

Overcoming Ubik Limitations

Marcio Barbosa
2019 OpenAFS Workshop



SINE NOMINE
ASSOCIATES

AGENDA

- Election
- Recovery
- Limitations
- Reads-during-sync
- Transactions
- Read-transaction
- Write-transaction
- Limitations
- Reads-during-commit
- Other fixes



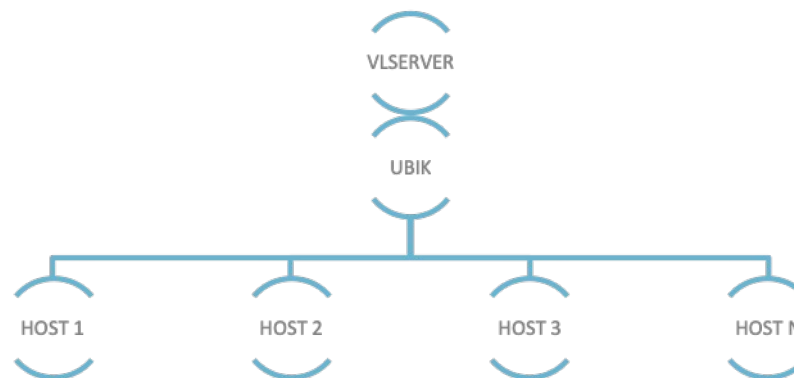
SINE NOMINE
ASSOCIATES

ELECTION



ELECTION

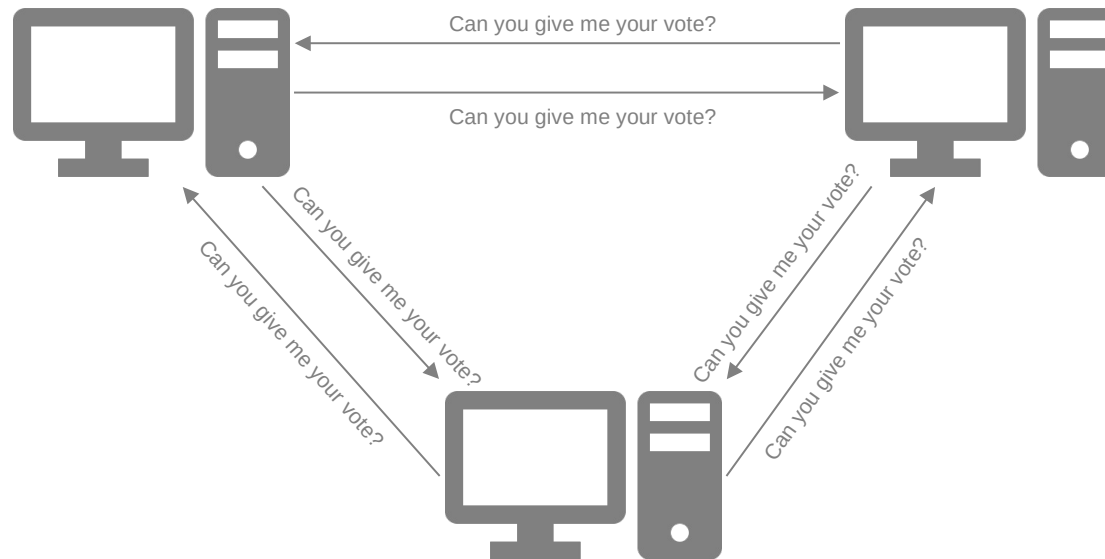
- A coordinator is elected by sending out beacon packets;
- A beacon implicitly asks the recipient to vote for the sender;
- Site with more votes is elected the synchronization-site;
- Coordinator will periodically attempt to extend its mandate;
- Voter that replied positively will not vote for another site before a timeframe;





SINE NOMINE
ASSOCIATES

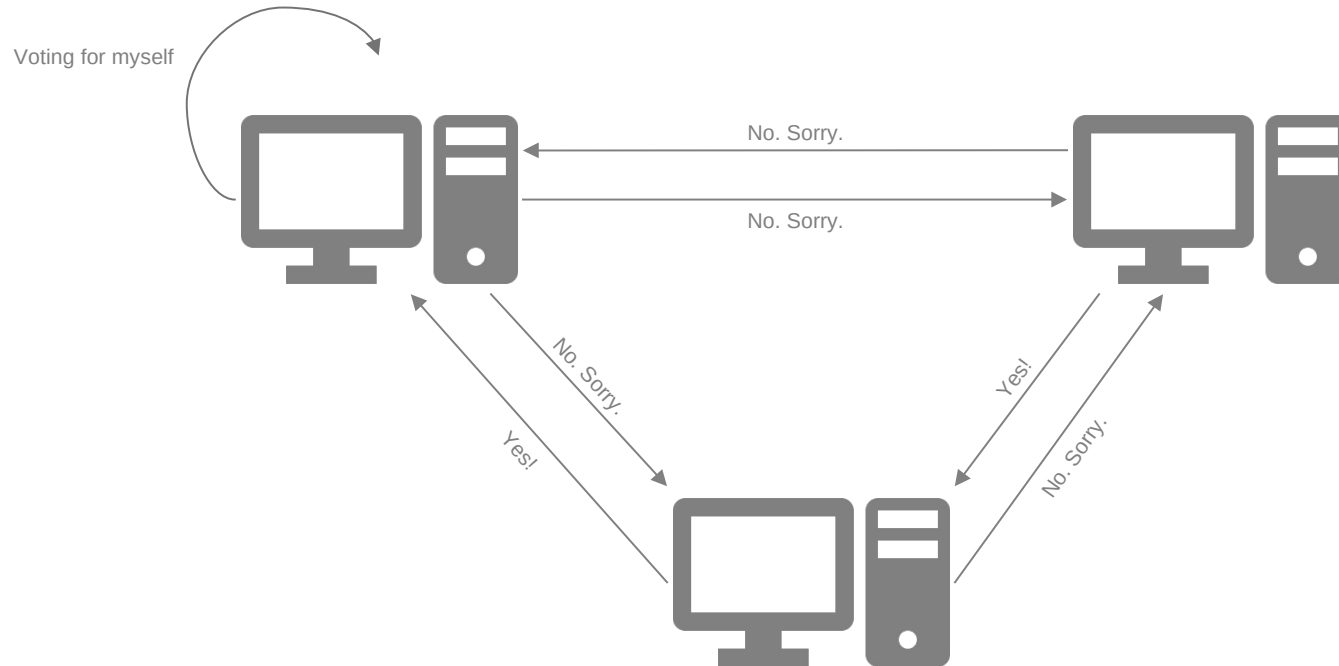
ELECTION: OVERVIEW





SINE NOMINE
ASSOCIATES

ELECTION: OVERVIEW





SINE NOMINE
ASSOCIATES

RECOVERY



SINE NOMINE
ASSOCIATES

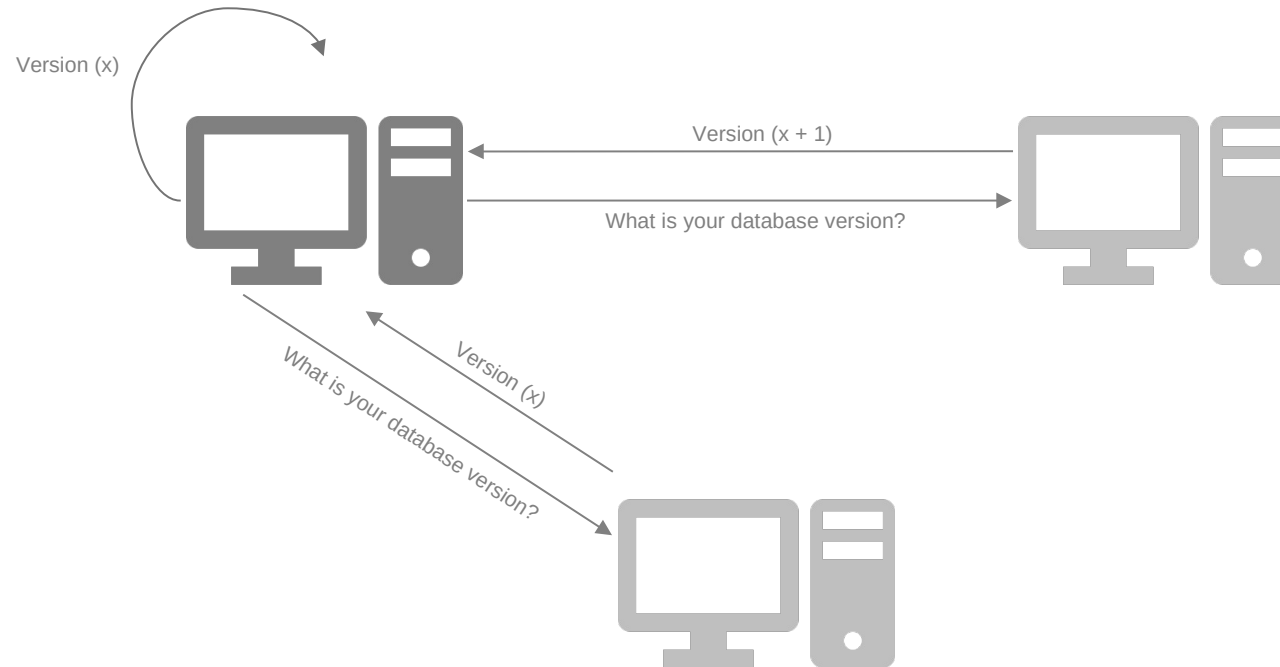
RECOVERY

- Recovery procedure is executed immediately after becoming sync-site:
 - Sync-site contacts all servers and determines the latest version;
 - Sync-site updates its local database to the latest version;
 - Coordinator relabels the database as the first version during his mandate;
 - Sync-site updates all remote databases to the latest version;



SINE NOMINE
ASSOCIATES

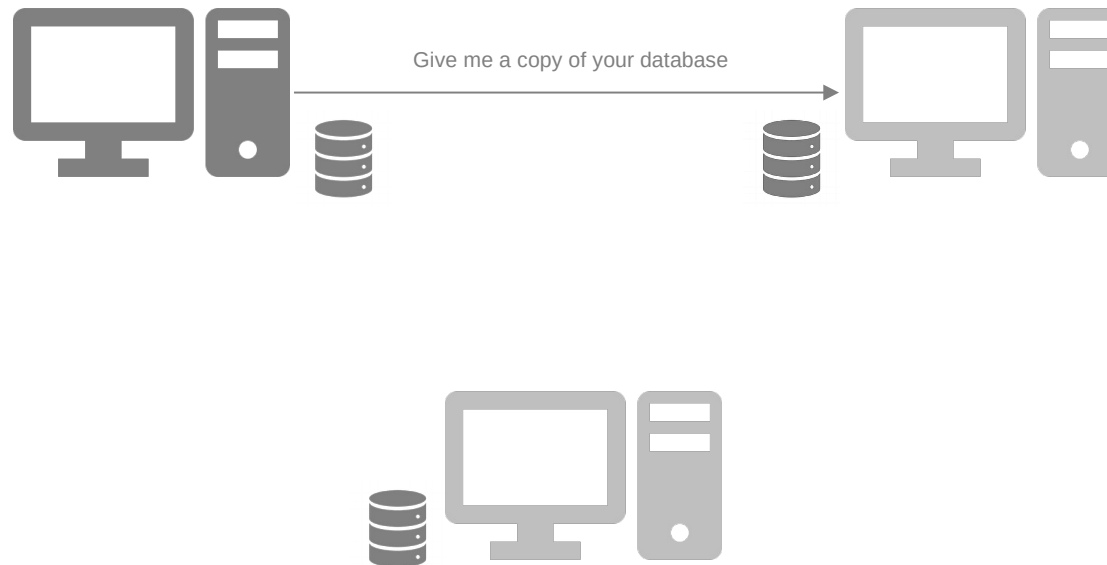
RECOVERY: OVERVIEW





SINE NOMINE
ASSOCIATES

RECOVERY: OVERVIEW





SINE NOMINE
ASSOCIATES

RECOVERY: LIMITATIONS

- Read-transactions not allowed;
- Write-transactions not allowed;
- In other words, sites involved are not available during this phase;
- Why? Because the live database is being replaced;
- Current version does not replace the database directly;
 - Received database is stored in a temporary file;
 - Temporary file replaces live database;



SINE NOMINE
ASSOCIATES

RECOVERY: OVERVIEW





READS-DURING-SYNC

- Scenario 1: site is sending a copy of the database;
 - Local database is not being modified;
 - Writes must be blocked;
 - There is no reason to block reads;
 - Allow reads but block writes;
- Scenario 2: site is receiving a copy of the database;
 - Received data is stored in a temporary file;
 - Live database will (eventually) be replaced by this temporary file;
 - Writes must be blocked;
 - Reads can be allowed until the replacement-phase;
 - Replacement-phase blocks new reads;
 - Replacement-phase aborts read-transactions;



SINE NOMINE
ASSOCIATES

TRANSACTIONS



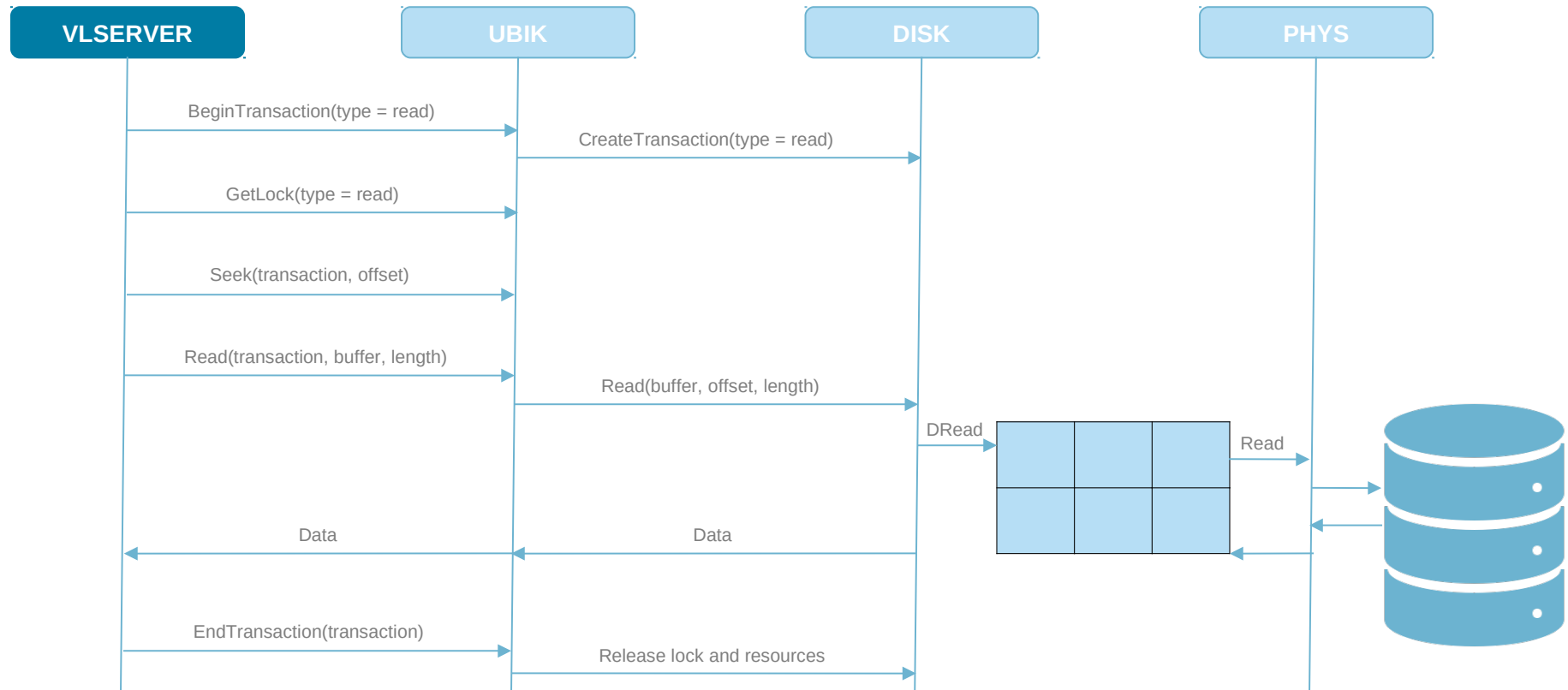
SINE NOMINE
ASSOCIATES

READ-TRANSACTIONS

- Read-transactions;
 - Designed to handle a high number of read transactions;
 - Executed by any server in the quorum;
 - Can handle multiple read-transactions at the same time;
 - Locking is done locally to the server receiving the request;
 - Reads data from a database under a transaction;
 - The parameters to read are a transaction, a buffer and a length;
 - It functions like the Unix read system call;
 - Reads length bytes from the current file position into the specified buffer;



READ-TRANSACTIONS (SIMPLIFICATION)





SINE NOMINE
ASSOCIATES

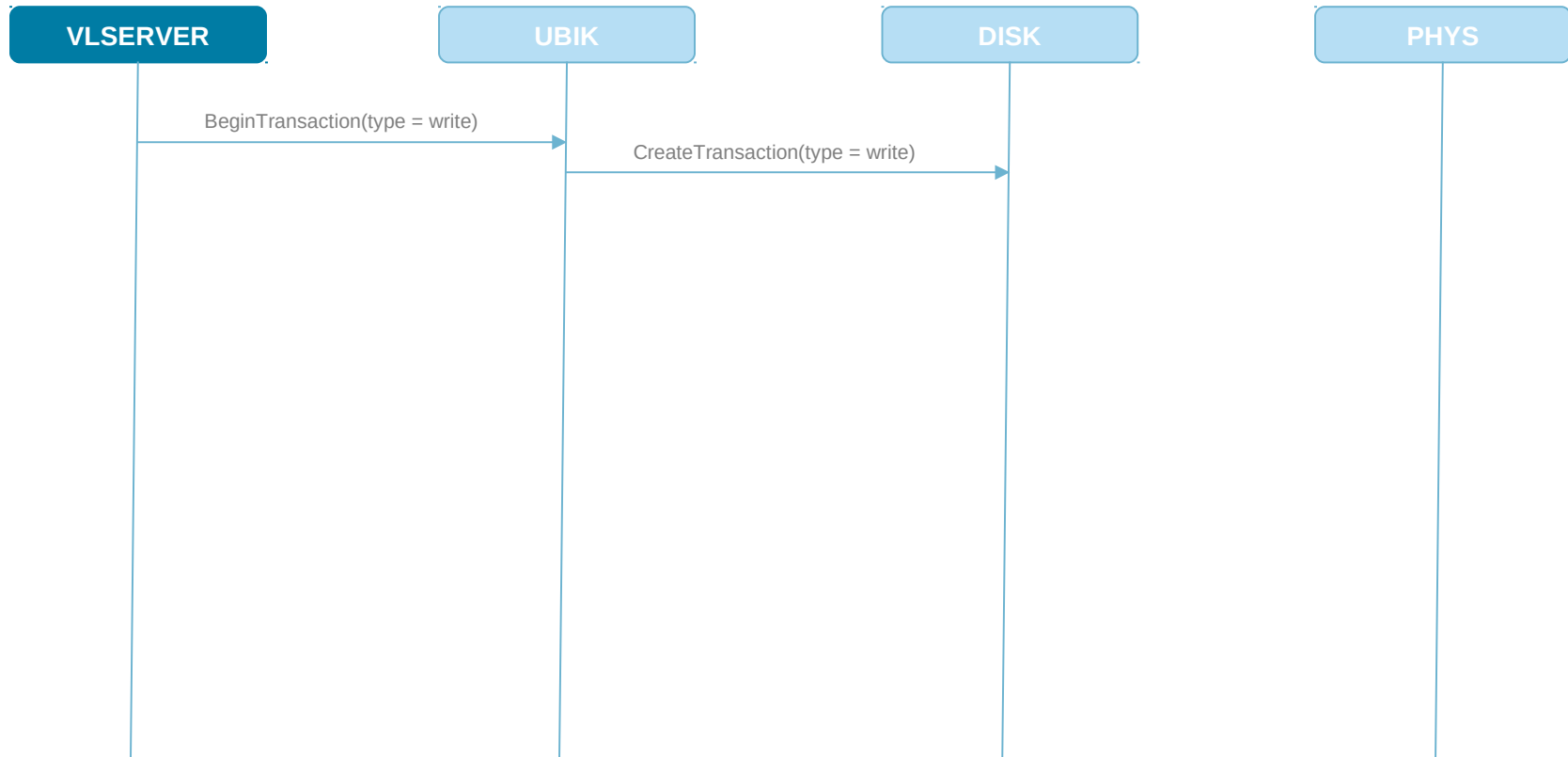
WRITE-TRANSACTIONS

- Write-transactions;
 - Not designed to handle a high number of write transactions;
 - Executed by every server in the quorum;
 - Can only handle one write-transaction at a specific time;
 - Locking is done globally;
 - Writes data to a database under a transaction;
 - The parameters to write are a transaction, a buffer and a length;
 - It functions like the Unix read system call;
 - Writes length bytes at the current file position from the specified buffer;



SINE NOMINE
ASSOCIATES

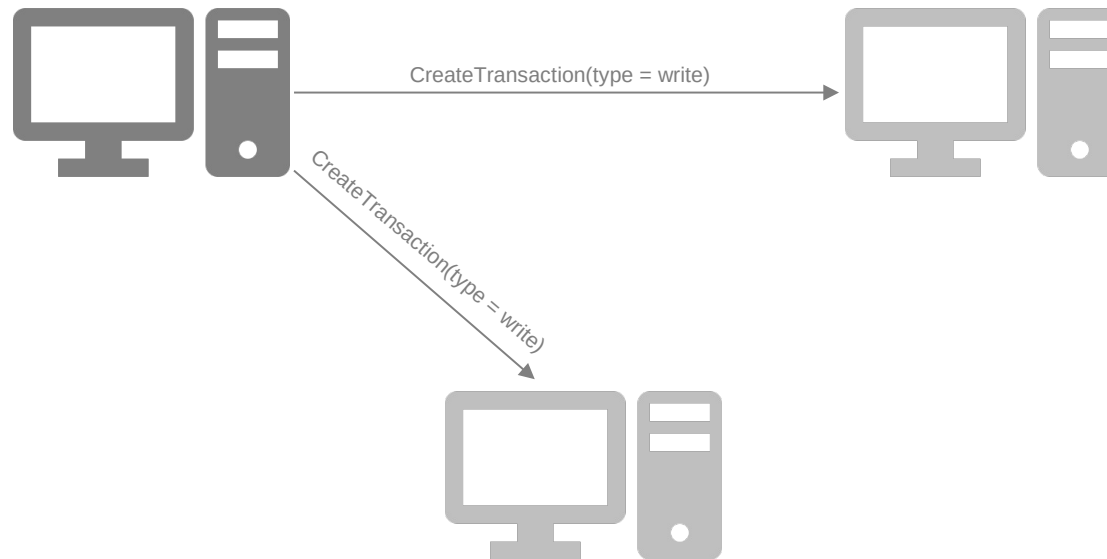
WRITE-TRANSACTIONS (SIMPLIFICATION)





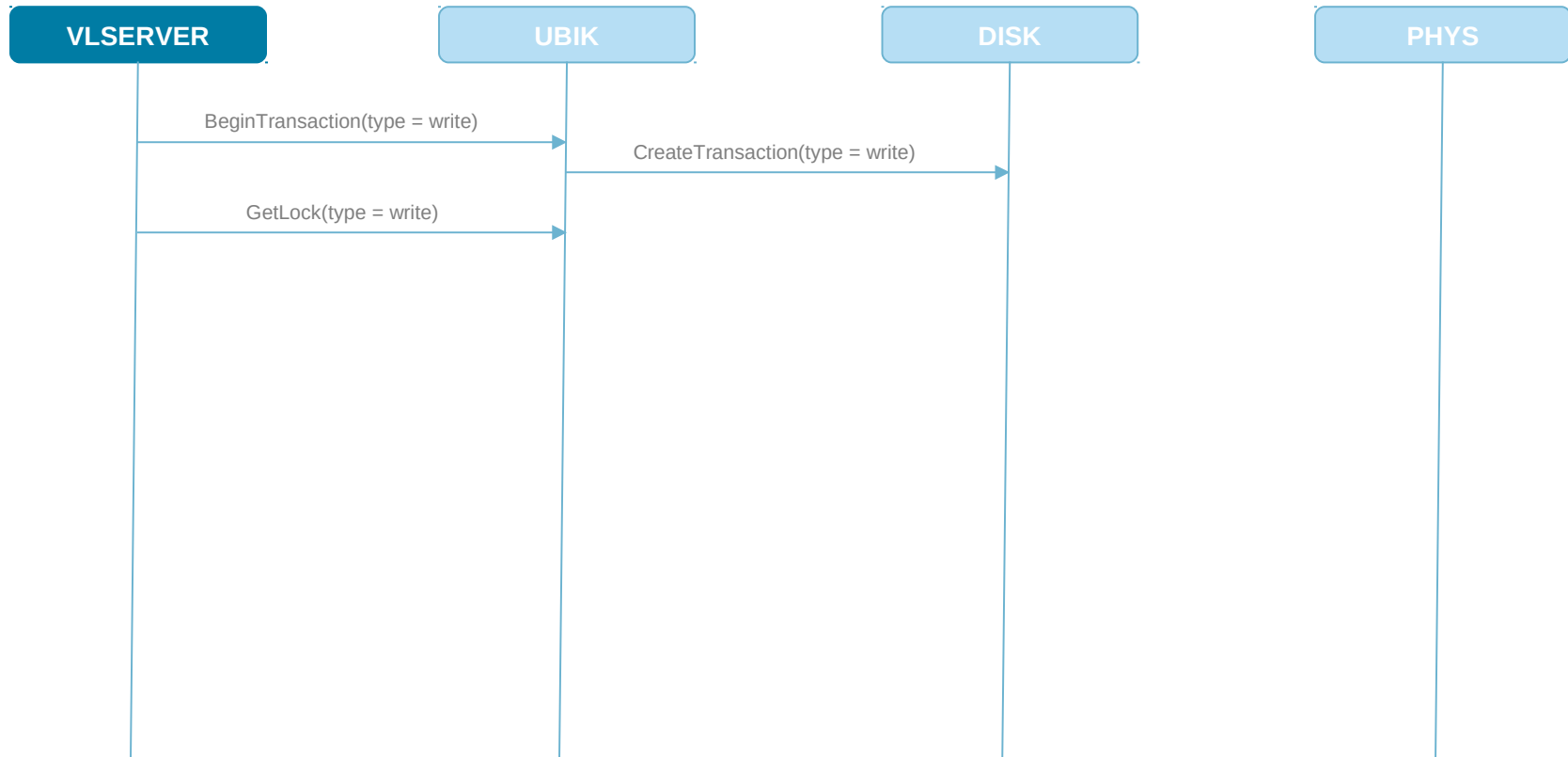
SINE NOMINE
ASSOCIATES

WRITE-TRANSACTIONS (SIMPLIFICATION)





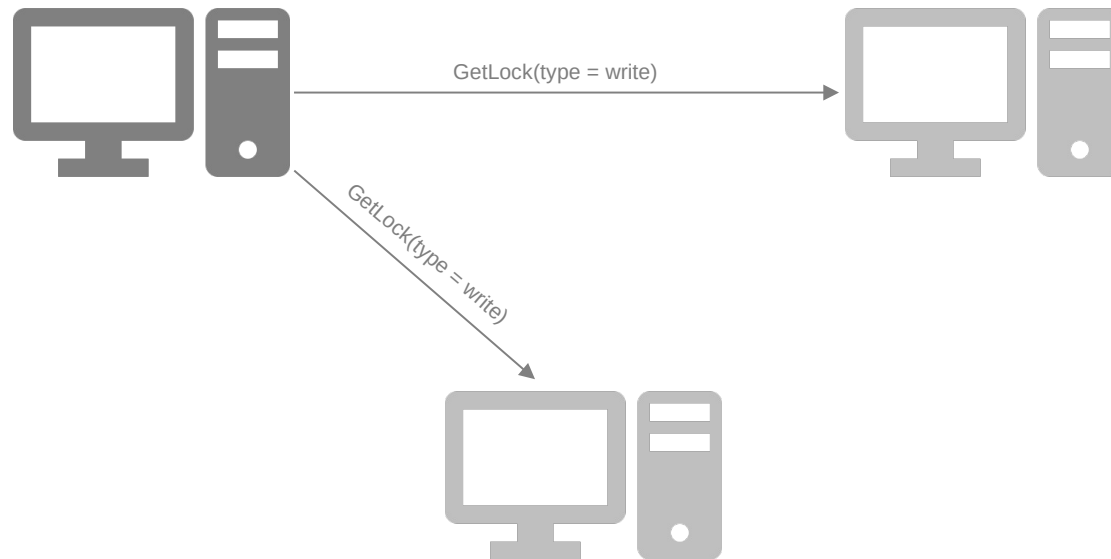
WRITE-TRANSACTIONS (SIMPLIFICATION)





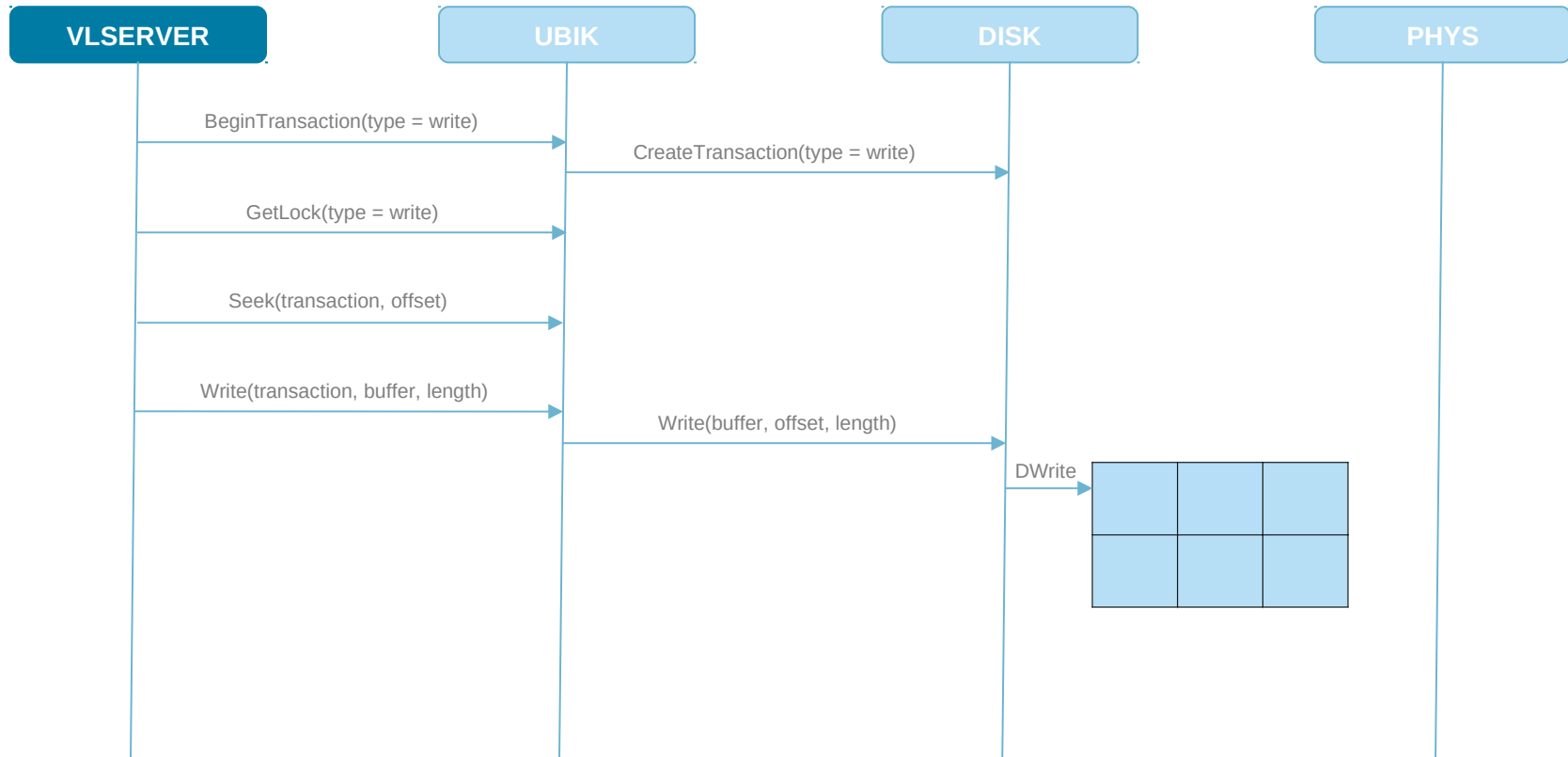
SINE NOMINE
ASSOCIATES

WRITE-TRANSACTIONS (SIMPLIFICATION)



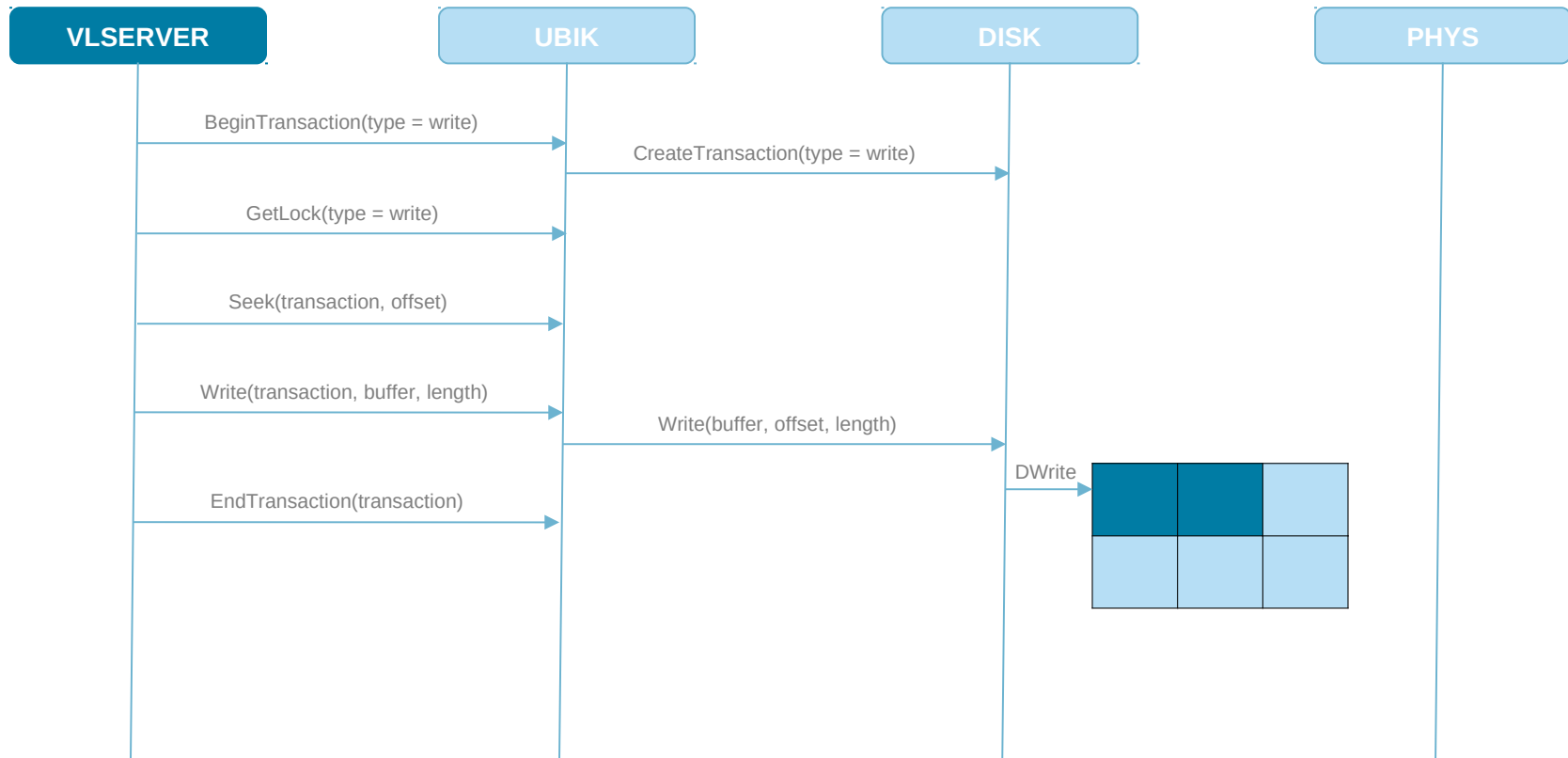


WRITE-TRANSACTIONS (SIMPLIFICATION)





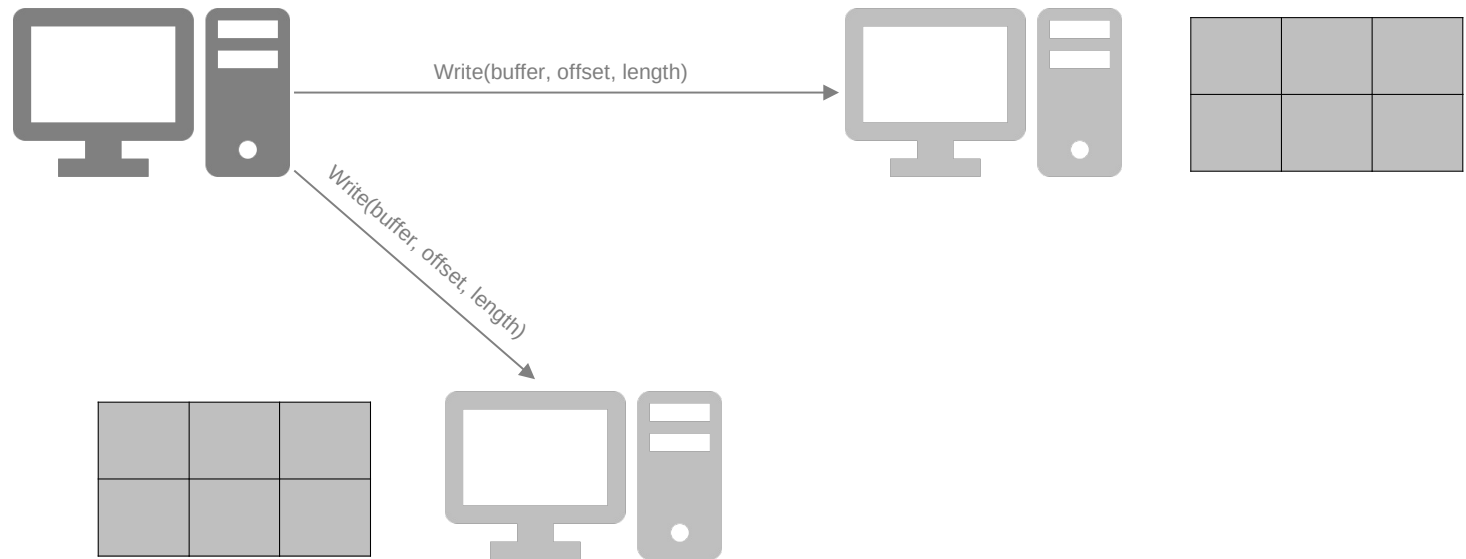
WRITE-TRANSACTIONS (SIMPLIFICATION)





SINE NOMINE
ASSOCIATES

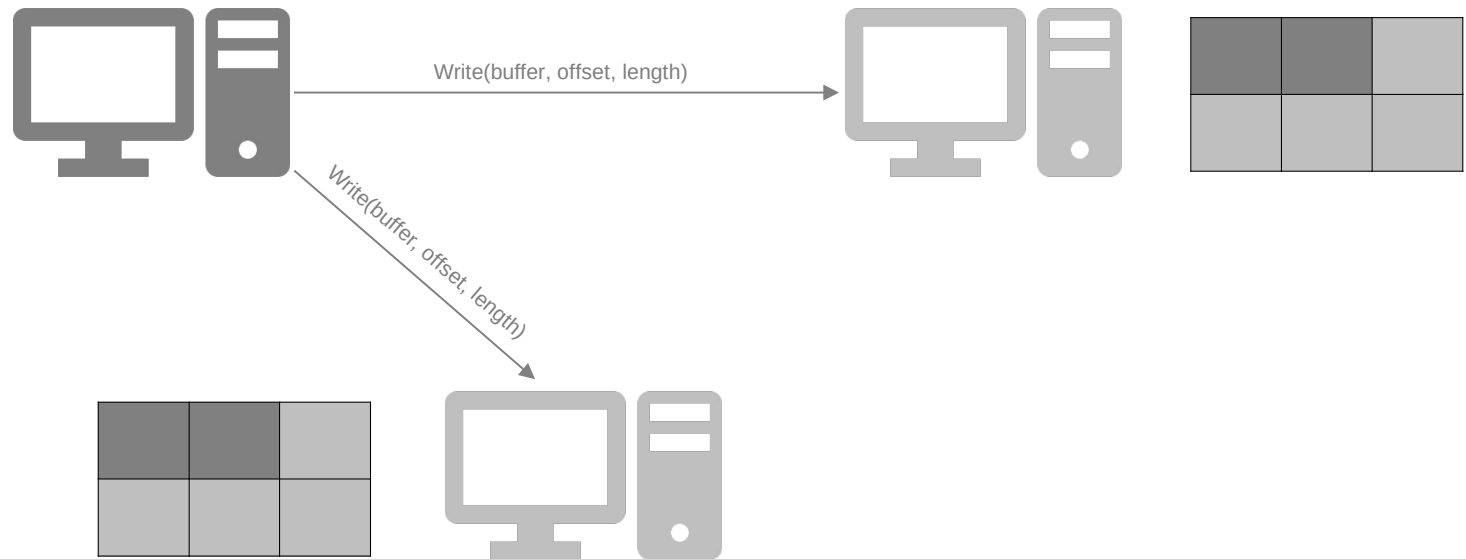
WRITE-TRANSACTIONS (SIMPLIFICATION)





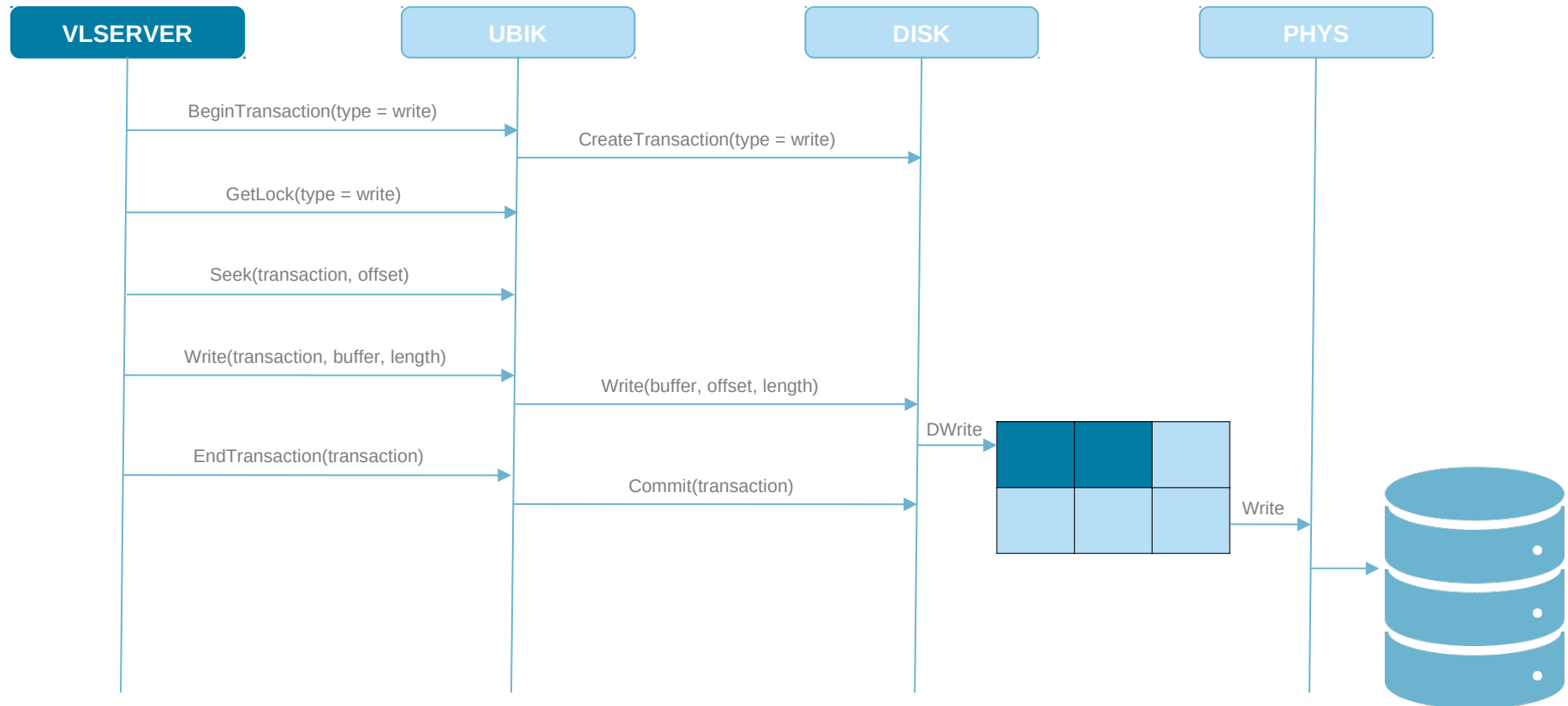
SINE NOMINE
ASSOCIATES

WRITE-TRANSACTIONS (SIMPLIFICATION)



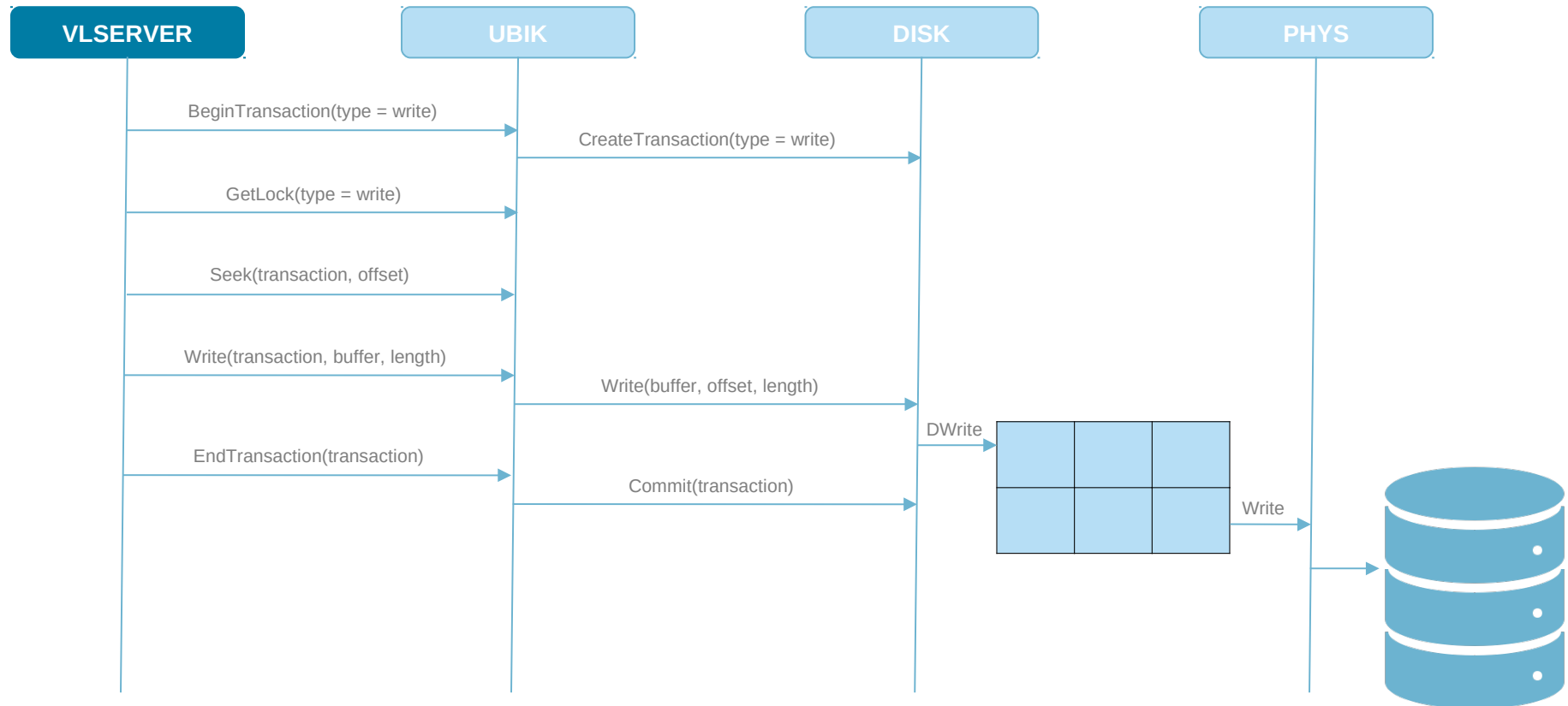


WRITE-TRANSACTIONS (SIMPLIFICATION)





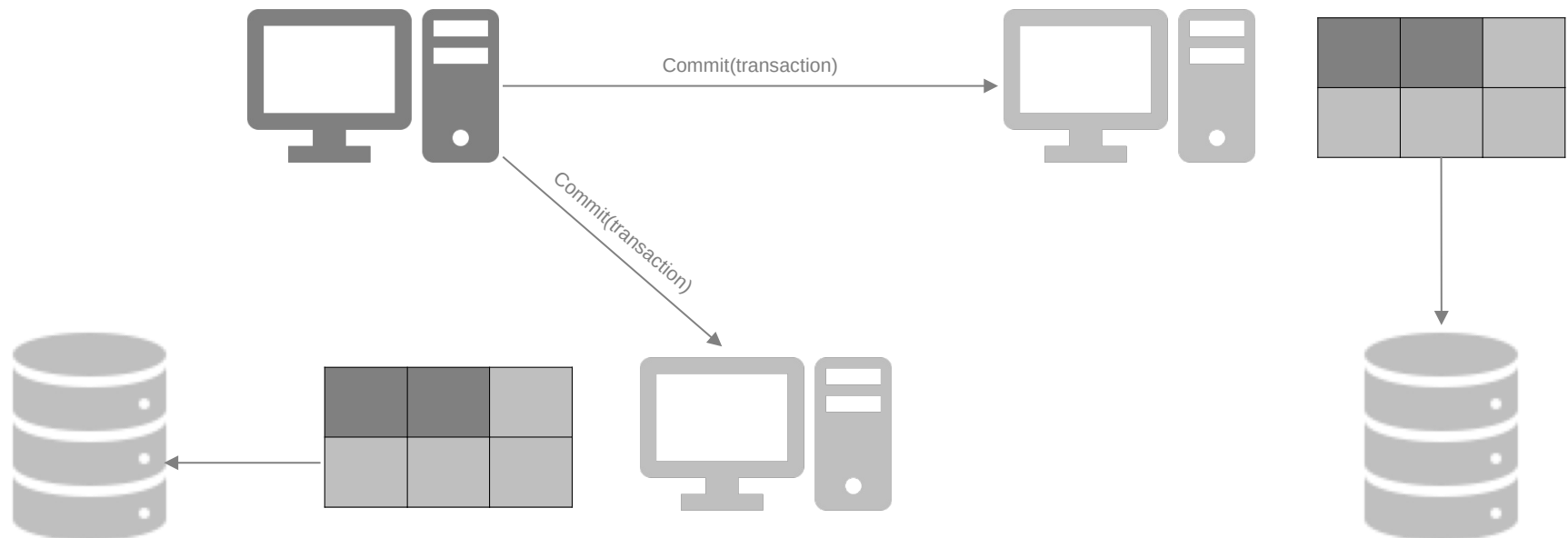
WRITE-TRANSACTIONS (SIMPLIFICATION)





SINE NOMINE
ASSOCIATES

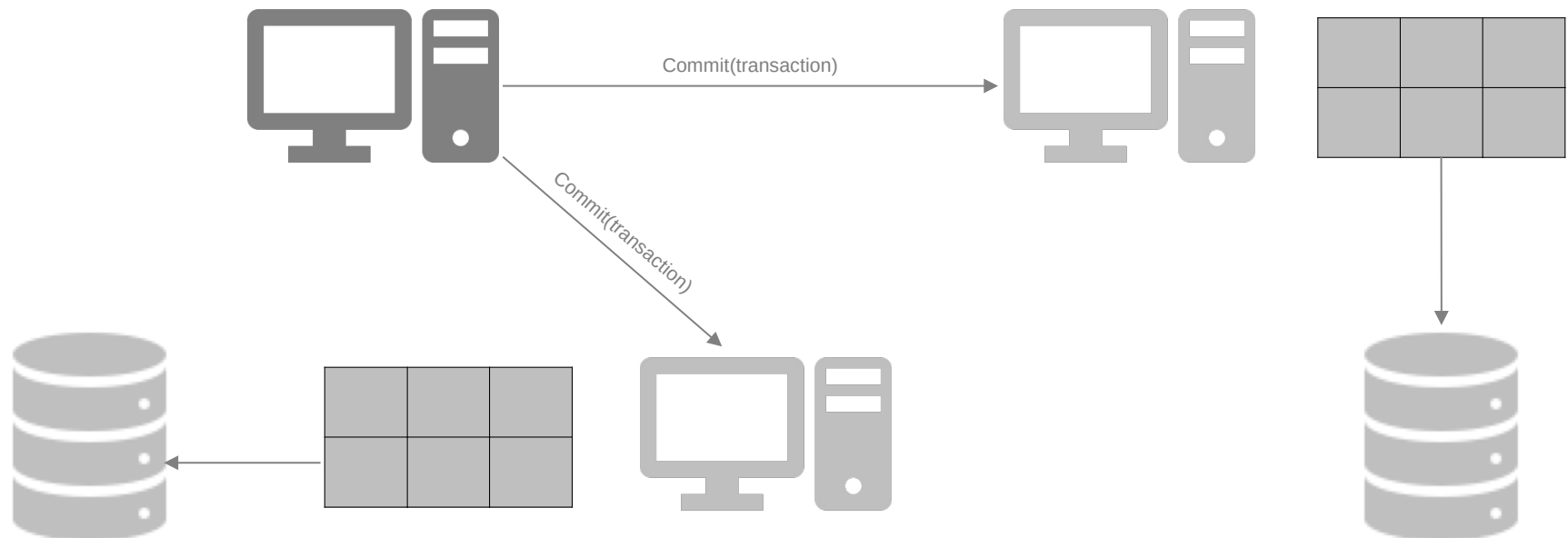
WRITE-TRANSACTIONS (SIMPLIFICATION)





SINE NOMINE
ASSOCIATES

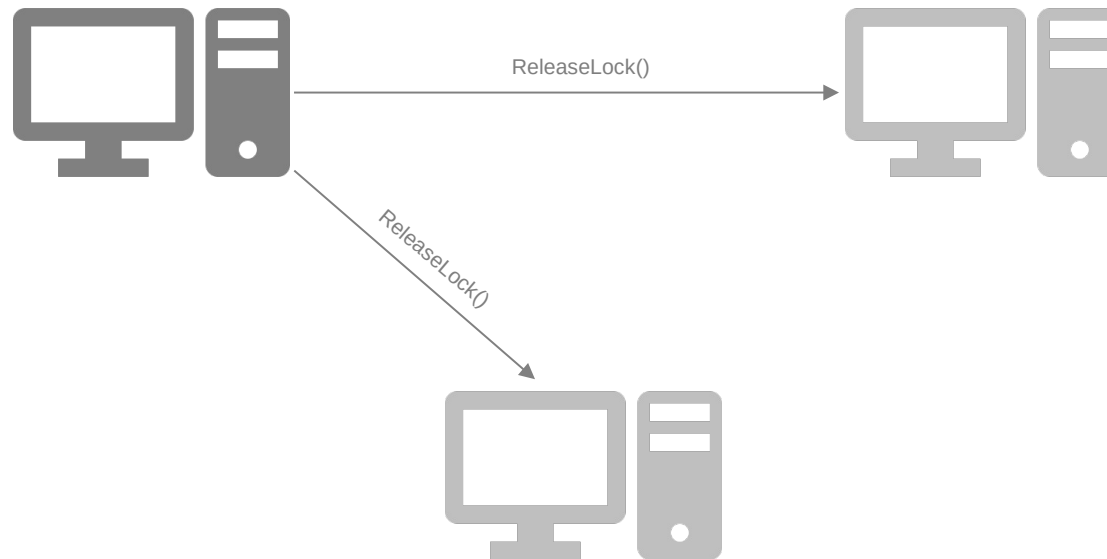
WRITE-TRANSACTIONS (SIMPLIFICATION)





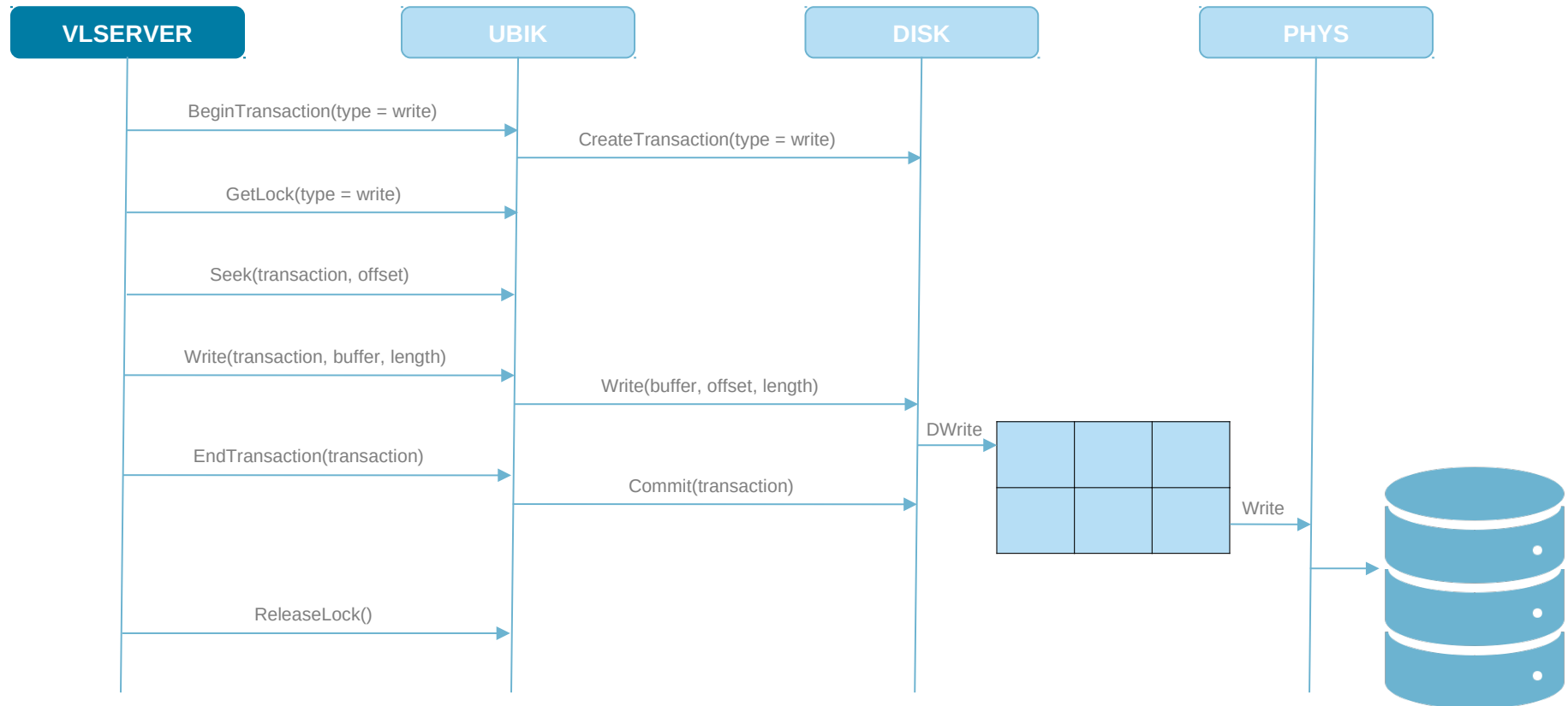
SINE NOMINE
ASSOCIATES

WRITE-TRANSACTIONS (SIMPLIFICATION)





WRITE-TRANSACTIONS (SIMPLIFICATION)





SINE NOMINE
ASSOCIATES

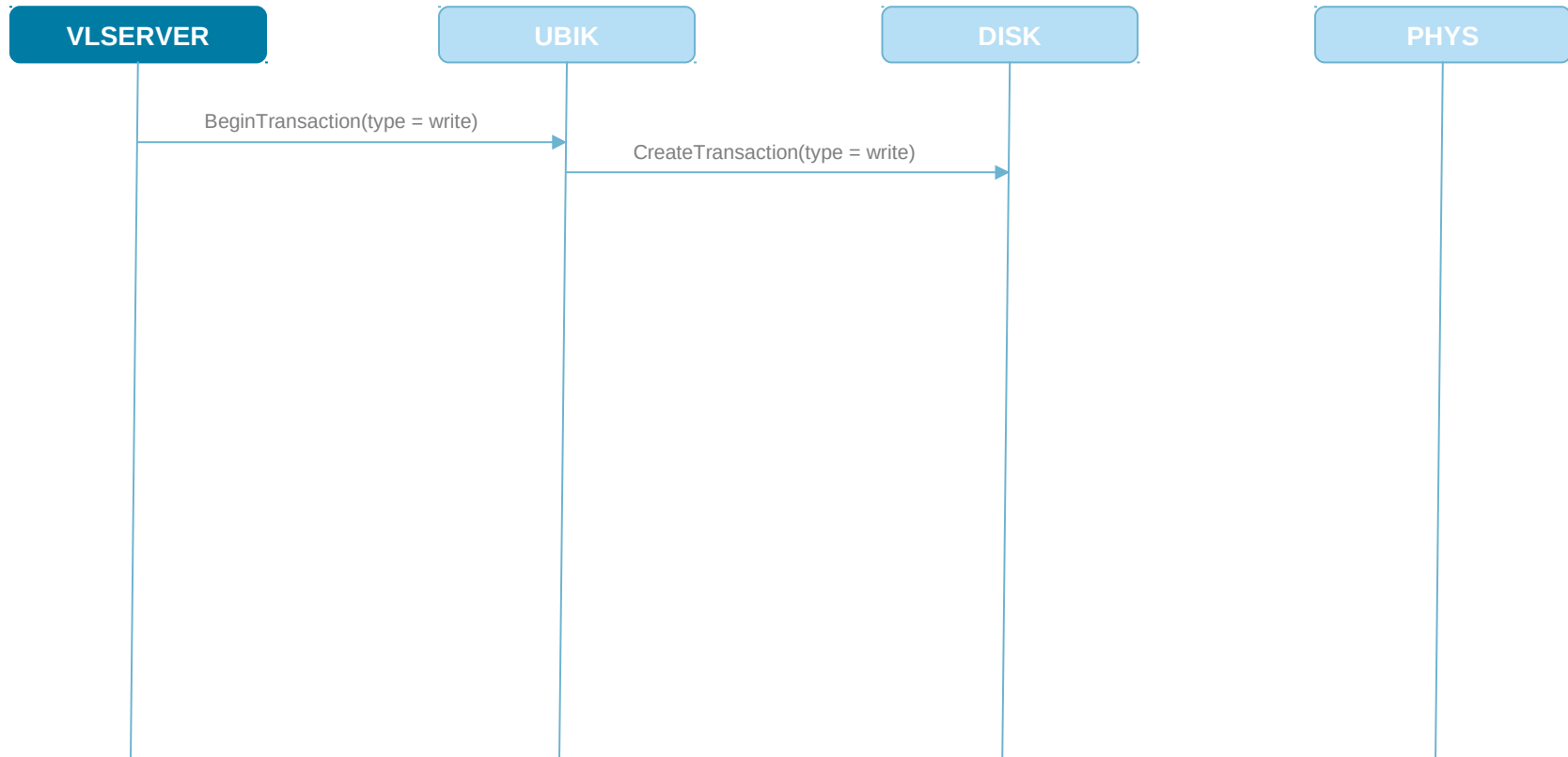
WRITE-TRANSACTIONS

- Can be slow (communication cost);
- Read-transactions not allowed during this process;
- Whole cell is blocked;
- How can we alleviate this problem?
 - Allowing reads-during-write;



SINE NOMINE
ASSOCIATES

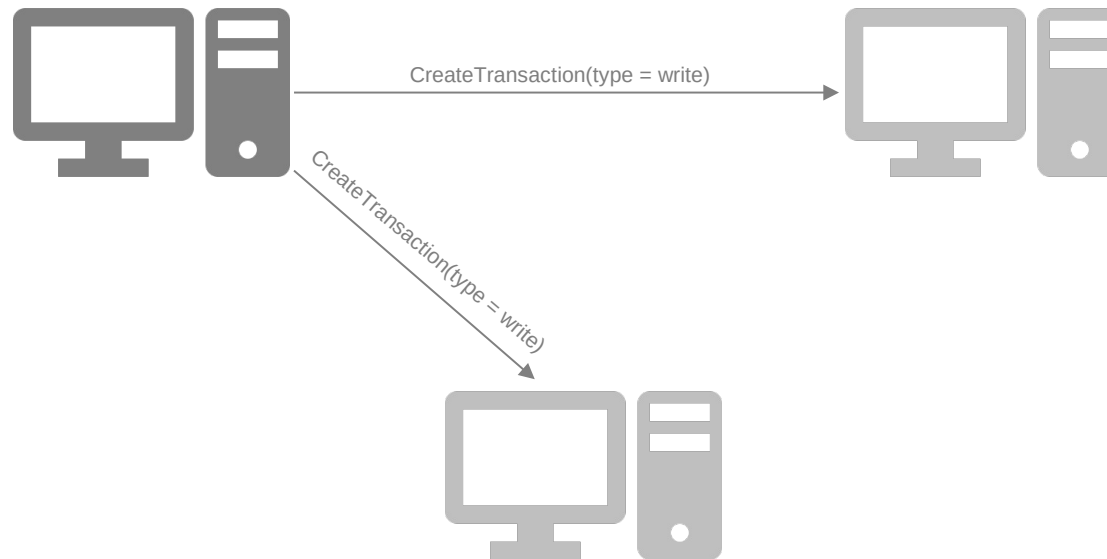
WRITE-TRANSACTIONS (SIMPLIFICATION)





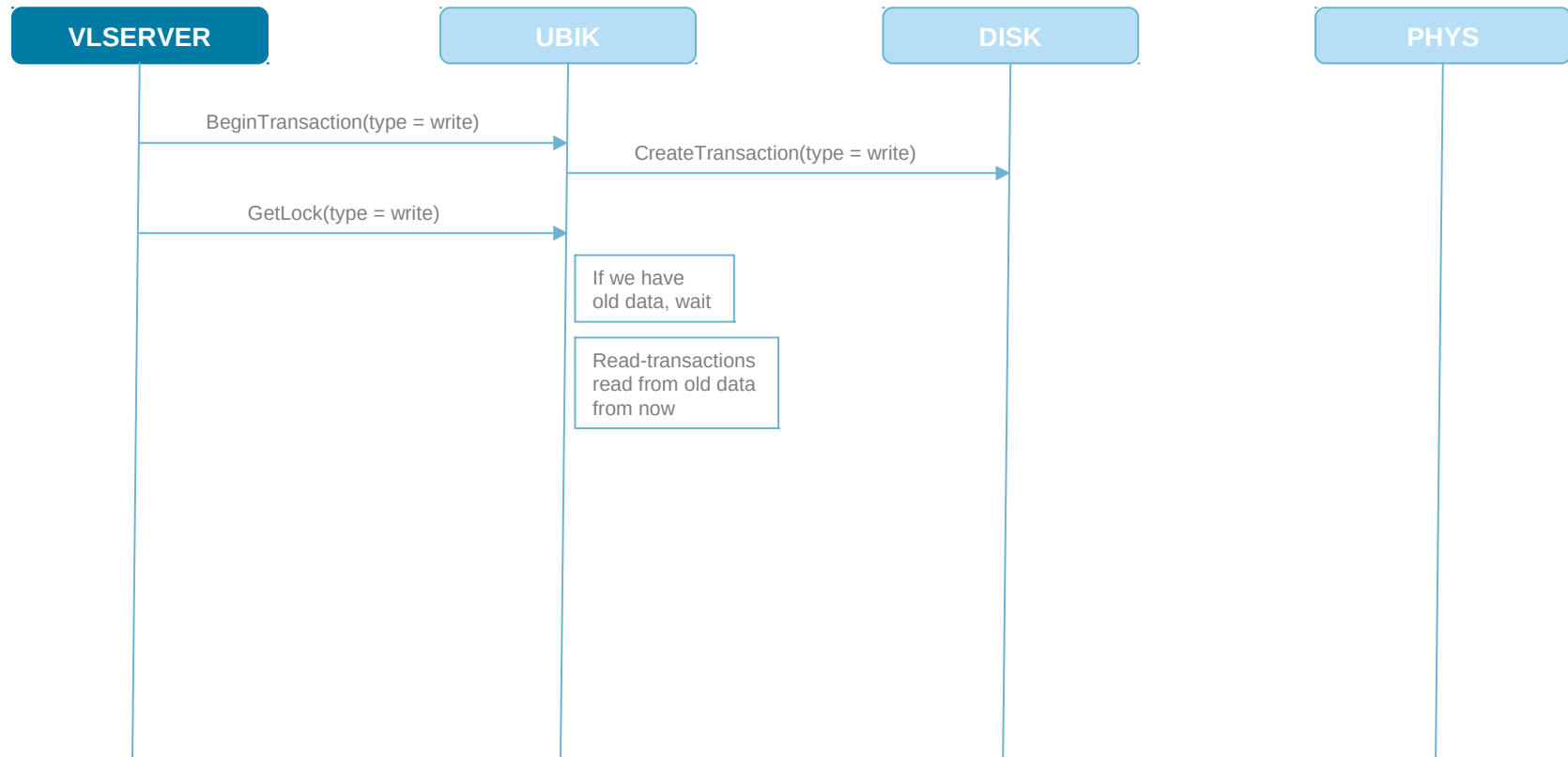
SINE NOMINE
ASSOCIATES

WRITE-TRANSACTIONS (SIMPLIFICATION)



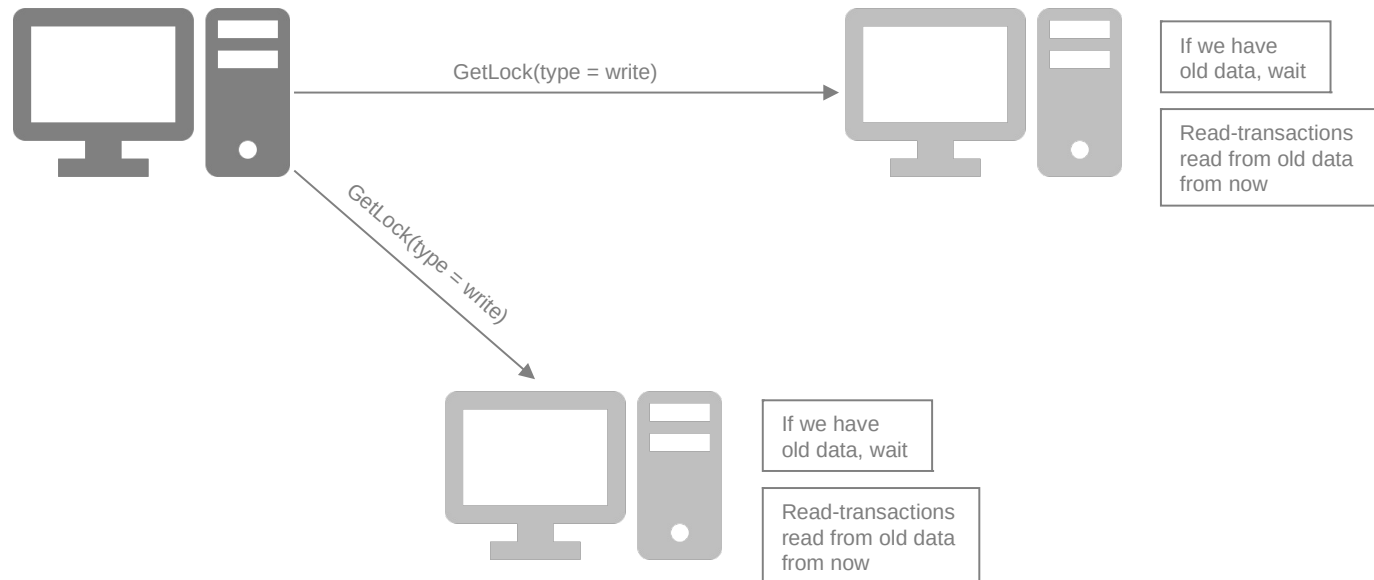


WRITE-TRANSACTIONS (SIMPLIFICATION)



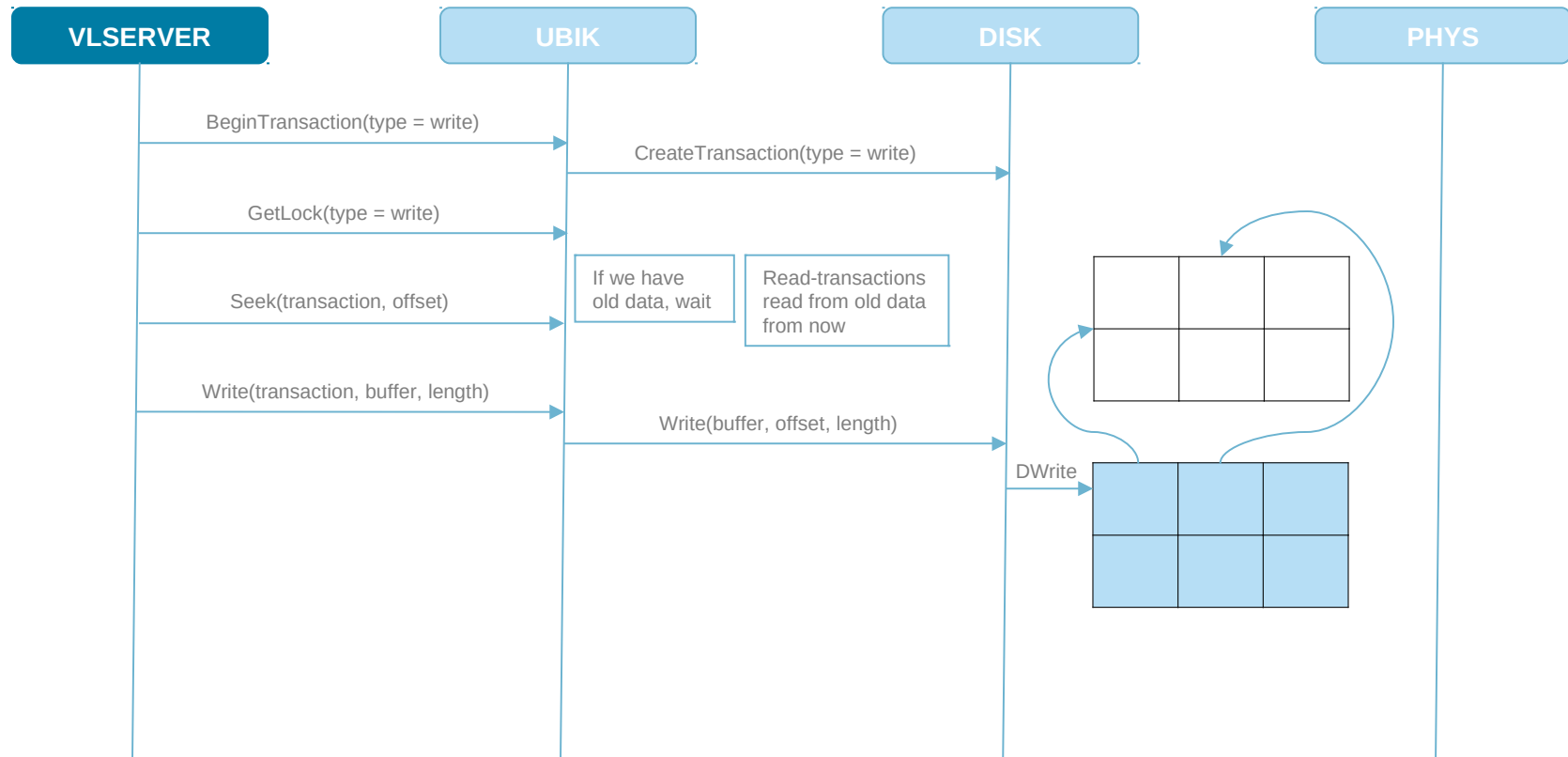


WRITE-TRANSACTIONS (SIMPLIFICATION)



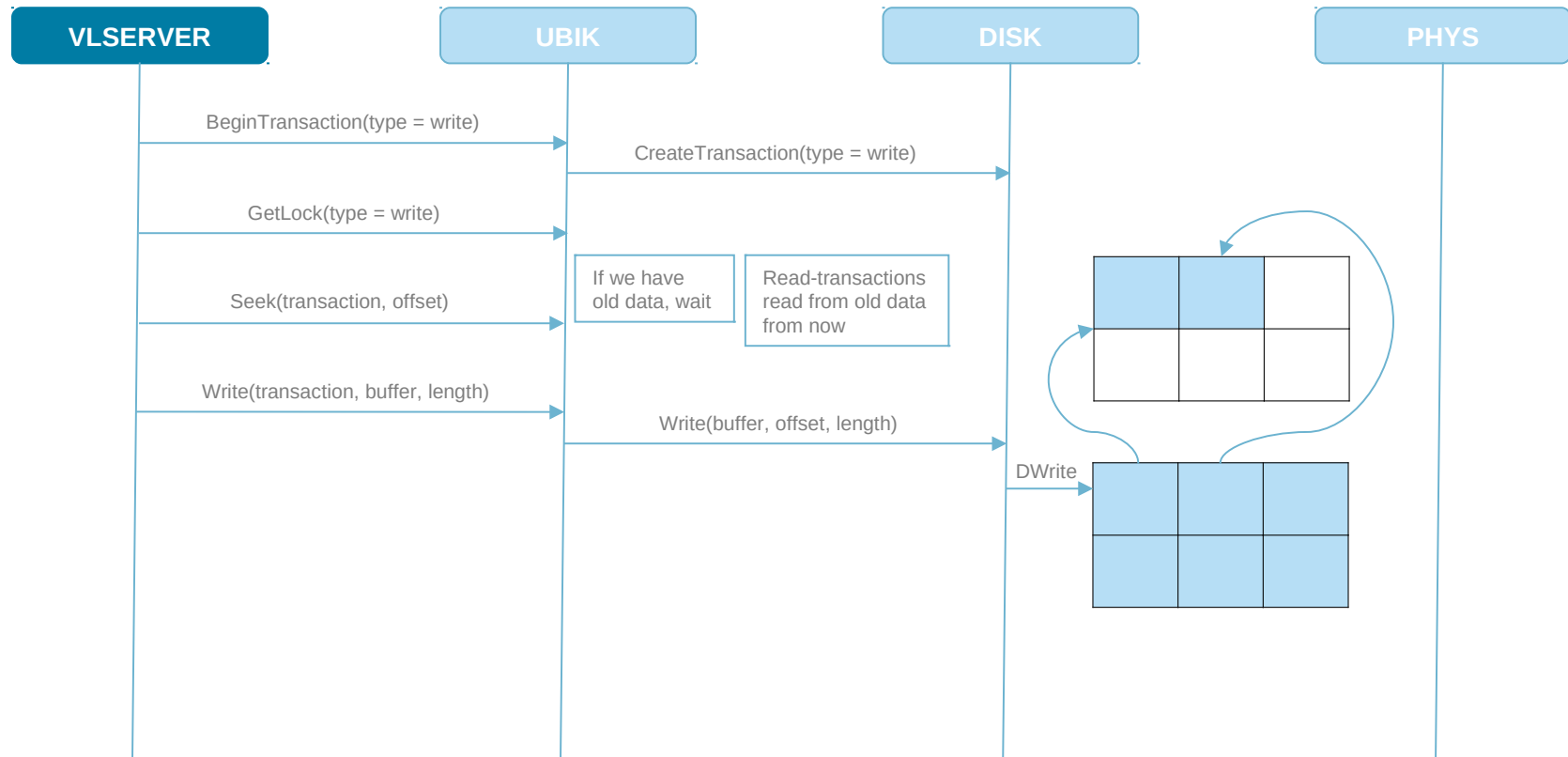


WRITE-TRANSACTIONS (SIMPLIFICATION)



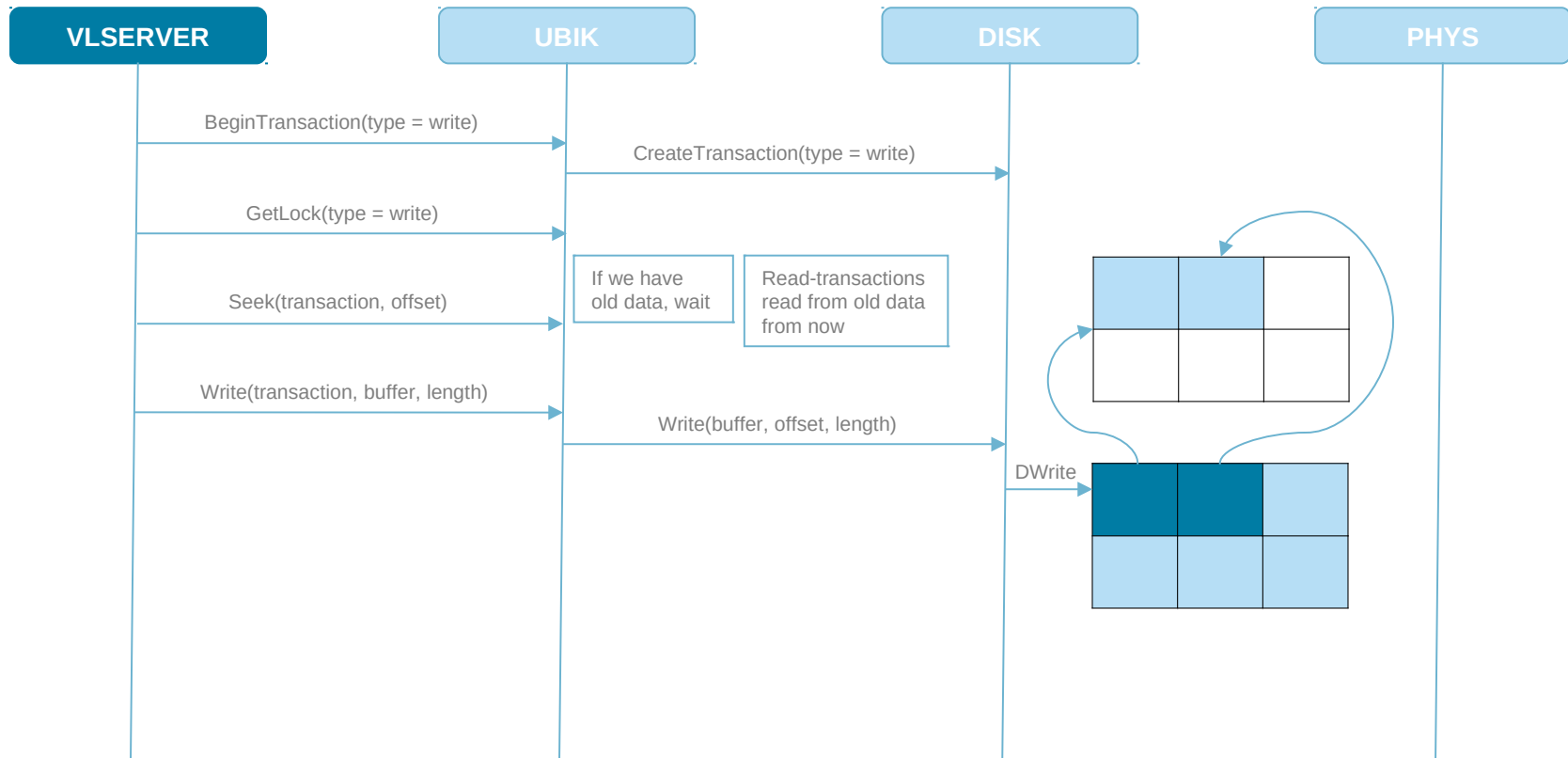


WRITE-TRANSACTIONS (SIMPLIFICATION)





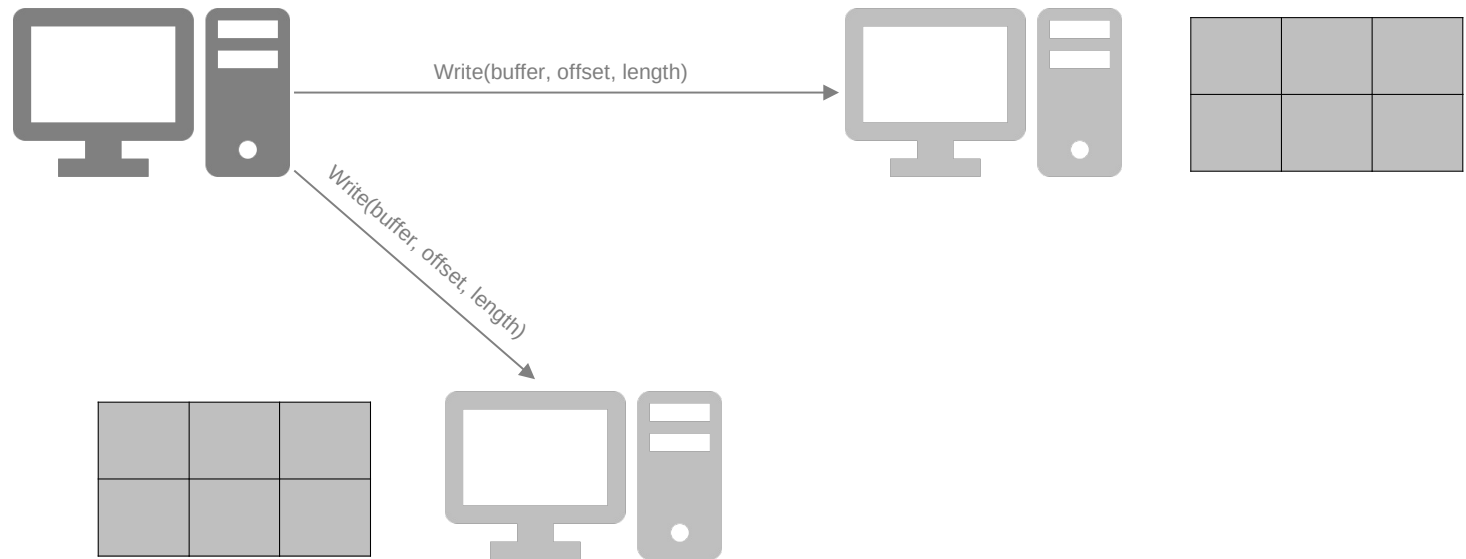
WRITE-TRANSACTIONS (SIMPLIFICATION)





SINE NOMINE
ASSOCIATES

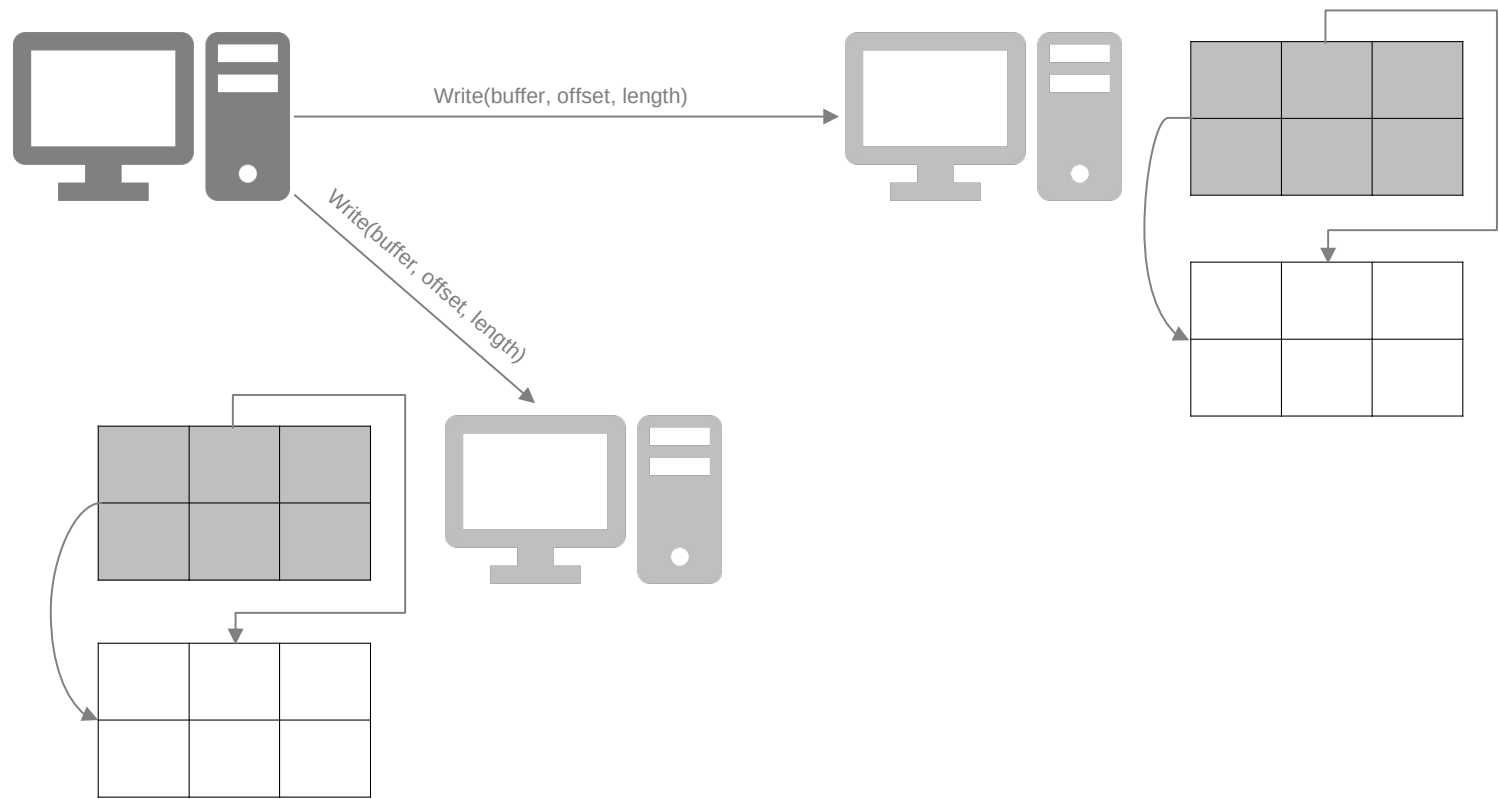
WRITE-TRANSACTIONS (SIMPLIFICATION)





SINE NOMINE
ASSOCIATES

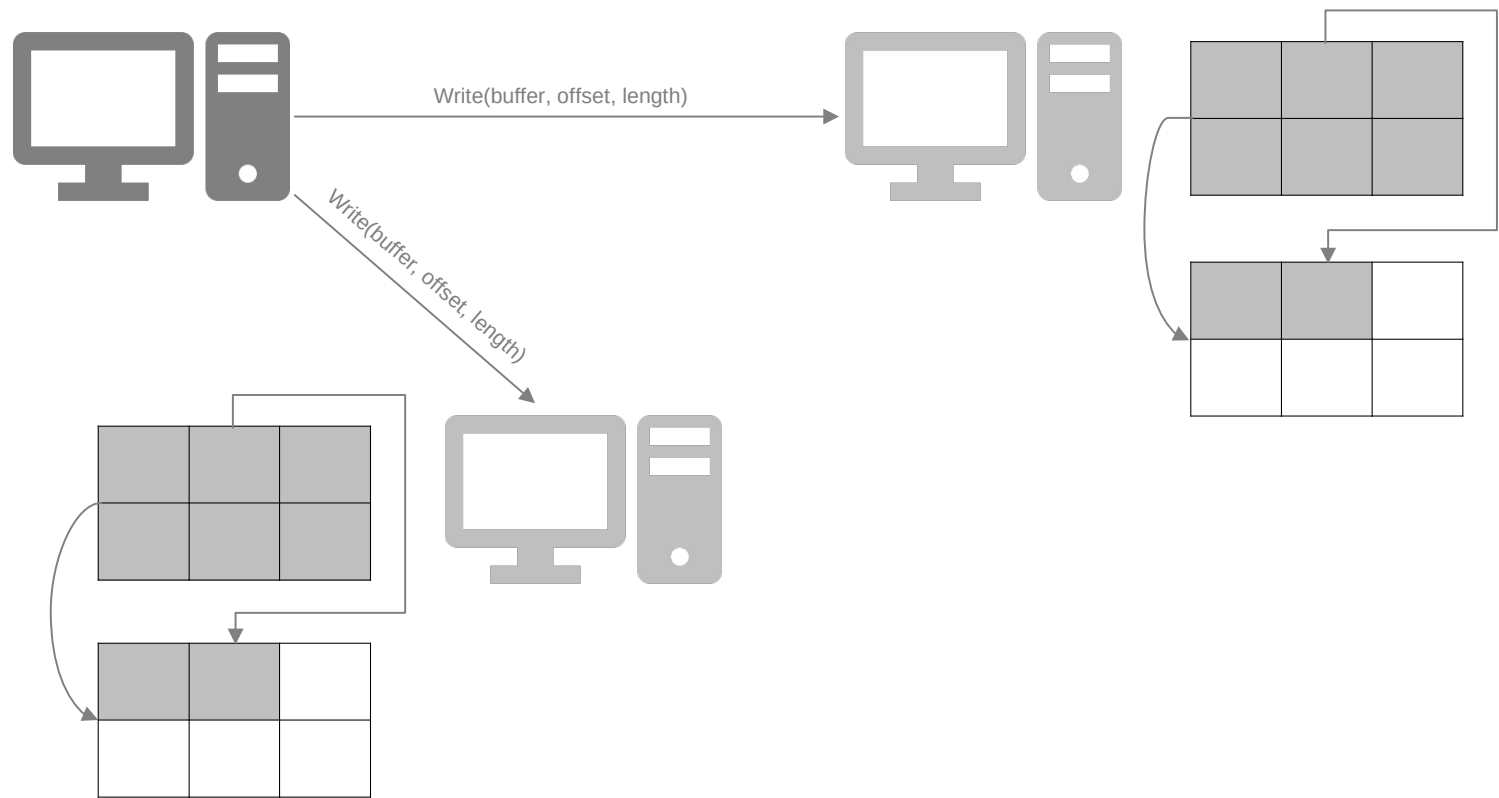
WRITE-TRANSACTIONS (SIMPLIFICATION)





SINE NOMINE
ASSOCIATES

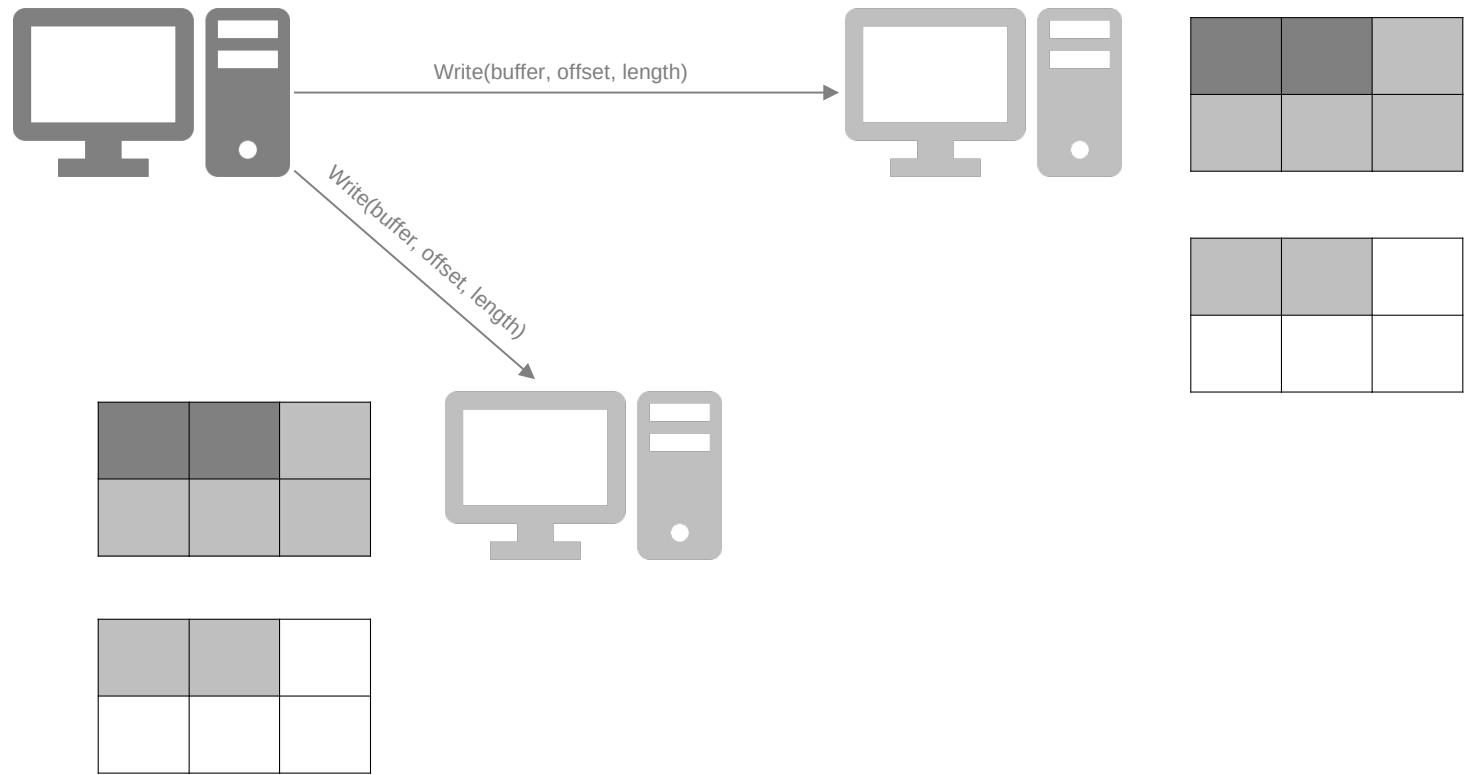
WRITE-TRANSACTIONS (SIMPLIFICATION)





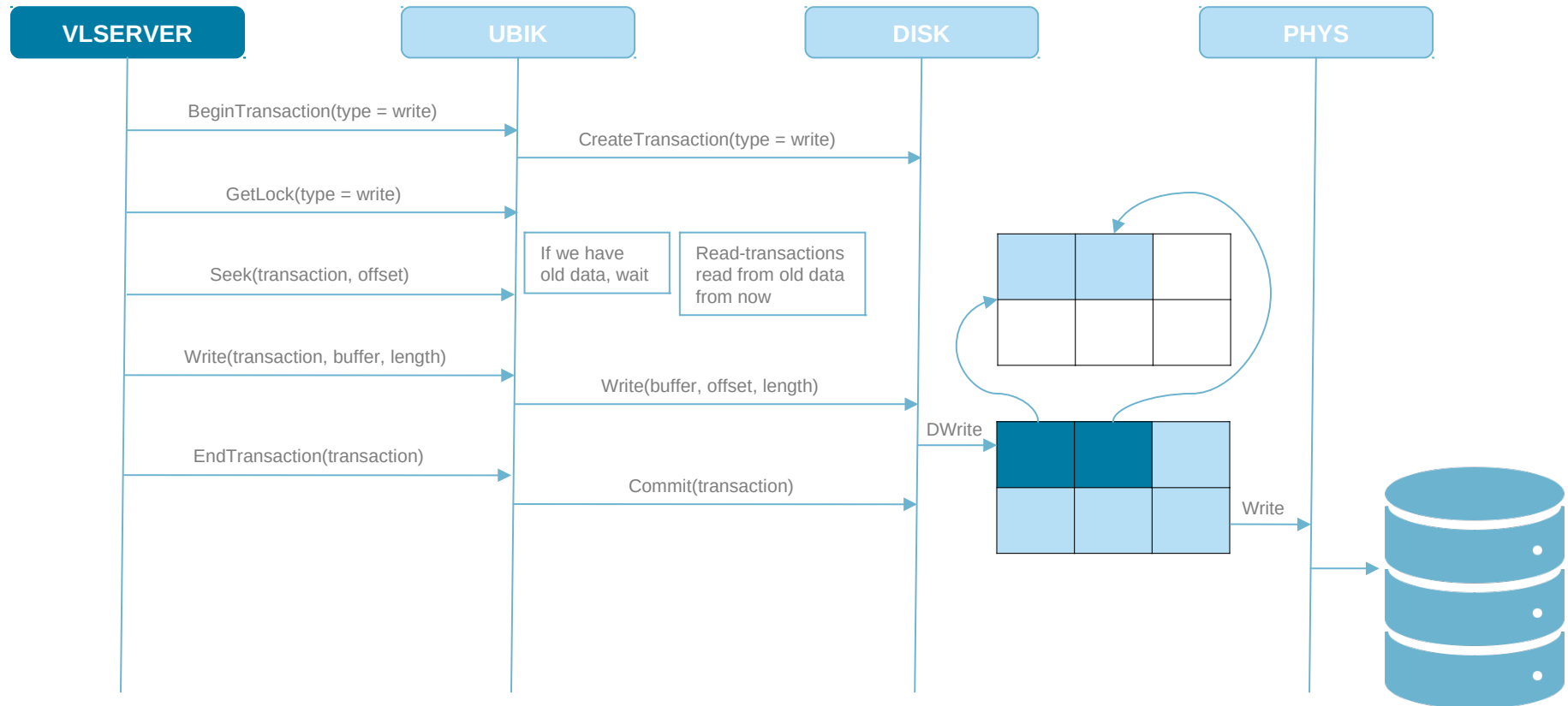
SINE NOMINE
ASSOCIATES

WRITE-TRANSACTIONS (SIMPLIFICATION)



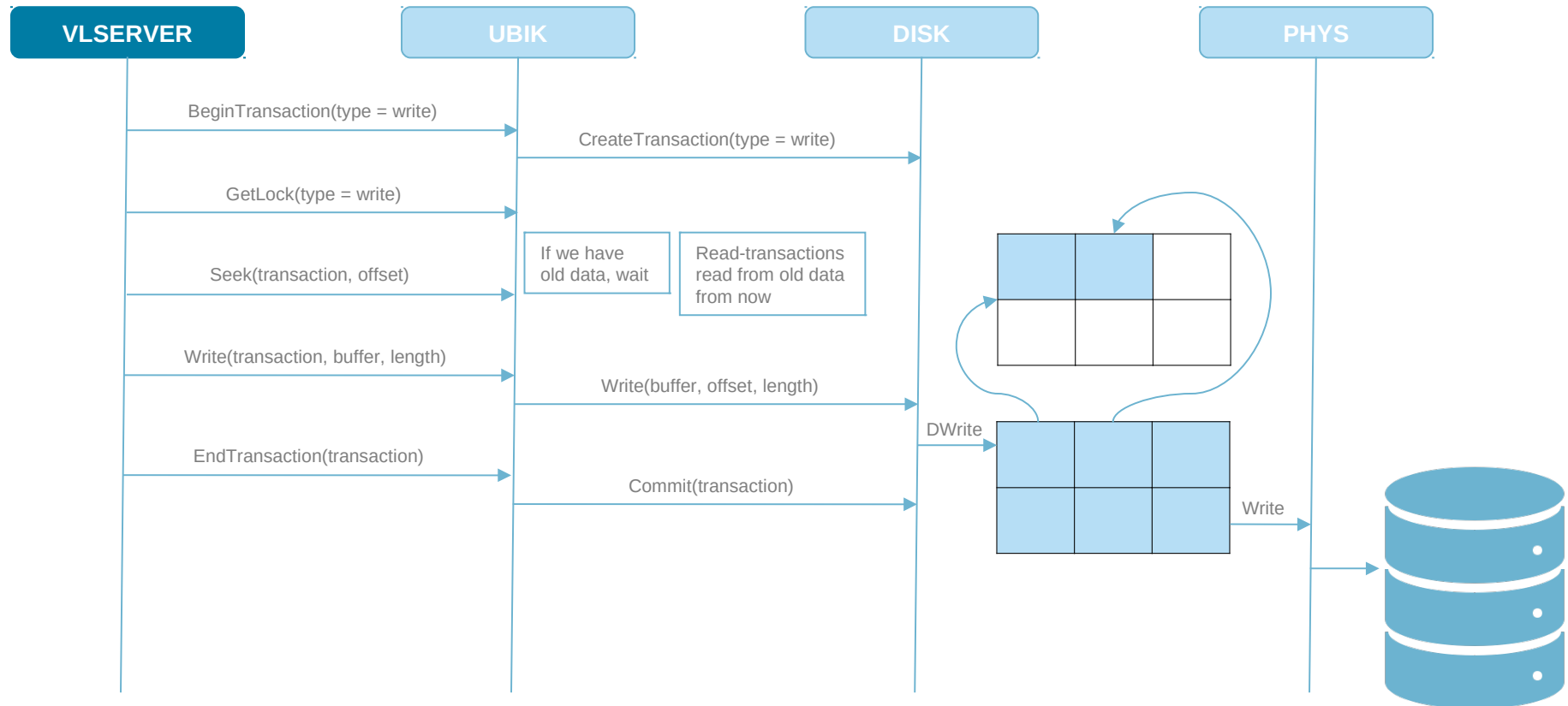


WRITE-TRANSACTIONS (SIMPLIFICATION)





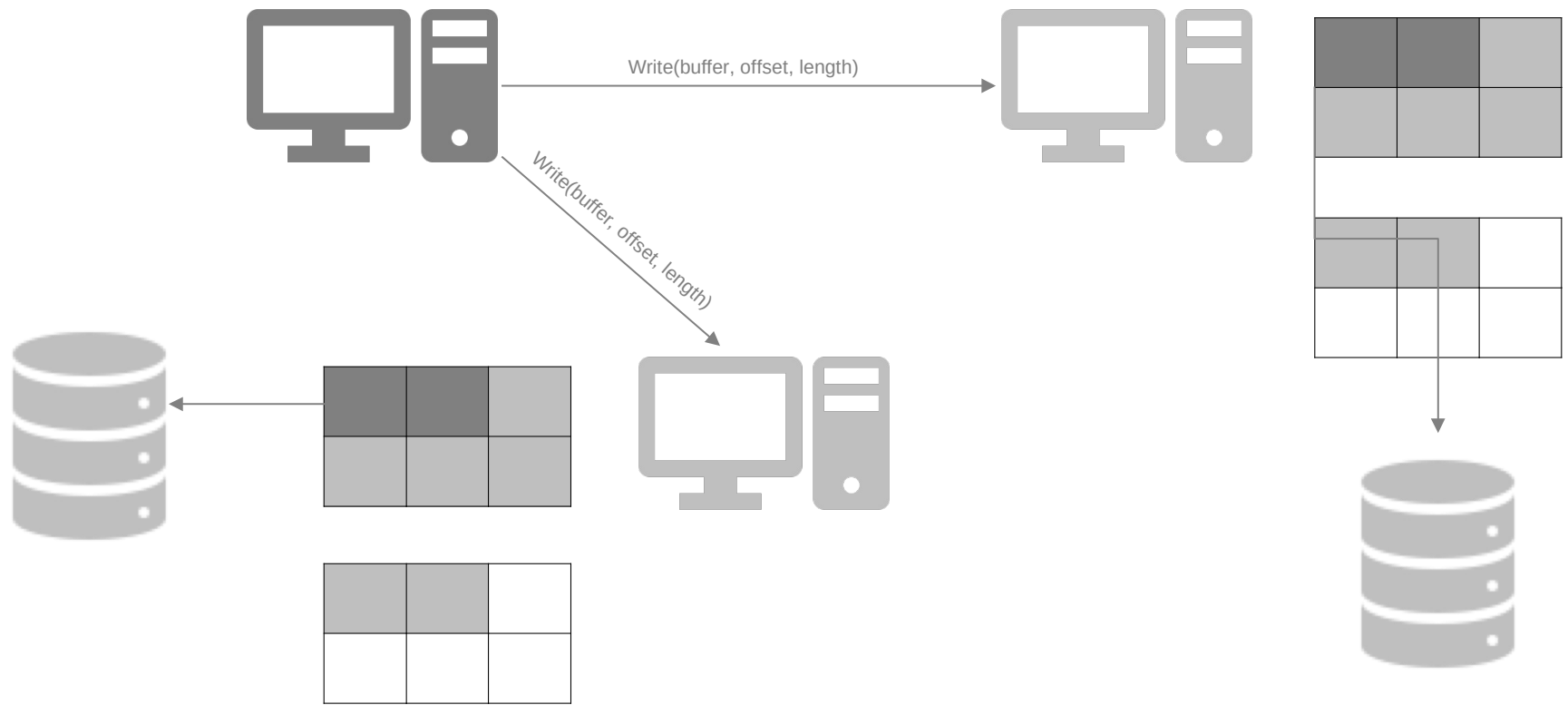
WRITE-TRANSACTIONS (SIMPLIFICATION)





SINE NOMINE
ASSOCIATES

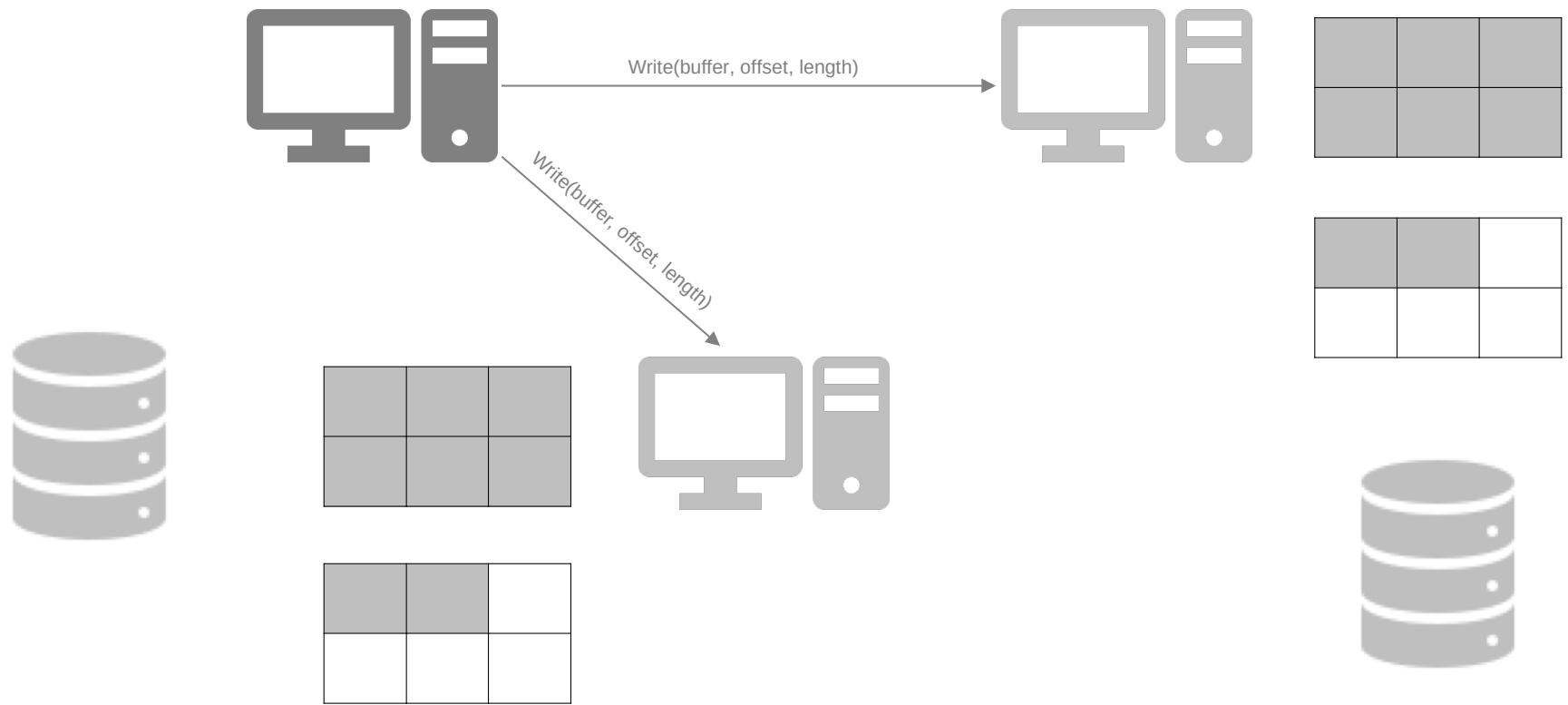
WRITE-TRANSACTIONS (SIMPLIFICATION)





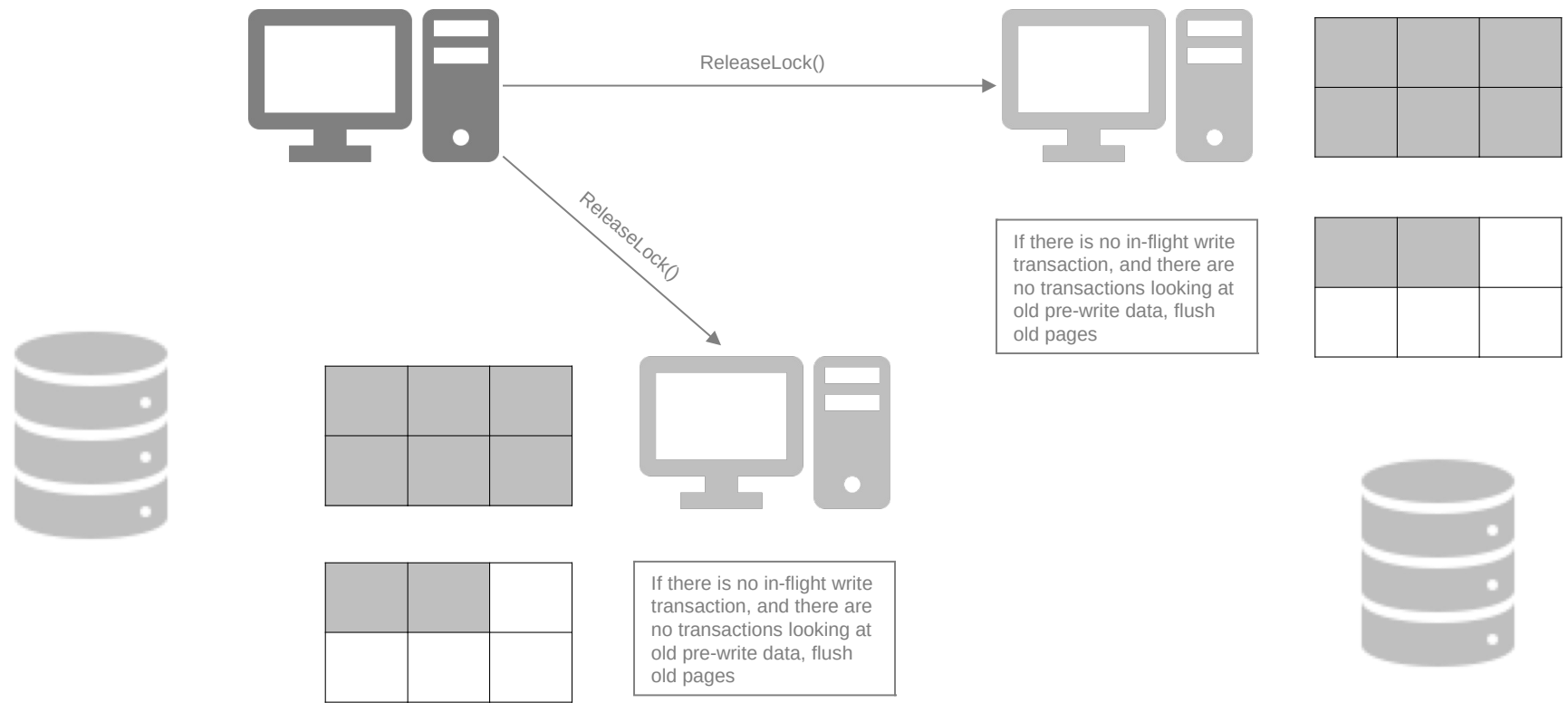
SINE NOMINE
ASSOCIATES

WRITE-TRANSACTIONS (SIMPLIFICATION)





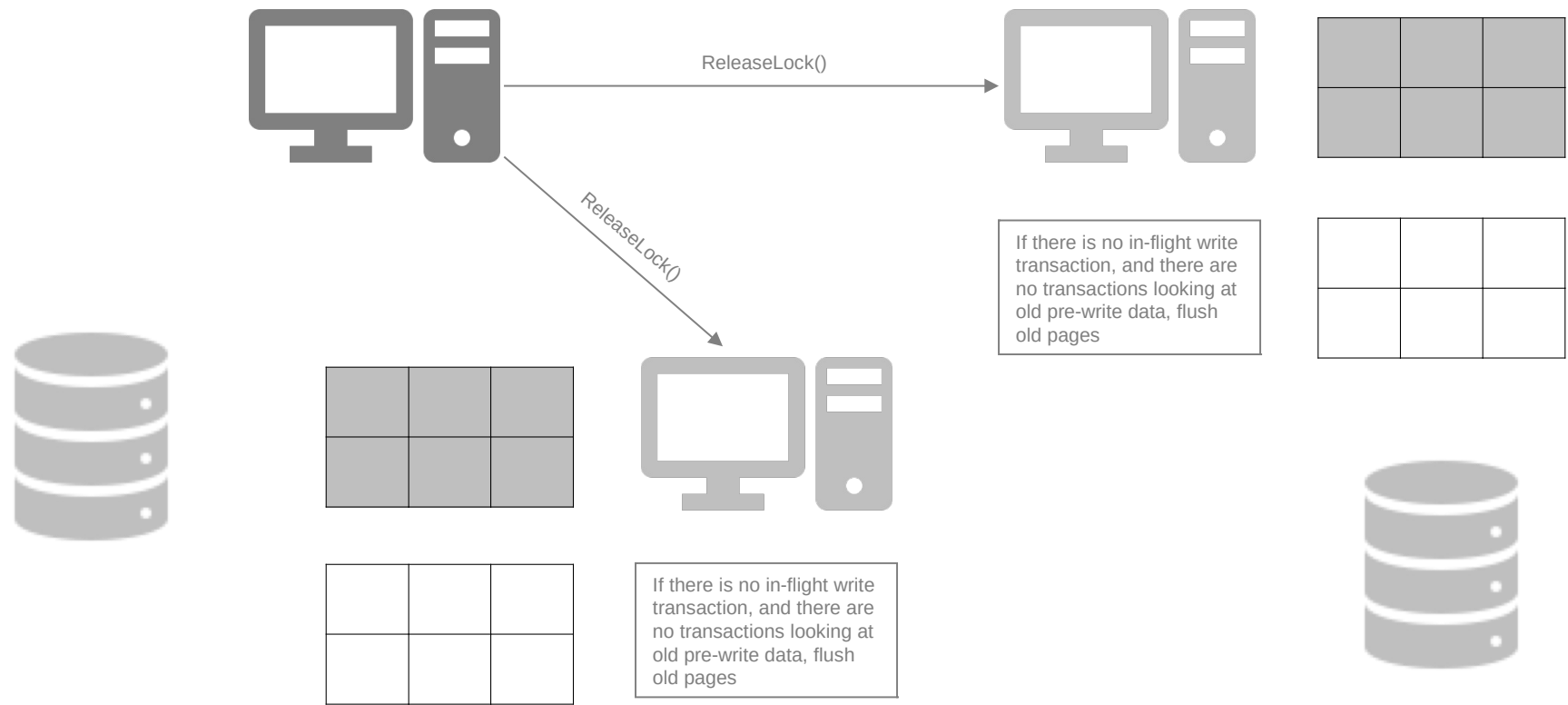
WRITE-TRANSACTIONS (SIMPLIFICATION)





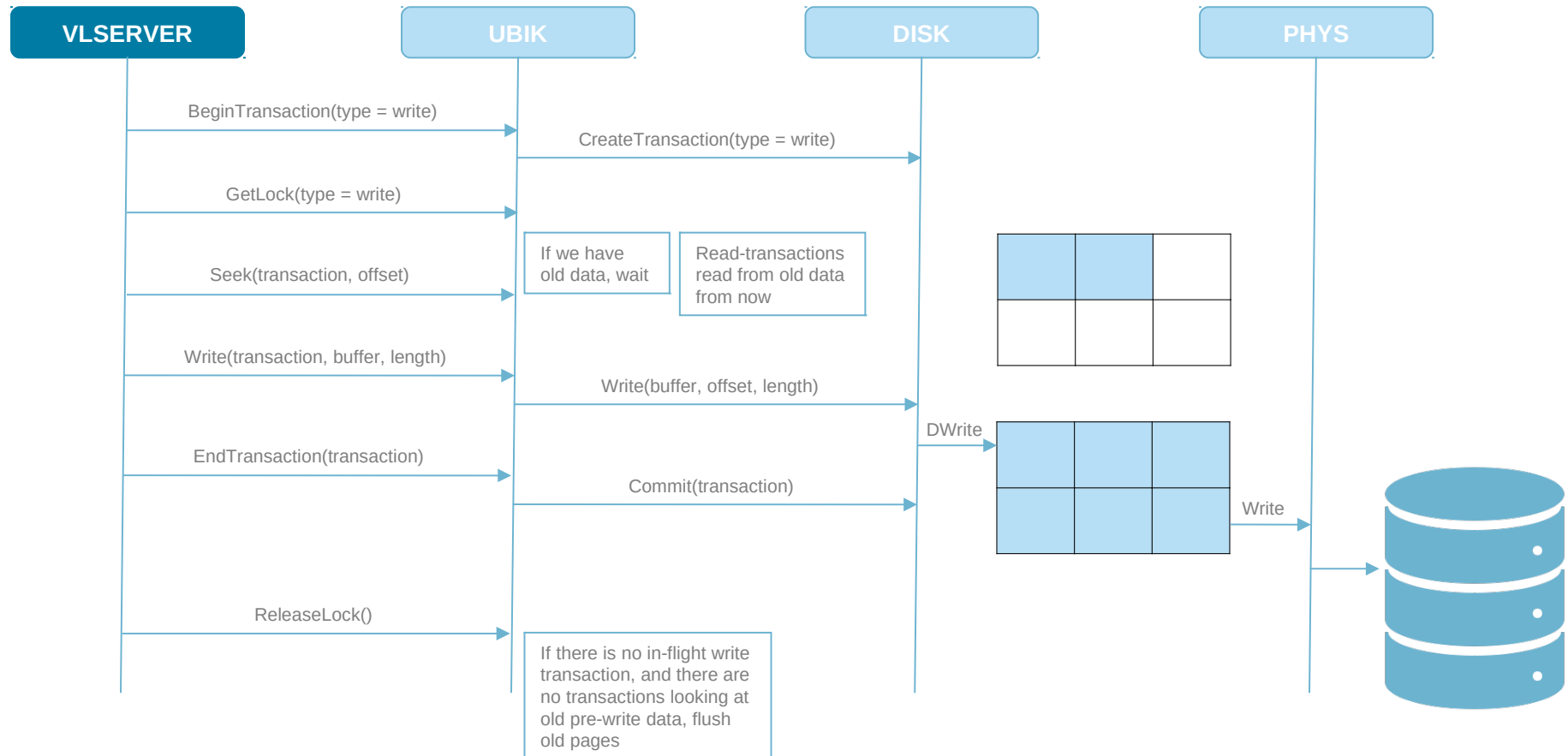
SINE NOMINE
ASSOCIATES

WRITE-TRANSACTIONS (SIMPLIFICATION)



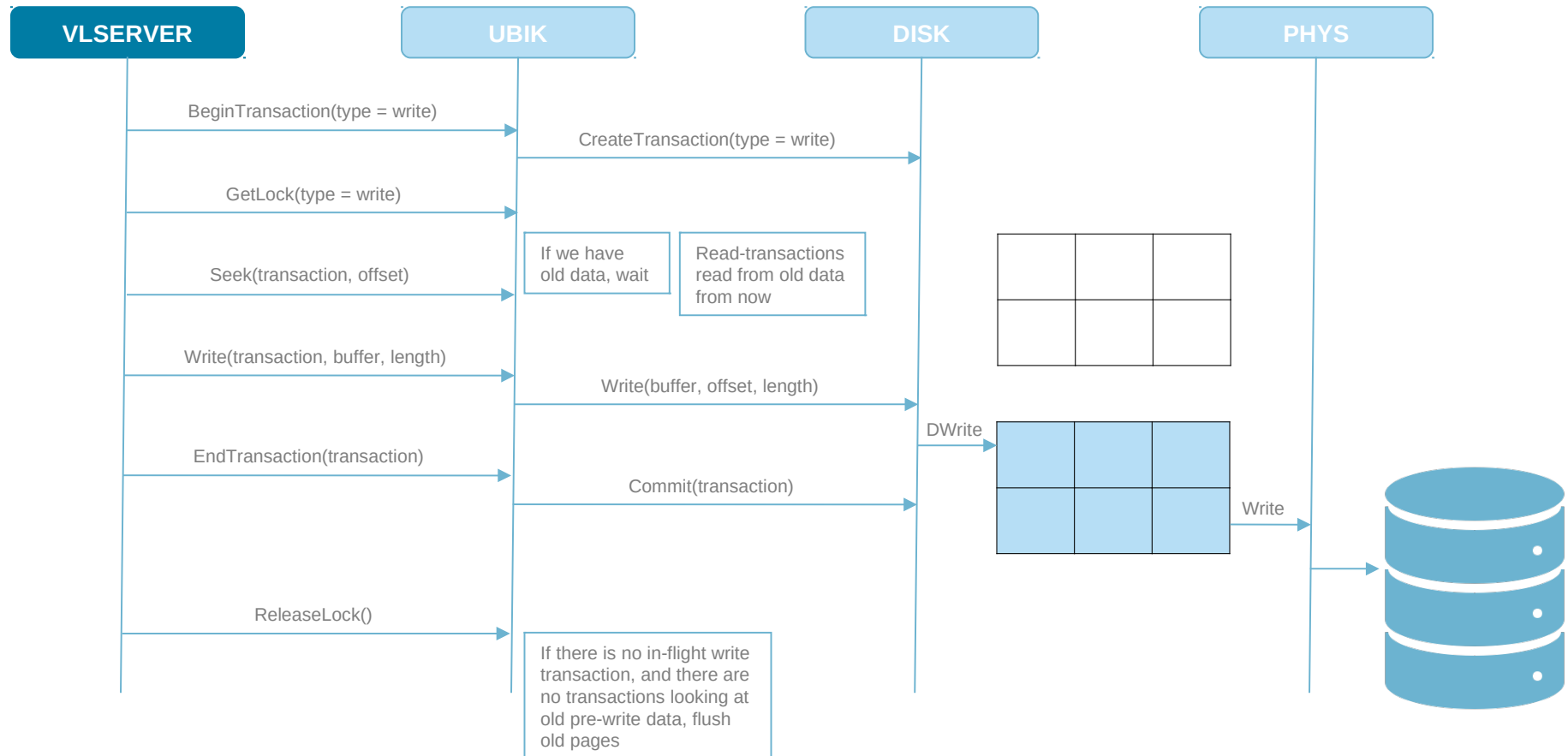


WRITE-TRANSACTIONS (SIMPLIFICATION)



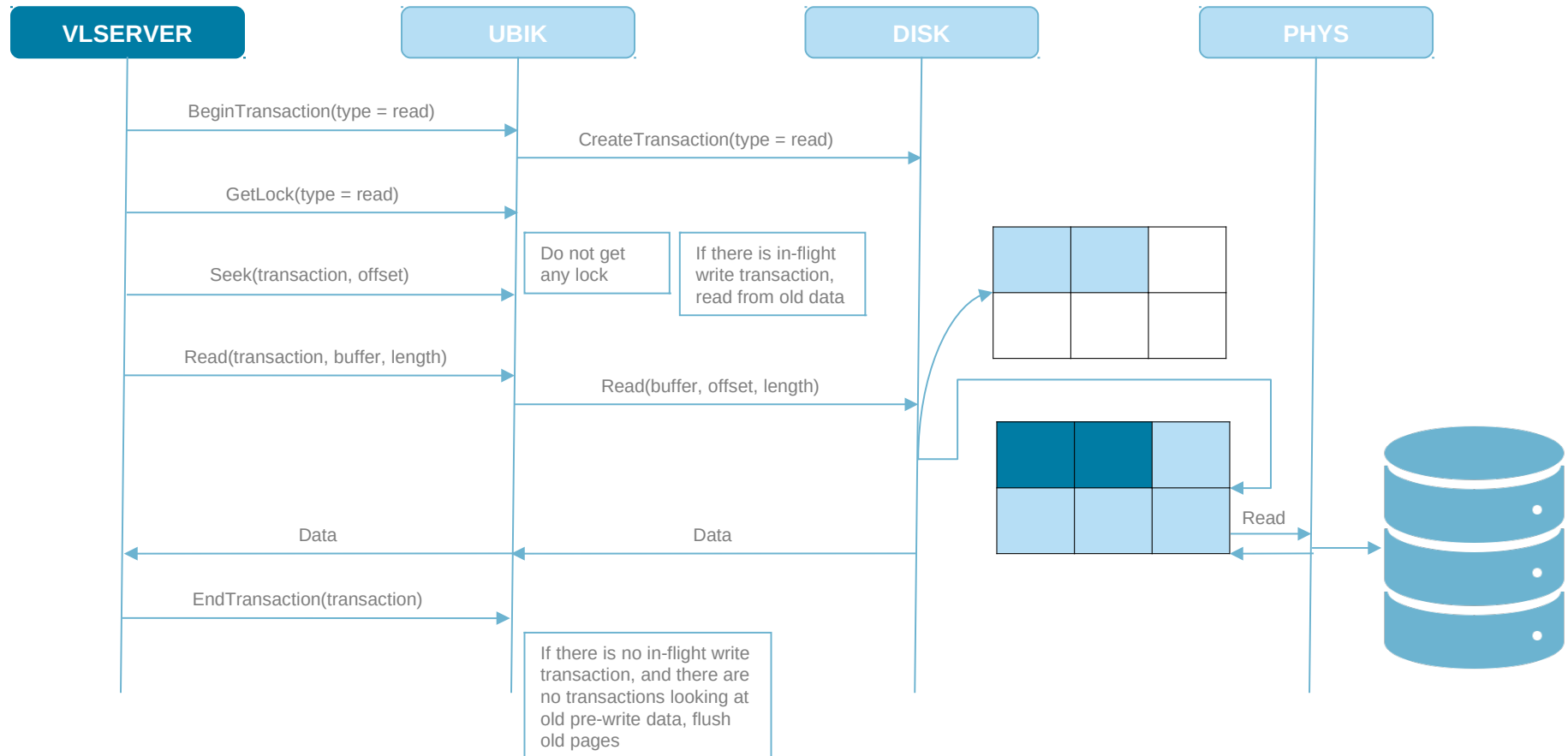


WRITE-TRANSACTIONS (SIMPLIFICATION)



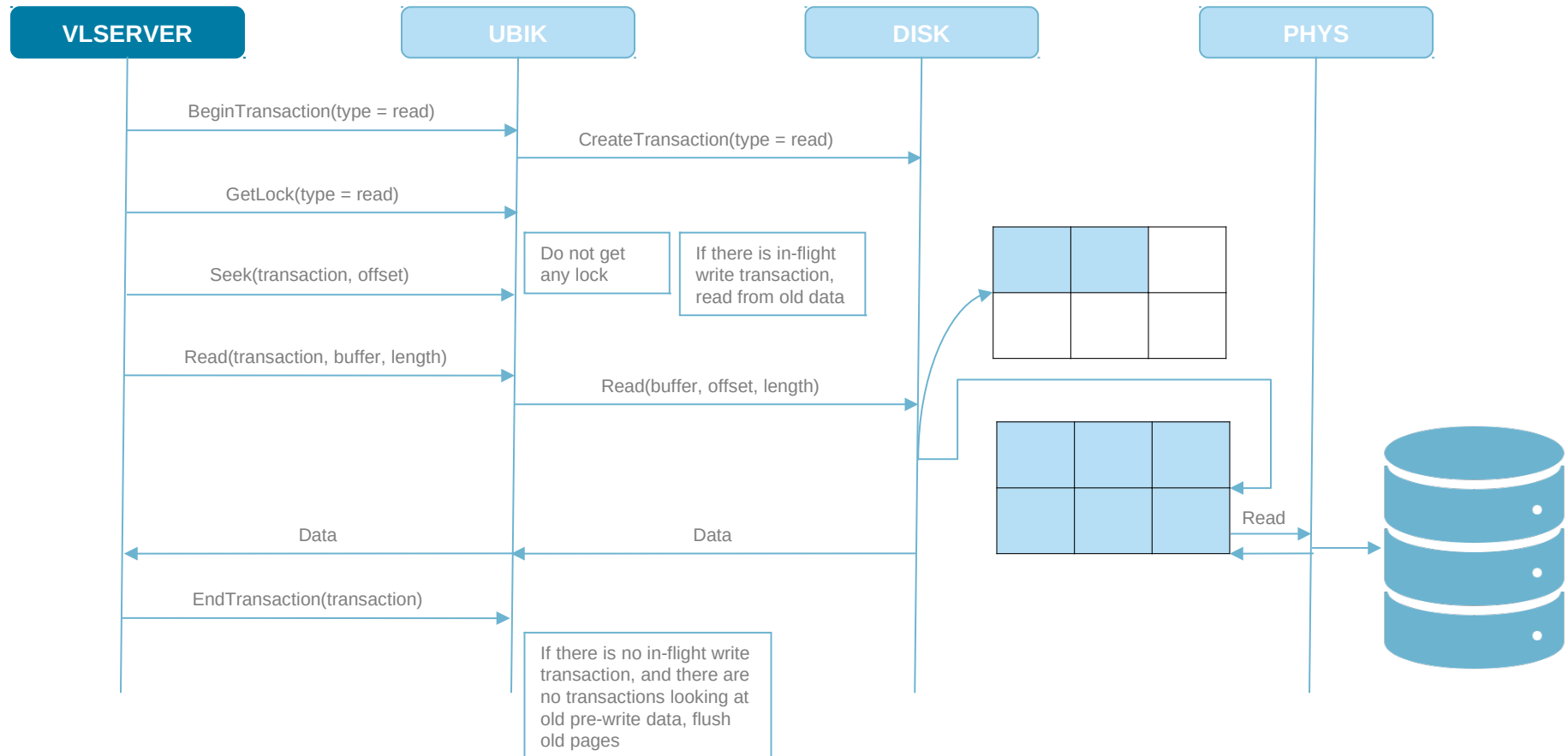


READ-TRANSACTIONS (SIMPLIFICATION)



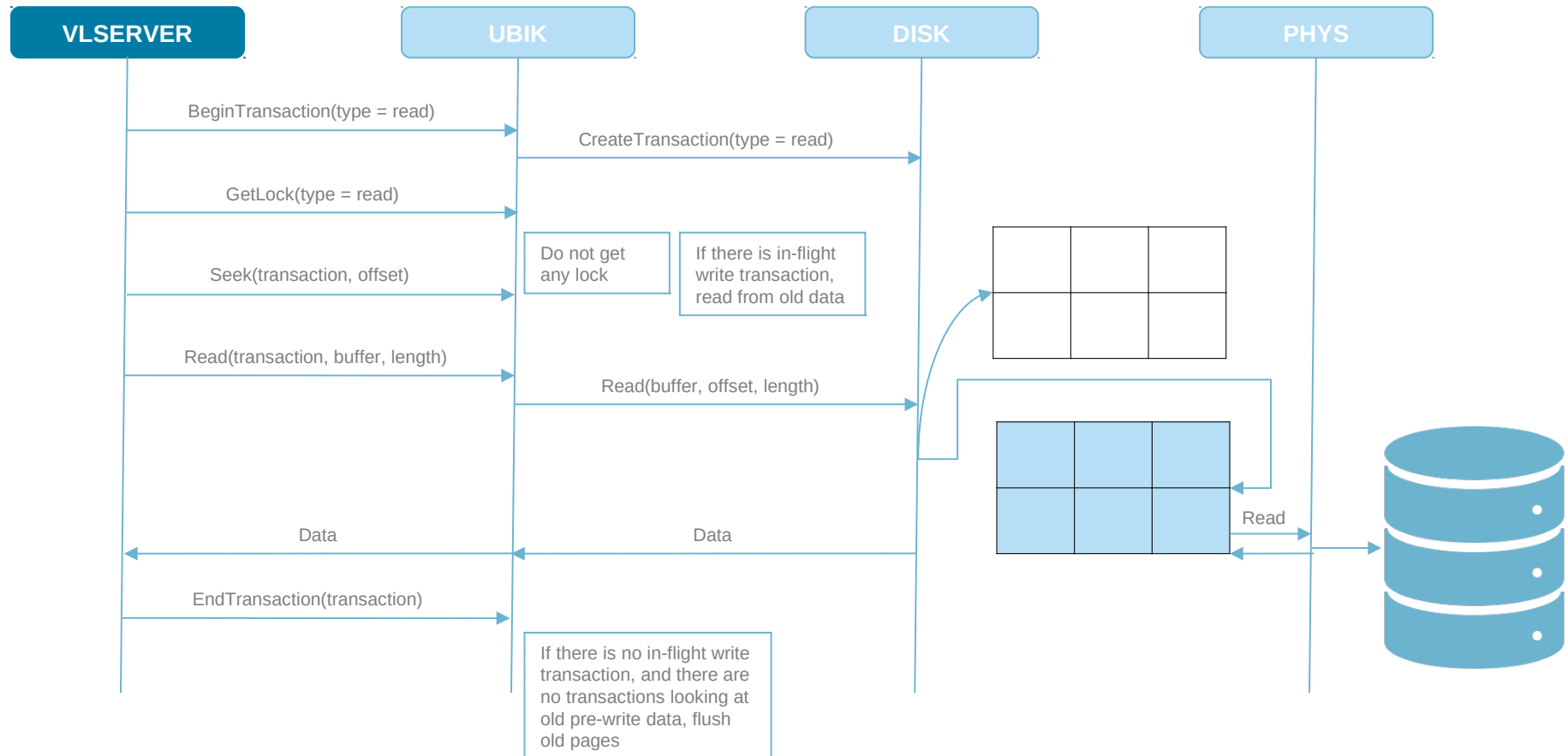


READ-TRANSACTIONS (SIMPLIFICATION)





READ-TRANSACTIONS (SIMPLIFICATION)





SINE NOMINE
ASSOCIATES

READS-DURING-COMMIT

- Write-transactions do not block read-transactions;
- Read-transactions do not block write-transactions;
- Limitations
 - Can not have multiple write-transactions running at the same time;
 - New write-transactions are blocked if we still have any read-transaction looking at old data;



SINE NOMINE
ASSOCIATES

PATCHES

- Patches can be found on gerrit;
- Reads-during-recovery;
 - Topic: ubik-reads-during-recovery;
- Reads-during-commit;
 - Topic: ubik/read-during-commit;



SINE NOMINE
ASSOCIATES

OTHER FIXES



SINE NOMINE
ASSOCIATES

AVOIDING SITES THAT DID NOT VOTE FOR SYNC



SINE NOMINE
ASSOCIATES

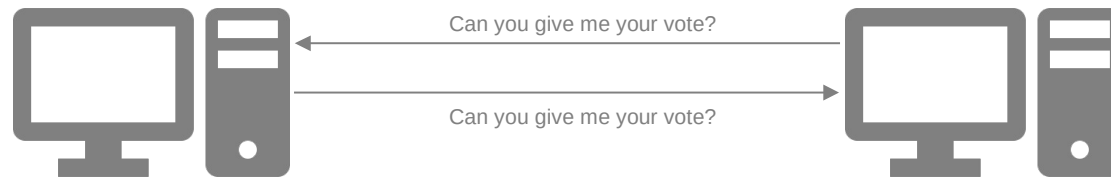
AVOIDING SITES THAT DID NOT VOTE FOR SYNC

- Remote-sites do not create write-transactions if it didn't vote for the sync-site;
- What happens when the request for a new transaction is refused?
 - Sync-site assumes that the remote-site is not "available";



SINE NOMINE
ASSOCIATES

AVOIDING SITES THAT DID NOT VOTE FOR SYNC





SINE NOMINE
ASSOCIATES

AVOIDING SITES THAT DID NOT VOTE FOR SYNC

Voting for myself





SINE NOMINE
ASSOCIATES

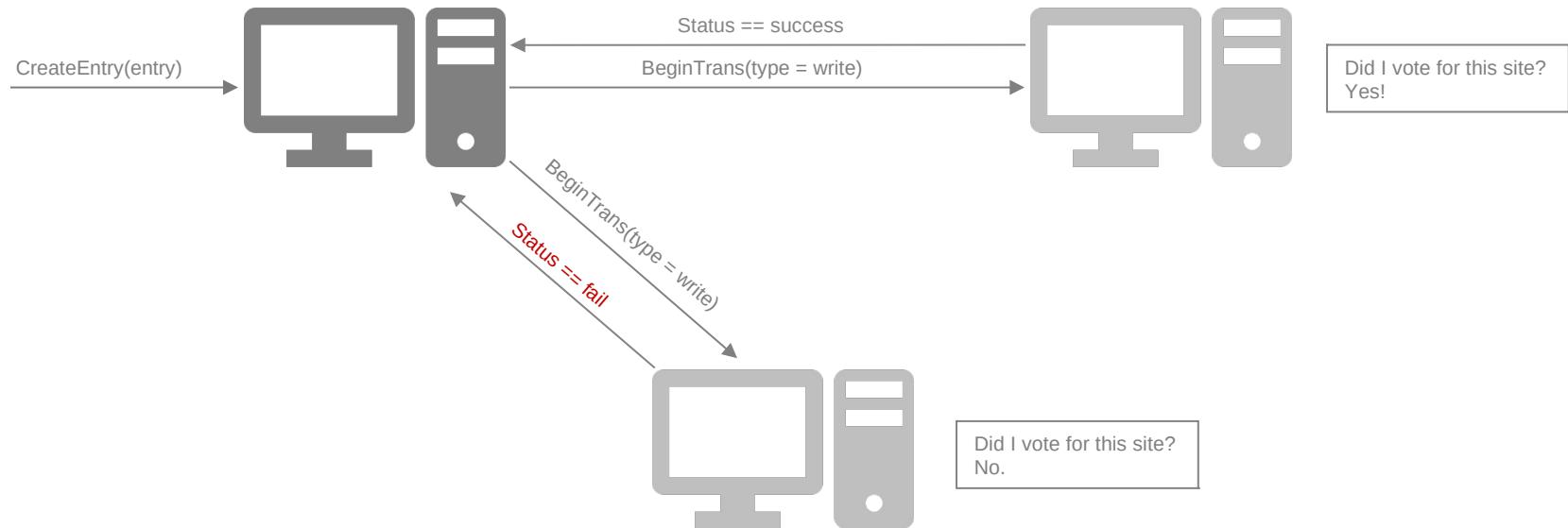
AVOIDING SITES THAT DID NOT VOTE FOR SYNC





SINE NOMINE
ASSOCIATES

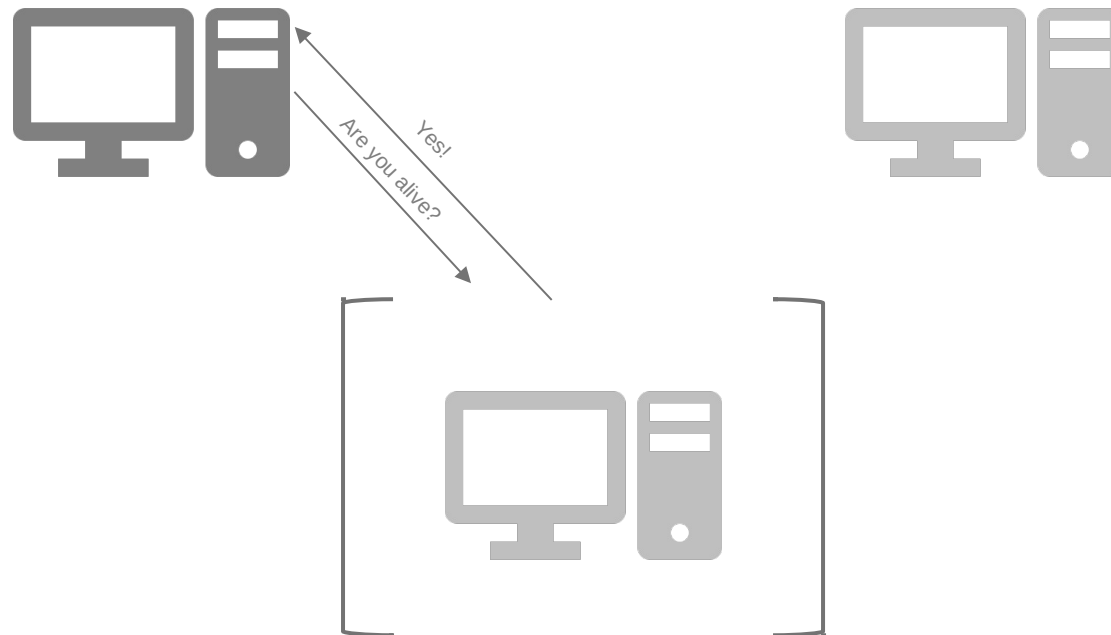
AVOIDING SITES THAT DID NOT VOTE FOR SYNC





SINE NOMINE
ASSOCIATES

AVOIDING SITES THAT DID NOT VOTE FOR SYNC





SINE NOMINE
ASSOCIATES

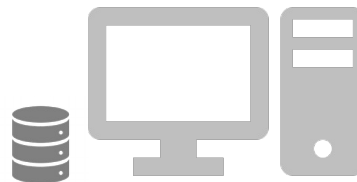
AVOIDING SITES THAT DID NOT VOTE FOR SYNC





SINE NOMINE
ASSOCIATES

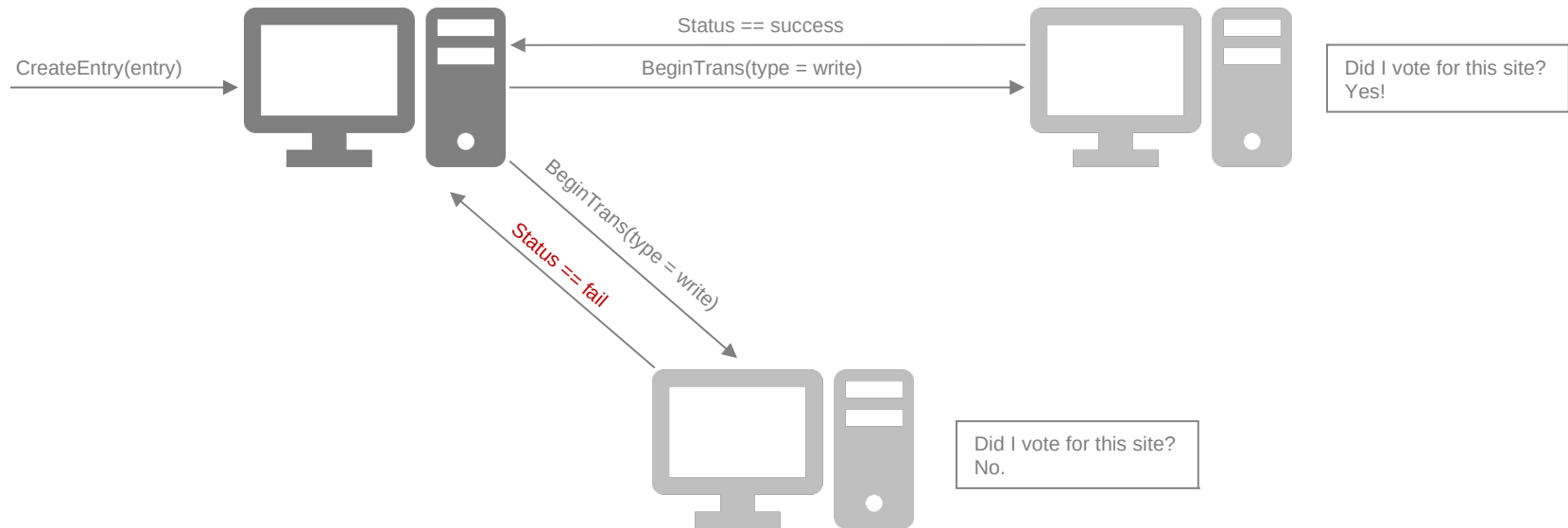
AVOIDING SITES THAT DID NOT VOTE FOR SYNC





SINE NOMINE
ASSOCIATES

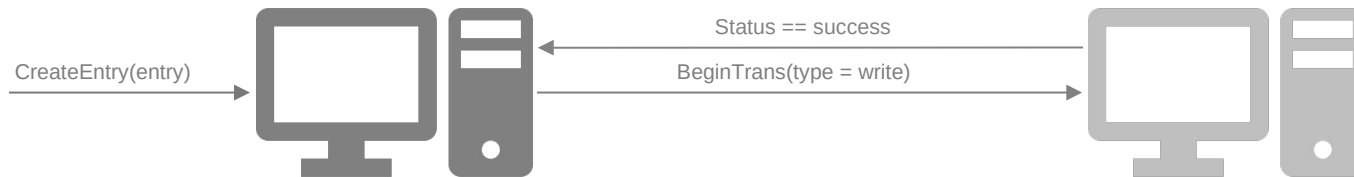
AVOIDING SITES THAT DID NOT VOTE FOR SYNC





SINE NOMINE
ASSOCIATES

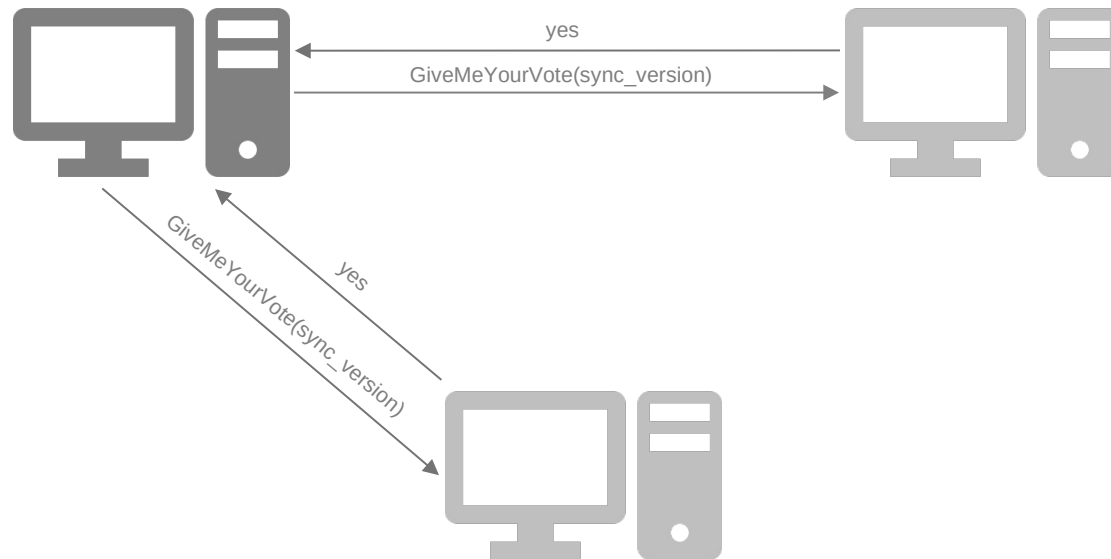
AVOIDING SITES THAT DID NOT VOTE FOR SYNC





SINE NOMINE
ASSOCIATES

AVOIDING SITES THAT DID NOT VOTE FOR SYNC





SINE NOMINE
ASSOCIATES

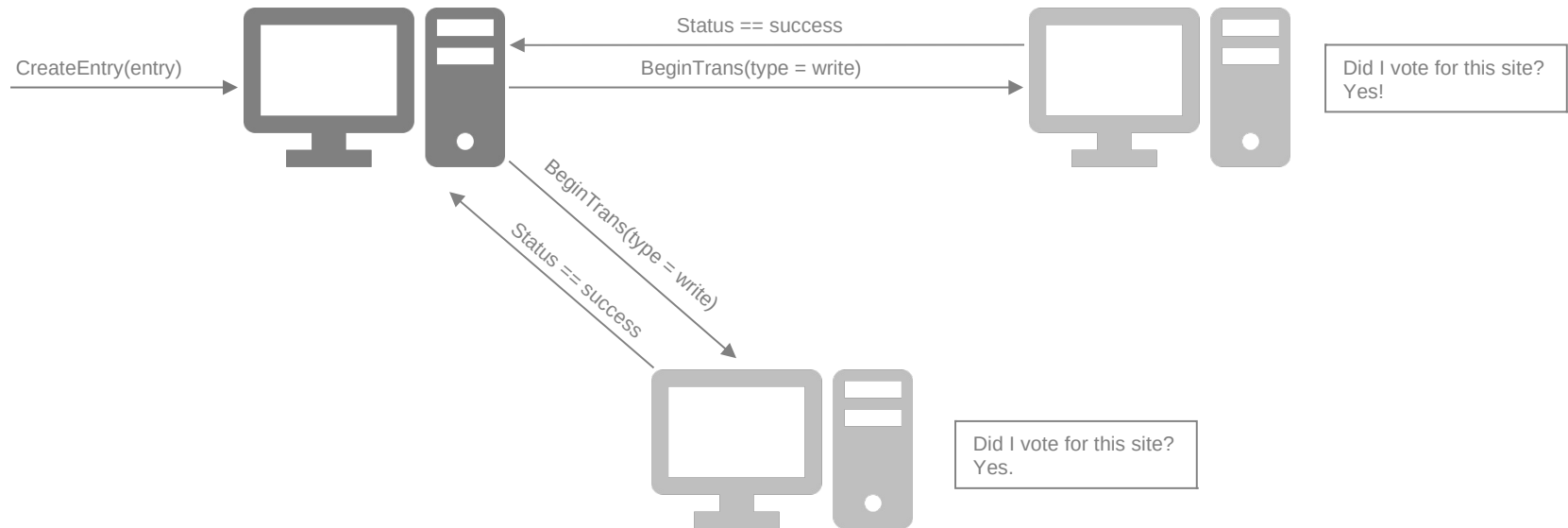
AVOIDING SITES THAT DID NOT VOTE FOR SYNC





SINE NOMINE
ASSOCIATES

AVOIDING SITES THAT DID NOT VOTE FOR SYNC





SINE NOMINE
ASSOCIATES

**UPDATE EPOCH AS SOON AS
SYNC-SITE IS ELECTED**



SINE NOMINE
ASSOCIATES

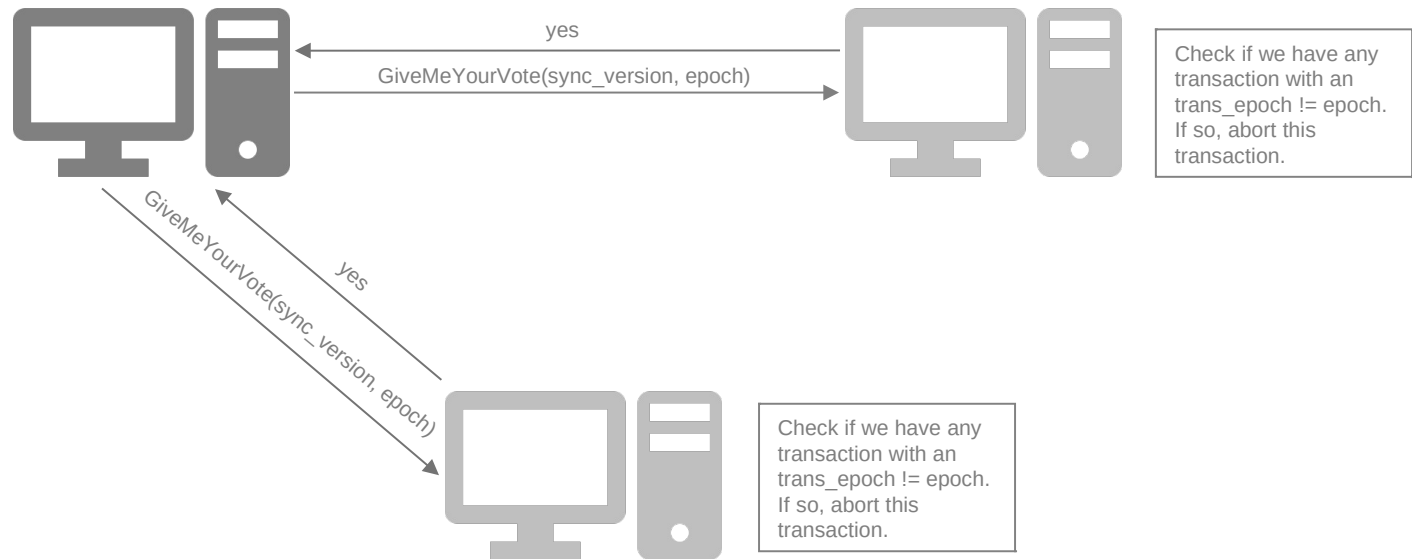
UPDATE EPOCH AS SOON AS SYNC IS ELECTED

- Epoch is global that represents the time in which the sync-site was elected;
- We use this global to differentiate transactions from different mandates;
 - Every transaction has an epoch;
 - If this epoch is not equal to the epoch advertised by the current sync-site, this transaction should be aborted;



SINE NOMINE
ASSOCIATES

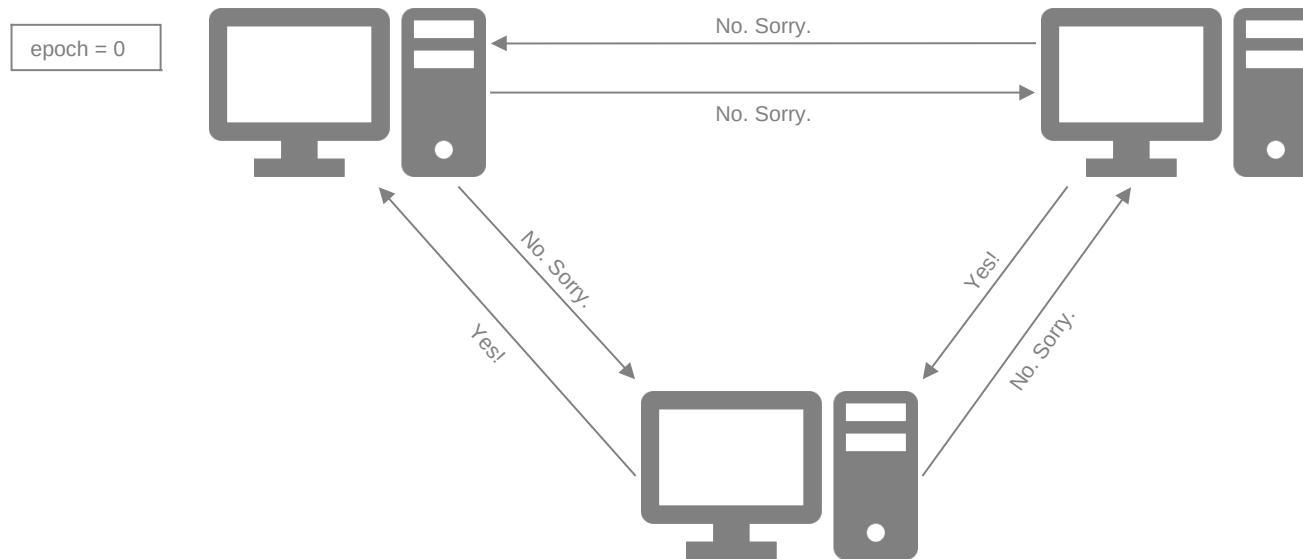
UPDATE EPOCH AS SOON AS SYNC IS ELECTED





SINE NOMINE
ASSOCIATES

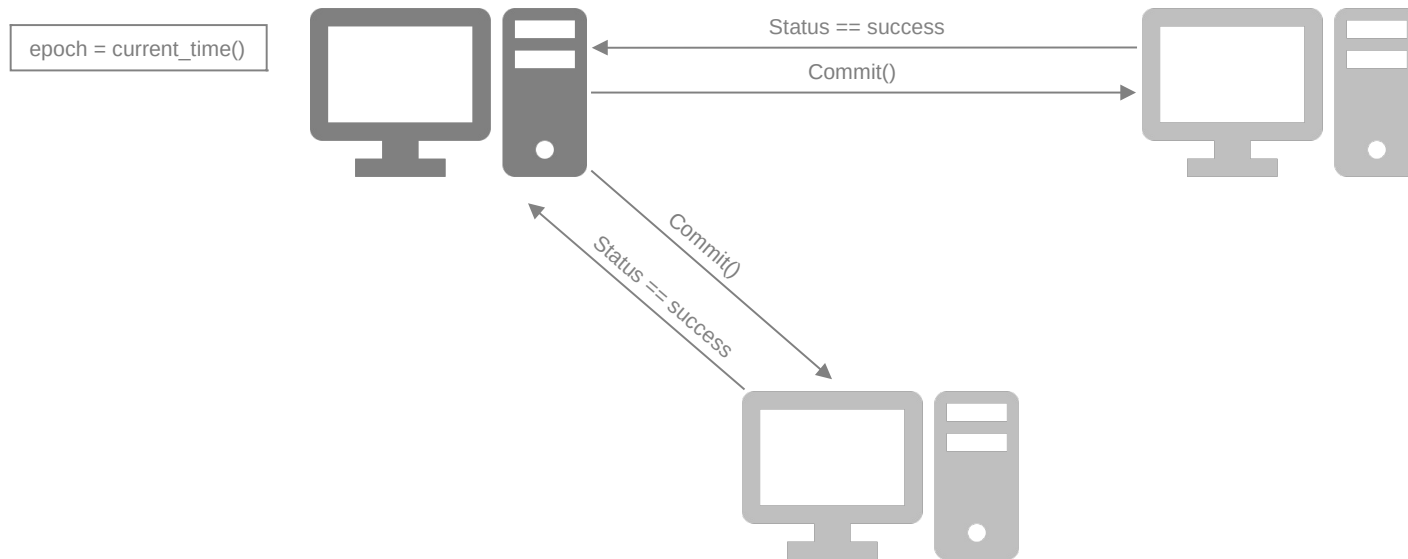
UPDATE EPOCH AS SOON AS SYNC IS ELECTED





SINE NOMINE
ASSOCIATES

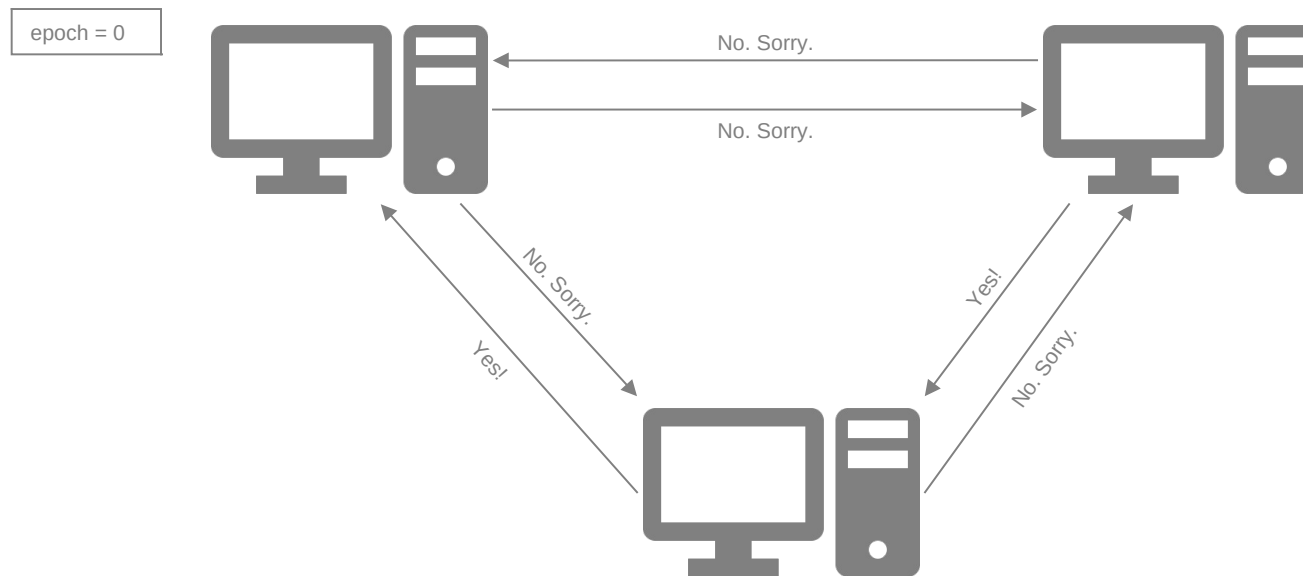
UPDATE EPOCH AS SOON AS SYNC IS ELECTED





SINE NOMINE
ASSOCIATES

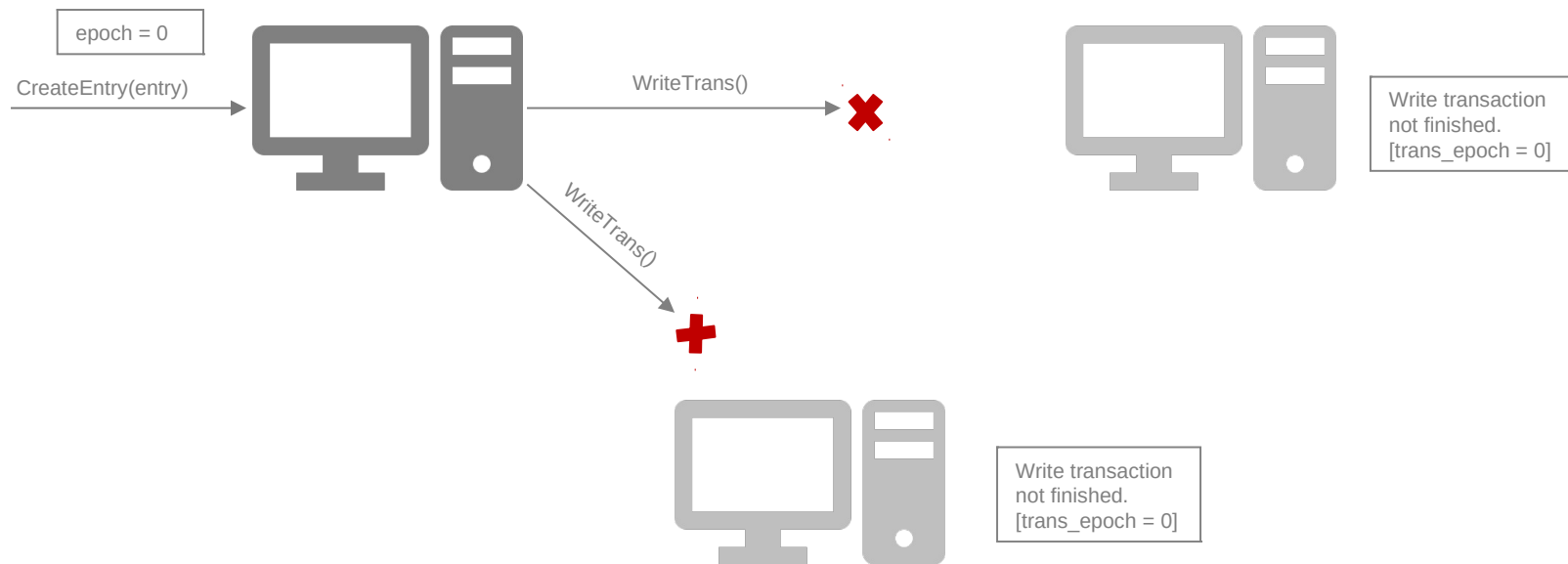
UPDATE EPOCH AS SOON AS SYNC IS ELECTED





SINE NOMINE
ASSOCIATES

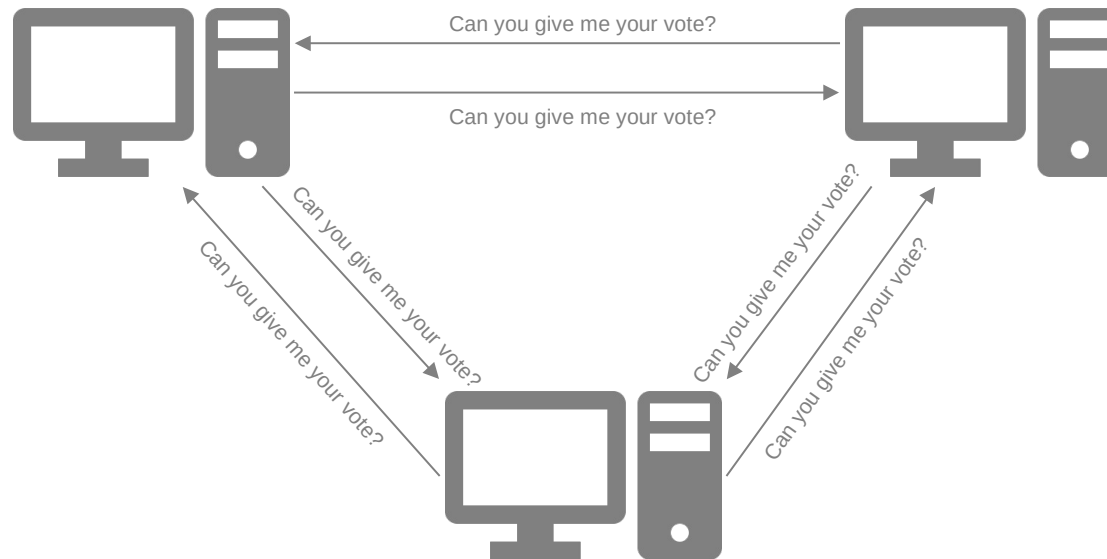
UPDATE EPOCH AS SOON AS SYNC IS ELECTED





SINE NOMINE
ASSOCIATES

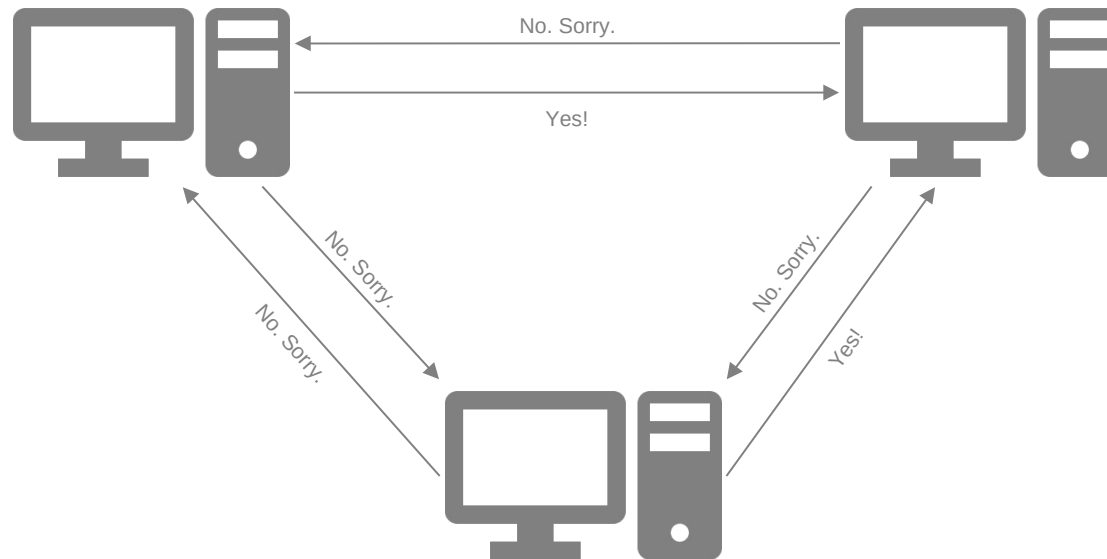
UPDATE EPOCH AS SOON AS SYNC IS ELECTED





SINE NOMINE
ASSOCIATES

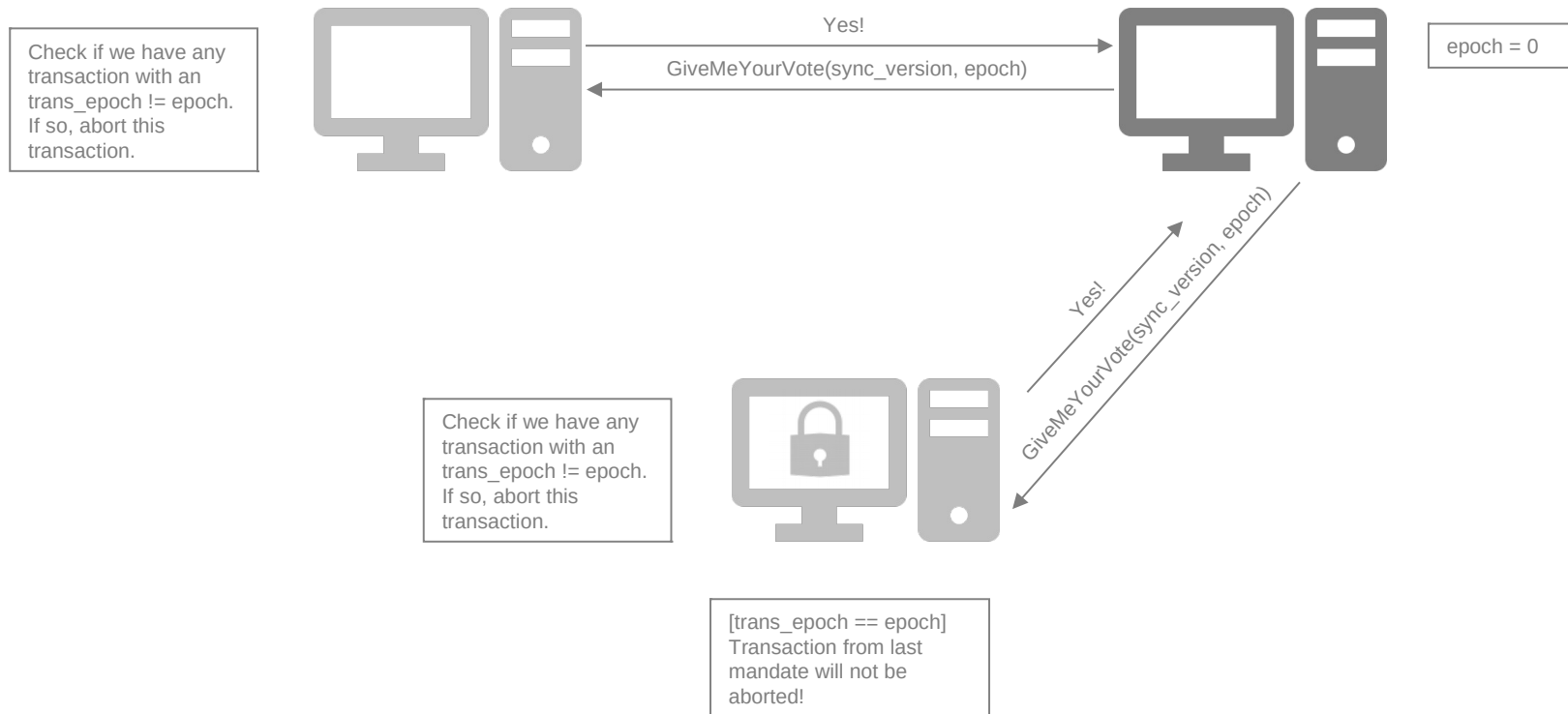
UPDATE EPOCH AS SOON AS SYNC IS ELECTED





SINE NOMINE
ASSOCIATES

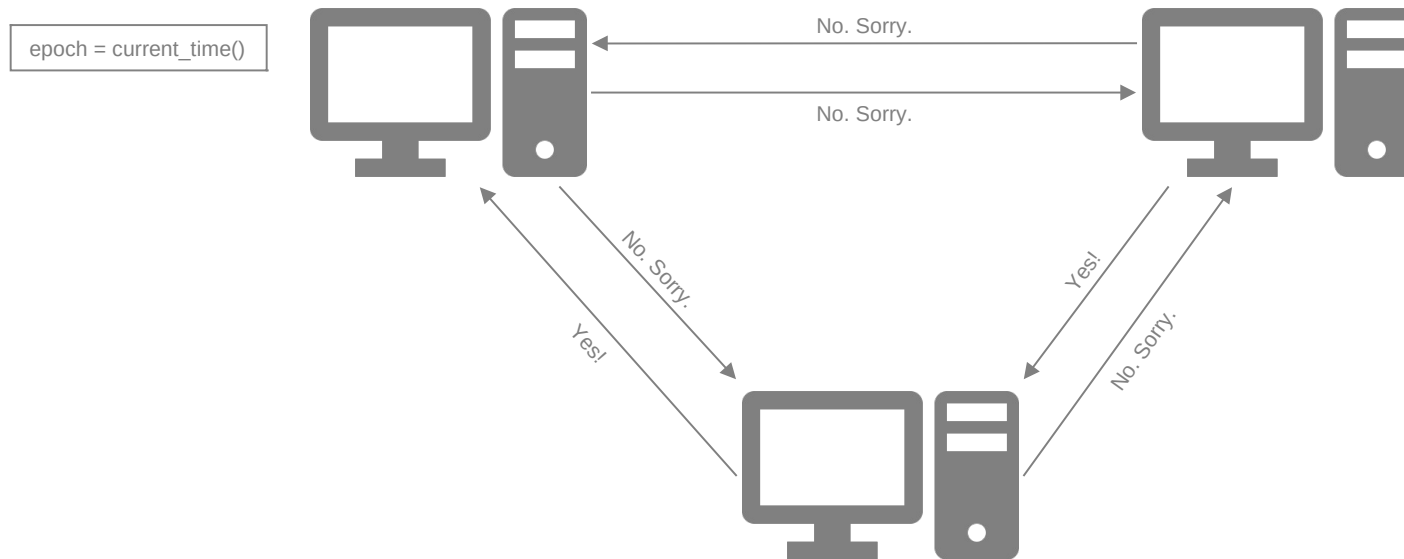
UPDATE EPOCH AS SOON AS SYNC IS ELECTED





SINE NOMINE
ASSOCIATES

UPDATE EPOCH AS SOON AS SYNC IS ELECTED





SINE NOMINE
ASSOCIATES

Thank you!