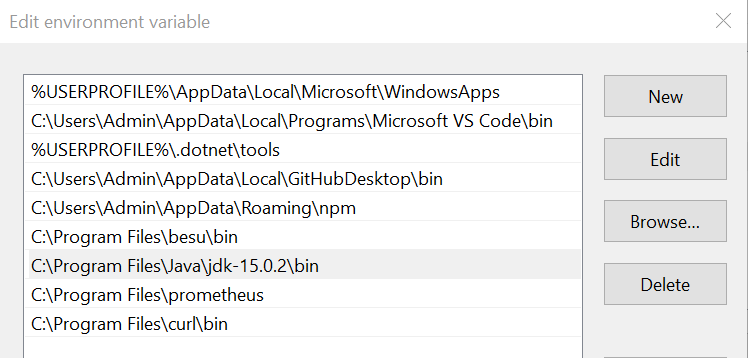
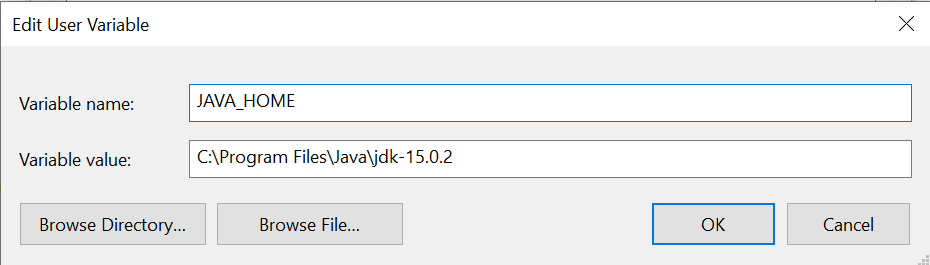
Create a private network using IBFT 2.0



* Install Prerequisites (Windows)
  + Install Java JDK 11+
    - Download Link for binary distribution: <https://www.oracle.com/java/technologies/downloads/#jdk18-windows>
    - After downloading, copy the bin path into environment variables:



* + - Copy the JDK path into environment variables (JAVA\_HOME):



* + - Restart Windows + Confirm Installation (Command Prompt)

C:\WINDOWS\system32>java --version  
java 15.0.2 2021-01-19  
Java(TM) SE Runtime Environment (build 15.0.2+7-27)  
Java HotSpot(TM) 64-Bit Server VM (build 15.0.2+7-27, mixed mode, sharing)

* + Install Hyperledger Besu
    - Download Link for Binary distribution:

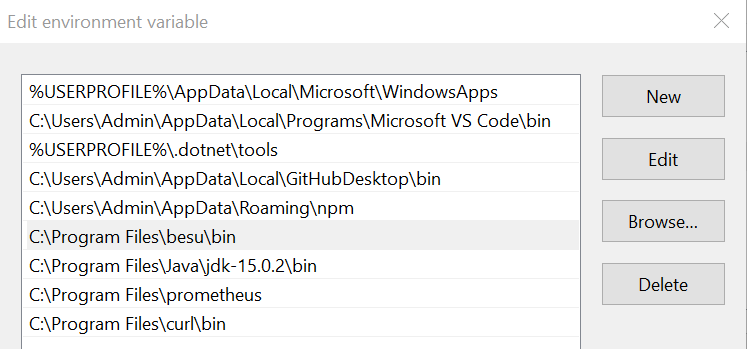
<https://hyperledger.jfrog.io/ui/native/besu-binaries/besu/22.7.2/besu-22.7.2.tar.gz>

* + - Extract tar.gz file

C:\Users\Admin\Downloads>tar xzvf besu-22.7.2.tar.gz  
x besu-22.7.2/  
x besu-22.7.2/lib/  
x besu-22.7.2/lib/besu-evmtool-22.7.2.jar  
x besu-22.7.2/lib/besu-22.7.2.jar  
x besu-22.7.2/lib/besu-ethereum-ethstats-22.7.2.jar  
x besu-22.7.2/lib/besu-clique-22.7.2.jar  
x besu-22.7.2/lib/besu-ibftlegacy-22.7.2.jar  
x besu-22.7.2/lib/besu-ibft-22.7.2.jar  
x besu-22.7.2/lib/besu-qbft-22.7.2.jar  
x besu-22.7.2/lib/besu-consensus-common-22.7.2.jar  
x besu-22.7.2/lib/besu-retesteth-22.7.2.jar  
x besu-22.7.2/lib/besu-ethereum-stratum-22.7.2.jar  
x besu-22.7.2/lib/besu-api-22.7.2.jar  
x besu-22.7.2/lib/besu-merge-22.7.2.jar

...

* + - Add Besu bin path to environment variables:



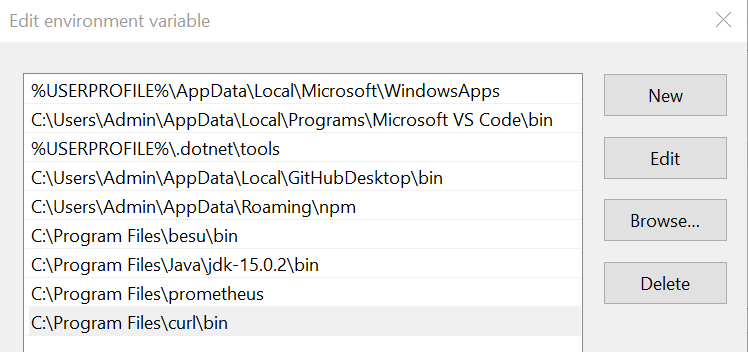
* + - Run Besu

C:\Users\Admin\Downloads>besu --version  
besu/v22.7.2/windows-x86\_64/oracle-java-15

* + Install Curl (Windows)
    - Download Link for Binary Distribution:

<https://curl.se/windows/>

* + - Extract the curl .zip folder
    - Add curl bin path to environment variables:



* + - Run curl

C:\Users\Admin\Downloads>curl --version  
curl 7.83.1 (Windows) libcurl/7.83.1 Schannel  
Release-Date: 2022-05-13  
Protocols: dict file ftp ftps http https imap imaps pop3 pop3s smtp smtps telnet tftp  
Features: AsynchDNS HSTS IPv6 Kerberos Largefile NTLM SPNEGO SSL SSPI UnixSockets

* Create a Private Network using IBFT 2.0
  + Open PowerShell and create a new folder

PS C:\WINDOWS\system32> cd C:\Users\Admin\Documents\Projects  
PS C:\Users\Admin\Documents\Projects> mkdir IBFT-Documentation  
  
  
 Directory: C:\Users\Admin\Documents\Projects  
  
  
Mode LastWriteTime Length Name  
---- ------------- ------ ----  
d----- 13/9/2022 9:23 am IBFT-Documentation

* + Create Folders for Node-1 to Node-4 with a data sub-directory

PS C:\Users\Admin\Documents\Projects> cd C:\Users\Admin\Documents\Projects\IBFT-Documentation  
PS C:\Users\Admin\Documents\Projects\IBFT-Documentation> mkdir Node-1/**data**  
  
  
 Directory: C:\Users\Admin\Documents\Projects\IBFT-Documentation\Node-1  
  
  
Mode LastWriteTime Length Name  
---- ------------- ------ ----  
d----- 13/9/2022 9:23 am **data**  
  
  
PS C:\Users\Admin\Documents\Projects\IBFT-Documentation> mkdir Node-2/**data**  
  
  
 Directory: C:\Users\Admin\Documents\Projects\IBFT-Documentation\Node-2  
  
  
Mode LastWriteTime Length Name  
---- ------------- ------ ----  
d----- 13/9/2022 9:24 am **data**  
  
  
PS C:\Users\Admin\Documents\Projects\IBFT-Documentation> mkdir Node-3/**data**  
  
  
 Directory: C:\Users\Admin\Documents\Projects\IBFT-Documentation\Node-3  
  
  
Mode LastWriteTime Length Name  
---- ------------- ------ ----  
d----- 13/9/2022 9:24 am **data**  
  
  
PS C:\Users\Admin\Documents\Projects\IBFT-Documentation> mkdir Node-4/**data**  
  
  
 Directory: C:\Users\Admin\Documents\Projects\IBFT-Documentation\Node-4  
  
  
Mode LastWriteTime Length Name  
---- ------------- ------ ----  
d----- 13/9/2022 9:24 am **data**

* + Create a Configuration File called ibftConfigFile.json in the IBFT-Documentation Directory
  + Inside the Configuration File include:

{  
 "genesis": {  
 "config": {  
 "chainId": 1337,  
 "berlinBlock": 0,  
 "ibft2": {  
 "blockperiodseconds": 2,  
 "epochlength": 30000,  
 "requesttimeoutseconds": 4  
 }  
 },  
 "nonce": "0x0",  
 "timestamp": "0x58ee40ba",  
 "gasLimit": "0x47b760",  
 "difficulty": "0x1",  
 "mixHash": "0x63746963616c2062797a616e74696e65206661756c7420746f6c6572616e6365",  
 "coinbase": "0x0000000000000000000000000000000000000000",  
 "alloc": {  
 "fe3b557e8fb62b89f4916b721be55ceb828dbd73": {  
 "privateKey": "8f2a55949038a9610f50fb23b5883af3b4ecb3c3bb792cbcefbd1542c692be63",  
 "comment": "private key and this comment are ignored. In a real chain, the private key should NOT be stored",  
 "balance": "0xad78ebc5ac6200000"  
 },  
 "627306090abaB3A6e1400e9345bC60c78a8BEf57": {  
 "privateKey": "c87509a1c067bbde78beb793e6fa76530b6382a4c0241e5e4a9ec0a0f44dc0d3",  
 "comment": "private key and this comment are ignored. In a real chain, the private key should NOT be stored",  
 "balance": "90000000000000000000000"  
 },  
 "f17f52151EbEF6C7334FAD080c5704D77216b732": {  
 "privateKey": "ae6ae8e5ccbfb04590405997ee2d52d2b330726137b875053c36d94e974d162f",  
 "comment": "private key and this comment are ignored. In a real chain, the private key should NOT be stored",  
 "balance": "90000000000000000000000"  
 }  
 }  
 },  
 "blockchain": {  
 "nodes": {  
 "generate": true,  
 "count": 4  
 }  
 }  
}

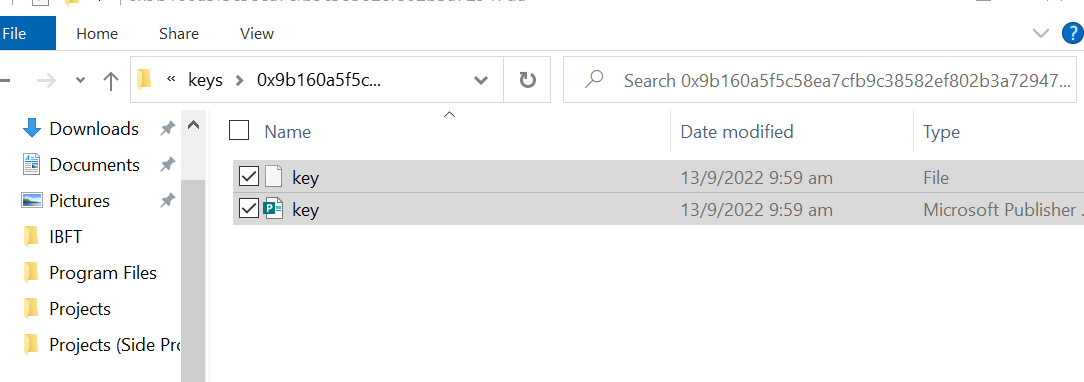
* + Generate the node keys and genesis file

PS C:\Users\Admin\Documents\Projects\IBFT-Documentation> besu operator generate-blockchain-config --config-file=ibftConfigFile.json --to=networkFiles --private-key-file-name=key  
2022-09-13 09:59:10.706+08:00 | main | INFO | SECP256K1 | Native secp256k1 not available  
2022-09-13 09:59:10.713+08:00 | main | INFO | GenerateBlockchainConfig | Generating 4 nodes keys.  
2022-09-13 09:59:10.716+08:00 | main | INFO | GenerateBlockchainConfig | Generating keypair **for** node 0.  
2022-09-13 09:59:10.752+08:00 | main | INFO | GenerateBlockchainConfig | Generating keypair **for** node 1.  
2022-09-13 09:59:10.759+08:00 | main | INFO | GenerateBlockchainConfig | Generating keypair **for** node 2.  
2022-09-13 09:59:10.764+08:00 | main | INFO | GenerateBlockchainConfig | Generating keypair **for** node 3.  
2022-09-13 09:59:10.769+08:00 | main | INFO | GenerateBlockchainConfig | Generating IBFT extra data.  
2022-09-13 09:59:10.779+08:00 | main | INFO | GenerateBlockchainConfig | Writing genesis file.

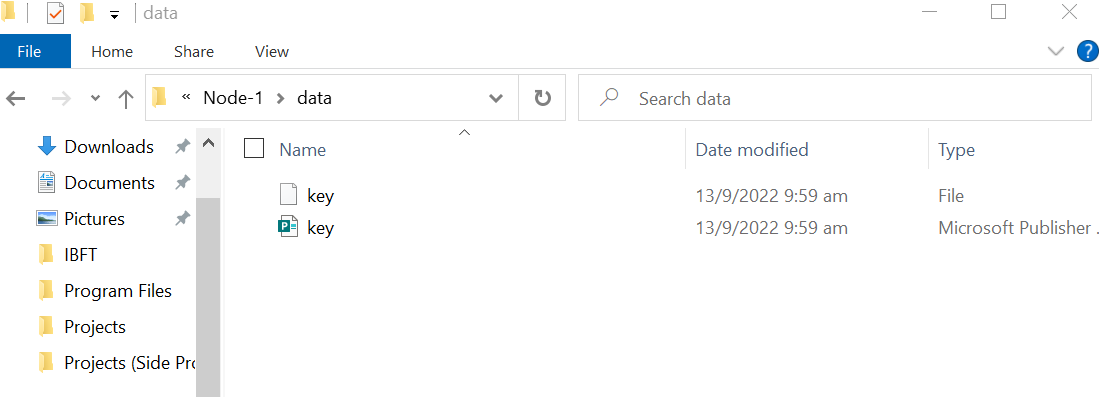
* + Observe the files in the networkFiles directory

PS C:\Users\Admin\Documents\Projects\IBFT-Documentation> cd C:\Users\Admin\Documents\Projects\IBFT-Documentation\networkFiles  
PS C:\Users\Admin\Documents\Projects\IBFT-Documentation\networkFiles> tree  
Folder PATH listing **for** volume Windows-SSD  
Volume serial number is A857-E874  
C:.  
└───keys  
 ├───0x33059f0475495ce974c36df6d8fce13b8577d5e1  
 ├───0x50aa0543e88b2dedff97ff5c54da3dfce91d67d5  
 ├───0x9b160a5f5c58ea7cfb9c38582ef802b3a72947da  
 └───0xd0ae027c05628694f063db4d373131181a783591

* + Copy the genesis file over to the IBFT-Documentation Directory
  + For each node, copy the key files to the data directory for that node

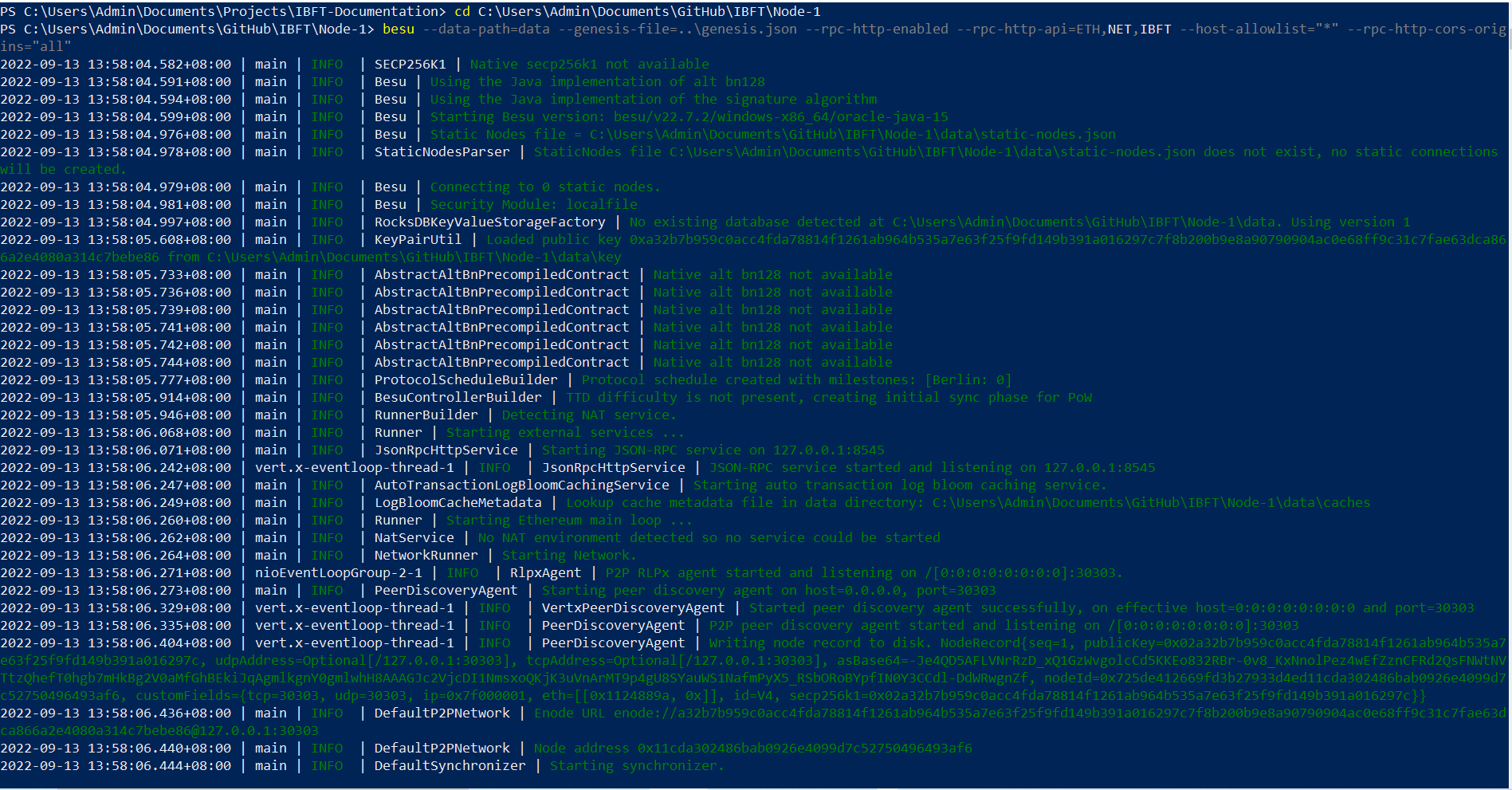


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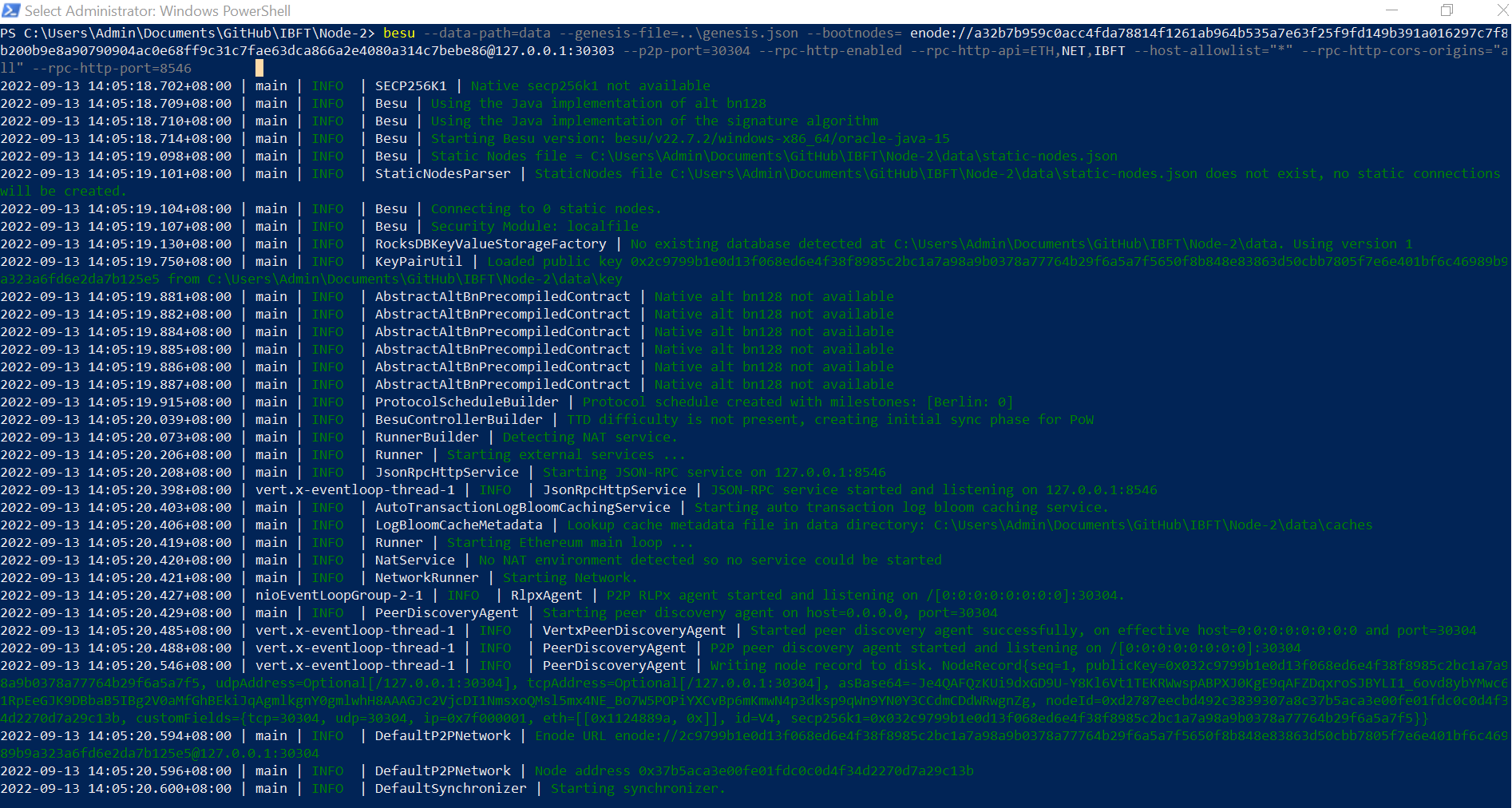


PS C:\Users\Admin\Documents\Projects\IBFT-Documentation> tree  
Folder PATH listing **for** volume Windows-SSD  
Volume serial number is A857-E874  
C:.  
├───networkFiles  
│ └───keys  
│ ├───0x33059f0475495ce974c36df6d8fce13b8577d5e1  
│ ├───0x50aa0543e88b2dedff97ff5c54da3dfce91d67d5  
│ ├───0x9b160a5f5c58ea7cfb9c38582ef802b3a72947da  
│ └───0xd0ae027c05628694f063db4d373131181a783591  
├───Node-1  
│ └───**data**  
├───Node-2  
│ └───**data**  
├───Node-3  
│ └───**data**  
└───Node-4  
 └───**data**

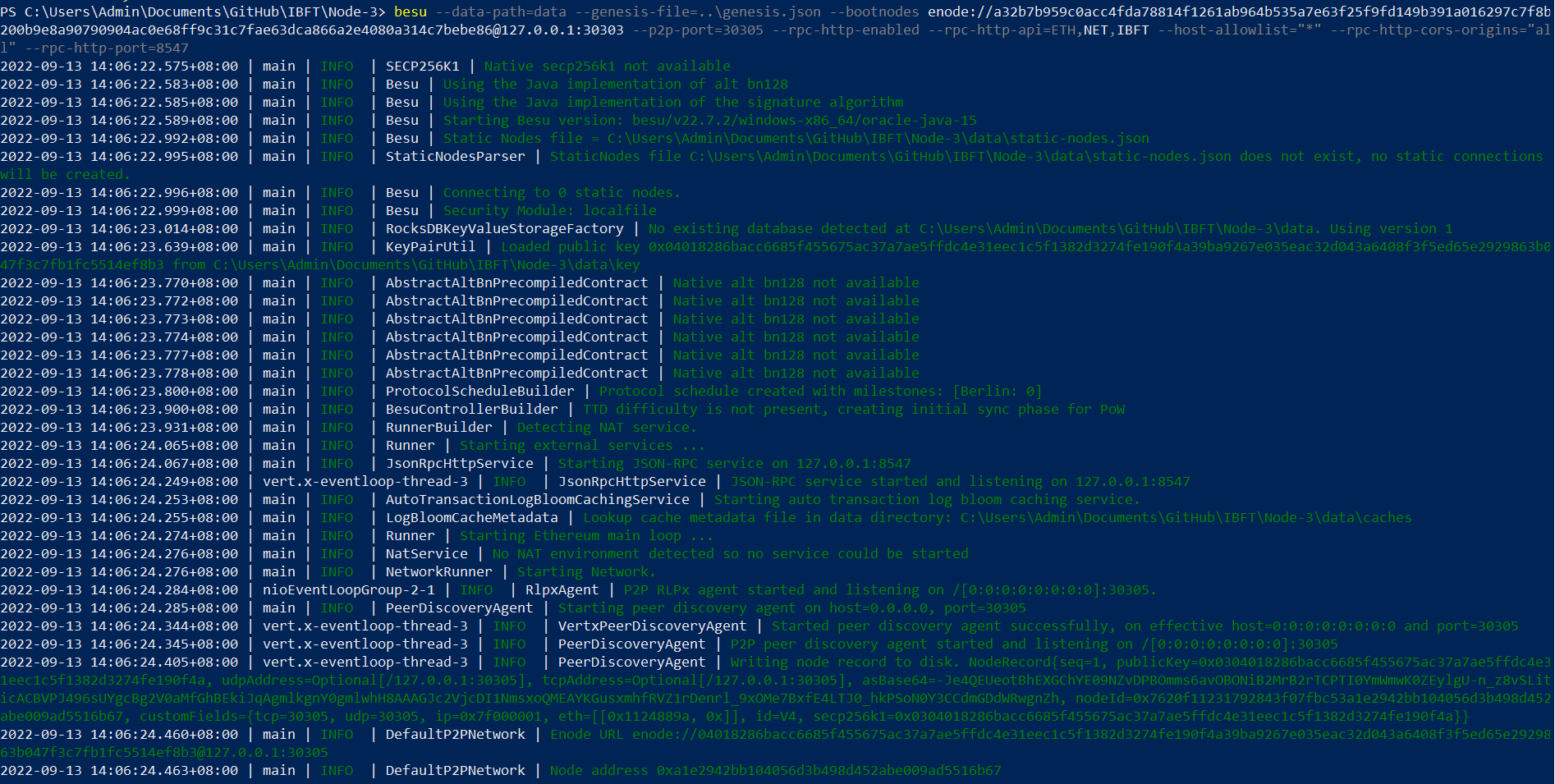
* + Start the first node as the bootnode (under IBFT-Documentation Directory)(Copy the Enode URI)

besu --data-path=**data** --genesis-file=..\genesis.json --rpc-http-enabled --rpc-http-api=ETH,NET,IBFT --host-allowlist="\*" --rpc-http-cors-origins="all" 

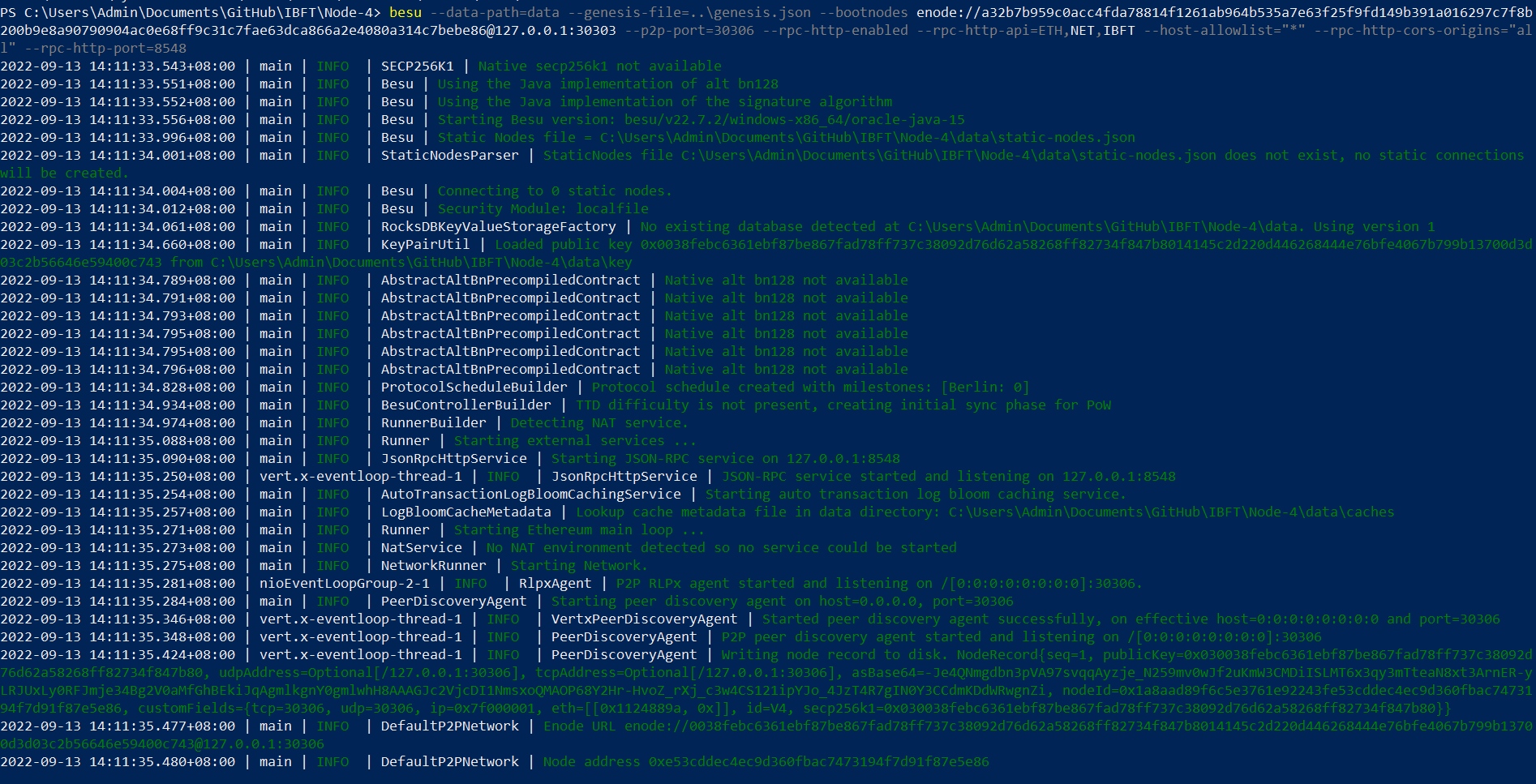
* + Start Node 2

besu --data-path=**data** --genesis-file=..\genesis.json --bootnodes= enode://a32b7b959c0acc4fda78814f1261ab964b535a7e63f25f9fd149b391a016297c7f8b200b9e8a90790904ac0e68ff9c31c7fae63dca866a2e4080a314c7bebe86@127.0.0.1:30303 --p2p-port=30304 --rpc-http-enabled --rpc-http-api=ETH,NET,IBFT --host-allowlist="\*" --rpc-http-cors-origins="all" --rpc-http-port=8546 

* + Start Node 3

besu --data-path=**data** --genesis-file=..\genesis.json --bootnodes enode://a32b7b959c0acc4fda78814f1261ab964b535a7e63f25f9fd149b391a016297c7f8b200b9e8a90790904ac0e68ff9c31c7fae63dca866a2e4080a314c7bebe86@127.0.0.1:30303 --p2p-port=30305 --rpc-http-enabled --rpc-http-api=ETH,NET,IBFT --host-allowlist="\*" --rpc-http-cors-origins="all" --rpc-http-port=8547 

* + Start Node 4

besu --data-path=**data** --genesis-file=..\genesis.json --bootnodes enode://a32b7b959c0acc4fda78814f1261ab964b535a7e63f25f9fd149b391a016297c7f8b200b9e8a90790904ac0e68ff9c31c7fae63dca866a2e4080a314c7bebe86@127.0.0.1:30303 --p2p-port=30306 --rpc-http-enabled --rpc-http-api=ETH,NET,IBFT --host-allowlist="\*" --rpc-http-cors-origins="all" --rpc-http-port=8548 

* + Difficulties Faced
    - Hyperledeger Besu Documentation was too overwhelming at first
    - Too many Prerequisites to install with no documentation by besu on how to download them
    - Too many binary distributions to choose from
    - Hyperledger Besu Documentation on how to create a private network barely had any examples or images on how to create your own directories etc., making it harder to follow along and understand
  + Solutions
    - Read through the besu documentation thoroughly

(<https://besu.hyperledger.org/en/stable/private-networks/tutorials/ibft/#prerequisites>)

* + - Watched YouTube Videos on how to download the prerequisites and set up the private network on windows

(<https://www.youtube.com/watch?v=U3T4flnoTbA&t=6s&ab_channel=EatTheBlocks>)

* + - Watched YouTube Videos on how to install besu on a binary distribution

(<https://youtu.be/5a7J3TnZpJ8>)

* + - Took a brief moment to read through all the documentation for other networks and command-line options to get myself familiarised with besu

(<https://besu.hyperledger.org/en/stable/public-networks/reference/cli/options/>)

Completed by: Ishan Singh Gill (203444P) , 7th September 2022