c3-4990-bcce-6e22a865a553: . Retrying...
2025-06-04 18:17:11 master_i3_fastapi      | 2025-06-04 15:17:11,045 - MASTER - ERROR - Failed to connect to http://secondary1:5001 for msg cab2439c-baaa-4870-bf0d-03deab575bd8: . Retrying...
2025-06-04 18:17:11 master_i3_fastapi      | 2025-06-04 15:17:11,045 - MASTER - ERROR - Failed to connect to http://secondary2:5002 for msg cab2439c-baaa-4870-bf0d-03deab575bd8: . Retrying...
2025-06-04 18:17:12 master_i3_fastapi      | 2025-06-04 15:17:12,064 - MASTER - INFO - Attempting to replicate message ID cab2439c-baaa-4870-bf0d-03deab575bd8 to http://secondary1:5001...
2025-06-04 18:17:12 master_i3_fastapi      | 2025-06-04 15:17:12,085 - MASTER - INFO - Attempting to replicate message ID cab2439c-baaa-4870-bf0d-03deab575bd8 to http://secondary2:5002...
2025-06-04 18:17:13 master_i3_fastapi      | 2025-06-04 15:17:13,026 - MASTER - ERROR - Timeout waiting for w=3 ACKs for message 7b9a8fcb-23c3-4990-bcce-6e22a865a553. Have 2 ACKs.
2025-06-04 18:17:13 secondary1_i3_fastapi  | 2025-06-04 15:17:13,130 - SECONDARY (secondary1) - INFO - Received replication request: ID cab2439c-baaa-4870-bf0d-03deab575bd8, Seq 4
2025-06-04 18:17:14 secondary1_i3_fastapi  | 2025-06-04 15:17:14,131 - SECONDARY (secondary1) - INFO - Received expected message Seq 4. Appending to log.
2025-06-04 18:17:14 secondary1_i3_fastapi  | 2025-06-04 15:17:14,131 - SECONDARY (secondary1) - INFO - Log size: 4. Next expected Seq: 5
2025-06-04 18:17:14 secondary1_i3_fastapi  | INFO:     172.28.0.2:42196 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 18:17:14 master_i3_fastapi      | 2025-06-04 15:17:14,132 - MASTER - INFO - HTTP Request: POST http://secondary1:5001/replicate "HTTP/1.1 200 OK"
2025-06-04 18:17:14 master_i3_fastapi      | 2025-06-04 15:17:14,133 - MASTER - INFO - Successfully replicated message ID cab2439c-baaa-4870-bf0d-03deab575bd8 to http://secondary1:5001. ACK received.
2025-06-04 18:17:14 master_i3_fastapi      | 2025-06-04 15:17:14,133 - MASTER - WARNING - Secondary http://secondary1:5001 is now HEALTHY.
2025-06-04 18:17:17 master_i3_fastapi      | 2025-06-04 15:17:17,086 - MASTER - ERROR - Failed to connect to http://secondary2:5002 for msg cab2439c-baaa-4870-bf0d-03deab575bd8: . Retrying...
2025-06-04 18:17:18 master_i3_fastapi      | 2025-06-04 15:17:18,148 - MASTER - INFO - Attempting to replicate message ID 7b9a8fcb-23c3-4990-bcce-6e22a865a553 to http://secondary2:5002...
2025-06-04 18:17:19 master_i3_fastapi      | 2025-06-04 15:17:19,107 - MASTER - INFO - Attempting to replicate message ID cab2439c-baaa-4870-bf0d-03deab575bd8 to http://secondary2:5002...
2025-06-04 18:17:23 master_i3_fastapi      | 2025-06-04 15:17:23,149 - MASTER - ERROR - Failed to connect to http://secondary2:5002 for msg 7b9a8fcb-23c3-4990-bcce-6e22a865a553: . Retrying...
2025-06-04 18:17:24 master_i3_fastapi      | 2025-06-04 15:17:24,108 - MASTER - ERROR - Failed to connect to http://secondary2:5002 for msg cab2439c-baaa-4870-bf0d-03deab575bd8: . Retrying...
```

6. Start S2

```
2025-06-04 18:12:42 INFO:     Will watch for changes in these directories: ['/app']
2025-06-04 18:12:42 INFO:     Uvicorn running on http://0.0.0.0:5002 (Press CTRL+C to quit)
2025-06-04 18:12:42 INFO:     Started reloader process [7] using WatchFiles
2025-06-04 18:12:43 INFO:     Started server process [9]
2025-06-04 18:12:43 INFO:     Waiting for application startup.
2025-06-04 18:12:43 INFO:     Application startup complete.
2025-06-04 18:14:34 INFO:     Will watch for changes in these directories: ['/app']
2025-06-04 18:14:34 INFO:     Uvicorn running on http://0.0.0.0:5002 (Press CTRL+C to quit)
2025-06-04 18:14:34 INFO:     Started reloader process [7] using WatchFiles
2025-06-04 18:14:34 INFO:     Started server process [9]
2025-06-04 18:14:34 INFO:     Waiting for application startup.
2025-06-04 18:14:34 INFO:     Application startup complete.
2025-06-04 18:14:34 2025-06-04 15:14:34,880 - SECONDARY (secondary2) - INFO - Received replication request: ID f3897719-fd96-47da-b40f-601f7d47101b, Seq 3
2025-06-04 18:14:34 2025-06-04 15:14:34,880 - SECONDARY (secondary2) - WARNING - Received out-of-order message Seq 3. Expected 1. Buffering.
2025-06-04 18:14:36 2025-06-04 15:14:36,271 - SECONDARY (secondary2) - INFO - Received replication request: ID b869b723-45b3-4141-a0c1-03502097cb2b, Seq 2
2025-06-04 18:14:36 2025-06-04 15:14:36,271 - SECONDARY (secondary2) - WARNING - Received out-of-order message Seq 2. Expected 1. Buffering.
2025-06-04 18:14:41 2025-06-04 15:14:41,950 - SECONDARY (secondary2) - INFO - Received replication request: ID 9c638a02-940a-46eb-87b3-d3d70e8ea64b, Seq 1
2025-06-04 18:14:41 2025-06-04 15:14:41,951 - SECONDARY (secondary2) - INFO - Received expected message Seq 1. Appending to log.
2025-06-04 18:14:41 2025-06-04 15:14:41,951 - SECONDARY (secondary2) - INFO - Log size: 1. Next expected Seq: 2
2025-06-04 18:14:41 2025-06-04 15:14:41,951 - SECONDARY (secondary2) - INFO - Processing buffered message Seq 2...
2025-06-04 18:14:41 2025-06-04 15:14:41,951 - SECONDARY (secondary2) - INFO - Log size: 2. Next expected Seq: 3
2025-06-04 18:14:41 2025-06-04 15:14:41,951 - SECONDARY (secondary2) - INFO - Processing buffered message Seq 3...
2025-06-04 18:14:41 2025-06-04 15:14:41,951 - SECONDARY (secondary2) - INFO - Log size: 3. Next expected Seq: 4
2025-06-04 18:17:47 INFO:     Will watch for changes in these directories: ['/app']
2025-06-04 18:17:47 INFO:     Uvicorn running on http://0.0.0.0:5002 (Press CTRL+C to quit)
2025-06-04 18:17:47 INFO:     Started reloader process [7] using WatchFiles
2025-06-04 18:17:47 INFO:     Started server process [9]
2025-06-04 18:17:47 INFO:     Waiting for application startup.
2025-06-04 18:17:47 INFO:     Application startup complete.
2025-06-04 18:14:34 INFO:     172.28.0.2:57742 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 18:14:36 INFO:     172.28.0.2:57746 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 18:14:41 INFO:     172.28.0.2:50468 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 18:18:02 2025-06-04 15:18:02,171 - SECONDARY (secondary2) - INFO - Received replication request: ID cab2439c-baaa-4870-bf0d-03deab575bd8, Seq 4
2025-06-04 18:18:02 2025-06-04 15:18:02,172 - SECONDARY (secondary2) - WARNING - Received out-of-order message Seq 4. Expected 1. Buffering.
2025-06-04 18:18:02 INFO:     172.28.0.2:52188 - "POST /replicate HTTP/1.1" 200 OK
2025-06-04 18:18:03 2025-06-04 15:18:03,152 - SECONDARY (secondary2) - INFO - Received replication request: ID 36ef7965-cd17-43de-9178-bba08a294015, Seq 1
2025-06-04 18:18:03 2025-06-04 15:18:03,152 - SECONDARY (secondary2) - INFO - Received expected message Seq 1. Appending to log.
2025-06-04 18:18:03 2025-06-04 15:18:03,153 - SECONDARY (secondary2) - INFO - Log size: 1. Next expected Seq: 2
2025-06-04 18:18:03 INFO:     172.28.0.2:52196 - "POST /replicate HTTP/1.1" 200 OK
```

7. Check messages on S2 - [Msg1, Msg2, Msg3, Msg4]