Ethereum Private Network Using Docker Compose

Ethereum Private Network(1/13)

- **Build Geth Image :**
  - **Step 01**. Make **directories** for each **Geth nodes**.

```
c:\Home\Project\Smart-Contract\Docker>mkdir node1

c:\Home\Project\Smart-Contract\Docker>mkdir node2

c:\Home\Project\Smart-Contract\Docker>mkdir node3
```

  - **Step 02.** Make Geth image with "**docker build -t geth .**" or "**docker build -t geth . --network=host**" command.

```
c:\Home\Project\Smart-Contract\Docker>docker images
REPOSITORY    TAG       IMAGE ID       CREATED              SIZE
geth          latest    df6f7221b8d5   About a minute ago   2.26GB
hello-world   latest    d1165f221234   4 months ago         13.3kB
```

Note : Geth Image Build in Window 10

- **Check Result :**

Ethereum Private Network(2/13)

- **Make Your Accounts :**
  - **Step 03**. Make **accounts** for each **Geth nodes**. To make an account in Geth node, you need to run "**docker run -it -v <full_directory_path_name>:/home/ethereum geth /bin/bash**" command for **node1**. It will use host directory in Geth container for account creation. Go to "**ethereum**" directory and run **"geth --datadir /home/ethereum account new**" command. **Remember your account and password**. Do the same things for **node2** and **node3**. Make "**account1.txt**" and "**password1.txt**" file with the password for node1. You need to make "**account2.txt, account3.txt and password2.txt, password3.txt**" also for each nodes.

```
c:\Home\Project\Smart-Contract\Docker\node1>docker run -it -v C:\Home\Project\Smart-Contract\Docker\node1:/home/ethereum geth /bin/bash
root@fba6cd1ed252:/home# geth --datadir /home/ethereum account new
INFO [07-08|01:17:02.204] Maximum peer count                       ETH=50 LES=0 total=50
INFO [07-08|01:17:02.204] Smartcard socket not found, disabling    err="stat /run/pcscd/pcscd.comm: no such file or directory"
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:   0xBe1F0126DbDeC69d22b5CF07AA939dE792b8825f
Path of the secret key file: /home/ethereum/keystore/UTC--2021-07-08T01-17-05.582289700Z--be1f0126dbdec69d22b5cf07aa939de792b8825f

- 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!

root@fba6cd1ed252:/home#
```

```
c:\Home\Project\Smart-Contract\Docker>tree
폴더 PATH의 목록입니다.
볼륨 일련 번호는 4E9A-22CD입니다.
C:.
├─node1
│  └─keystore
├─node2
│  └─keystore
└─node3
   └─keystore
```

Ethereum Private Network(3/13)

- **Make Genesis File :**
  - **Step 04**. Run "**puppeth**" program to generate "**genesis.json**" file. Here we will use "**PoA(Clique)**" consensus algorithm.

```
Please specify a network name to administer (no spaces, hyphens or capital letters please)
> docker

Sweet, you can set this via --network=docker next time!

INFO [07-08|10:24:39.741] Administering Ethereum network           name=docker
WARN [07-08|10:24:39.819] No previous configurations found         path=.puppeth\docker

What would you like to do? (default = stats)
 1. Show network stats
 2. Configure new genesis
 3. Track new remote server
 4. Deploy network components
> 2

What would you like to do? (default = create)
 1. Create new genesis from scratch
 2. Import already existing genesis
> 1

Which consensus engine to use? (default = clique)
 1. Ethash - proof-of-work
 2. Clique - proof-of-authority
> 2

How many seconds should blocks take? (default = 15)
> 1

Which accounts are allowed to seal? (mandatory at least one)
> 0xBe1F0126DbDeC69d22b5CF07AA939dE792b8825f
> 0x53350Fe0d0D69f14adbc1b54B46971552B0FEaA8
> 0x7829FD00a73979985057CdbC66551655de5c5980
> 0x

Which accounts should be pre-funded? (advisable at least one)
> 0xBe1F0126DbDeC69d22b5CF07AA939dE792b8825f
> 0x53350Fe0d0D69f14adbc1b54B46971552B0FEaA8
> 0x7829FD00a73979985057CdbC66551655de5c5980
> 0x

Should the precompile-addresses (0x1 .. 0xff) be pre-funded with 1 wei? (advisable yes)
>
```

```
Should the precompile-addresses (0x1 .. 0xff) be pre-funded with 1 wei? (advisable yes)
> yes

Specify your chain/network ID if you want an explicit one (default = random)
> 786
INFO [07-08|10:26:45.139] Configured new genesis block

What would you like to do? (default = stats)
 1. Show network stats
 2. Manage existing genesis
 3. Track new remote server
 4. Deploy network components
> 2

 1. Modify existing configurations
 2. Export genesis configurations
 3. Remove genesis configuration
> 2

Which folder to save the genesis specs into? (default = current)
  Will create docker.json, docker-aleth.json, docker-harmony.json, docker-parity.json
>
INFO [07-08|10:26:57.612] Saved native genesis chain spec          path=docker.json
ERROR[07-08|10:26:57.614] Failed to create Aleth chain spec        err="unsupported consensus engine"
ERROR[07-08|10:26:57.615] Failed to create Parity chain spec       err="unsupported consensus engine"
INFO [07-08|10:26:57.617] Saved genesis chain spec                 client=harmony path=docker-harmony.json

What would you like to do? (default = stats)
 1. Show network stats
 2. Manage existing genesis
 3. Track new remote server
 4. Deploy network components
> CRIT [07-08|10:27:11.132] Failed to read user input              err=EOF

c:\Home\Project\Smart-Contract\Docker>
```

Ethereum Private Network(4/13)

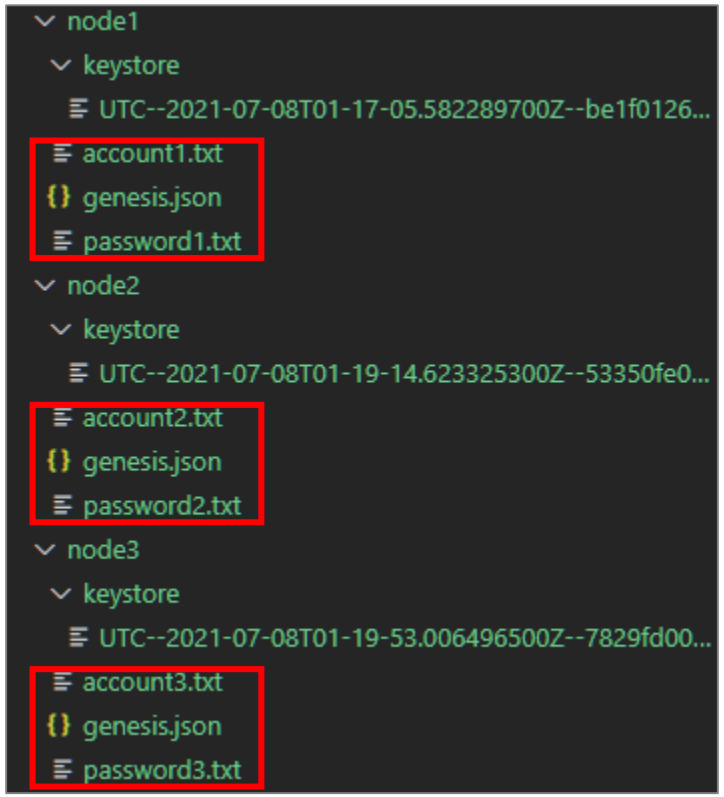
- **Change Your Genesis File :**
  - **Step 04**. Change "**period**" to "**0**" to generate a block only for when there are transactions in the network. Change the "**gasLimit**" to **higher value**. When you migration a contract using truffle, you can meet an error if the "**gasLimit**" is too low.

```
  "clique": {
    "period": 0,
    "epoch": 30000
  }
},
"nonce": "0x0",
"timestamp": "0x60e653dc",
"extraData":
"0x0000000000000000000000000000000000000000000000000000000000000000053350fe0d0d69f14adbc1b54b46971552b0feaa87829fd00a
73979985057cdbc66551655de5c5980be1f0126dbdec69d22b5cf07aa939de792b8825f0000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000",
"gasLimit": "0x7a1200",
"difficulty": "0x1",
"mixHash": "0x0000000000000000000000000000000000000000000000000000000000000000",
"coinbase": "0x0000000000000000000000000000000000000000",
"alloc": {
```

  - **Step 05**. Rename the "**xxxx.json**" file into "**genesis.json**" using "**rename docker.json genesis.json**" command.

Ethereum Private Network(5/13)

- **Initialize Geth :**
  - **Step 06**. Copy the "**genesis.json**" file into each directories. Copy "**account1.txt and password1.txt**" into **node1**. You need to do the same things for **node2** and **node3** also.



Ethereum Private Network(6/13)

- **Initialize Geth :**
  - **Step 07**. Run **Geth** for Node1 with "**docker run -it -v C:₩Home₩Project₩Smart-Contract₩Docker₩node3:/home/ethereum geth /bin/bash**" command and "**geth --datadir /home/ethereum init /home/ethereum/genesis.json**" command in the container. You need to **do the same things for the node2 and node3** also.

```
c:\Home\Project\Smart-Contract\Docker>docker run -it -v C:\Home\Project\Smart-Contract\Docker\node1:/home/ethereum geth /bin/bash
root@75436df666b4:/home# geth --datadir /home/ethereum init /home/ethereum/genesis.json
INFO [07-08|02:10:19.109] Maximum peer count                       ETH=50 LES=0 total=50
INFO [07-08|02:10:19.109] Smartcard socket not found, disabling    err="stat /run/pcscd/pcscd.comm: no such file or directory"
INFO [07-08|02:10:19.125] Set global gas cap                       cap=50,000,000
INFO [07-08|02:10:19.125] Allocated cache and file handles         database=/home/ethereum/geth/chaindata cache=16.00MiB h
INFO [07-08|02:10:19.159] Writing custom genesis block
INFO [07-08|02:10:19.166] Persisted trie from memory database      nodes=359 size=50.97KiB time=2.6287ms gcnodes=0 gcsize=
INFO [07-08|02:10:19.170] Successfully wrote genesis state         database=chaindata                    hash=3f6056..1b7
INFO [07-08|02:10:19.170] Allocated cache and file handles         database=/home/ethereum/geth/lightchaindata cache=16.00
INFO [07-08|02:10:19.197] Writing custom genesis block
INFO [07-08|02:10:19.204] Persisted trie from memory database      nodes=359 size=50.97KiB time=2.3699ms gcnodes=0 gcsize=
INFO [07-08|02:10:19.207] Successfully wrote genesis state         database=lightchaindata                    hash=3f6056
root@75436df666b4:/home#
```

```
c:\Home\Project\Smart-Contract\Docker>tree
폴더 PATH의 목록입니다.
볼륨 일련 번호는 4E9A-22CD입니다.
C:.
├─.puppeth
├─node1
│  ├─geth
│  │  ├─chaindata
│  │  └─lightchaindata
│  └─keystore
├─node2
│  ├─geth
│  │  ├─chaindata
│  │  └─lightchaindata
│  └─keystore
└─node3
    ├─geth
    │  ├─chaindata
    │  └─lightchaindata
    └─keystore

c:\Home\Project\Smart-Contract\Docker>
```

Ethereum Private Network(7/13)

- **Run Geth :**
  - **Step 08**. Run **Geth** for Node1 with "**docker run -it -v C:₩Home₩Project₩Smart-Contract₩Docker₩node1:/home/ethereum geth /bin/bash**" command and go to "**/home/ethereum**" directory in the container using "**cd /home/ethereum**" command. Then use the following command for each nodes.

```
geth --identity 'geth01' --nousb --datadir /home/ethereum --nodiscover --syncmode full --port 30303 --miner.gasprice 0 --
miner.gastarget 470000000000 --http --http.addr 0.0.0.0 --http.corsdomain '*' --http.port 8545 --http.api
admin,eth,miner,net,txpool,personal,web3 --mine --allow-insecure-unlock --unlock
"0xBe1F0126DbDeC69d22b5CF07AA939dE792b8825f" --password password1.txt

geth --identity 'geth02' --nousb --datadir /home/ethereum --nodiscover --syncmode full --port 30303 --miner.gasprice 0 --
miner.gastarget 470000000000 --http --http.addr 0.0.0.0 --http.corsdomain '*' --http.port 8545 --http.api
admin,eth,miner,net,txpool,personal,web3 --mine --allow-insecure-unlock --unlock
"0x53350Fe0d0D69f14adbc1b54B46971552B0FEaA8" --password password2.txt

geth --identity 'geth03' --nousb --datadir /home/ethereum --nodiscover --syncmode full --port 30303 --miner.gasprice 0 --
miner.gastarget 470000000000 --http --http.addr 0.0.0.0 --http.corsdomain '*' --http.port 8545 --http.api
admin,eth,miner,net,txpool,personal,web3 --mine --allow-insecure-unlock --unlock
"0x7829FD00a73979985057CdbC66551655de5c5980" --password password3.txt
```

  - **Step 09**. You need to get the "**enode**" information for each nodes.

```
INFO [07-08|04:12:36.324] Started P2P networking                  self="enode://fce9d0b7422cef2f06dd0dc23c7c2e0c42190bbcf8de0cb948388cd23af3fb6633e8a97756a63f3031b2d9bd23
f9a7006c4d1d1514bb5d8d6f1f7b34148e3668@127.0.0.1:30303?discport=0"
INFO [07-08|04:12:36.327] IPC endpoint opened                     url=/home/ethereum/geth.ipc
INFO [07-08|04:12:36.328] HTTP server started                     endpoint=[::]:8545 prefix= cors=* vhosts=localhost
INFO [07-08|04:12:37.064] Unlocked account                        address=0xBe1F0126DbDeC69d22b5CF07AA939dE792b8825f
INFO [07-08|04:12:37.064] Transaction pool price threshold updated price=0
INFO [07-08|04:12:37.064] Transaction pool price threshold updated price=0
INFO [07-08|04:12:37.064] Etherbase automatically configured      address=0xBe1F0126DbDeC69d22b5CF07AA939dE792b8825f
```

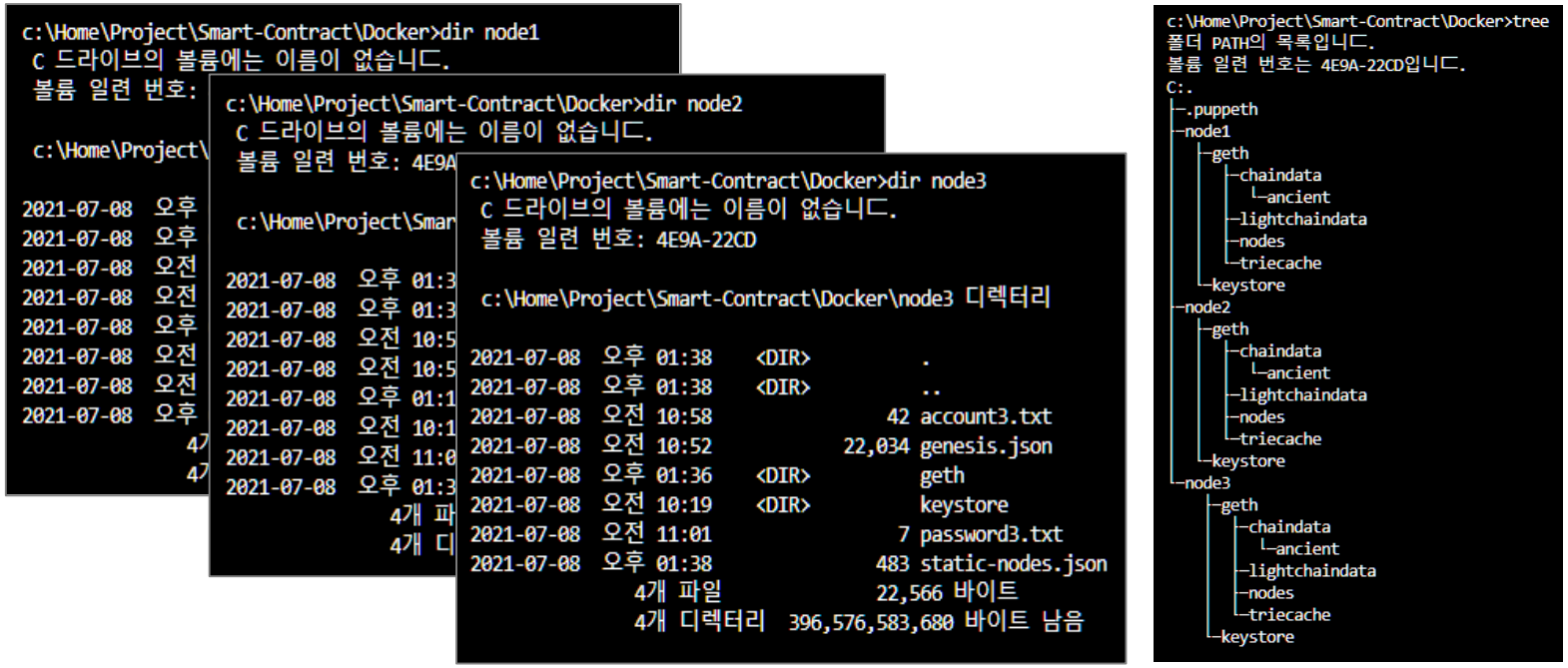
Ethereum Private Network(8/13)

- **Make Static Nodes Information :**
  - **Step 10**. Make "**static-nodes.json**" file with the "**enode**" information you got before. Here we **assigned IP address** for each nodes, which will be used in Docker Compose.

static-nodes.json > ...

```
[
  "enode://fce9d0b7422cef2f06dd0dc23c7c2e0c42190bbcf8de0cb948388cd23af3fb6633e8a97756a63f3031b2d9bd23f9a7006c4d1d1514bb5d8d6f1f7b34148e3668@172.20.0.2:30303",
  "enode://df1cf4331b36b9f388f9c41c5a99c2f388338ccd7cc63e50a1a70f75f858b4a43f914dd6def05e6997e071143fd999943e7086d41f72bb14b3f93f6ee325cae3@172.20.0.3:30303",
  "enode://ad90bf8a65692680a961c7c7cc3ee912af9ee56d2221363589a0bd2f685c3b16f3aa8618d70a2e3980806d37e37b930e9e9d7048f7e9c146863896e6bd0f2723@172.20.0.4:30303"
]
```

  - **Step 11**. Copy "**static-nodes.json**" file into "**node1, node2, and node3"** directories.



Ethereum Private Network(9/13)

- **Docker Compose Setting :**
  - **Step 12**. Make "**docker-compose.yml**" file.

```
version: "3"

networks:
  private:
    ipam:
      config:
        - subnet: 172.20.0.0/16

services:
  geth01:
    image: geth
    volumes:
      - ./node1:/home/ethereum
    networks:
      private:
        ipv4_address: 172.20.0.2
    ports:
      - 8545:8545
    container_name: geth01
    command: geth --identity 'geth01' --nousb --datadir /home/ethereum --nodiscover --syncmode full --port 30303 --miner.gasprice 0 --miner.gastarget 470000000000
--http --http.addr 0.0.0.0 --http.corsdomain '*' --http.port 8545 --http.api admin,eth,miner,net,txpool,personal,web3 --mine --allow-insecure-unlock --unlock
"0xBe1F0126DbDeC69d22b5CF07AA939dE792b8825f" --password password1.txt
    working_dir: /home/ethereum
```

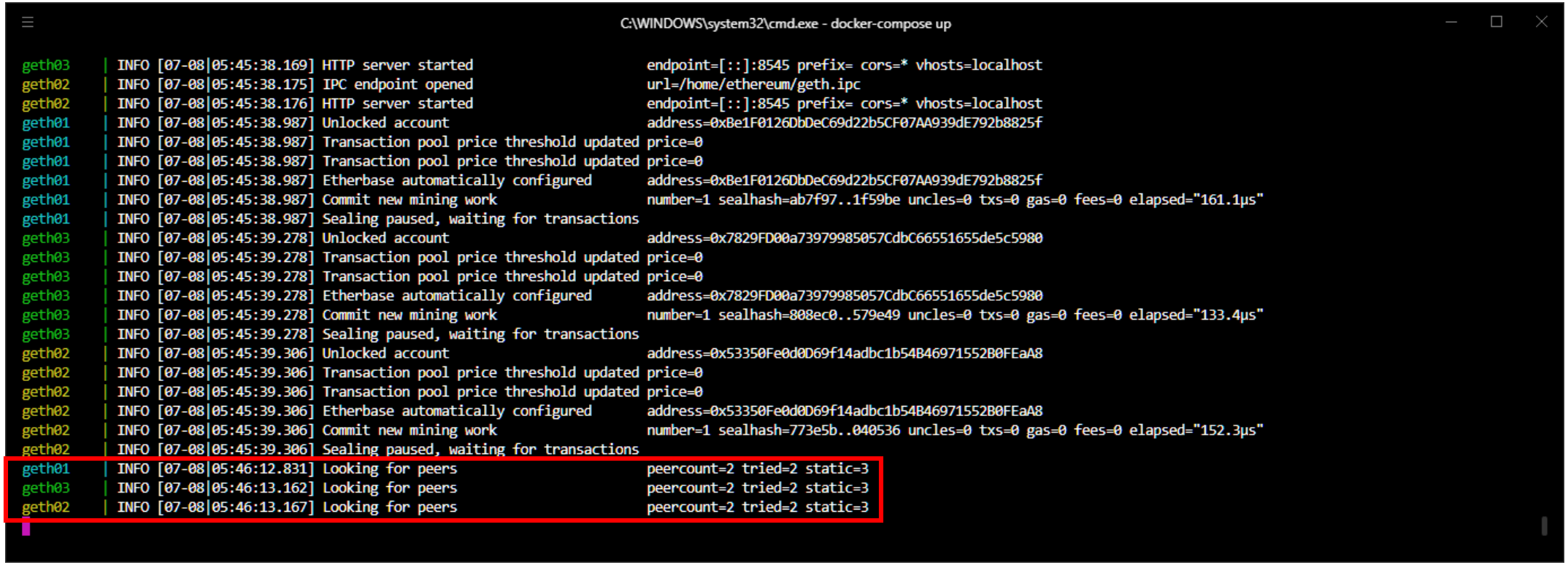
Ethereum Private Network(10/13)

- **Docker Compose Setting :**
  - **Step 12**. Make "**docker-compose.yml**" file.(continued)

```
  geth02:
    image: geth
    volumes:
      - ./node2:/home/ethereum
    tty: true
    networks:
      private:
        ipv4_address: 172.20.0.3
    ports:
      - 8546:8545
    container_name: geth02
    command: geth --identity 'geth02' --nousb --datadir /home/ethereum --nodiscover --syncmode full --port 30303 --miner.gasprice 0 --miner.gastarget 470000000000
--http --http.addr 0.0.0.0 --http.corsdomain '*' --http.port 8545 --http.api admin,eth,miner,net,txpool,personal,web3 --mine --allow-insecure-unlock --unlock
"0x53350Fe0d0D69f14adbc1b54B46971552B0FEaA8" --password password2.txt
    working_dir: /home/ethereum

  geth03:
    image: geth
    volumes:
      - ./node3:/home/ethereum
    tty: true
    networks:
      private:
        ipv4_address: 172.20.0.4
    ports:
      - 8547:8545
    container_name: geth03
    command: geth --identity 'geth03' --nousb --datadir /home/ethereum --nodiscover --syncmode full --port 30303 --miner.gasprice 0 --miner.gastarget 470000000000
--http --http.addr 0.0.0.0 --http.corsdomain '*' --http.port 8545 --http.api admin,eth,miner,net,txpool,personal,web3 --mine --allow-insecure-unlock --unlock
"0x7829FD00a73979985057CdbC66551655de5c5980" --password password3.txt
    working_dir: /home/ethereum
```

Ethereum Private Network(11/13)

- **Run the Ethereum Private Network with Docker Compose :**
  - **Step 13**. Use "**docker-compose up -d**" command in the project root directory. Check the **peer count** in the console.



Ethereum Private Network(12/13)

- **Get a Smart Contract for migration :**
  - **Step 14**. Use Truffle for testing. Run "**truffle unbox metacoin**" command.

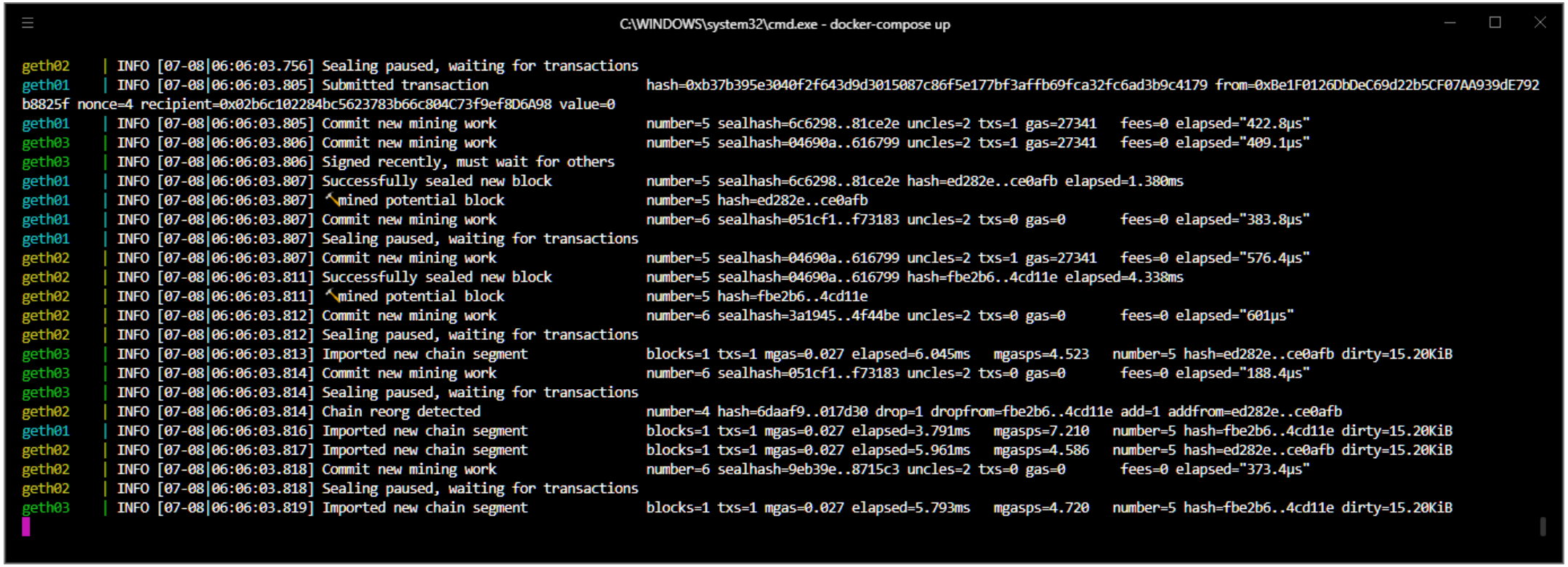
```
c:\Home\Project\Smart-Contract\Truffle>truffle unbox metacoin

Starting unbox...
=================

✓ Preparing to download box
✓ Downloading
✓ Cleaning up temporary files
✓ Setting up box

Unbox successful, sweet!

Commands:

  Compile contracts: truffle compile
  Migrate contracts: truffle migrate
  Test contracts:    truffle test


c:\Home\Project\Smart-Contract\Truffle>
```

  - **Step 15**. Check the "**truffle-config.js**" to connect to the private Ethereum network.

```
networks: {
  development: {
    host: "127.0.0.1",
    port: 8545,
    network_id: "*",
  },
},
```

Ethereum Private Network(13/13)

- **Migrate a Smart Contract :**
  - **Step 16**. Run "**truffle migrate**" command in the truffle project root directory.



? & !

Thanks!!!