

## Setting Up a Private Ethereum Network:

### 1. Prerequisites:

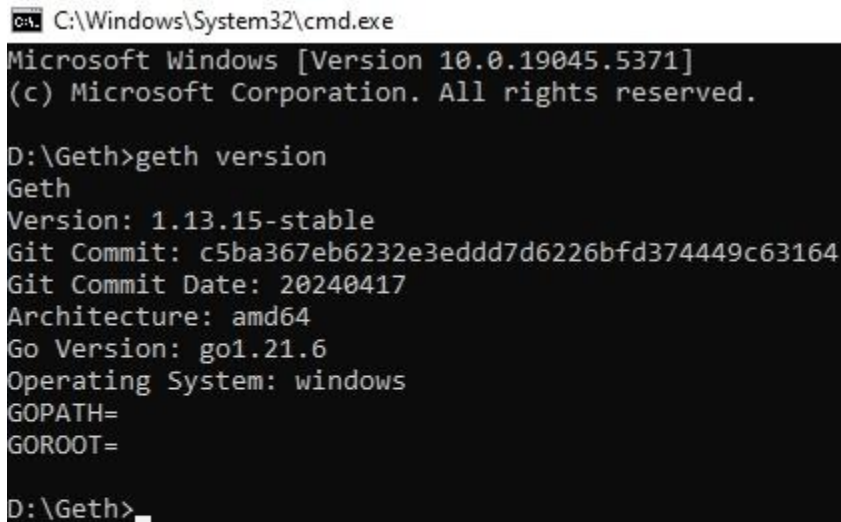
#### Required Software:

- Geth (Go Ethereum) v1.13.15 or later.
- Windows 10/11 or Linux operating system

#### Installation Verification:

##### Cmd:

- Geth version



```
C:\Windows\System32\cmd.exe
Microsoft Windows [Version 10.0.19045.5371]
(c) Microsoft Corporation. All rights reserved.

D:\Geth>geth version
Geth
Version: 1.13.15-stable
Git Commit: c5ba367eb6232e3eddd7d6226bfd374449c63164
Git Commit Date: 20240417
Architecture: amd64
Go Version: go1.21.6
Operating System: windows
GOPATH=
GOROOT=

D:\Geth>_
```

### 2. Directory Setup and Account Creation:

#### Create Project Structure:

##### Cmd:

- Open cmd from geth setup directory.
- mkdir node1 node2

## Create Account for Node 1 and Node 2

### Cmd:

- `geth --datadir node1 account new`
- `geth --datadir node2 account new`

### Command Explanation:

- **--datadir:** Specifies the data directory
- **account new:** Creates a new account.

```
C:\Windows\System32\cmd.exe

D:\Geth>mkdir node1 node2

D:\Geth>geth --datadir node1 account new
INFO [02-09|17:36:24.713] Maximum peer count          ETH=50 total=50
Your new account is locked with a password. Please give a password. Do not forget this password.
Password:
Repeat password:

Your new key was generated

Public address of the key:  0x32C4142C66dfacB14029677b6e3f3286B29BBfE0
Path of the secret key file: node1\keystore\UTC--2025-02-09T12-06-28.589348200Z--32c4142c66dfacB14029677b6e3f3286b29bbfe0

- You can share your public address with anyone. Others need it to interact with you.
- You must NEVER share the secret key with anyone! The key controls access to your funds!
- You must BACKUP your key file! Without the key, it's impossible to access account funds!
- You must REMEMBER your password! Without the password, it's impossible to decrypt the key!

D:\Geth>geth --datadir node2 account new
INFO [02-09|17:36:36.947] Maximum peer count          ETH=50 total=50
Your new account is locked with a password. Please give a password. Do not forget this password.
Password:
Repeat password:

Your new key was generated

Public address of the key:  0xC251a7aD684fa74337029E64cd5bF68C30e7807B
Path of the secret key file: node2\keystore\UTC--2025-02-09T12-06-41.309093000Z--c251a7ad684fa74337029e64cd5bf68c30e7807b

- You can share your public address with anyone. Others need it to interact with you.
- You must NEVER share the secret key with anyone! The key controls access to your funds!
- You must BACKUP your key file! Without the key, it's impossible to access account funds!
- You must REMEMBER your password! Without the password, it's impossible to decrypt the key!
```

After creating password.txt in both file Node 1 and Node 2 which have your password of both accounts generated at time of accounts creation.

## 3. Genesis Configuration:

Create a file named genesis.json with the following content:

```
{

  "config": {
```

[illegible]



## Purpose:

### 1. Blockchain Start:

- Creates the first block (genesis)
- Establishes blockchain state
- Sets up network parameters

### 2. Consistency:

- Ensures all nodes start from the same state
- Maintains network synchronization
- Prevents fork issues.

```
C:\Windows\System32\cmd.exe
D:\Geth>geth init --datadir node1 genesis.json
INFO [02-09|17:42:59.414] Maximum peer count                ETH=50 total=50
INFO [02-09|17:42:59.426] Set global gas cap                 cap=50,000,000
INFO [02-09|17:42:59.426] Initializing the KZG library        backend=gokzg
INFO [02-09|17:42:59.583] Defaulting to pebble as the backing database
INFO [02-09|17:42:59.627] Allocated cache and file handles   database=D:\Geth\node1\geth\chaindata cache=16.00MiB handles=16
INFO [02-09|17:42:59.628] Opened ancient database             database=D:\Geth\node1\geth\chaindata\ancient\chain readonly=false
INFO [02-09|17:42:59.629] State schema set to default         scheme=hash
INFO [02-09|17:42:59.633] Writing custom genesis block        nodes=3 size=407.00B time=2.1872ms gcnodes=0 gcsizes=0.00B gctime=0s livenodes=0 livesize=0.00B
INFO [02-09|17:42:59.633] Persisted trie from memory database database=chaindata hash=45d659..45b56a
INFO [02-09|17:42:59.648] Successfully wrote genesis state     database=D:\Geth\node1\geth\lightchaindata cache=16.00MiB handles=16
INFO [02-09|17:42:59.649] Defaulting to pebble as the backing database database=D:\Geth\node1\geth\lightchaindata\ancient\chain readonly=false
INFO [02-09|17:42:59.650] Allocated cache and file handles   scheme=hash
INFO [02-09|17:42:59.684] Opened ancient database             nodes=3 size=407.00B time=1.6767ms gcnodes=0 gcsizes=0.00B gctime=0s livenodes=0 livesize=0.00B
INFO [02-09|17:42:59.687] State schema set to default         database=lightchaindata hash=45d659..45b56a
INFO [02-09|17:42:59.687] Writing custom genesis block
INFO [02-09|17:42:59.691] Persisted trie from memory database nodes=3 size=407.00B time=2.0223ms gcnodes=0 gcsizes=0.00B gctime=0s livenodes=0 livesize=0.00B
INFO [02-09|17:42:59.706] Successfully wrote genesis state     database=lightchaindata hash=45d659..45b56a

D:\Geth>geth init --datadir node2 genesis.json
INFO [02-09|17:43:05.934] Maximum peer count                ETH=50 total=50
INFO [02-09|17:43:05.956] Set global gas cap                 cap=50,000,000
INFO [02-09|17:43:05.956] Initializing the KZG library        backend=gokzg
INFO [02-09|17:43:06.084] Defaulting to pebble as the backing database
INFO [02-09|17:43:06.085] Allocated cache and file handles   database=D:\Geth\node2\geth\chaindata cache=16.00MiB handles=16
INFO [02-09|17:43:06.118] Opened ancient database             database=D:\Geth\node2\geth\chaindata\ancient\chain readonly=false
INFO [02-09|17:43:06.120] State schema set to default         scheme=hash
INFO [02-09|17:43:06.121] Writing custom genesis block        nodes=3 size=407.00B time=2.0223ms gcnodes=0 gcsizes=0.00B gctime=0s livenodes=0 livesize=0.00B
INFO [02-09|17:43:06.125] Persisted trie from memory database database=chaindata hash=45d659..45b56a
INFO [02-09|17:43:06.139] Successfully wrote genesis state     database=D:\Geth\node2\geth\lightchaindata cache=16.00MiB handles=16
INFO [02-09|17:43:06.140] Defaulting to pebble as the backing database database=D:\Geth\node2\geth\lightchaindata\ancient\chain readonly=false
INFO [02-09|17:43:06.142] Allocated cache and file handles   scheme=hash
INFO [02-09|17:43:06.177] Opened ancient database             nodes=3 size=407.00B time=1.6488ms gcnodes=0 gcsizes=0.00B gctime=0s livenodes=0 livesize=0.00B
INFO [02-09|17:43:06.178] State schema set to default         database=lightchaindata hash=45d659..45b56a
INFO [02-09|17:43:06.180] Writing custom genesis block
INFO [02-09|17:43:06.183] Persisted trie from memory database
INFO [02-09|17:43:06.198] Successfully wrote genesis state
```

## 5. Bootnode Setup:

### Create Bootnode Key:

#### Cmd:

bootnode -genkey boot.key

### Start Bootnode:

#### Cmd:

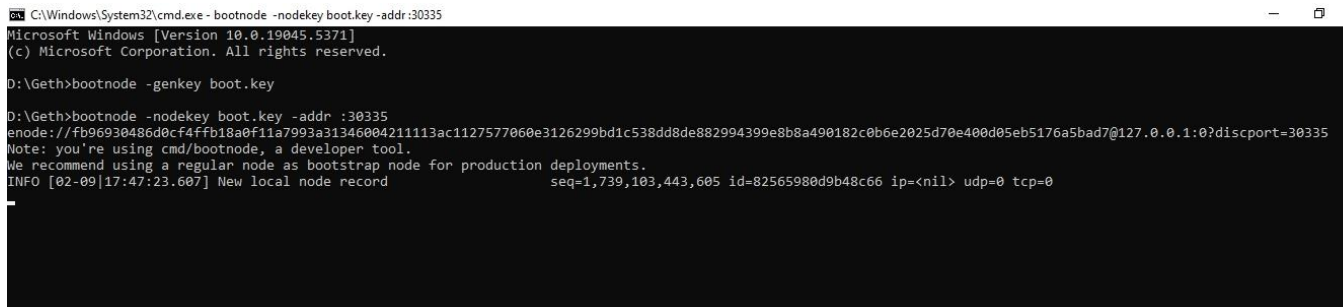
bootnode -nodekey boot.key -addr :30335

### Command explanation:

- **-nodekey:** Specifies the node's private key file
- **-addr:** Specifies the listening address and port

## Purpose:

1. **Node Discovery:** Acts as a meeting point for network participants
2. **Network Organization:** Helps nodes find and connect to each other
3. **Decentralization:** Enables peer-to-peer network formation
4. **Efficiency:** Reduces the need for manual peer addition.



```

C:\Windows\System32\cmd.exe - bootnode -nodekey boot.key -addr:30335
Microsoft Windows [Version 10.0.19045.5371]
(c) Microsoft Corporation. All rights reserved.

D:\Geth>bootnode -genkey boot.key

D:\Geth>bootnode -nodekey boot.key -addr :30335
enode://fb96930486d0cf4ffb18a0f11a7993a31346004211113ac1127577060e3126299bd1c538dd8de882994399e8b8a490182c0b6e2025d70e400d05eb5176a5bad7@127.0.0.1:0?discport=30335
Note: you're using cmd/bootnode, a developer tool.
We recommend using a regular node as bootstrap node for production deployments.
INFO [02-09|17:47:23.607] New local node record          seq=1,739,103,443,605 id=82565980d9b48c66 ip=<nil> udp=0 tcp=0

```

## 6. Node Startup:

### Start Node 1:

#### Cmd:

```

geth --datadir node1 --port 30306 --bootnodes
enode://fb96930486d0cf4ffb18a0f11a7993a31346004211113ac1127577060e3126299bd1c538dd8de882994399e8b8a490182c0b6e2025d70e400d05eb5176a5bad7@127.0.0.1:0?discport=30335
--networkid 123454321 --unlock 0x32C4142C66dfaCB14029677b6e3f3286B29BBfE0 --
password node1/password.txt --authrpc.port 8551 --mine --miner.etherbase
0x32C4142C66dfaCB14029677b6e3f3286B29BBfE0

```

### Start Node 2:

#### Cmd:

```

geth --datadir node2 --port 30307 --bootnodes
enode://fb96930486d0cf4ffb18a0f11a7993a31346004211113ac1127577060e3126299bd1c538dd8de882994399e8b8a490182c0b6e2025d70e400d05eb5176a5bad7@127.0.0.1:0?discport=30335
--networkid 123454321 --unlock 0xC251a7aD684fa74337029E64cd5bF68C30e7807B --
password node2/password.txt --authrpc.port 8552 --ipcdisable

```

## Command parameters explained:

- **--port:** P2P network listening port



- ```
C:\Windows\System32\cmd.exe
Microsoft Windows [Version 10.0.19045.5371]
(c) Microsoft Corporation. All rights reserved.

D:\Geth>geth --datadir node1 --port 30306 --bootnodes enode://fb96930486d0cf4ff18a0f11a7993a3134600421113ac127577060e3126299bd1c538dd8e882994399e8b8a490182c0b6e2025d70e400d5eb5176a5bad7@127.0.0.1:0?discport=30335 --networkid 123454321 --unlock 0x32c4142c66dafc81402967b6e3f32868298BfE0 --password node1/password.txt --authrpc.port 8551 --mine --miner.etherbase 0x32c4142c66dafc81402967b6e3f32868298BfE0
INFO [02-09|17:52:01.828] Maximum peer count          ETH=50 total=50
INFO [02-09|17:52:01.842] Set global gas cap          cap=50,000,000
INFO [02-09|17:52:01.842] Initializing the KZG library backend=gokzg
INFO [02-09|17:52:01.974] Allocated trie memory caches clean=154.00MiB
INFO [02-09|17:52:01.975] Using pebble as the backing database
INFO [02-09|17:52:01.976] Allocated cache and file handles database=D:\Geth
\node1\geth\chaindata cache=512.00MiB handles=8192
INFO [02-09|17:52:01.994] Opened ancient database database=D:\Geth
\node1\geth\chaindata\ancient\chain readonly=false
INFO [02-09|17:52:01.995] State scheme set to already existing scheme=hash
INFO [02-09|17:52:01.997] Initialising Ethereum protocol network=123,454,321 dbversion=<nil>
INFO [02-09|17:52:02.000] -----
INFO [02-09|17:52:02.000] Chain ID: 123454321 (unknown)
INFO [02-09|17:52:02.000] Consensus: Clique (proof-of-authority)
INFO [02-09|17:52:02.000] -----
INFO [02-09|17:52:02.006] Pre-Merge hard forks (block based):
INFO [02-09|17:52:02.006] - Homestead: #0 (https://github.com/ethereum/execution-specs/blob/master/network-upgrades/mainnet-upgrades/homestead.md)
INFO [02-09|17:52:02.006] - Tangerine Whistle (EIP 150): #0 (https://github.com/ethereum/execution-specs/blob/master/network-upgrades/mainnet-upgrades/tangerine-whistle.md)
INFO [02-09|17:52:02.006] - Spurious Dragon/1 (EIP 155): #0 (https://github.com/ethereum/execution-specs/blob/master/network-upgrades/mainnet-upgrades/spurious-dragon.md)
INFO [02-09|17:52:02.006] - Spurious Dragon/2 (EIP 158): #0 (https://github.com/ethereum/execution-specs/blob/master/network-upgrades/mainnet-upgrades/spurious-dragon.md)
INFO [02-09|17:52:02.006] - Byzantium: #0 (https://github.com/ethereum/execution-specs/blob/master/network-upgrades/mainnet-upgrades/byzantium.md)

D:\Geth>geth --datadir node2 --port 30307 --bootnodes enode://fb96930486d0cf4ff18a0f11a7993a3134600421113ac127577060e3126299bd1c538dd8e882994399e8b8a490182c0b6e2025d70e400d5eb5176a5bad7@127.0.0.1:0?discport=30335 --networkid 123454321 --unlock 0x251a706d84fa74337029f64cd5bf68c30e78078 --password node2/password.txt --authrpc.port 8552 --ipcdisable
INFO [02-09|17:52:12.498] Maximum peer count          ETH=50 total=50
INFO [02-09|17:52:12.508] Set global gas cap          cap=50,000,000
INFO [02-09|17:52:12.508] Initializing the KZG library backend=gokzg
INFO [02-09|17:52:12.624] Allocated trie memory caches clean=154.00MiB
INFO [02-09|17:52:12.626] Using pebble as the backing database
INFO [02-09|17:52:12.627] Allocated cache and file handles database=D:\Geth
\node2\geth\chaindata cache=512.00MiB handles=8192
INFO [02-09|17:52:12.644] Opened ancient database database=D:\Geth
\node2\geth\chaindata\ancient\chain readonly=false
INFO [02-09|17:52:12.646] State scheme set to already existing scheme=hash
INFO [02-09|17:52:12.648] Initialising Ethereum protocol network=123,454,321 dbversion=<nil>
INFO [02-09|17:52:12.651] -----
INFO [02-09|17:52:12.651] Chain ID: 123454321 (unknown)
INFO [02-09|17:52:12.651] Consensus: Clique (proof-of-authority)
INFO [02-09|17:52:12.651] -----
INFO [02-09|17:52:12.651] Pre-Merge hard forks (block based):
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INFO [02-09|17:52:12.651] - Spurious Dragon/1 (EIP 155): #0 (https://github.com/ethereum/execution-specs/blob/master/network-upgrades/mainnet-upgrades/spurious-dragon.md)
INFO [02-09|17:52:12.651] - Spurious Dragon/2 (EIP 158): #0 (https://github.com/ethereum/execution-specs/blob/master/network-upgrades/mainnet-upgrades/spurious-dragon.md)
INFO [02-09|17:52:12.651] - Byzantium: #0 (https://github.com/ethereum/execution-specs/blob/master/network-upgrades/mainnet-upgrades/byzantium.md)

D:\Geth>geth --datadir node1 --port 30306 --bootnodes enode://fb96930486d0cf4ff18a0f11a7993a3134600421113ac127577060e3126299bd1c538dd8e882994399e8b8a490182c0b6e2025d70e400d5eb5176a5bad7@127.0.0.1:0?discport=30335 --networkid 123454321 --unlock 0x32c4142c66dafc81402967b6e3f32868298BfE0 --password node1/password.txt --authrpc.port 8551 --mine --miner.etherbase 0x32c4142c66dafc81402967b6e3f32868298BfE0
INFO [02-09|17:52:01.828] Maximum peer count          ETH=50 total=50
INFO [02-09|17:52:01.842] Set global gas cap          cap=50,000,000
INFO [02-09|17:52:01.842] Initializing the KZG library backend=gokzg
INFO [02-09|17:52:01.974] Allocated trie memory caches clean=154.00MiB
INFO [02-09|17:52:01.975] Using pebble as the backing database
INFO [02-09|17:52:01.976] Allocated cache and file handles database=D:\Geth
\node1\geth\chaindata cache=512.00MiB handles=8192
INFO [02-09|17:52:01.994] Opened ancient database database=D:\Geth
\node1\geth\chaindata\ancient\chain readonly=false
INFO [02-09|17:52:01.995] State scheme set to already existing scheme=hash
INFO [02-09|17:52:01.997] Initialising Ethereum protocol network=123,454,321 dbversion=<nil>
INFO [02-09|17:52:02.000] -----
INFO [02-09|17:52:02.000] Chain ID: 123454321 (unknown)
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INFO [02-09|17:52:02.006] - Tangerine Whistle (EIP 150): #0 (https://github.com/ethereum/execution-specs/blob/master/network-upgrades/mainnet-upgrades/tangerine-whistle.md)
INFO [02-09|17:52:02.006] - Spurious Dragon/1 (EIP 155): #0 (https://github.com/ethereum/execution-specs/blob/master/network-upgrades/mainnet-upgrades/spurious-dragon.md)
INFO [02-09|17:52:02.006] - Spurious Dragon/2 (EIP 158): #0 (https://github.com/ethereum/execution-specs/blob/master/network-upgrades/mainnet-upgrades/spurious-dragon.md)
INFO [02-09|17:52:02.006] - Byzantium: #0 (https://github.com/ethereum/execution-specs/blob/master/network-upgrades/mainnet-upgrades/byzantium.md)

D:\Geth>geth --datadir node2 --port 30307 --bootnodes enode://fb96930486d0cf4ff18a0f11a7993a3134600421113ac127577060e3126299bd1c538dd8e882994399e8b8a490182c0b6e2025d70e400d5eb5176a5bad7@127.0.0.1:0?discport=30335 --networkid 123454321 --unlock 0x251a706d84fa74337029f64cd5bf68c30e78078 --password node2/password.txt --authrpc.port 8552 --ipcdisable
INFO [02-09|17:52:12.498] Maximum peer count          ETH=50 total=50
INFO [02-09|17:52:12.508] Set global gas cap          cap=50,000,000
INFO [02-09|17:52:12.508] Initializing the KZG library backend=gokzg
INFO [02-09|17:52:12.624] Allocated trie memory caches clean=154.00MiB
INFO [02-09|17:52:12.626] Using pebble as the backing database
INFO [02-09|17:52:12.627] Allocated cache and file handles database=D:\Geth
\node2\geth\chaindata cache=512.00MiB handles=8192
INFO [02-09|17:52:12.644] Opened ancient database database=D:\Geth
\node2\geth\chaindata\ancient\chain readonly=false
INFO [02-09|17:52:12.646] State scheme set to already existing scheme=hash
INFO [02-09|17:52:12.648] Initialising Ethereum protocol network=123,454,321 dbversion=<nil>
INFO [02-09|17:52:12.651] -----
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INFO [02-09|17:52:12.651] Consensus: Clique (proof-of-authority)
INFO [02-09|17:52:12.651] -----
INFO [02-09|17:52:12.651] Pre-Merge hard forks (block based):
INFO [02-09|17:52:12.651] - Homestead: #0 (https://github.com/ethereum/execution-specs/blob/master/network-upgrades/mainnet-upgrades/homestead.md)
INFO [02-09|17:52:12.651] - Tangerine Whistle (EIP 15
```

## 7. Network Testing and Transactions Perform:

### Cmd:

net.peerCount

eth.getBalance()

eth.sendTransaction()

eth.getTransaction()

### Purpose:

#### 1. Connectivity Verification:

- Ensures nodes can find each other.
- Verifies peer connections
- Checks network stability

#### 2. Functionality Testing:

- Verifies transaction processing
- Confirms block creation
- Tests account operations

#### 3. Performance Validation:

- Checks block propagation
- Verifies consensus mechanism
- Validates network speed



```
Attach
Welcome to the Geth JavaScript console!

instance: Geth/v1.13.15-stable-c5ba367e/windows-amd64/go1.21.6
coinbase: 0x32c4142c66dfacB14029677b6e3f3286b29bbfe0
at block: 11 (Sun Feb 09 2025 17:53:38 GMT+0530 (IST))
datadir: D:\Geth\node1
modules: admin:1.0 clique:1.0 debug:1.0 engine:1.0 eth:1.0 miner:1.0 net:1.0 rpc:1.0 txpool:1.0 web3:1.0

To exit, press ctrl-d or type exit
> net.peerCount
1
> admin.peers
[[
  caps: ["eth/68", "snap/1"],
  enode: "enode://879e0aa38f1b73a1674dae07effdc29858fb9bea5eb70ce268211687f3cc8d923f4810fb758337bb4d17f88f8c9b089689ee97f47730ce9394ca3885e56707b5@127.0.0.1:54688",
  id: "77d5c7b6311e3b69421b21a814fae4bcd454bb223e4e3d0cc7f1236fe6c161",
  name: "Geth/v1.13.15-stable-c5ba367e/windows-amd64/go1.21.6",
  network: {
    inbound: true,
    localAddress: "127.0.0.1:30306",
    remoteAddress: "127.0.0.1:54688",
    static: false,
    trusted: false
  },
  protocols: {
    eth: {
      version: 68
    },
    snap: {
      version: 1
    }
  }
}]
> eth.getBalance('0x32C4142C66dfacB14029677b6e3f3286B29BBfE0') //node1
1000000000000000000
> eth.getBalance('0xC251a7aD684fa74337029E64cd5bF68C30e7807B') //node2
1000000000000000000
> eth.sendTransaction({
  ..... to: '0xC251a7aD684fa74337029E64cd5bF68C30e7807B', //node2
  ..... from: '0x32C4142C66dfacB14029677b6e3f3286B29BBfE0', //node1
  ..... value: 1020
  ..... });
"0xdf8373bd949acc1a18bdd5ce04f0bd528b04aee85bb07d36e19c2c30977509e7"
```

```
Attach
  ..... value: 1020
  ..... });
"0xdf8373bd949acc1a18bdd5ce04f0bd528b04aee85bb07d36e19c2c30977509e7"
> eth.getTransaction('0xdf8373bd949acc1a18bdd5ce04f0bd528b04aee85bb07d36e19c2c30977509e7');
{
  accessList: [],
  blockHash: "0x6d42467659dc805f503d688795ab79c4e3130b4e205787168f3ec57a1f5ddcf87",
  blockNumber: 117,
  chainId: "0x75bc371",
  from: "0x32c4142c66dfacB14029677b6e3f3286b29bbfe0",
  gas: 21000,
  gasPrice: 1000000167,
  hash: "0xdf8373bd949acc1a18bdd5ce04f0bd528b04aee85bb07d36e19c2c30977509e7",
  input: "0x",
  maxFeePerGas: 1000000380,
  maxPriorityFeePerGas: 1000000000,
  nonce: 0,
  r: "0x147baf91545411453b49afd0ec7e9f5739f26f546786aed06ed4d6b35f9ed871",
  s: "0x66299cae4c049514c2baac8524fe221860f1488e5df769961403034e0bc5e591",
  to: "0xC251a7aD684fa74337029E64cd5bF68C30e7807B",
  transactionIndex: 0,
  type: "0x2",
  v: "0x1",
  value: 1020,
  yParity: "0x1"
}
> eth.sendTransaction({
  to: '0xC251a7aD684fa74337029E64cd5bF68C30e7807B', //node2
  from: '0x32C4142C66dfacB14029677b6e3f3286B29BBfE0', //node1
  value: 1020
> eth.getBalance('0x32C4142C66dfacB14029677b6e3f3286B29BBfE0') //node1
999999996491980
> eth.sendTransaction({
  to: '0xC251a7aD684fa74337029E64cd5bF68C30e7807B', //node2
  from: '0x32C4142C66dfacB14029677b6e3f3286B29BBfE0', //node1
  value: 1020
> eth.getBalance('0xC251a7aD684fa74337029E64cd5bF68C30e7807B') //node2
10000000000001020
>
```