

IBC relaying guide

Celestia uses [IBC](#) (Inter-Blockchain Communication protocol) to enable cross-chain transfer of tokens. To support this capability it relies on relayers, processes that can be run by anyone which constantly scan for outbound packets on one chain and submits these packets alongside corresponding proofs on the destination chain. This section describes how one can setup a relayer and create new connections between chains. There are two standard implementations:

- [Hermes](#)
- built in Rust
- [Go Relayer](#)
- built in Go

The following guide explains how to establish IBC connections and relay packets between [Mocha testnet](#) and [Cosmos hub testnet](#) networks by using the Hermes relayer.

Check the [latest celestia-app release's go.mod](#) for the version of ibc-go that is currently used.

Hermes

[Hermes](#) is an open-source Rust implementation of an IBC relayer released as part of the `ibc-relayer-cli` crate. It includes a CLI for relaying packets between Cosmos SDK chains, as well as Prometheus metrics and a REST API.

Please follow the steps at [Hermes Quick Start](#) to install Hermes. Before proceeding, verify that Hermes is installed correctly by running `hermes version`.

TIP

Hermes currently doesn't support configuring the `TendermintCompatMode` in chain config (see [hermes#3623](#)). Until that issue is resolved, please use Hermes [v1.7.0](#) + because it falls back to `TendermintCompatMode v0.34` (see [hermes#3663](#)) which is compatible with Celestia.

Configuration

After you have successfully installed Hermes and created the necessary folders, you now have to edit `config.toml` and add the appropriate configurations for the chains you want to relay between.

For this tutorial, we will be using the following chains:

- Celestia's `smocha-4`
- `testnet`
- Cosmos Hub's `theta-testnet-001`
- `testnet`

Edit the Hermes configuration.

```
bash vim HOME /.hermes/config.toml vim HOME /.hermes/config.toml toml [ global ] log_level = "info"
```

```
[ mode . clients ] enabled = true refresh = true misbehaviour = true
```

```
[ mode . connections ] enabled = false
```

```
[ mode . channels ] enabled = false
```

```
[ mode . packets ] enabled = true clear_interval = 100 clear_on_start = true tx_confirmation = false
auto_register_counterparty_payee = false
```

```
[ rest ] enabled = false host = "127.0.0.1" port = 3000
```

```
[ telemetry ] enabled = false host = "127.0.0.1" port = 3001
```

```
[ telemetry . buckets . latency_submitted ] start = 500 end = 20000 buckets = 10
```

```
[ telemetry . buckets . latency_confirmed ] start = 1000 end = 30000 buckets = 10
```

```
[[ chains ]] id = "theta-testnet-001" type = "CosmosSdk" rpc_addr = "https://rpc.sentry-01.theta-testnet.polypore.xyz"
grpc_addr = "https://grpc.sentry-01.theta-testnet.polypore.xyz" rpc_timeout = "10s" trusted_node = false account_prefix =
"cosmos" key_name = "key-cosmos" key_store_type = "Test" store_prefix = "ibc" default_gas = 100000 max_gas = 400000
gas_multiplier = 1.5 max_msg_num = 30 max_tx_size = 180000 max_grpc_decoding_size = 33554432 clock_drift = "5s"
max_block_time = "30s" ccv_consumer_chain = false memo_prefix = "" sequential_batch_tx = false
```

```
[ chains . event_source ] mode = "push" url = "ws://rpc.sentry-01.theta-testnet.polypore.xyz:26657/websocket" batch_delay =
"500ms"

[ chains . trust_threshold ] numerator = "1" denominator = "3"

[ chains . gas_price ] price = 0.025 denom = "uatom"

[ chains . packet_filter ] policy = "allow" list = [ [ "transfer" , "channel-3108" ] ]

[ chains . packet_filter . min_fees ]

[ chains . address_type ] derivation = "cosmos"

[[ chains ]] id = "mocha-4" type = "CosmosSdk" rpc_addr = "https://rpc-celestia-mocha.architectnodes.com" grpc_addr =
"https://grpc.celestia-mocha.com:443" rpc_timeout = "10s" trusted_node = false account_prefix = "celestia" key_name =
"celestia-key" key_store_type = "Test" store_prefix = "ibc" default_gas = 100000 max_gas = 400000 gas_multiplier = 1.5
max_msg_num = 30 max_tx_size = 180000 max_grpc_decoding_size = 33554432 clock_drift = "5s" max_block_time =
"30s" ccv_consumer_chain = false memo_prefix = "" sequential_batch_tx = false

[ chains . event_source ] mode = "push" url = "ws://rpc-mocha.pops.one:26657/websocket" batch_delay = "500ms"

[ chains . trust_threshold ] numerator = "1" denominator = "3"

[ chains . gas_price ] price = 0.1 denom = "utia"

[ chains . packet_filter ] policy = "allow" list = [ [ "transfer" , "channel-0" ] ]

[ chains . packet_filter . min_fees ]

[ chains . address_type ] derivation = "cosmos" [ global ] log_level = "info"

[ mode . clients ] enabled = true refresh = true misbehaviour = true

[ mode . connections ] enabled = false

[ mode . channels ] enabled = false

[ mode . packets ] enabled = true clear_interval = 100 clear_on_start = true tx_confirmation = false
auto_register_counterparty_payee = false

[ rest ] enabled = false host = "127.0.0.1" port = 3000

[ telemetry ] enabled = false host = "127.0.0.1" port = 3001

[ telemetry . buckets . latency_submitted ] start = 500 end = 20000 buckets = 10

[ telemetry . buckets . latency_confirmed ] start = 1000 end = 30000 buckets = 10

[[ chains ]] id = "theta-testnet-001" type = "CosmosSdk" rpc_addr = "https://rpc.sentry-01.theta-testnet.polypore.xyz"
grpc_addr = "https://grpc.sentry-01.theta-testnet.polypore.xyz" rpc_timeout = "10s" trusted_node = false account_prefix =
"cosmos" key_name = "key-cosmos" key_store_type = "Test" store_prefix = "ibc" default_gas = 100000 max_gas = 400000
gas_multiplier = 1.5 max_msg_num = 30 max_tx_size = 180000 max_grpc_decoding_size = 33554432 clock_drift = "5s"
max_block_time = "30s" ccv_consumer_chain = false memo_prefix = "" sequential_batch_tx = false

[ chains . event_source ] mode = "push" url = "ws://rpc.sentry-01.theta-testnet.polypore.xyz:26657/websocket" batch_delay =
"500ms"

[ chains . trust_threshold ] numerator = "1" denominator = "3"

[ chains . gas_price ] price = 0.025 denom = "uatom"

[ chains . packet_filter ] policy = "allow" list = [ [ "transfer" , "channel-3108" ] ]

[ chains . packet_filter . min_fees ]

[ chains . address_type ] derivation = "cosmos"

[[ chains ]] id = "mocha-4" type = "CosmosSdk" rpc_addr = "https://rpc-celestia-mocha.architectnodes.com" grpc_addr =
"https://grpc.celestia-mocha.com:443" rpc_timeout = "10s" trusted_node = false account_prefix = "celestia" key_name =
"celestia-key" key_store_type = "Test" store_prefix = "ibc" default_gas = 100000 max_gas = 400000 gas_multiplier = 1.5
max_msg_num = 30 max_tx_size = 180000 max_grpc_decoding_size = 33554432 clock_drift = "5s" max_block_time =
"30s" ccv_consumer_chain = false memo_prefix = "" sequential_batch_tx = false
```

```
[ chains . event_source ] mode = "push" url = "ws://rpc-mocha.pops.one:26657/websocket" batch_delay = "500ms"
[ chains . trust_threshold ] numerator = "1" denominator = "3"
[ chains . gas_price ] price = 0.1 denom = "utia"
[ chains . packet_filter ] policy = "allow" list = [[ "transfer" , "channel-0" ]]
[ chains . packet_filter . min_fees ]
[ chains . address_type ] derivation = "cosmos"
```

Add relayer wallets

Now that we have successfully configured our relaying chains, we need to import the wallets that will be used for relaying. Please note that both wallets need to be funded with the native tokens of each chain.

You can get testnet tokens from faucets for bot testnets via Discord:

- Celestia: <https://discord.gg/celestiacommunity>
- Cosmos Hub: <https://discord.gg/cosmosnetwork>

Add your seed phrase to a file and upload it to the server. Do not use wallets for anything else but relaying to avoid running into account sequence errors.

Follow the steps at [adding-keys-to-hermes](#) to add keys for each chain

```
bash hermes
```

```
keys
```

```
add
```

```
--chain
```

```
mocha-4
```

```
--mnemonic-file
```

```
< seed-fil e
```

```
hermes
```

```
keys
```

```
add
```

```
--chain
```

```
theta-testnet-001
```

```
--mnemonic-file
```

```
< seed-fil e
```

```
hermes
```

```
keys
```

```
add
```

```
--chain
```

```
mocha-4
```

```
--mnemonic-file
```

```
< seed-fil e
```

```
hermes
```

```
keys
```

```
add
```

--chain

theta-testnet-001

--mnemonic-file

< seed-file

Verify configuration files

After editing `config.toml` and adding wallet keys, it's time to test the configurations and ensure the system is healthy. Run the following:

`bash hermes`

`health-check hermes`

`config`

`validate hermes`

`health-check hermes`

`config`

`validate` If everything was set up correctly, you should see output like:

`bash SUCCESS`

`performed`

`health`

`check`

`for`

`all`

`chains`

`in`

`the`

`config SUCCESS`

`"configuration is valid" SUCCESS`

`performed`

`health`

`check`

`for`

`all`

`chains`

`in`

`the`

`config SUCCESS`

`"configuration is valid"`

Create a connection between 2 chains

If you're attempting to create new connections, verify that the chains in question don't already have connections and clients

in place and use the existing ones if they do. In that case you can skip this step and go to [Configure channels in Hermes](#) section.

In this example, we are creating new clients and a new connection between mocha-4 and theta-testnet-001 networks.

Create clients

To learn if a client already exists, you can use the following command:

```
bash hermes
query
clients
--host-chain
mocha-4
--reference-chain
theta-testnet-001 hermes
query
clients
--host-chain
```

```
mocha-4
```

```
--reference-chain
```

theta-testnet-001 To create a new client, use the [create-client command](#) :

```
bash hermes
create
client
--host-chain
mocha-4
--reference-chain
theta-testnet-001 hermes
create
client
--host-chain
mocha-4
--reference-chain
```

theta-testnet-001 Create a second client:

```
bash hermes
create
client
--host-chain
theta-testnet-001
--reference-chain
```

mocha-4 hermes

create

client

--host-chain

theta-testnet-001

--reference-chain

mocha-4

Open connection over new clients

To create a new connection over clients, use the following command:

bash hermes

create

connection

--a-chain

mocha-4

--b-chain

theta-testnet-001 hermes

create

connection

--a-chain

mocha-4

--b-chain

theta-testnet-001 You should be seeing a similar output to this:

bash SUCCESS

Connection

{ delay_period:

0 ns, a_side:

ConnectionSide

{ chain:

BaseChainHandle

{ chain_id:

ChainId

{ id:

"theta-testnet-001", version:

0 , }, runtime_sender:

Sender

{

..

```
}, }, client_id:
ClientId ( "07-tendermint-2382" , ) , connection_id:
Some ( ConnectionId( "connection-2727" , ) , ), }, b_side:
ConnectionSide
{ chain:
BaseChainHandle
{ chain_id:
ChainId
{ id:
"mocha-4", version:
4 , }, runtime_sender:
Sender
{
..
}, }, client_id:
ClientId ( "07-tendermint-0" , ) , connection_id:
Some ( ConnectionId( "connection-0" , ) , ), }, } SUCCESS
Connection
{ delay_period:
0 ns, a_side:
ConnectionSide
{ chain:
BaseChainHandle
{ chain_id:
ChainId
{ id:
"theta-testnet-001", version:
0 , }, runtime_sender:
Sender
{
..
}, }, client_id:
ClientId ( "07-tendermint-2382" , ) , connection_id:
Some ( ConnectionId( "connection-2727" , ) , ), }, b_side:
ConnectionSide
{ chain:
BaseChainHandle
```

```
{ chain_id:
```

```
ChainId
```

```
{ id:
```

```
"mocha-4", version:
```

```
4 , }, runtime_sender:
```

```
Sender
```

```
{
```

```
..
```

```
}, }, client_id:
```

```
ClientId ( "07-tendermint-0" , ) , connection_id:
```

Some (ConnectionId("connection-0" ,) ,), }, } Now that the connection has been established over the clients, we need to create a new channel, by leveraging an existing connection:

```
bash hermes
```

```
create
```

```
channel
```

```
--a-chain
```

```
theta-testnet-001
```

```
--a-connection
```

```
connection-2727
```

```
--a-port
```

```
transfer
```

```
--b-port
```

```
transfer hermes
```

```
create
```

```
channel
```

```
--a-chain
```

```
theta-testnet-001
```

```
--a-connection
```

```
connection-2727
```

```
--a-port
```

```
transfer
```

```
--b-port
```

transfer You should be seeing a similar output to this:

```
bash SUCCESS
```

```
Channel
```

```
{ ordering:
```

```
Unordered, a_side:
```

```
ChannelSide
```



```
{ chain:
BaseChainHandle
{ chain_id:
ChainId
{ id:
"theta-testnet-001", version:
0 , }, runtime_sender:
Sender
{
..
}, }, client_id:
ClientId ( "07-tendermint-2382" , ) , connection_id:
ConnectionId ( "connection-2727" , ) , port_id:
PortId ( "transfer" , ) , channel_id:
Some ( ChannelId( "channel-3152" , ) , ), version:
None, }, b_side:
ChannelSide
{ chain:
BaseChainHandle
{ chain_id:
ChainId
{ id:
"mocha-4", version:
4 , }, runtime_sender:
Sender
{
..
}, }, client_id:
ClientId ( "07-tendermint-0" , ) , connection_id:
ConnectionId ( "connection-0" , ) , port_id:
PortId ( "transfer" , ) , channel_id:
Some ( ChannelId( "channel-0" , ) , ), version:
None, }, connection_delay:
0 ns, } SUCCESS
Channel
{ ordering:
Unordered, a_side:
```

ChannelSide

{ chain:

BaseChainHandle

{ chain_id:

ChainId

{ id:

"theta-testnet-001", version:

0 , }, runtime_sender:

Sender

{

..

}, }, client_id:

ClientId ("07-tendermint-2382" ,) , connection_id:

ConnectionId ("connection-2727" ,) , port_id:

PortId ("transfer" ,) , channel_id:

Some (ChannelId("channel-3152" ,) ,), version:

None, }, b_side:

ChannelSide

{ chain:

BaseChainHandle

{ chain_id:

ChainId

{ id:

"mocha-4", version:

4 , }, runtime_sender:

Sender

{

..

}, }, client_id:

ClientId ("07-tendermint-0" ,) , connection_id:

ConnectionId ("connection-0" ,) , port_id:

PortId ("transfer" ,) , channel_id:

Some (ChannelId("channel-0" ,) ,), version:

None, }, connection_delay:

0 ns, } Congratulations!

You have successfully created a new IBC connection between two networks.

Configure channels in Hermes

Now that we have created new connections and opened channels, we need to edit `config.toml` again and add the newly created channels, or use the already existing ones.

Formocha-4 add:

```
bash [chains.packet_filter] policy
=
'allow' list
= [ [ 'transfer' , 'channel-0' ] ,
```

theta-testnet-001

```
] [chains.packet_filter] policy
=
'allow' list
= [ [ 'transfer' , 'channel-0' ] ,
```

theta-testnet-001

```
] Fortheta-testnet-001 add:
bash [chains.packet_filter] policy
=
'allow' list
= [ [ 'transfer' , 'channel-3108' ] ,
```

mocha-4

```
] [chains.packet_filter] policy
=
'allow' list
= [ [ 'transfer' , 'channel-3108' ] ,
```

mocha-4

```
]
```

Start the relayer

Start the relayer via [hermes start](#)

Transfer

The Celestia state machine is built with the IBC transfer module, allowing for the native Celestia token to be transferred to any other IBC enabled chain. Transfer can be initialized through the `celestia-appd` CLI. Information can be found via the help label as follows:

```
bash celestia-appd
tx
ibc-transfer
transfer
```

--help celestia-appd

tx

ibc-transfer

transfer

--help

Token filter

The transfer module uses a token filter middleware which serves to prevent non-native Celestia tokens from being on Celestia. If a user is to try to send a token from another chain across, it will be simply rejected and the token returned back to the user. [\[Edit this page on GitHub\]](#) Last updated: [Previous page Consensus](#) [Next page Metrics](#) [\[\]](#)