

TerraBTC: A Peer-to-Peer 3D World Real Estate System

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Abstract. Today, many properties in certain metropolises are simply bought and resold for speculative purposes, they are not used for residential or commercial purposes and are kept closed. Their value is fundamentally determined not so much by beauty or usability, but by the value per square meter (square foot) and their location within the metropolis. The idea is to replicate the same real estate dynamics in a decentralized virtual world. Therefore, it is necessary to have a digital environment that replicates the same behavior in terms of location and area, construction or renovation costs, design and customization, historical significance, etc., but above all, that it cannot be turned off or manipulated by anyone and that the exchange can take place without any intermediary, integrating a secure and immutable notarization system.

1. Introduction

TerraBTC arises from the desire to historicize an eternal 3D virtual world that cannot be deleted by anyone, stored on the most redundant storage in the world (Bitcoin Blockchain), completely in clear text, using a set of rules (protocol) that can be followed without the necessary presence of source codes. This will ensure the reconstruction of the virtual world and the protocol from the data itself, even in the event of permanent loss of this document and all source codes written for its execution. For the implementation, the focus has been on minimizing and simplifying operations. To encourage adoption and use, it was decided to inherit typical characteristics of Bitcoin: scarcity, trustless, durability, privacy, fully opensource and opendata, and to implement a concept of "genesis address" for decentralization and as an additional incentive for the adoption of the protocol. This project seeks to implement the "codeless" principle: The design of TerraBTC was inspired by the Eternity Wall project, which was born in 2015. After a few years, the client and website for visualization were shut down, but the protocol continued to live on and be used by the community that still wrote on Bitcoin Blockchain. Subsequently, the visualization website was made available again and constantly updated. Eternity Wall proved to be resilient; the protocol was used even though no tools for visualization/interactivity were directly available to users. TerraBTC, based on the initial idea of Eternity Wall of writing textual messages on "stone," aims to lay the groundwork for a simple full-text protocol that allows a network of users around the world to hold and exchange virtual land on the universal unique registry, Bitcoin, by following this simple textual protocol.

2. TerraBTC is a Bitcoin Application Protocol

TerraBTC is an application protocol on Bitcoin, just like the TCP/IP stack which is a framework for organizing the set of internet protocols, in this case Bitcoin constitutes the "transport layer" and below, while TerraBTC is a true application layer like HTTP or FTP. The protocol only makes sense to exist if implemented on top of the Bitcoin timechain, only in this way does it inherit all the characteristics that make it a true decentralized peer-to-peer system, and only in this way can its resilience be guaranteed.

3. The Protocol

The protocol involves writing 1x1 blocks of a 3D matrix-style virtual world similar to Minecraft on blockchain of type Bitcoin, implementing peer-to-peer exchange of land/properties(Terra), digitally reflecting the market dynamics of the real estate world. The protocol provides for the generation of a matrix world of 10000 lands symmetrically divided into 4 quadrants, with 2500 lands per quadrant. The objective of this project is to clearly save on the Bitcoin Blockchain a 3D cube-style Minecraft world, making each land a high-prestige work of art because it is inscribed on the most important distributed unique ledger in human history, ensuring its recovery and reconstruction even hundreds, if not millions, of years later, much like the first engravings on stone.

The protocol uses Bitcoin as a write-once append-only ledger, which is non-modifiable, where transactions are recorded starting from the genesis address. By writing everything clearly and analyzing blockchain from the genesis address, it will always be possible to reconstruct the virtual world even in the event of loss of documentation of the protocol itself and/or client source code for interactions.

In this protocol, the entity performing the operation is the input address contained in each transaction. All transactions that have more than one address in input will be discarded by the protocol.

WARNING! There must always be only one address in the 'input' of the transaction.

4. The Genesis Address

The Genesis Address is the bookmark from which to analyze on-chain transactions to reconstruct the world based on the data carved on the blockchain, the chronological order given by the block height in which the transaction in question was included. Each land is owned by the one who first correctly completed the purchase from genesis address, wrong transactions will not determine the purchase of the land and will not be reversible. According to the protocol, the first land will be acquired by those who have made the purchase transaction on genesis address:

1B8YAhuyy5iKYDPHEa8HSZy4gfeqzwyYNn using the exact amount of the transaction to buy from genesis address:

Quadrant 1: 0.001
Quadrant 2: 0.01
Quadrant 3: 0.1
Quadrant 4: 1

Example Buy from Genesis:

- Sign and broadcast this transaction:
 - Address:
1B8YAhuyy5iKYDPHEa8HSZy4gfeqzwyYNn
 - Amount: 0.01
- Now it is owner of a Terra on Quadrant 2

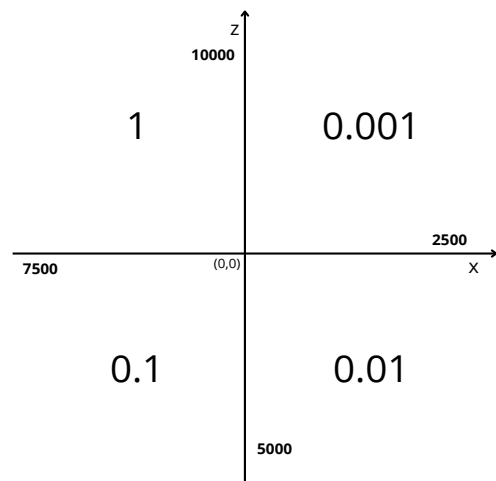


Figure 1: World division into 4 quadrants

All Quadrants are immediately open to buy, once all the lands in a quadrant have been sold, subsequent transactions will not be considered for the protocol and will be invalid.

The Genesis address keys have not been saved, so all funds sent will be donated to the entire Bitcoin ecosystem as a burn, this operation propagates the mining cost directly on the value of a single land, in this way it is possible to give the starting reference value; answering the question: how much hash/s is approximately needed to mine a land?

5. Ownership

The ownership of a "Terra" (the term "Terra" refers to a land in the 3D world) is determined by:

- 1) Buy from the genesis address (until the end of the supply for each quadrant)
- 2) Buy from a private owner (land put up for sale by the address of an existing owner)

The owner who has followed the protocol is the one who has the writing privileges for the blocks for that land.

6. P2P Market

Any land purchased can be resold at any price. The advantage related to scarcity would allow people who buy in a cheaper quadrant, upon the depletion of that quadrant, to resell at the price of the next quadrant. Once all quadrants are depleted, the price will clearly have a market value that cannot be estimated.

6.1. Sale Listing (FOR SALE)

The sale listing is a special OP_RETURN transaction inserted by the current owner (ideally as an identity transaction) indicating the requested amount as a string.

For Sale is revocable, but it is also possible to update the price with a new "for sale transaction" with a different amount (the registry is append-only).

6.2. Buy from Genesis

First buy of a Terra (Buy from Genesis):

- Check availability of lands still for sale, number of remaining lands per quadrant (max 2500 for single quadrant)
- The buyer sends the transaction from just one of its input addresses with the exact amount for that quadrant excluding Fees to Genesis Address

6.3. Buy from Private Owner

The purchase of a land not from the genesis address but from a private owner involves:

- The owner sends the "for sale" transaction (show for sale sign)
- The buyer waits for the necessary confirmations (the order is given by the sequence of blocks in the blockchain, on the single block the order of the transactions established during the mining phase)
- The buyer sends the transaction with the exact amount excluding the fee to the owner's address or makes a "purchase commitment proposal" following the appropriate procedure.
- With the purchase transaction, the buyer becomes the owner and acquires the writing privileges for that land, that is, the ability to modify the blocks and to be able to put the land up for sale at the price he prefers.

6.4. Purchase Commitment Proposal

A way to avoid concurrency on purchase transactions during the acquisition phase is the purchase commitment proposal.

A buyer can:

- Send a purchase proposal that describes the purchase commitment, once the proposal is sent, the buyer has 48 time blocks to complete the transaction, if he don't do it in time, it expires and another buyer can step in.

With the proposal inserted on-chain, the seller cannot dismiss the Terra listing until the expiration, which corresponds to the 48th block after the insertion of the proposal (including the 48th block).

6.5 Sale Proposal (Ask to sell)

A buyer who wants to purchase a land can make an offer to an owner who is not selling, hoping that it will accept. If the seller accepts the offer within 48 time blocks, the buyer will have another 48 time blocks to complete the purchase (sending the requested amount). If the buyer fails to meet their commitment by the deadline, the land will no longer be for sale. A new sale request will need to be accepted again by the seller. All transactions with a deadline cannot be revoked and are used to manage concurrency among users.

7. Scarcity by protocol

The limit of 10000 Terra lands is a limit imposed by the protocol, only 4 digits in base 10 describe the Terra id, so from 0000 to 9999, transactions outside the range will not be considered by clients/validators.

However, those who wish to do so can continue to buy land outside the range by inserting modified transactions that do not follow the protocol, in any case they will be aware that those transactions do not respect the protocol and will be discarded by the clients/validators that will validate the transactions following the protocol, as for Bitcoin users and developers will be more incentivized to ensure scarcity and enforce a protocol shared by all.

8. Infinite Single Registry

To trace the current owner of the land(Terra), a validator of the protocol must read all the on-chain transactions starting from the Genesis Address up to the last validated block, following all the sales and modifications to the land made by the owners who have followed one another over time, up to the last buyer who made the last valid purchase transaction and no one will ever be able to revoke it.

Bitcoin is blockchain ; TerraBTC is salechain (notarized sales protocol).

So at the end of the validator's processing, the last buyer will find himself the owner of a land with all the modifications made by the others up to that moment (a built-up land).

The owner can decide to rebuild as he likes but will still have to bear the costs all the on-chain writing transactions to replace an empty block (Air) on each block, so he will be encouraged to preserve the building works already present on the land or make slight changes rather than erasing everything up and rebuilding from scratch.

It is important to keep in mind that the register is in perpetual append, so anyone can render the land at time t owned by the owner a , and the entire history of the land will remain forever written and recoverable.

9. Build on a Terra

Once the ownership of the land (write privileges) is obtained, it is possible to replace the blocks of that land, and this is exactly the privilege that determines ownership.

The writing of a block corresponds to the replacement of the previous block (for example, I replace an empty air block with a grass block).

The correctly replaced blocks will be only those inserted as a transaction sent by the current owner's address as an OP_RETURN string (identity transaction) and only within the range of absolute coordinates in which the 64x64 block land. This means that even if another address inserts a block modification transaction in a land that is not its own, this modification is discarded by the validators, so no one, even by inserting syntactically correct transactions, modifies the land of the true owner, because they will all be discarded during the validation phase.

A simple example:

Owner A wants to complete his masonry work on his 64x64 land, but the completion exceeds his range, and therefore he would like to write some blocks in the position 66,68, then he inserts write transactions in that position from his address, which unfortunately does not match the current owner address of those blocks. Even though he has inserted them and therefore written them forever, these

will be forever ignored by the validators, who will instead only consider the transactions inserted by the correct owner.

10. Why TerraBTC implemented on Bitcoin instead of Ethereum or others?

Bitcoin is the best candidate to be the single distributed and redundant ledger worldwide, information written on this "support" has the highest probability of being recovered in the future compared to any other support and above all completely immutable.

11. Why a 3D World Minecraft style?

Minecraft is the best three-dimensional environment for representing a cube in three-dimensional space, it is the most popular, has the largest community, and the code for developing extensions is the most well-known among developers. It has a huge development community and a lot of documentation. Its simplicity makes it easy to understand and approachable for everyone.

12. Actions/Transactions

This whitepaper document describes the exact rules for interacting with the 3D world on Bitcoin. Bitcoin blockchain is used as perpetual append storage. Bitcoin, being a timechain, allows for the reconstruction of the complete history of all transactions provided by the TerraBTC protocol, starting from the first genesis transaction up to the last mined block. The TerraBTC protocol bases its entire operation on reading transactions starting from the Genesis address: First, the purchase transactions from genesis are read, and all the first owners who are correctly identified as the initial owners are analyzed, always starting from the block in which the first valid transaction of type 'buy from genesis' of land 0000 ($n = 1$) occurred with the Genesis Address. All subsequent transactions for each individual owner are then analyzed, allowing for the reconstruction of all structural changes made to the world and transfers of ownership.

The macro sequence of the actions/transactions of the TerraBTC protocol follows the progressive sequence of the block height: the order dictated by the sequence of the blockchain blocks, the sequence of the actions/transactions present on the single mined block corresponds to the order of the transactions determined by the miners who contributed to the creation of the block.

The order of the actions/transactions that end up in the same mined block therefore follow an "arbitrary" order: they do not follow a specific order based on criteria such as the amount or the date, the order can vary from one block to another and varies depending on the selected transactions and the associated commissions.

There are two types of transactions to validate:

- Payment Transaction (UTXO)
- Write Transaction (OP_RETURN)

Land sale and construction operations are of the Write Transaction type, these are transactions that involve a simple writing of clear text as OP_RETURN inserted as ASCII to HEX, these transactions are signed as transactions identified by the Owner Address as OP_RETURN transaction.

For example, writing a block of type "Wood" on land n. 73 will be (just coordinates are enough):

ASCII: TB0001SET005120051203317

HEX: 544230303031534554303035313230303531323033333137

The only operation that does not have any text transaction to write on blockchain is the direct purchase of a land from Genesis address or from a private owner without the "commitment to purchase" which is carried out without text writing, as a pure transfer transaction of UTXO.

WARNING: the lands go from 1 to 10000, on chain the land n is written as n - 1 with 4 fixed digits in base 10 so the land n=1 onchain is 0000 instead the land n= 10000 onchain is 9999.

List of Actions/Transactions on TerraBTC protocol:

Action/ Transaction	Type	Description	Example
1. Buy from Genesis	Payment Transaction	User A wants to buy the next genesis land still available	User A send <GenesisAmount> to genesis address in order to acquire next genesis land ownership
2. Buy from Private Owner	Payment Transaction	User A wants to directly buy the User B land	User A send <Amount> to User B in order to acquire the land ownership
3. Build Add/Edit a Block	Write Transaction - OP_RETURN Clear-text	User A owns land, he wants to modify a block of his land	User A write an identity OP_RETURN transaction respecting the protocol. For Example: TB0001SET09999099999999
4. Sell Order	Write Transaction - OP_RETURN Clear-text	User B wants to put his land up for sale	User B write an identity OP_RETURN transaction respecting the protocol. For Example: TB0001SELL99990.012
5. Revoke Sell Order	Write Transaction - OP_RETURN Clear-text	User B wants to revoke land up for sale, (a Sell Order with impossible price or Empty Amount)	User B write an identity OP_RETURN transaction respecting the protocol. For Example: TB0001SELL999910000.00 Or Example: TB0001SELL9999
6. Submits a Commitment to Purchase	Write Transaction - OP_RETURN Clear-text	User A (buyer) undertakes to make the purchase within a time limit, submits a "commitment to purchase" (lock the purchase negotiation)	User A write an identity OP_RETURN transaction respecting the protocol. For Example: TB0001PROP9999 Or Example (or with useful counter-offer price): TB0001PROP99990.1522
7. Submits a sale proposal	Write Transaction - OP_RETURN Clear-text	User A (potential buyer) submits a sale proposal to User B	User A write an identity OP_RETURN transaction respecting the protocol. For Example: TB0001ASK99990.1844
8. Accept Sale Proposal	Write Transaction - OP_RETURN Clear-text	User B accepts the sales proposal sent by User B with a transaction "7. Submits a sale proposal"	User B write an identity OP_RETURN transaction respecting the protocol. For Example: TB0001ACPT99990.1844

12.1. Concurrency

The build scripts do not require concurrency management (only the current owner can write)

The purchase of land from genesis does not require concurrency management, purchases can arrive in bulk, the assignment is progressive, **WARNING:** close to the 2500th, whoever buys from Genesis address land n.2501 with the amount of the previous quadrant will have performed a burn, it will not be possible to recover the amount, because the transaction is not valid for the protocol.

The purchase from a private owner, on large trading volumes, the problem of concurrency arises, for the purchase from a private there are three p2p market scenarios envisaged:

Scenario(4, 2), Scenario(4, 6, 2) and Scenario(7, 8, 2)

- WARNING Scenario (4, 2) does not manage concurrency, the purchase is direct through UTXO transfer only

- SAFE Scenarios (4, 6, 2), (7, 8, 2) manage concurrency, these scenarios include a transaction lock that lasts 48 blocks of blockchain.

12.2. Lock Tx and Expiration

Some protocol instructions have the characteristic of being Lock Transactions, similar to the concept of Row Lock in relational databases, which blocks the modification of a row by another user different from the one currently performing the operation. In this protocol, a Transaction Lock has become necessary, which invalidates subsequent transactions on that land for a limited time to ensure the successful completion of the operation.

In the specific case of TerraBTC, the Lock is linked to a fixed timeout and is linked to the number of consecutive blocks mined on blockchain. In TerraBTC, it was opted for 48 consecutive blocks to wait. Lock until the 48th block after the insertion of the transaction that provides for it (including the 48th block).

The temporal lock could be thought of as not a good implementation, but for this project, it turns out to be excellent because it exactly replicates the expiration date of a real estate purchase proposal.

12.3. Revoke

All the Actions/Transactions of the protocol are not revocable, only the Sell Order can be revoked with its command, the revocation applies to commands that once launched do not have an expiration date, for TerraBTC the "Sell Order" does not have an expiration date and therefore a command is necessary to remove or update the conditions for the sale, the revocation is also a sequential writing, if between a Sell Order and a subsequent one the sale has been completed, any revocation command has no effect.

12.4. Multiple Buying and Selling

A user with the same address who owns multiple lands decides to sell two or more lands using the same amount for the sale. Therefore, more than two lands are available on the market for sale simultaneously by the same owner with the same sale amount.

In these cases, the order in which the sales are filled, that is:

On which of the "for sale" lands is the ownership transferred during the execution of the command "2. Buy from private"? This can be determined through the following two steps:

Step 1) First, priority is given to actions/transactions that have an active LOCK (Commands: 6, 7, 8).

Step 2) Subsequently, if there are any, the "for sale" lands without expiration with a non-revoked "generic sell order" are filled.

Both steps described in 1) and 2), if there are multiple transactions for a single step and it is necessary to determine which land n corresponds to the sale for that specific txid, the first land that is filled for sale is the one with the lowest progressive number of land n. Therefore, the sales are filled using the land number n starting from the smallest to the largest.

This behavior occurs only when the same address puts two or more lands in "for sale" with the same amount, and one or more buyers want to purchase all for sale lands.

For example:

- User B "SELLER" submit a Sell Order with Land n 23 and Amount 0.012

- TerraBTC string: TB0001SELL00220.012

In a subsequent block User B "SELLER" submit another Sell Order with Land n 5 and Amount 0.012

- TerraBTC string: TB0001SELL00040.012

User A send exactly 0.012 BTC to <User B address>

User C send exactly 0.012 BTC to <User B address>

Now User A own land n. 5 (Terra 0004/9999)

Now User C own land n. 23 (Terra 0022/9999)

12.5. Undefined Length Fields

All Actions/Transaction fields are of fixed size, the only fields with undefined size are “Amount” and “BlockData”.

For the Amount field, numbers from 0 to 9 and a single dot are allowed. To indicate the exact Amount relative to the action/transaction command, other characters are not allowed. For example 12.58342 or 0.0356302

For the BlockData field there are no limits. Later versions of the protocol, maintaining everything described in this document, will be able to extend BlockData by adding additional features for that single block. Version 0001 is the basic protocol that provides:

BlockId:BlockColor example Acacia Oak Planks BlockId:BlockColor = 5:4

So for BlockData, numbers from 0 to 9 are provided followed by the character : and then other numbers from 0 to 9 that identify the block color/type.

Future versions in addition to BlockId:BlockColor may follow the character ; to add additional parameters and characteristics to enrich the block at that point of x,z,y coordinates

The BlockData field will then correspond to a CSV line with a separator ; where the first field is always BlockId or BlockId:BlockColor

Examples:

- BlockData contains BlockId of type “Oak Planks” which is 5
TerraBTC string: TB0001SET00064101280325
- BlockData contains BlockId:BlockColor of type “Acacia Oak Planks” which is 5:4
TerraBTC string: TB0001SET00064101280325:4
- BlockData contains BlockId:BlockColor of type “Acacia Oak Planks” which is 5:4 and others Metadata
TerraBTC string: TB0002SET00064101280325:4;<Metadata>

The Actions/Transactions have specific characteristics described in this table:

Action/ Transaction	User Authorized	Lock Tx	Type	Expire	Revocable	Empty Fields	Undefined Length Fields
1. Buy from Genesis	ALL	False	UTXO	False	False	-	-
2. Buy from Private Owner	*ALL	False	UTXO	False	False	-	-
3. Build Add/Edit a Block	Owner	False	OP_RETURN	False	False	-	BlockData
4. Sell Order	Owner	False	OP_RETURN	False	*True	-	Amount
5. Revoke Sell Order	Owner	False	OP_RETURN	False	*True	Amount	Amount
6. Submits a Commitment to Purchase	ALL	True	OP_RETURN	True	False	Amount	Amount
7. Submits a sale proposal	ALL	True	OP_RETURN	True	False	-	Amount
8. Accept Sale Proposal	Owner	True	OP_RETURN	True	False	-	Amount

The table above shows some characteristics of the instructions defined in the protocol.

** Allowed Action/Transaction is valid only if there are no Locks or if Lock is Expired.*

13. Protocol instructions

Below is a detailed list of the protocol instructions:

1) Buy from Genesis Address - BUY

- User A wants to buy the next genesis land still available on Quadrant 2
- User A send Genesis Quadrant 2 Amount to Genesis Mainnet Address
Genesis Mainnet Address: 1B8YAhuuy5iKYDPHEa8HSZy4gfeqzwyYNn
Genesis Quadrant 2 Amount: 0.01
- User A send 0.01 BTC to 1B8YAhuuy5iKYDPHEa8HSZy4gfeqzwyYNn
- Now User A own last genesis land still available on quadrant 2

The transaction identified with the hash id identifies the title of ownership of the land.

If this transaction is the 2501st, this transaction will have no value, this is valid for all four quadrants, once all Genesis transactions are made, it will no longer be possible for anyone to buy from genesis.

WARNING: If the transaction don't have exactly Amount 0.01, for example a transaction with Amount 0.01001 this is not valid and you don't own last genesis land.

Genesis Transaction limits:

- max 2500 transactions with Amount 0.001
- max 2500 transactions with Amount 0.01
- max 2500 transactions with Amount 0.1
- max 2500 transactions with Amount 1

2) Buy from Private Owner - BUY

- User A wants to directly buy User B's land, according to the protocol they must:
- User A checks that there is a Sell Order transaction from User B for that land and that there is no subsequent Sell Order or revocation (with empty Amount). The Sell Order has no expiration, but any new Sell Order invalidates the previous one (Price Change or Revocation of the sale).
- User A checks that there are no valid 'Commitment to Purchase' PROP requests with an active expiration in the next 48 blocks.
- User A checks that there are no 'Accept Sale Proposal' ACPT transactions sent by User B (land owner) that are valid with an active expiration in the next 48 blocks.
- User A send Sell Order Amount to User B Address:
Address: <User B Address>
Amount: exactly <Sell Order Amount>
- User A send <Exact Sell Amount> BTC to <User B Address>
- Now User A own User B land

WARNING: it is recommended to always purchase using methods that utilize Locks: Buy from Private Owner using "Commitment to Purchase – PROP" or using "Submit Sale Proposal ASK/ACPT", especially during high trading volumes, because this method is simple and useful in the beginning when there are very few users, but becomes less secure with high trading volumes (it does not handle concurrency).

3) Build on your own Terra - SET

After obtaining writing privileges by purchasing a land (genesis or private), it is possible to change the blocks and modify what has already been built previously by the previous owners.

- User A owns land, it wants to modify a block of his land
- User A signs and broadcasts an identity OP_RETURN text transaction using "SET" of TerraBTC protocol.

Let's analyze how the string is composed to Set a block on a land already owned:

TB0001	SET	0	9999	0	9999	999	9
Version	Command	+/-	X	+/-	Z	Y	BlockData

Version: Protocol prefix "TB" and Version "0001"

Fixed TB string

Fixed 4 characters only digits or characters, no special characters

Command: Command string of TerraBTC protocol

Fixed SET string

X sign +/- : The sign of the coordinates for the X-axis ; 0 Positive ; 1 Negative

Fixed 1 binary digit

X coordinates: Absolute X-axis coordinates of the block to be written

Fixed 4 digits for 0000 to 9999

Z sign +/- : The sign of the coordinates for the Z-axis ; 0 Positive ; 1 Negative

Fixed 1 binary digit

Z coordinates: Absolute Z-axis coordinates of the block to be written

Fixed 4 digits for 0000 to 9999

Y coordinates: Absolute Y-axis coordinates of the block to be written (corresponds to altitude)

Fixed 3 digits from 000 to 319 (Height limit in Minecraft is 320 blocks)

BlockData: It contains the data of the block to be written; it may include BlockId:BlockColor and other metadata. No Fixed Length, it includes digits the identify BlockId followed by colon character ':' followed by other digits the identify the BlockColor, followed by the semicolon character ';' for other metadata.

To define the BlockId with a second parameter detailing the block, such as type/color a valid example is: Acacia Oak Planks BlockId:BlockColor = 5:4

Regex: TB[a-zA-Z0-9]{4}SET[01]\d{4}[01]\d{4}\d{3}(?:\d+|\d+:\d+|\d+;\d+;*)\$

Valid RegEx Examples:

TB0001SET029990299920812

TB1c34SET0244401234133245067890123

TB1224SET01234026781991:99

TB1224SET012340267819912:99;

TB1234SET129991399918812:99;StringData Example

Example:

Write a block of SAND at the point (x0,z0) of the Terra n 2503 with Y-height 1

X sign +/- : the X sign is 0 (+ Positive)

X coordinates: The absolute X coordinate of Terra n.2503 is 64

Z sign +/- : the Z sign is 1 (- Negative)

Z coordinates: The absolute Z coordinate of Terra n.2503 is -128

Y coordinates: The absolute Y coordinate of a block with Y-height 1 is 32

BlockData: The BlockId of Sand is 12

TerraBTC string: TB0001SET000641012803212

4) Sell to Private User on p2p market - SELL

After having already purchased a land from genesis or from a private owner, it is possible to put it up for sale on blockchain using this protocol.

- User B owns land, it wants to put his land up for sale
- User B signs and broadcasts an identity OP_RETURN text transaction using "SELL" of TerraBTC protocol. This Transaction corresponds to putting up a large "for sale" sign visible to everyone. The land will be acquired with what has already been built on it by the previous owners as AS IS. This Transaction is not valid if there is another transaction with LOCK:
 - "Commitment to Purchase - PROP" valid with an active expiration in the next 48 blocks.
 - "Accept Sale Proposal - ACPT" sent by User B (land owner) valid with an active expiration in the next 48 blocks.

If this SELL Transaction is inserted during the expiration of a LOCK, if the operation requested by the Lock transaction is not executed, the effect of the new SELL (also revoke SELL) will be valid from the block after the expiration of the Lock, therefore valid for all transactions subsequent to the 48th block in which the LOCK was inserted.

Let's analyze how the string for putting an already owned land up for sale is composed:

TB0001	SELL	9999	0.0124
Version	Command	n	Amount

Version: Protocol prefix "TB" and Version "0001"

Fixed TB string

Fixed 4 characters only digits or characters, no special characters

Command: Command string of TerraBTC protocol

Fixed SELL string

n : It is the number that identifies Terra n. from 0000 to 9999

Fixed 4 digits for 0000 to 9999

On-chain, the number must always be written as n-1 ; the counter starting from 0 to 9999

Amount: Contains the exact amount required to be received for sale Terra

NO Fixed digits, Only digits [0,9]

Single pointer to separate decimal digit of Amount

RegEx:

Empty Amount RegEx: TB[a-zA-Z0-9]{4}SELL\d{4}

Or RegEx: TB[a-zA-Z0-9]{4}SELL\d{4}\d+(?:\.\d{1,8})?\$\$

Valid RegEx Examples:

TB0001SELL9999

TB0001SELL999912

TB0001SELL999912.1

TB0001SELL99990.12345678

Example:

Put Terra n. 2503 up for sale with required Amount 0.0124

n : 2502 (n-1 on-chain)

Amount: 0.0124

TerraBTC string: TB0001SELL25020.0124

5) Owner Revoke Sell Order – Revoke SELL

After broadcasting a Sell Order transaction, it is possible to revoke it

- User B owns land, sent a listing transaction using “SELL” of TerraBTC protocol with the Amount
- User B signs and broadcasts an identity OP_RETURN text transaction using “SELL” of TerraBTC protocol without Amount in order to revoke previous sell order.

This Transaction removes the listing visible to everyone and the land will no longer be for sale.

This Transaction is not valid if there is an active LOCK:

- “Commitment to Purchase - PROP” valid with expiration on the next 48 blocks.
- “Accept Sale Proposal - ACPT” sent by User B (land owner) valid with active expiration on the next 48 blocks.

If this Transaction is inserted during the expiration of a LOCK, the effect of the revocation will be valid after the lock period, therefore valid for all transactions subsequent to the 48th block in which the LOCK was inserted.

Let's analyze how the string to Revoke the for sale transaction of a Terra already owned is composed:

TB0001	SELL	9999	
Version	Command	n	Amount

Version: Protocol prefix “TB” and Version “0001”

Fixed TB string

Fixed 4 characters only digits or characters, no special characters

Command: Command string of TerraBTC protocol

Fixed SELL string

n : It is the number that identifies Terra n. from 0000 to 9999

Fixed 4 digits for 0000 to 9999

On-chain, the number must always be written as n-1 ; the counter starting from 0 to 9999

Amount: Empty

RegEx:

Empty Amount RegEx: TB[a-zA-Z0-9]{4}SELL\d{4}

Or RegEx: TB[a-zA-Z0-9]{4}SELL\d{4}\d+(?:\.\d{1,8})?\$\$

Valid RegEx Examples:

TB0001SELL9999

Example:

Revoke Terra n. 2503 up for sale

n : 2502 (n-1 on-chain)

Amount: Empty

TerraBTC string: TB0001SELL2502

6) Buy from Private Owner using a Commitment to Purchase - PROP

User B puts his land up for sale, User A wants to buy it by signing a commitment to purchase request PROP, putting a Lock that will last for 48 blocks after the block where the SELL transaction appears.

- User B owns land, sent a listing transaction using "SELL" of TerraBTC protocol with the Amount.
 - User A checks that there are no other BUY transactions from private (UTXO), checks that there are no more recent SELL orders and no other transaction that provides LOCK.
 - User A commits to buying the land by signing and broadcasting an identity OP_RETURN text transaction using "PROP" of the TerraBTC protocol using the same Amount used in the "SELL" transaction.
 - User A will have to send the exact Amount to User B to obtain the ownership, if User A does not send the Amount confirmed in the commitment within 48 blocks after the PROP, the "PROP" transaction will expire and the land will still be owned by User B, the land will be available again but with the same/other conditions or the sale could have been revoked (if during the PROP lock a SELL transaction has been propagated by User B, the new conditions will be valid once the PROP has expired).
- Let's analyze how the string is composed to make a purchase commitment proposal on a Terra put up for sale through a SELL transaction:

TB0001	PROP	9999	0.023
Version	Command	n	Amount

Version: Protocol prefix "TB" and Version "0001"

Fixed TB string

Fixed 4 characters only digits or characters, no special characters

Command: Command string of TerraBTC protocol

Fixed PROP string

n : It is the number that identifies Terra n. from 0000 to 9999

Fixed 4 digits for 0000 to 9999

On-chain, the number must always be written as n-1 ; the counter starting from 0 to 9999

Amount: Contains the exact amount required or Empty

NO Fixed digits, Only digits [0,9]

Single pointer to separate decimal digit of Amount

RegEx:

Empty Amount RegEx: TB[a-zA-Z0-9]{4}PROP\d{4}

Or RegEx: TB[a-zA-Z0-9]{4}PROP\d{4}\d+(?:\.\d{1,8})?\$\$

Valid RegEx Examples:

TB0001PROP9999

TB0001PROP999912

TB0001PROP999912.1

TB0001PROP99990.12345678

Example:

Purchase commitment request on Terra n. 2503 up for sale

n : 2502 (n-1 on-chain)

Amount: 0.023

TerraBTC string: TB0001PROP25020.023

7) Submits a Sale Proposal - ASK

User A would like to purchase a land from User B that is not for sale or is for sale at a different price, thus communicating their interest in wanting to buy it.

User A wants to purchase it by submitting a sale proposal request, placing a Lock that will last for 48 subsequent blocks from the block where the request is made.

- User A checks that there are no other purchase UTXO transactions already made, no more recent SELL Orders, and no other transactions that involve a LOCK.

- User A proposes a sale price and commits to purchasing the land by signing and broadcasting an identity OP_RETURN text transaction using the "ASK" of the TerraBTC protocol. The sale proposal will last for 48 blocks after the transaction block.

- User B must send an "ACPT" (Acceptance) transaction of the TerraBTC protocol within the 48 blocks from the "ASK". The amount of the ACPT must be the same as the ASK, otherwise the acceptance will not be valid.

- User A must send the exact Amount to User B to obtain the property. If User A does not send the Amount confirmed in the "ACPT" within the 48 subsequent blocks, the land will remain the property of User B, but the conditions of the last Sell Order sent by User B will be applied. If there is no Sell Order transaction for this land, the land will simply no longer be for sale.

The ASK is valid even if launched during an active SELL Order. Even if User A sends the sale proposal ASK during an active SELL order, another User C can still proceed with a direct purchase or make a PROP. The sale proposal ASK is not blocking for others, but it obliges the seller User B to sell to User A only if the seller sends the ACPT acceptance of the offer. If User A does not complete the purchase, the ACPT will expire and the land will still be for sale to all other users until the seller expressly revokes the SELL.

Let's analyze how the string to send a Sale Proposal to an already owner user is composed:

TB0001	ASK	9999	0.1512
Version	Command	n	Amount

Version: Protocol prefix "TB" and Version "0001"

Fixed TB string

Fixed 4 characters only digits or characters, no special characters

Command: Command string of TerraBTC protocol

Fixed ASK string

n : It is the number that identifies Terra n. from 0000 to 9999

Fixed 4 digits for 0000 to 9999

On-chain, the number must always be written as n-1 ; the counter starting from 0 to 9999

Amount: Contains the exact amount required

NO Fixed digits, Only digits [0,9]

Single pointer to separate decimal digit of Amount

RegEx: TB[a-zA-Z0-9]{4}ASK\d{4}\d+(?:\.\d{1,8})?&

Valid RegEx Examples:

TB0001ASK9999

TB0001ASK999912

TB0001ASK999912.1

TB0001ASK99990.12345678

Example:

Submits a sale proposal request on Terra n. 2503

n : 2502 (n-1 on-chain)

Amount: 0.1512

TerraBTC string: TB0001ASK25020.1512

8) Accept a Sale Proposal - ACPT

User B has received a request to sell (ASK) from User A. User B wants to accept the offer, committing to sell only to User A at that exact price.

User B wants to sell it to User A by signing a request to accept a sale proposal (ACPT), placing a lock that will last for 48 blocks following the block where the ASK request is recorded.

- User A signs and broadcasts the “ASK” transaction with the amount.

- User B must send an acceptance transaction (ACPT) of the TerraBTC protocol within 48 blocks of the “ASK”; the amount must be the same as the ASK, otherwise the acceptance will not be valid.

- User A must send the exact Amount to User B using the same address used to submit the “ASK” transaction. The exact amount must arrive within 48 blocks following the ACPT to obtain ownership; if User A does not send the amount confirmed by the seller in the “ACPT,” the transaction will expire, and the land will still belong to User B.

Tip: ASK and ACPT with lower or higher amounts are not valid transactions under the protocol but can be used to negotiate the price peer-to-peer between the parties.

Let’s analyze how the string is composed to send an Accept a Sale Proposal from a user who is already the owner:

TB0001	ACPT	9999	0.1512
Version	Command	n	Amount

Version: Protocol prefix “TB” and Version “0001”

Fixed TB string

Fixed 4 characters only digits or characters, no special characters

Command: Command string of TerraBTC protocol

Fixed ACPT string

n : It is the number that identifies Terra n. from 0000 to 9999

Fixed 4 digits for 0000 to 9999

On-chain, the number must always be written as n-1 ; the counter starting from 0 to 9999

Amount: Contains the exact amount required, it is indicates in the previous ASK request

NO Fixed digits, Only digits [0,9]

Single pointer to separate decimal digit of Amount

RegEx: `TB[a-zA-Z0-9]{4}ACPT\d{4}\d+(?:\.\d{1,8})?&`

Valid RegEx Examples:

TB0001ACPT9999

TB0001ACPT999912

TB0001ACPT999912.1

TB0001ACPT99990.12345678

Example:

Accept a sale proposal on Terra n. 2503

n : 2502 (n-1 on-chain)

Amount: 0.1512

TerraBTC string: TB0001ACPT25020.1512

14. P2P Exchange Valid Scenarios for the protocol

The following describes the valid scenarios for making p2p exchanges through the protocol instructions.

14.1. Buy a Land from Private Owner

WARNING: does not manage concurrency for purchase, this solution is to be used only during low trading volumes.

The following transactions/actions are used in sequence:

- [4] - User B runs "SELL" Order transaction
- [2] - User A send UTXO to User B using Buy from Private Owner

Example:

- User B submit a Sell Order on Terra n. 37 and Amount 0.053
TerraBTC String: TB0001SELL00360.053
- User A send exactly 0.053 BTC to <User B address>
- Now User A own Terra n. 37

14.2. Buy a Land using a Commitment to Purchase

The following transactions/actions are used in sequence:

- [4] - User B runs "SELL" Order transaction
- [6] - User A Signs and broadcasts "PROP" a Commitment to Purchase transaction
- [2] - User A send UTXO to User B using Buy from Private Owner within 48 blocks

Example:

- User B submit Sell Order on Terra n. 37 and Amount 0.053
TerraBTC String: TB0001SELL00360.053
- User A submit Commitment to Purchase transaction PROP
TerraBTC String: TB0001PROP00360.053
- User A send exactly 0.053 BTC to <User B address> within the Lock deadline (48 blocks)
- Now User A own Terra n. 37

14.3. Buy a Land using Submits a Sale Proposal

The following transactions/actions are used in sequence:

- [7] - User A runs Submits a sale proposal transaction "ASK"
- [8] - User B runs Submits an Accept a sale proposal transaction "ACPT" within 48 blocks.
- [2] - User A send UTXO to User B using Buy from Private Owner within 48 blocks

Example:

- User A submit a Sale proposal transaction on Terra n. 37 and Amount 0.053
TerraBTC String: TB0001ASK00360.053
- User B submit Accept Sale Proposal transaction on Terra n. 37 and Amount 0.053 within the Lock deadline (48 blocks)
TerraBTC String: TB0001ACPT00360.053
- User A send exactly 0.053 BTC to <User B address> within the Lock deadline (48 blocks)
- Now User A own Terra n. 37

14.4. Revoke Sell Order

The following transactions/actions are used in sequence:

- [4] - User B runs "SELL" Order transaction
- [5] - User B runs "SELL" Revoke Sell Order transaction

Example:

- User B submit Sell Order on Terra n. 37 and Amount 0.053
TerraBTC String: TB0001SELL00360.053
- User B submit Revoke Sell Order on Terra n. 37 and Empty Amount
TerraBTC String: TB0001SELL0036
- Now User B has revoked the sale for his Terra n. 37

14.5. Selling Price Change

The following transactions/actions are used in sequence:

- [4] - User B runs "SELL" Order with Amount transaction
- [4] - User B runs "SELL" Order with a NEW Amount transaction

Example:

- User B submit Sell Order on Terra n. 37 and Amount 0.053
TerraBTC String: TB0001SELL00360.053
- User B submit Sell Order on Terra n. 37 and NEW Amount 0.075
TerraBTC String: TB0001SELL00360.075
- Now User B has updated the selling price for his Terra n. 37

15. List of Genesis Address

Below is the list of public Genesis Addresses to interact with the TerraBTC 3D World:

Blockchain	Network	GenesisAddress
<u>Bitcoin</u>	<u>Mainnet</u>	1B8YAhuuy5iKYDPHEa8HSZy4gfeqzwyYNn
Bitcoin	Testnet	mx9VGsYXQMBBA7cYZo8T4yJvEwxdhutaFt
<u>Litecoin</u>	<u>Mainnet</u>	Lfds9rTbw5XjMufve7whEy5xmp3yYbB8Tm
Litecoin	Testnet	mqBBda583hwoiEkxKAGbpGc9nGmuvPFcHa
<u>Dogecoin</u>	<u>Mainnet</u>	D5iSP4xFxo3HPsVhqPqDj6qF8QC81WfQGW
Dogecoin	Testnet	nok3AjnuKVf1rGpxGMc77EViMnTVxmg6MQ

On Bitcoin, the cost of fees will become increasingly higher; writing on layer 1 will become a significant operation. This will be the price to pay for having a land in the best existing storage support. Therefore, in order to still experiment and use the TerraBTC protocol to write and delete rapidly at accessible costs for everyone, valid alternative chain Genesis Addresses have been generated: Litecoin LTC and Dogecoin DOGE. The TerraBTC protocol is also valid for these alternative chains, which do not propagate the same level of relevance and value as the Bitcoin blockchain Mainnet but are very useful for experimentation/gaming.

16. TerraBTC world specifications

To manage the horizontal extension of the world, it is possible to simplify by working as a 2D matrix, imagining the whole in a 2D plain visualization of the world, excluding the Y-axis (3rd Dimension: Height) This 3D matrix world in 3 dimensions is described with the following Axes:

- X-axis: Width of the world
- Z-axis: Length of the world
- Y-axis: Height of the world (3rd dimension)

The map of the 3D world in its entirety is formed by:

- A single large Map composed of 10000 lands divided into 4 Quadrants (2500 per quadrant)
- Each quadrant is composed of 2500 individual lands where each land has its own absolute coordinates
- A single land is of size 64x64 blocks (X,Z) and 320 blocks in height (Y)
- Each individual land in the genesis phase has the following default block layers at these height levels Y:

Layer Y > 31;	Block Air
Layer Y = 31;	Block Grass
Layer Y > 0 and Y < 31;	Block Stone
Layer Y = 0;	Block Bedrock

The following are the details for each of the four quadrants, each quadrant has its own logic and the relative instructions for the subdivision and positioning of the lands.

For each quadrant Q, the progression of the numbering of the 2500 lands is shown graphically. The progression of the numbering does not extend in a straight line, but follows an onion-like extension: from the first and smallest ring closest to the point of absolute coordinates 0,0 up to the largest ring which is the one closest to the 2500 land of quadrant Q (at the borders of the world).

Each quadrant has its own set of formulas to obtain the land number and the relative position in absolute coordinates starting from the progressive numbering, each land has its unique and absolute x0,z0 and x64,z64 coordinates.

For each quadrant, the following are described:

- Range of lands included in the quadrant
- Genesis Acquisition Amount
- getAbsCoords Formula - Given the number of a land, know the absolute coordinates of the 0,0 point of the land
- getTerraNumber Formula - Given the absolute coordinates, know the number of the belonging land

Quadrant 1 Specifications

- RANGE: from 0000 to 2499 included
- Genesis Acquisition Amount: 0.001

Quadrant 2 Specifications

- RANGE: from 2500 to 4999 included
- Genesis Acquisition Amount: 0.01

Quadrant 3 Specifications

- RANGE: from 5000 to 7499 included
- Genesis Acquisition Amount: 0.1

Quadrant 4 Specifications

- RANGE: from 7500 to 9999 included
- Genesis Acquisition Amount: 1

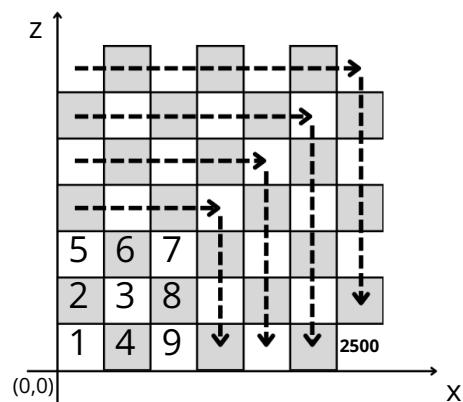


Figure 2: This image graphically shows the progressive numbering of the first 2500 lands in quadrant 1

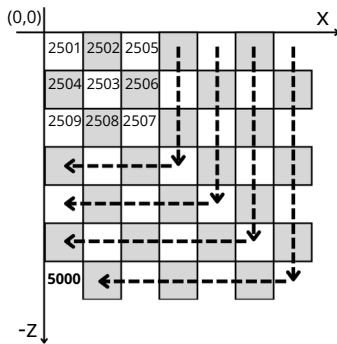


Figure 3: This image graphically shows the progressive numbering of the 2500 lands in quadrant 2 from land 2501 to land 5000

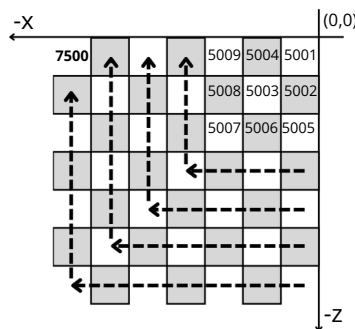


Figure 4: This image graphically shows the progressive numbering of the 2500 lands in quadrant 3 from land 5001 to land 7500

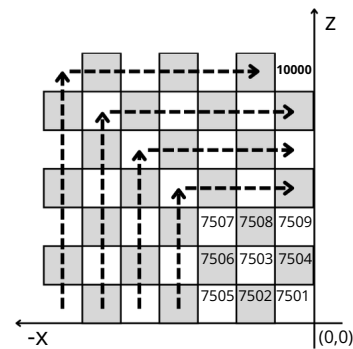


Figure 5: This image graphically shows the progressive numbering of the 2500 lands in quadrant 4 from land 7501 to land 10000

17. Mathematical Formulas

17.1. Mathematical formula to obtain the coordinates of the block x0, z0 given an input Terra n:

$x = (a2(n) - 1) * T_SIZE$	when $1 \leq n \leq 2500$	Quadrant 1
$z = (a3(n) - 1) * T_SIZE$	when $1 \leq n \leq 2500$	Quadrant 1
$x = (a3(n - 2500) - 1) * T_SIZE$	when $2501 \leq n \leq 5000$	Quadrant 2
$z = (a2r(n - 2500) + 1) * T_SIZE$	when $2501 \leq n \leq 5000$	Quadrant 2
$x = (a2r(n - 5000) + 1) * T_SIZE$	when $5001 \leq n \leq 7500$	Quadrant 3
$z = (a3r(n - 5000) + 1) * T_SIZE$	when $5001 \leq n \leq 7500$	Quadrant 3
$x = (a3r(n - 7500) + 1) * T_SIZE$	when $7501 \leq n \leq 10000$	Quadrant 4
$z = (a2(n - 7500) - 1) * T_SIZE$	when $7501 \leq n \leq 10000$	Quadrant 4

Where:

$$\begin{aligned}
 T_SIZE &= 64 \\
 a2(n) &= \min(a1(n), n - (a1(n) - 1)^2) \\
 a3(n) &= \min(a1(n), (a1(n)^2) - n + 1) \\
 a2r(n) &= -1 * a2(n) - 1 \\
 a3r(n) &= -1 * a3(n) - 1 \\
 a1(n) &= \text{int}(\sqrt{n - 1}) + 1
 \end{aligned}$$

17.2. Mathematical formula to obtain Terra n given any input coordinates of a block(x, z):

$n = b3(x, z)$	when $x \geq 0$ and $z \geq 0$	Quadrant 1
$n = b3r(x, (-1 * z) - 1) + 2500$	when $x \geq 0$ and $z < 0$	Quadrant 2
$n = b3((-1 * x) - 1, (-1 * z) - 1) + 5000$	when $x < 0$ and $z < 0$	Quadrant 3
$n = b3r((-1 * x) - 1, z) + 7500$	when $x < 0$ and $z \geq 0$	Quadrant 4

Where:

$$\begin{aligned}
 T_SIZE &= 64 \\
 b3(x, z): \\
 \quad n &= b1(\text{int}(x / T_SIZE), \text{int}(z / T_SIZE)) && \text{when } x \leq z \\
 \quad n &= b2(\text{int}(x / T_SIZE), \text{int}(z / T_SIZE)) && \text{when } x > z \\
 b3r(x, z) &= b3(z, x) \\
 b2(x, z) &= \text{int}(((\max(x, z) + 1)^2) - z) \\
 b1(x, z) &= \text{int}((\max(x, z)^2) + 1 + x)
 \end{aligned}$$

18. Coordinates Schema and Basic references for orientation

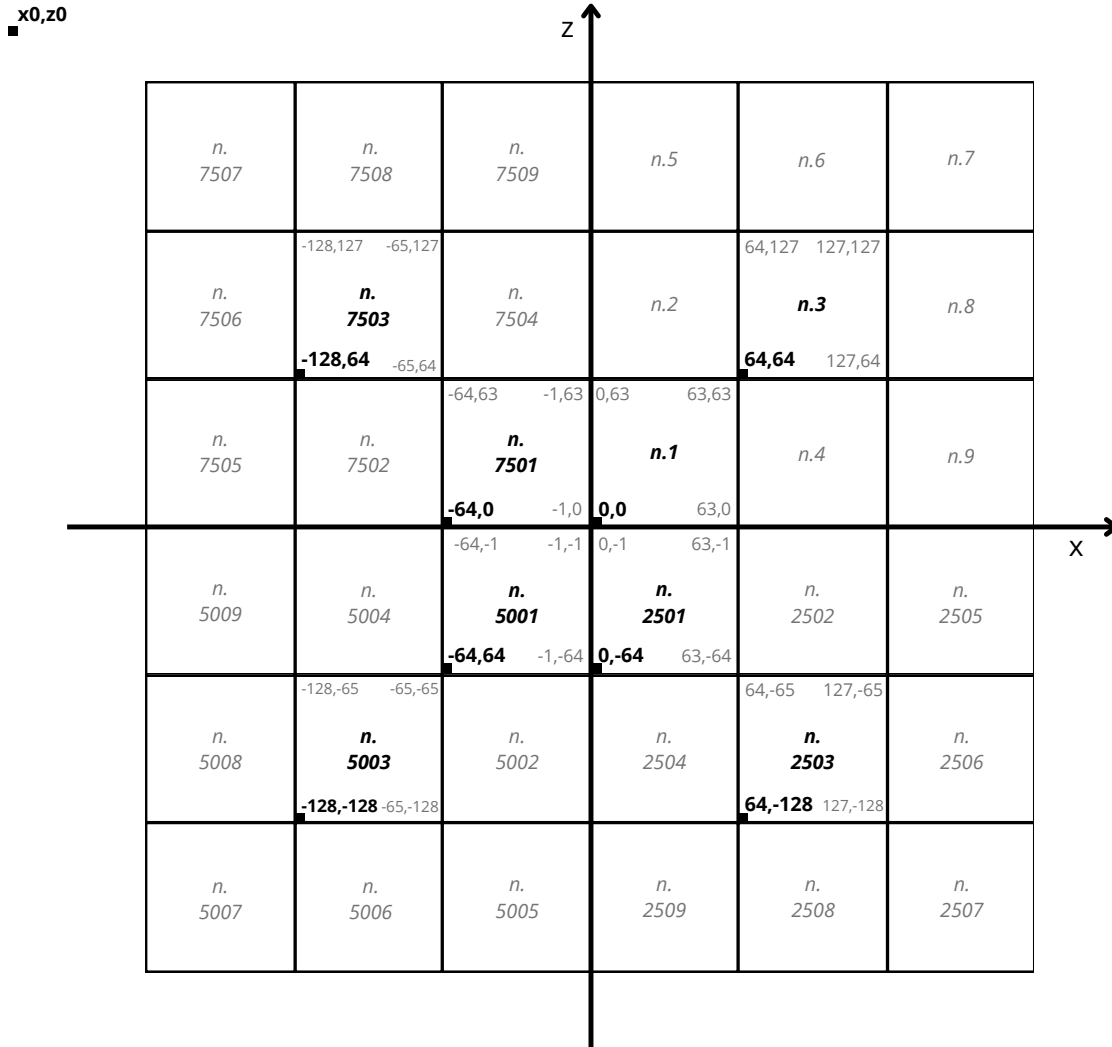


Figure 6: The figure shows for some lands, the Terra number, the x0,z0 coordinates and the four absolute coordinates of the border that delimit the 64x64 size.

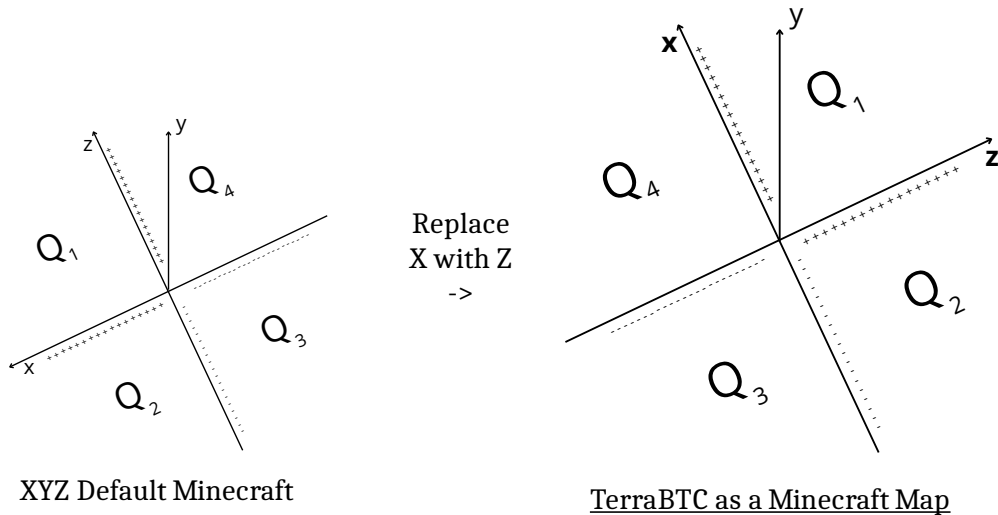


Figure 7: The figure shows orientation and progression of the axes on Minecraft and how to render TerraBTC matrix on Minecraft.
 - "XYZ Default Minecraft": On Minecraft, x-axis has a positive right-to-left orientation.
 - "TerraBTC as a Minecraft Map": To get the orientation needed to render TerraBTC world is to reflect the axes: all (x,z) in-game coordinates correspond to values of (z,x) in TerraBTC Protocol.
 Replace in-game x coordinates with z coordinates and vice versa to obtain valid data for the TerraBTC protocol

19. Python3 Script (paste and run)

Below is the python3 script of the mathematical formulas described above, valid for each quadrant:

```
import math
T_SIZE = 64

def a1(n):
    return int(math.sqrt(n - 1)) + 1

def a2(n):
    t = a1(n)
    return min(t, n - (t - 1) ** 2)

def a3(n):
    t = a1(n)
    return min(t, t ** 2 - n + 1)

def a2r(n):
    return (a2(n) * -1) - 1

def a3r(n):
    return (a3(n) * -1) - 1

def b1(x, z):
    return int((max(x, z) ** 2) + 1 + x)

def b2(x, z):
    return int(((max(x, z) + 1) ** 2) - z)

def b3(x, z):
    x = int(x / T_SIZE)
    z = int(z / T_SIZE)
    if x <= z:
        n = b1(x, z)
    else:
        n = b2(x, z)
    return n

def b3r(x, z):
    return b3(z, x)

def get_matrix_position_from_terra(n):
    if n >= 1 and n <= 2500:
        x = a2(n) - 1
        z = a3(n) - 1
    elif n >= 2501 and n <= 5000:
        n = n - 2500
        x = a3(n) - 1
        z = a2r(n) + 1
    elif n >= 5001 and n <= 7500:
        n = n - 5000
        x = a2r(n) + 1
        z = a3r(n) + 1
    elif n >= 7501 and n <= 10000:
        n = n - 7500
        x = a3r(n) + 1
        z = a2(n) - 1
    else:
        return None
    return x, z

def get_x0_z0_from_terra(n):
    matrix = get_matrix_position_from_terra(n)
    x = matrix[0] * T_SIZE
    z = matrix[1] * T_SIZE
    return x, z

def get_terra_from_x_z(x, z):
    if x >= 0 and z >= 0:
        n = b3(x, z)
    elif x >= 0 and z < 0:
        z = (-1 * z) - 1
        n = b3r(x, z)
        n = n + 2500
    elif x < 0 and z < 0:
        x = (-1 * x) - 1
        z = (-1 * z) - 1
        n = b3(x, z)
        n = n + 5000
    elif x < 0 and z >= 0:
        x = (-1 * x) - 1
        n = b3r(x, z)
        n = n + 7500
    else:
        return None
    return n













































































































# HEX To ASCII string
hex_string = "48656c6c6f2c20576f726c6421"
print('Input HEX String: ' + hex_string)
# Convert hexadecimal string to bytes and Decode bytes to ASCII string
ascii_string = bytes.fromhex(hex_string).decode('ascii')
print('Output ASCII string:')
print(ascii_string)

# ASCII string To HEX
ascii_string = "Hello, World!"
print('Input ASCII String: ' + ascii_string)
# Convert ASCII string to hexadecimal
hex_string = ascii_string.encode().hex()
print('Output Hexadecimal string:')
print(hex_string)

# Get Coordinates (x0,z0) from Terra n
n = 24
print('Get Coordinates (x0,z0) from Terra n ' + str(n) + ':')
print('x0,z0= ' + str(get_x0_z0_from_terra(n)))

# Get Terra n [1,10000] from coordinates (x,z)
x = 256
z = 64
print('Get Terra n [1,10000] from coordinates (x,z) (' + str(x) + ', ' + str(z) + ')')
num = get_terra_from_x_z(x, z)
print('n= ' + str(num))
print('REMEMBER! On-chain you have to write n-1 [0000,9999]')
print('n= ' + '{:04d}'.format(num - 1))
```

List of blocks

ID	Name	ID	Name	ID	Name	ID	Name
	0 Air		1 Stone		2 Grass		3 Dirt
	4 Cobblestone		5 Oak Planks		6 Oak Sapling		7 Bedrock
	8 Flowing Water		9 Water		10 Flowing Lava		11 Lava
	12 Sand		13 Gravel		14 Gold Ore		15 Iron Ore
	16 Coal Ore		17 Wood		18 Oak Leaves		19 Sponge
	20 Glass		21 Lapis Lazuli Ore		22 Lapis Lazuli		23 Dispenser
	24 Sandstone		25 Note Block		26 Bed		27 Powered Rail
	28 Detector Rail		29 Sticky Piston		30 Cobweb		31 Tall Grass
	32 Dead Bush		33 Piston		34 Piston Head		35 White Wool
	36 Piston Moving		37 Dandelion		38 Poppy		39 Brown Mushroom
	40 Red Mushroom		41 Gold Block		42 Iron Block		43 Stone Double Slab
	44 Stone Slab		45 Bricks		46 TNT Block		47 Bookshelf
	48 Mossy Cobblestone		49 Obsidian		50 Torch		51 Fire
	52 Spawner		53 Oak Stairs		54 Chest		55 Redstone Wire
	56 Diamond Ore		57 Diamond Block		58 Crafting Table		59 Wheat Crops
	60 Farmland		61 Furnace		62 Lit Furnace		63 Sign
	64 Oak Door		65 Ladder		66 Rail		67 Cobblestone Stairs
	68 Wall Sign		69 Lever		70 Stone Pressure Plate		71 Iron Door
	72 Oak Pressure Plate		73 Redstone Ore		74 Glowing Redstone Ore		75 Unlit Redstone Torch
	76 Redstone Torch		77 Stone Button		78 Snow		79 Ice
	80 Snow Block		81 Cactus		82 Clay Block		83 Sugar Cane
	84 Jukebox		85 Oak Fence		86 Pumpkin		87 Netherrack
	88 Soul Sand		89 Glowstone		90 Nether Portal		91 Jack o'Lantern
	92 Cake		93 Unlit Redstone Repeater		94 Lit Redstone Repeater		95 Stained Glass
	96 Oak Trapdoor		97 Monster Egg (Stone)		98 Stone Bricks		99 Brown Mushroom Block
	100 Red Mushroom Block		101 Iron Bars		102 Glass Pane		103 Melon
	104 Pumpkin Stem		105 Melon Stem		106 Vines		107 Oak Fence Gate

20. Conclusion

This protocol aims to show in an unusual way to the IT sector and beyond, the importance of having a single fully open cleartext "book" available, accessible to anyone, immutable, not controllable and cannot be turned off, the writings in the single book with the right attention protect the privacy of the writer and anyone can write freely and exchange value through a protocol mainly formed by a set of textual strings adopted without coercion.

This protocol aims to demonstrate that over time, from scratch, with self-incentivising logics it is possible to achieve significant resonance and it is possible to bring innovation into the world even without necessarily starting a tech company or starting a token for crowdfunding.

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21. The Print Promise

This protocol represents a good implementation of storage of a 3d minecraft-style world: immutable, indestructible, uncensorable and resistant to any technological attack or natural catastrophe or extinction of man as we know it, you should take into account the following promise:

If you are the owner of a land, for a quick retrieval and recovery of this decentralized 3D world and the corresponding land value (the data is still in clear text), you should print this document on paper and save a copy on your hard disk. This will provide an additional redundancy over-the-internet and over-the-electricity.