Ethereum Smart Contract

Tutorial & Demo

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Agenda

- Setup Ethereum and Start Dev Network
- Allocate & Transfer ether “Money” (Tokens)
- Smart Contract & Demo

Private/Dev Network Setup

- Steps:
  1. Download Ethereum and Client Wallet
  2. Start Dev Network
  3. Creating Dev Network Accounts and allocate funds
  4. Running private miner and getting Ethers
  5. Development Smart Contract

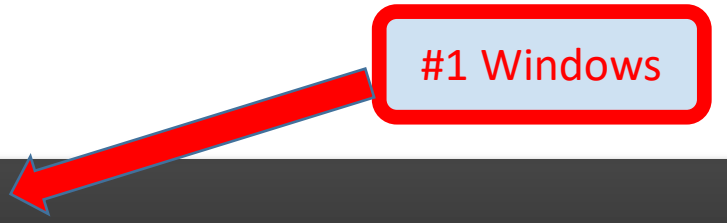
- Official Website: http://Ethereum.org
- Downloads https://geth.ethereum.org/downloads/
  - geth-alltools-windows-amd64-1.6.0-facc47cb.zip
- Wallet https://github.com/ethereum/mist/releases/download/v0.8.9/Ethereum-Wallet-win64-0-8-9.zip
- Support platforms: Linux, macOS, Windows

Ethereum Node Utilities and Wallets Installed

- Full node utilities include:
  - geth - main Ethereum CLI client
  - abigen - abi generator to convert smart contract
  - bootnode - for peers to find the bootstrap node
  - disasm - disassmbler to convert EVM bytecode to readable assembly code
  - evm - evm environment for running EVM byecode
  - gethrpctest - developer tools for rpc-test
  - rlpdum - developer tool to conver rlp dump
  - swarm - swarm daemon and tool
- Popular Wallets
  - Ethereum Wallet, Mist, Parity (Here we will use Ethereum Wallet for demo)
- Download and Install, make sure all the utils are include in the $PATH

Create dev folder & start Ethereum node in dev mode On #1 Windows

C:\eth_dev\dev01>**geth --datadir data_d1 --dev**




```
C:\eth_dev\dev01>geth --datadir data_d1 --dev
WARN [05-11|15:43:20] No etherbase set and no accounts found as default
INFO [05-11|15:43:20] Starting peer-to-peer node               instance=Geth/v1.6.1-stable-021c3c28/windows-amd64/go1.8.1
INFO [05-11|15:43:20] Allocated cache and file handles         database=C:\\eth_dev\\dev01\\data_d1\\geth\\chaindata cache=128 handle
s=1024
INFO [05-11|15:43:20] Writing custom genesis block
INFO [05-11|15:43:20] Initialised chain configuration          config="{ChainID: 1337 Homestead: 0 DAO: <nil> DAOSupport: false EIP15
0: 0 EIP155: 0 EIP158: 0 Engine: ethash}"
WARN [05-11|15:43:20] Ethash used in test mode
WARN [05-11|15:43:20] Upgrading db log bloom bins
INFO [05-11|15:43:20] Bloom-bin upgrade completed              elapsed=3.007ms
INFO [05-11|15:43:20] Initialising Ethereum protocol           versions="[63 62]" network=1
INFO [05-11|15:43:20] Loaded most recent local header          number=0 hash=e5be92…38f3bc td=131072
INFO [05-11|15:43:20] Loaded most recent local full block      number=0 hash=e5be92…38f3bc td=131072
INFO [05-11|15:43:20] Loaded most recent local fast block      number=0 hash=e5be92…38f3bc td=131072
INFO [05-11|15:43:20] Starting P2P networking
INFO [05-11|15:43:20] started whisper v.5.0
INFO [05-11|15:43:20] RLPx listener up                         self="enode://059ea7908cb964378aab90f7fd32f224742b1d4897ee0324253ebe70
c66cc3b4b9d669b2c72b532ed436e95713e96baa0d591facc956b3ea656e4b0dd3be2e97@[::]:58048?discport=0"
INFO [05-11|15:43:20] IPC endpoint opened: \\.\pipe\geth.ipc
```

Open #2 window attach to the up & running Ethereum node.

C:\Program Files\Geth>geth attach ipc:\\.\pipe\geth.ipc

#2 Windows

```
C:\Program Files\Geth>geth attach ipc:\\.\pipe\geth.ipc
Welcome to the Geth JavaScript console!

instance: Geth/v1.6.1-stable-021c3c28/windows-amd64/go1.8.1
 modules: admin:1.0 debug:1.0 eth:1.0 miner:1.0 net:1.0 personal:1.0 rpc:1.0 shh:1.0 txpool:1.0 web3:1.0

> eth.accounts
[]
> personal.newAccount("Good4Testing")
"0x4d6736d479e3facfde81fef388c2d3ce3faeb586"
> eth.getBalance(eth.accounts[0])
0
> miner.start()
```

When account created, the #1 windows which started the

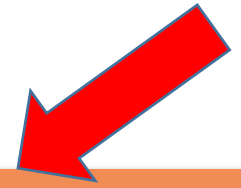
#1 Windows

```
INFO [05-11|15:47:19] New wallet appeared                    url=keystore://C:\\eth_dev\\dev01\\dat…
status=Locked
```

Open #3 window to launch the Ethereum wallet .

C:\Program Files\Ethereum-Wallet>"Ethereum Wallet.exe" ipc:\\.\pipe\geth.ipc
- Or simply click “Ethereum Wallet” icon from your desktop
- For windows platform, Wallet will automatically find the proper geth.ipc unless specified

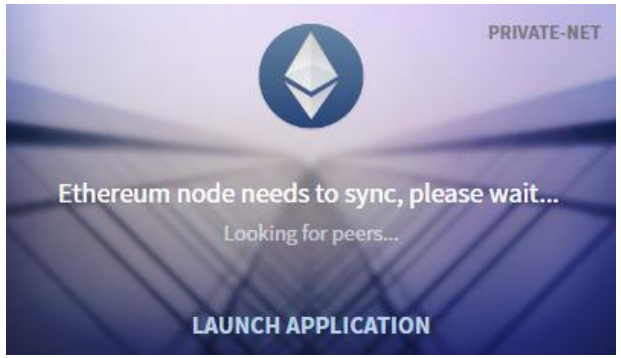
#3 Windows

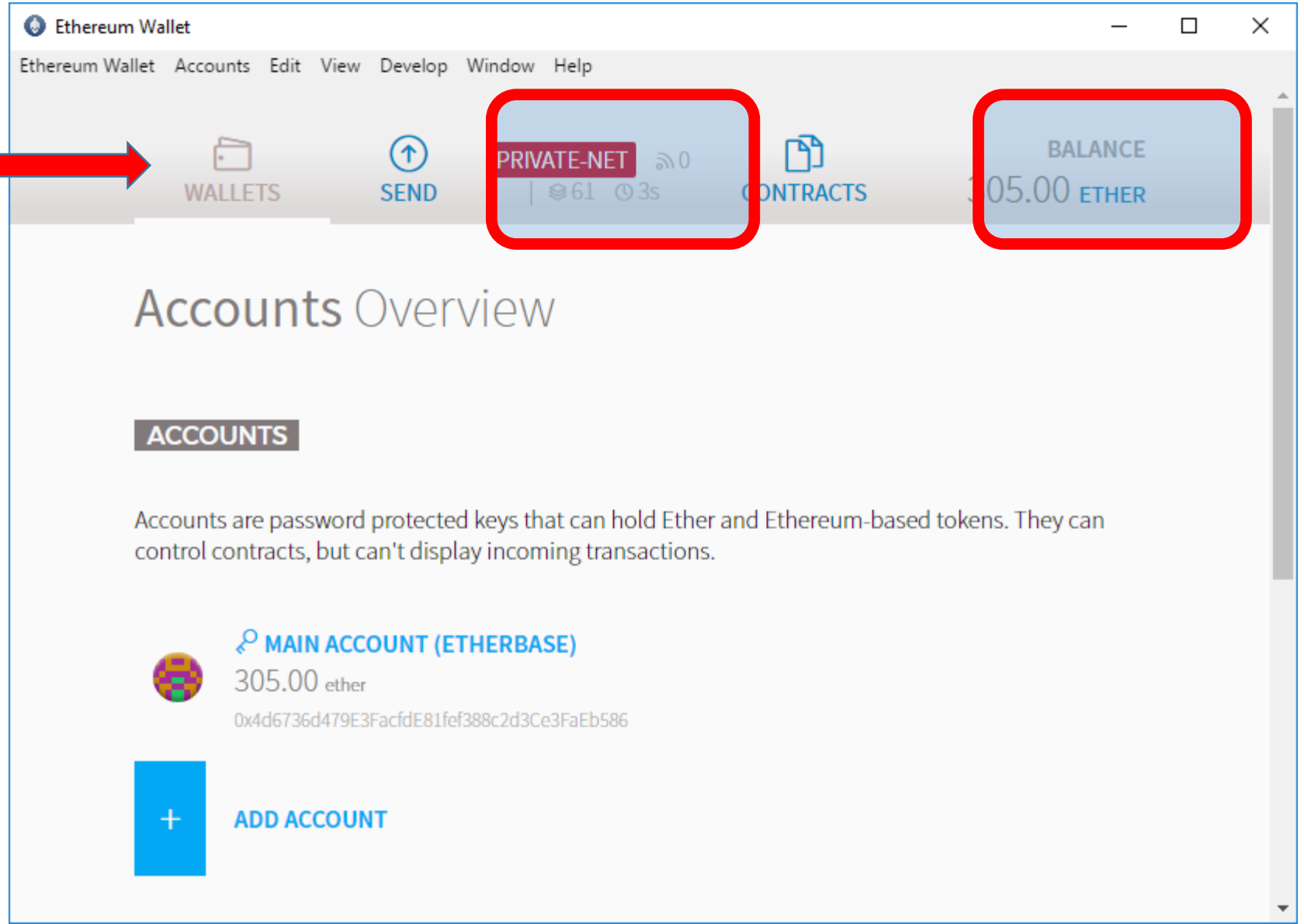


```
C:\Program Files\Ethereum-Wallet>"Ethereum Wallet.exe" ipc:\\.\pipe\geth.ipc
C:\Program Files\Ethereum-Wallet>
[2017-05-11 15:59:11.199] [INFO] main - Running in production mode: true
Secp256k1 bindings are not compiled. Pure JS implementation will be used.
[2017-05-11 15:59:11.744] [INFO] main - Starting in Wallet mode
[2017-05-11 15:59:14.163] [INFO] Db - Loading db: C:\Users\Dou\AppData\Roaming\Ethereum Wallet\mist.lokidb
[2017-05-11 15:59:14.192] [INFO] Windows - Creating commonly-used windows
[2017-05-11 15:59:14.194] [INFO] Windows - Create secondary window: loading, owner: notset
[2017-05-11 15:59:14.372] [INFO] updateChecker - Check for update...
…
[2017-05-11 15:59:54.929] [INFO] Sockets/node-ipc - Connect to {"path":"\\\\.\\pipe\\geth.ipc"}
[2017-05-11 15:59:54.962] [INFO] Sockets/3 - Connected!
[2017-05-11 15:59:54.996] [INFO] (ui: splashscreen) - Network is privatenet
[2017-05-11 15:59:57.133] [INFO] NodeSync - No more sync necessary
[2017-05-11 15:59:57.134] [INFO] main - Loading Interface at file://C:\Program Files\Ethereum-Wallet\resources\app.asar/interface/wallet/index.html
[2017-05-11 15:59:57.143] [INFO] NodeSync - Sync loop ended
[2017-05-11 16:00:01.275] [INFO] Sockets/2 - Connect to {"path":"\\\\.\\pipe\\geth.ipc"}
[2017-05-11 16:00:01.278] [INFO] Sockets/2 - Connected!
[2017-05-11 16:00:01.294] [INFO] Sockets/2 - Disconnecting...
[2017-05-11 16:00:03.812] [INFO] Sockets/2 - Connect to {"path":"\\\\.\\pipe\\geth.ipc"}
[2017-05-11 16:00:05.204] [INFO] Sockets/2 - Connected!
[2017-05-11 16:00:07.450] [INFO] (ui: browser) - Connect to node...
```

Ethereum Wallet is UP

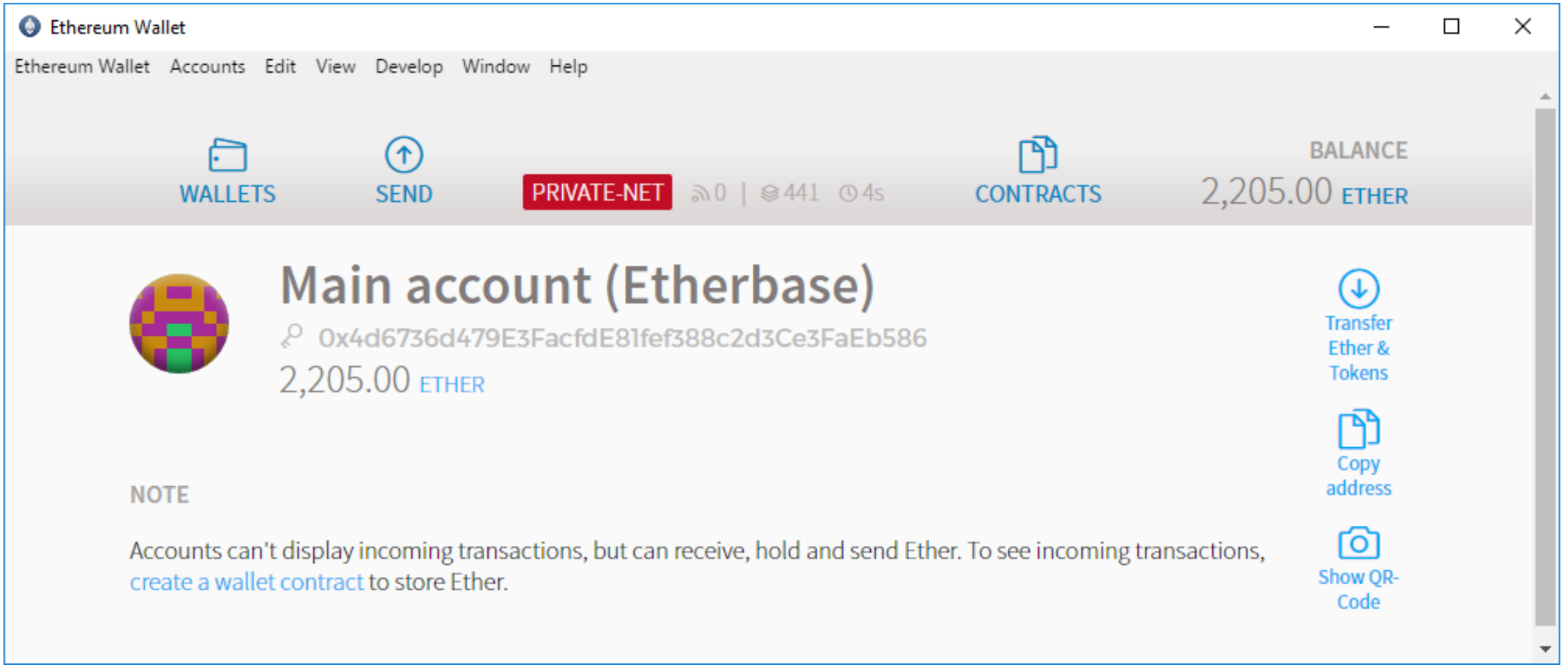
- It’s a private DEV net, and the miner makes the ether keep growing as shown





Ethereum Wallet is UP

- It’s a private DEV net, and the miner makes the ether keep growing as shown
- Main Account is the account with a long string as address

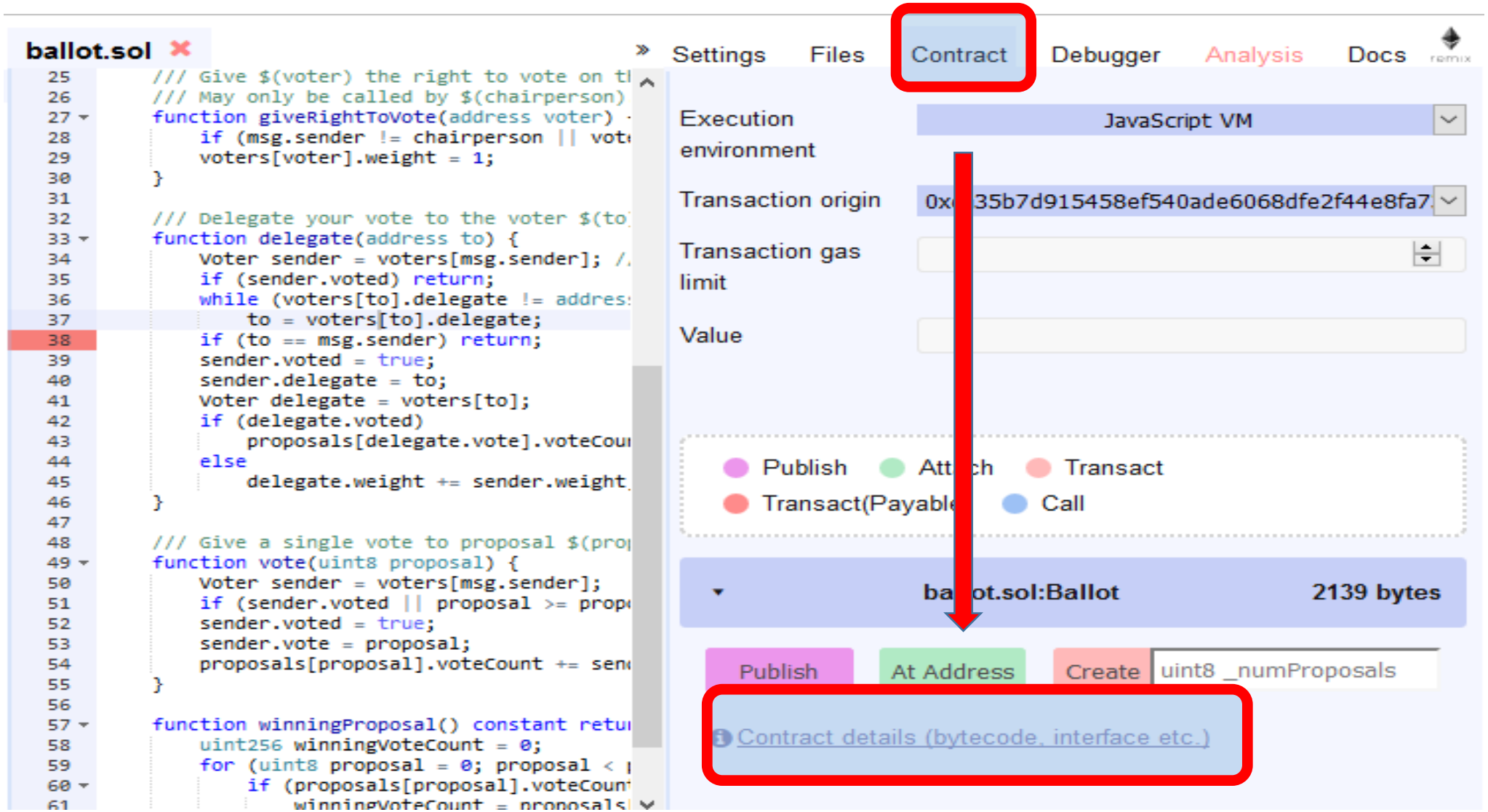


#1 window shows the detail mining status


```
INFO [05-11|15:58:58] Generating DAG in progress          epoch=1 percenta=39 elapsed=11.724s
INFO [05-11|15:59:00] Generating DAG in progress          epoch=1 percentage=45 elapsed=12.983s
INFO [05-11|15:59:00] Generating DAG in progress          epoch=1 percentage=51 elapsed=13.080s
INFO [05-11|15:59:00] Successfully sealed new block       number=5 hash=752a0f…9b1977
INFO [05-11|15:59:00] Generating DAG in progress          epoch=1 percentage=52 elapsed=13.771s
INFO [05-11|15:59:00] Generating DAG in progress          epoch=1 percentage=53 elapsed=13.779s
INFO [05-11|15:59:00] Generating DAG in progress          epoch=1 percentage=54 elapsed=13.785s
INFO [05-11|15:59:00] Generating DAG in progress          epoch=1 percentage=55 elapsed=13.794s
INFO [05-11|15:59:00] 🔨 mined potential block            number=5 hash=752a0f…9b1977
INFO [05-11|15:59:00] Commit new mining work              number=6 txs=0 uncles=0 elapsed=1.001ms
INFO [05-11|15:59:01] 🔗 block reached canonical chain    number=1 hash=49f561…177682
INFO [05-11|15:59:01] Commit new mining work              number=7 txs=0 uncles=0 elapsed=0s
INFO [05-11|15:59:01] Generating DAG in progress          epoch=1 percentage=64 elapsed=14.284s
INFO [05-11|15:59:01] Generating DAG in progress          epoch=1 percentage=65 elapsed=14.291s
INFO [05-11|15:59:01] Generating DAG in progress          epoch=1 percentage=69 elapsed=14.334s
INFO [05-11|15:59:01] Generating DAG in progress          epoch=1 percentage=70 elapsed=14.345s
INFO [05-11|15:59:01] Generating DAG in progress          epoch=1 perce
```

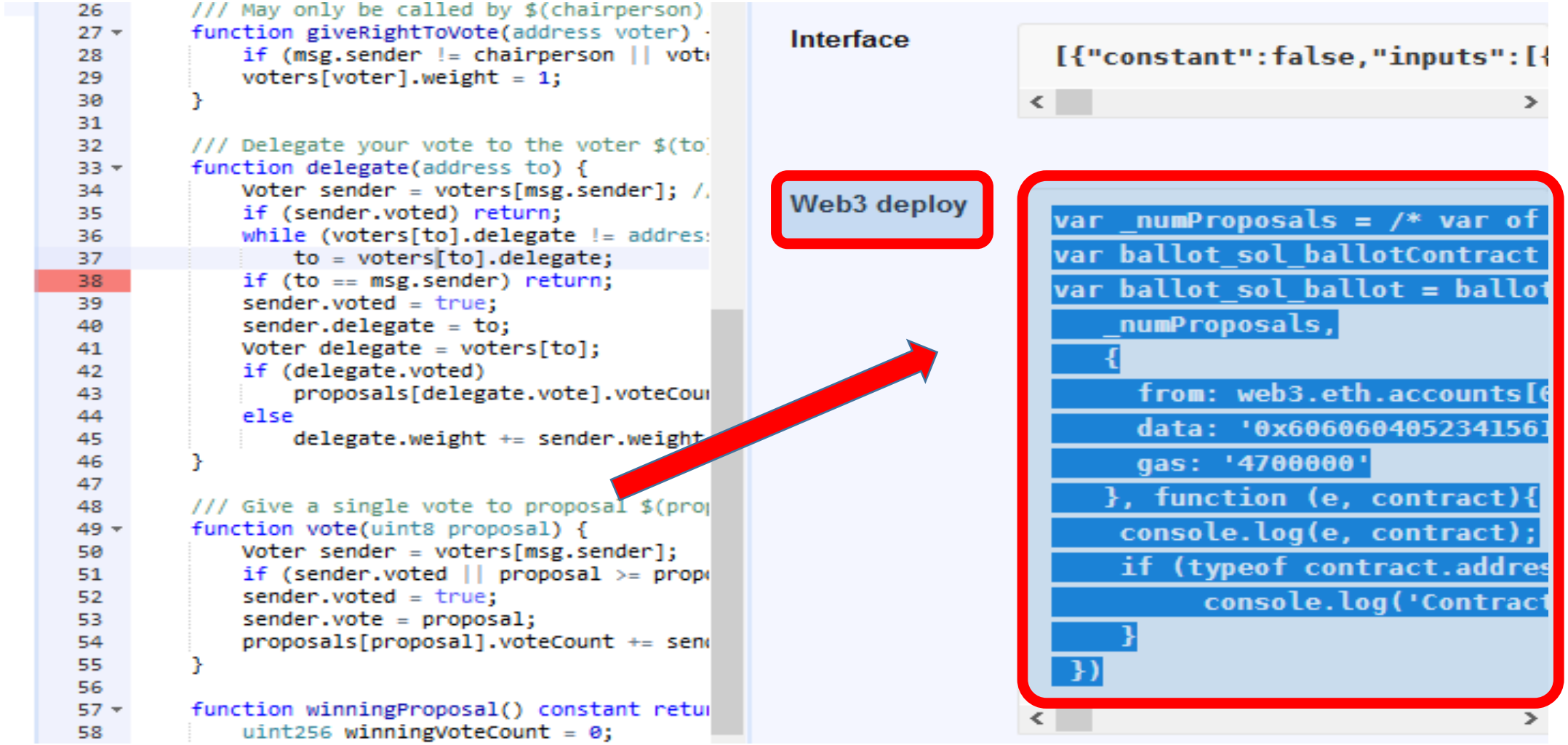
remix.Ethereum.org – Smart Contract Online Compiler/Browser Editor

1. Goto remix.Ethereum.org and a sample smart contract is listed
2. Click "Contract" Tab → "Contract details (bytecode, interface etc.) " link on the web page as shown



remix.Ethereum.org – Smart Contract Online Compiler/Browser Editor

- Goto Web3 deploy, select the contract code and copy onto the clipboard (Ctl+C on Windows)
- Then go back to #2 windows which has geth command line web3 interface.



remix.Ethereum.org – Smart Contract Online Compiler/Browser Editor

- The contract code for web3 deploy looks like below
- Provide the number of 8 as shown and Ctrl + C to copy to clipboard again

```
var _numProposals = 8 /* var of type uint8 here */ ;
var ballot_sol_ballotContract
web3.eth.contract([{"constant":false,"inputs":[{"name":"to","type":"address"}],"name":"delegate","outputs":[],"payable":false,"type":"function"},{"constant":true,"inputs":
[],"name":"winningProposal","outputs":[{"name":"winningProposal","type":"uint8"}],"payable":false,"type":"function"},{"constant":false,"inputs":[{"name":"voter","type":"
address"}],"name":"giveRightToVote","outputs":[],"payable":false,"type":"function"},{"constant":false,"inputs":[{"name":"proposal","type":"uint8"}],"name":"vote","output
s":[],"payable":false,"type":"function"},{"inputs":[{"name":"_numProposals","type":"uint8"}],"payable":false,"type":"constructor"}]);
var ballot_sol_ballot = ballot_sol_ballotContract.new(
  _numProposals,
  {
   from: web3.eth.accounts[0],
   data: '0x606060405341561000c57fe5b6040516020806108b83398101604052808051906020019091905050505b336
..
5156106bb57fe5b906000526020600020900160005b5060000160008282540192505081905550505b50505600a165627a7a72305820a7b4a27338b0d7e0632269bd6c19e0f7
64f685718ffac81e3d2cf54775a4a3590029',
    gas: '4700000'
  }, function (e, contract){
   console.log(e, contract);
   if (typeof contract.address !== 'undefined') {
       console.log('Contract mined! address: ' + contract.address + ' transactionHash: ' + contract.transactionHash);
   }
 })
```

Smart Contract geth command line approach

- Window #1 - C:\eth_dev\dev01> **geth --datadir data_d1 –dev –unlocked 0**
- Window #2 - C:\Program Files\Geth> **geth attach ipc:\\.\pipe\geth.ipc**

```
C:\Program Files\Geth>geth attach ipc:\\.\pipe\geth.ipc
Welcome to the Geth JavaScript console!
instance: Geth/v1.6.1-stable-021c3c28/windows-amd64/go1.8.1
coinbase: 0x4d6736d479e3facfde81fef388c2d3ce3faeb586
at block: 2417 (Thu, 11 May 2017 18:04:02 CST)
 datadir: C:\eth_dev\dev01\data_d1
 modules: admin:1.0 debug:1.0 eth:1.0 miner:1.0 net:1.0 personal:1.0 rpc

> miner.start()
null
> personal.unlockAccount(eth.accounts[0])

Unlock account 0x4d6736d479e3facfde81fef388c2d3ce3f[illegible]b586
Passphrase:
true
> var _numProposals = 8 /* var of type uint8 here */ ;
Undefined
> var ballot_sol_ballotContract =
web3.eth.contract([{"constant":false,"inputs":[{"name":"to","type":"address"}],"name":
"delegate","outputs":[],"payable":false,"type":"function"},{"constant":true,"inputs":[],"name":"winningProposal",..
```

Paste the copied web3 deploy contract code from clipboard directly into the geth web3 interface

Smart Contract geth command line approach

- Paste the web3 contract conde into the geth command line screen as shown.

```
C:\Program Files\Geth>geth attach ipc:\\.\pipe\geth.ipc
Welcome to the Geth JavaScript console!

instance: Geth/v1.6.1-stable-021c3c28/windows-amd64/go1.8.1
coinbase: 0x4d6736d479e3facfde81fef388c2d3ce3faeb586
at block: 2417 (Thu, 11 May 2017 18:04:02 CST)
 datadir: C:\eth_dev\dev01\data_d1
 modules: admin:1.0 debug:1.0 eth:1.0 miner:1.0 net:1.0 personal:1.0 rpc:1.0 sh

> miner.start()
null
> personal.unlockAccount(eth.accounts[0])




Unlock account 0x4d6736d479e3facfde81fef388c2d3ce3faeb586
Passphrase:
true
> var _numProposals = 8 /* var of type uint8 here */ ;
undefined
> var ballot_sol_ballotContract = web3.eth.contract([{"constant":false,"inputs"
"delegate","outputs":[],"payable":false,"type":"function"},{"constant":true,"in
s":[{"name":"winningProposal","type":"uint8"}],"payable":false,"type":"functio
oter","type":"address"}],"name":"giveRightToVote","outputs":[],"payable":false,
uts":[{"name":"proposal","type":"uint8"}],"name":"vote","outputs":[],"payable"
e":"_numProposals","type":"uint8"}],"payable":false,"type":"constructor"}]);
undefined
> var ballot_sol_ballot = ballot_sol_ballotContract.new(
```

Smart Contract geth command line approach

- Contract address: 0x4f64e010d7987693098d4757393f9ef9391c68b8

```
ffffffffffffffffffffffffffffffffffffffff16141580610 5a2575060016000 8273ffffffff
ffffffffffffffffffffffffffffffffffffffff168152602001908152602001600020600101600090549
00160016000 8373ffffffffffffffffffffffffffffffffffffffff1673ffffffffffffffffffff
00160002060000 1819055505b50565b600060016000 3373ffffffffffffffffffffffffffffffffffff
fffffffffff168152602001908152602001600020905080600101600090549061010 00a900460f
561066a576106db565b600181600101600061010 00a81548160ff021916908315150217905550 8
0ff160217905550806000015460028360ff16815481101515610 6bb57fe5b9060005260206000 2
5505b50505600a165627a7a72305820a7b4a27338b0d7e0632269bd6c19e0f764f685718ffac81
......       gas: '4700000'
......     }, function (e, contract){
......      console.log(e, contract);
......      if (typeof contract.address !== 'undefined') {
.........           console.log('Contract mined! address: ' + contract.address
ionHash);
.........      }
......   })
null [object Object]
undefined
>  null [object Object]
Contract mined! address: 0x4f64e010d7987693098d4757393f9ef9391c68b8 transactio
c4c7d5fc71b627180d81960edc7fd11
```

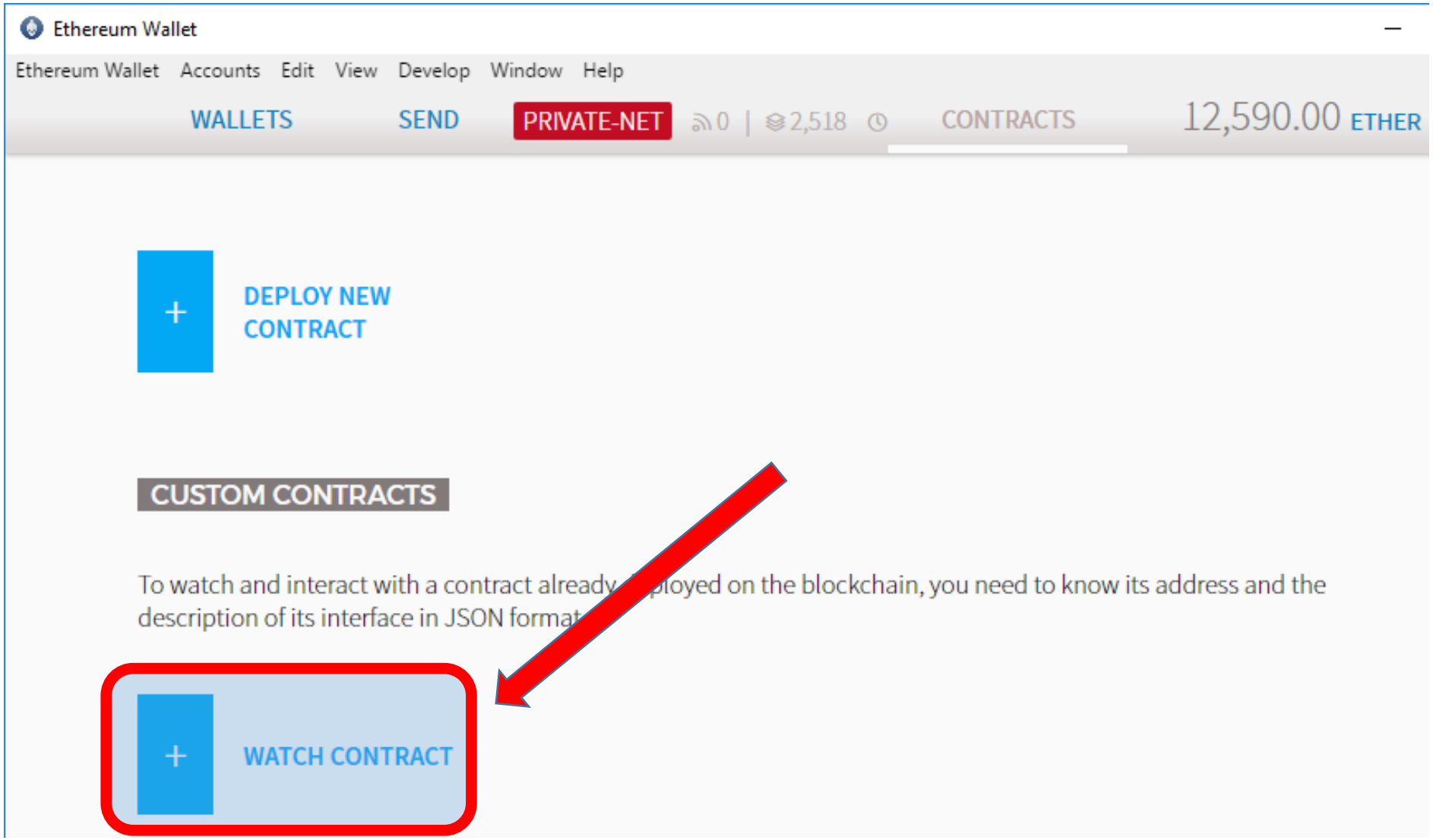
Smart Contract geth command line approach

- Smart contract transaction Hash:
  0xd77b6215e88ce1b4d85030d7500f06dc1c4c7d5fc71b627180d81960edc7fd11

```
27] Successfully sealed new block                  number=2507 hash=533dfc…fffa3e
27] □□ block reached canonical chain               number=2502 hash=4341e6…cb867a
27] □□ mined potential block                       number=2507 hash=533dfc…fffa3e
27] Commit new mining work                         number=2508 txs=0 uncles=0 elapsed=1.003ms
30] Submitted contract creation                    fullhash=0xd77b6215e88ce1b4d85030d7500f06dc1
f64e010d7987693098d4757393f9ef9391c68b8
37] Successfully sealed new block                  number=2508 hash=ee89ba…9e557f
37] □□ block reached canonical chain               number=2503 hash=c43ec6…543538
37] Commit new mining work                         number=2509 txs=1 uncles=0 elapsed=1.999ms
37] □□ mined potential block                       number=2508 hash=ee89ba…9e557f
40] Successfully sealed new block                  number=2509 hash=0e90a9…b9be9f
40] □□ block reached canonical chain               number=2504 hash=eb8a99…379639
40] □□ mined potential block                       number=2509 hash=0e90a9…b9be9f
40] Commit new mining work                         number=2510 txs=0 uncles=0 elapsed=0s
40] Successfully sealed new block                  number=2510 hash=e164fb…16635b
40] □□ block reached canonical chain               number=2505 hash=38653e…eeba7c
40] □□ mined potential block                       number=2510 hash=e164fb…16635b
40] Commit new mining work                         number=2511 txs=0 uncles=0 elapsed=0s
42] Successfully sealed new block                  number=2511 hash=ec076e…916782
42] □□ block reached canonical chain               number=2506 hash=0a92d8…8b85f3
42] □□ mined potential block                       number=2511 hash=ec076e…916782
42] Commit new mining work                         number=2512 txs=0 uncles=0 elapsed=0s
```

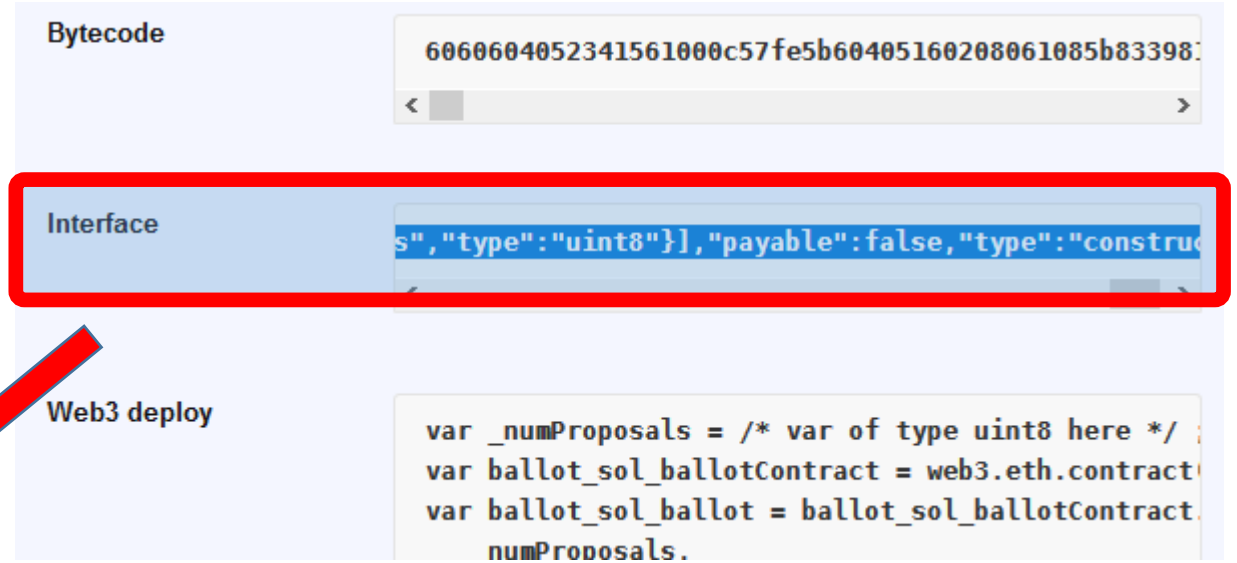
Smart Contract from Ethereum Wallet:

- From Wallet on Dev network, click “WATCH CONTRACT”



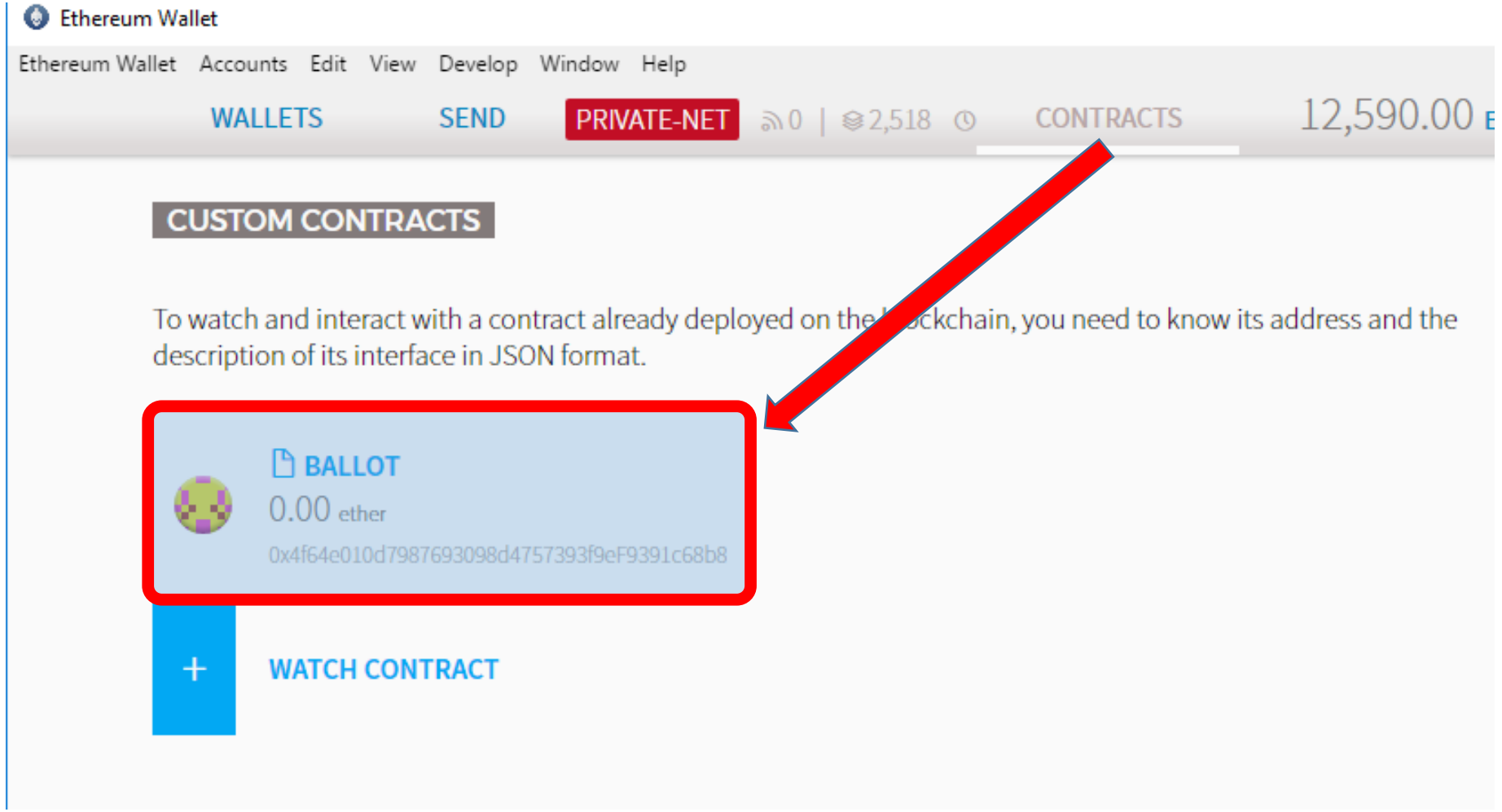
Smart Contract from Ethereum Wallet:

- Enter contract info, NAME, ADDRESS, INTERFACE as shown



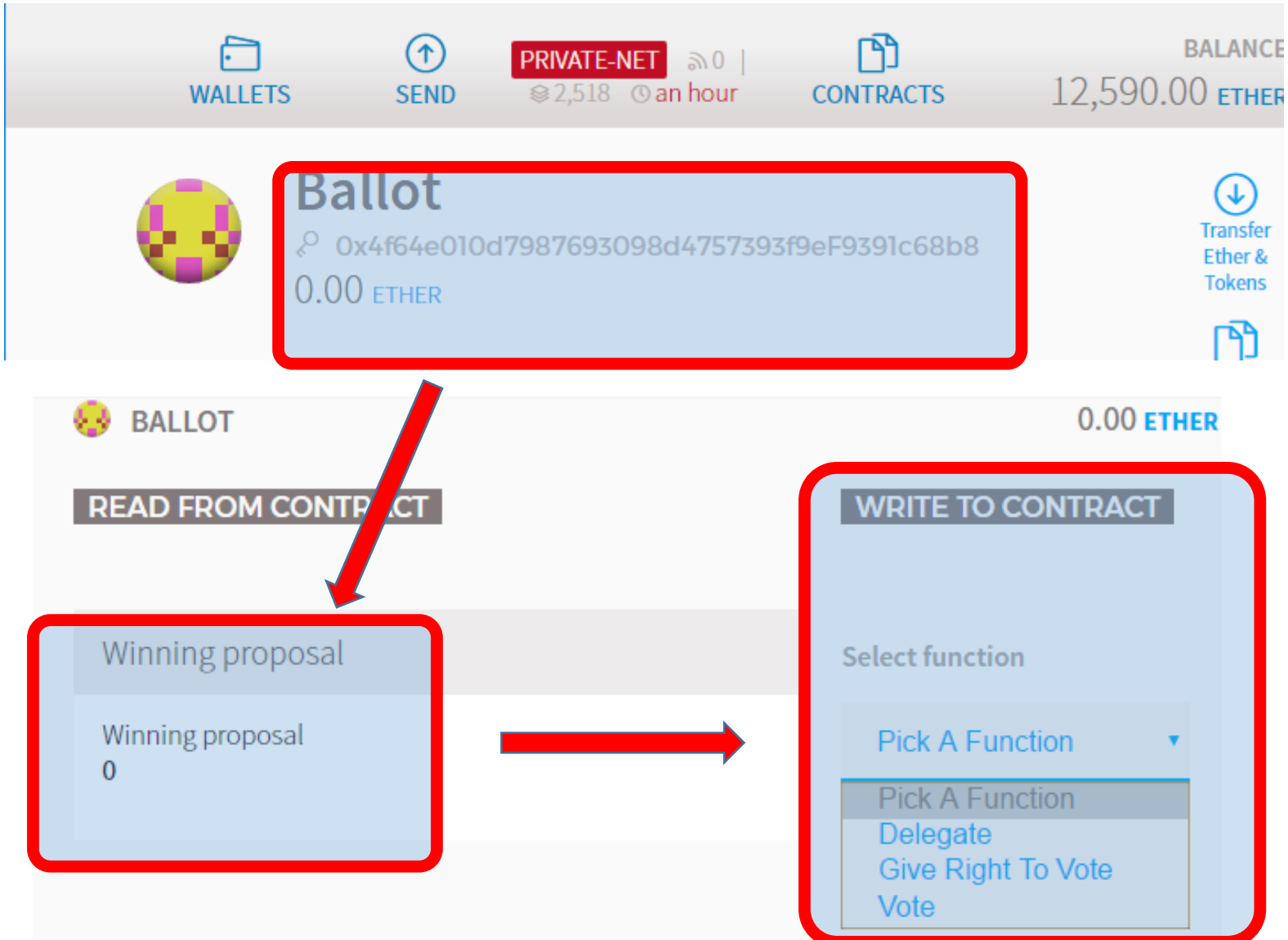
Smart Contract from Ethereum Wallet:

- Smart Contract BALLOT which has deployed with address as 0x4f64e010d7987693098d4757393f9ef9391c68b8
-



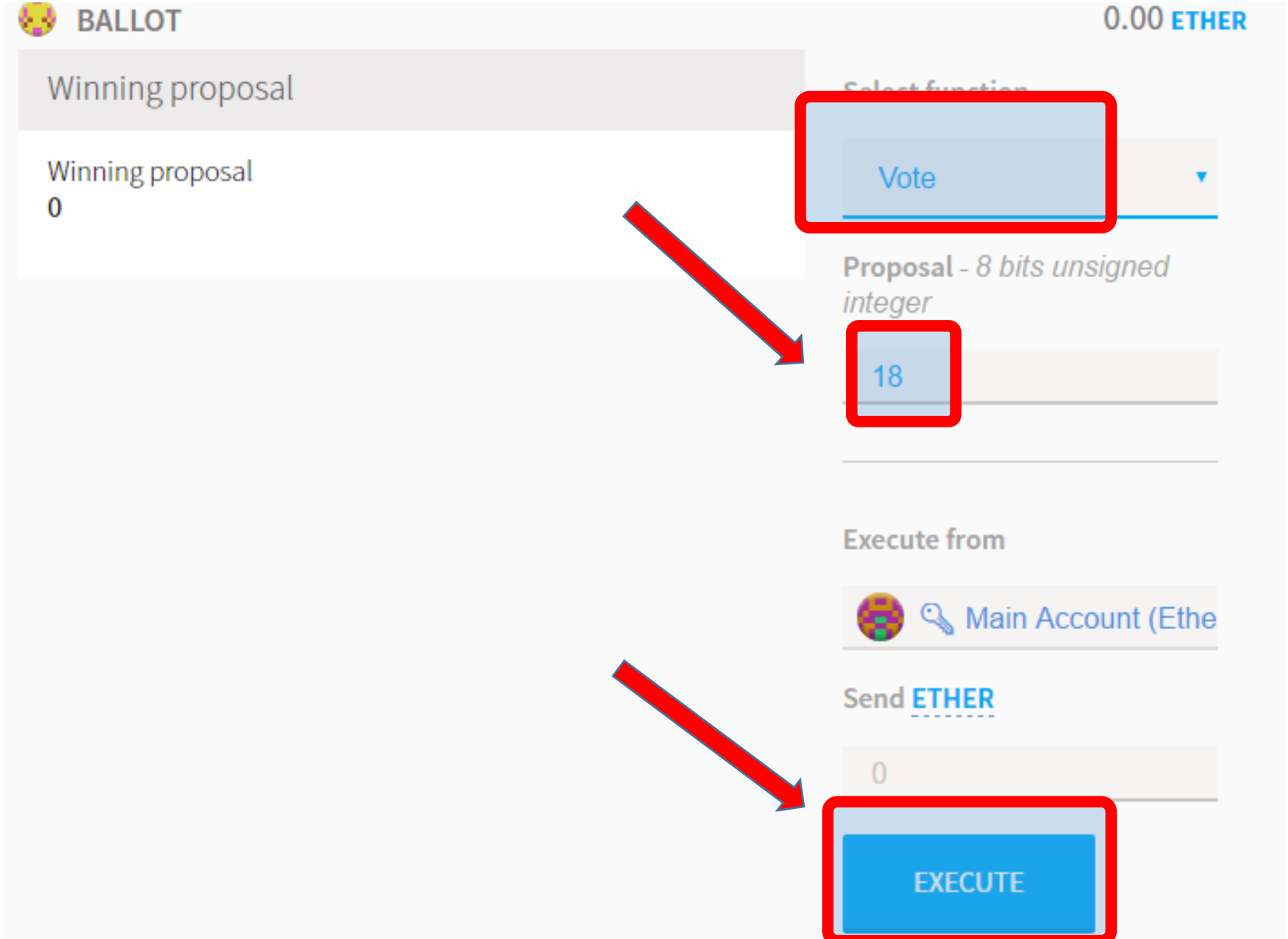
Smart Contract from Ethereum Wallet:

- Smart Contract BALLOT deployed with address as 0x4f64e010d7987693098d4757393f9ef9391c68b8



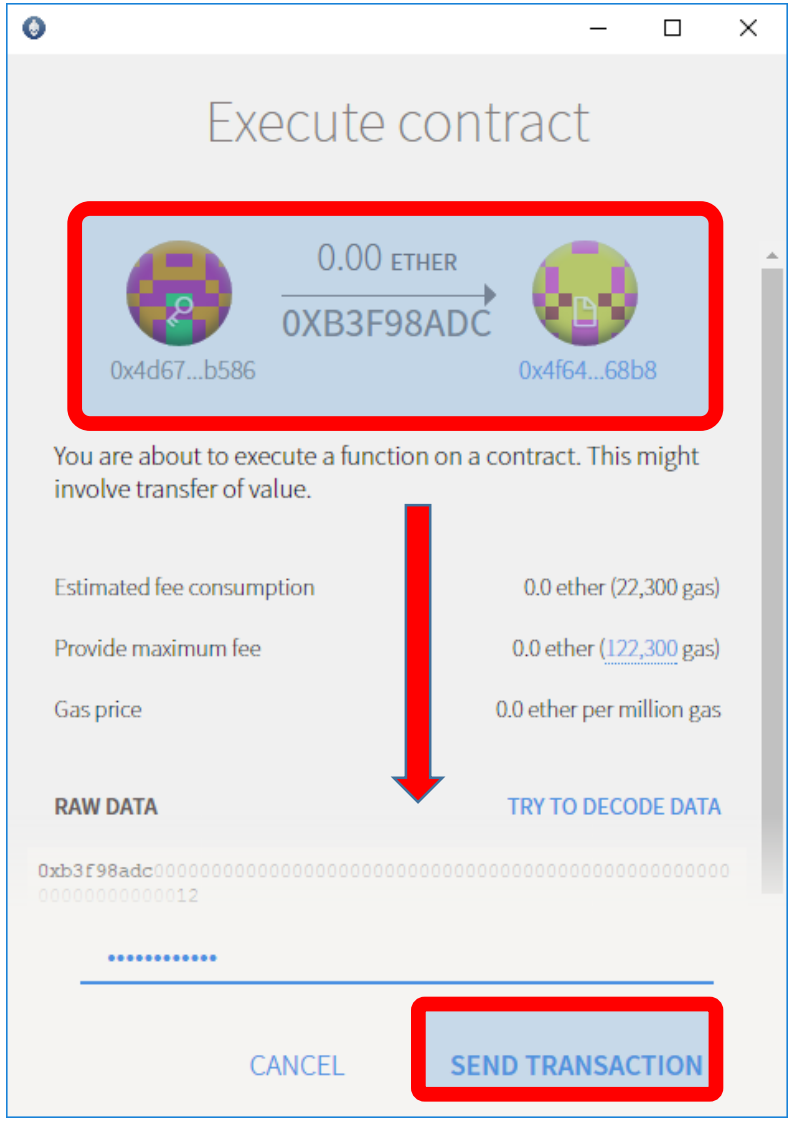
Smart Contract from Ethereum Wallet:

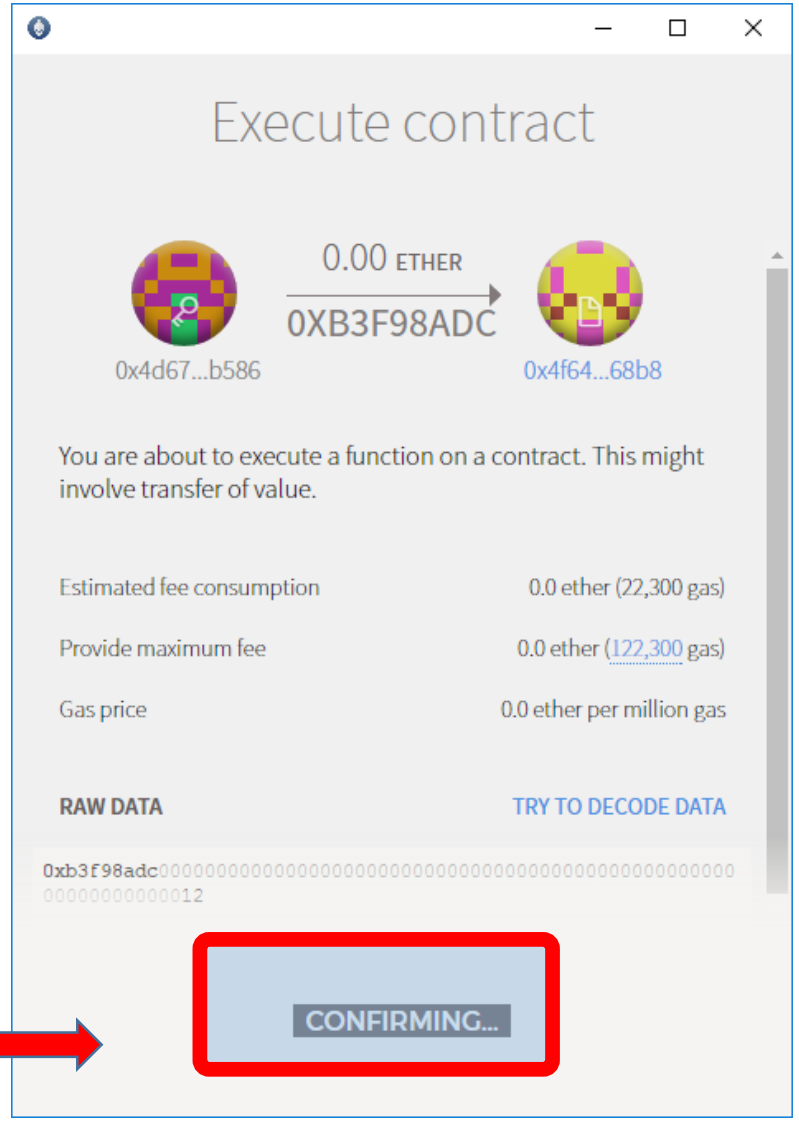
- Smart Contract BALLOT function, write to contract



Smart Contract from Ethereum Wallet:

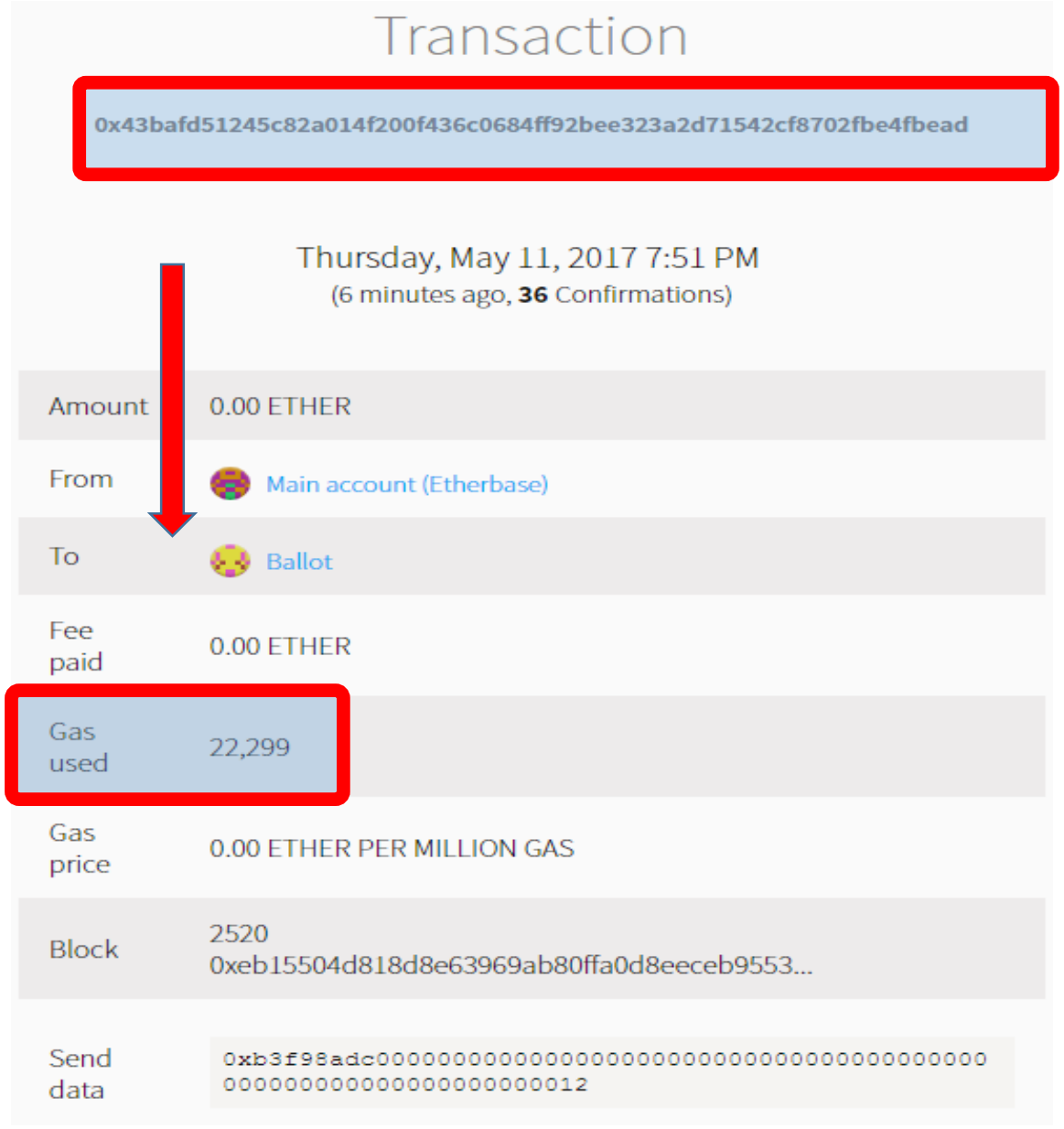
- So you can interact with the smart contract.





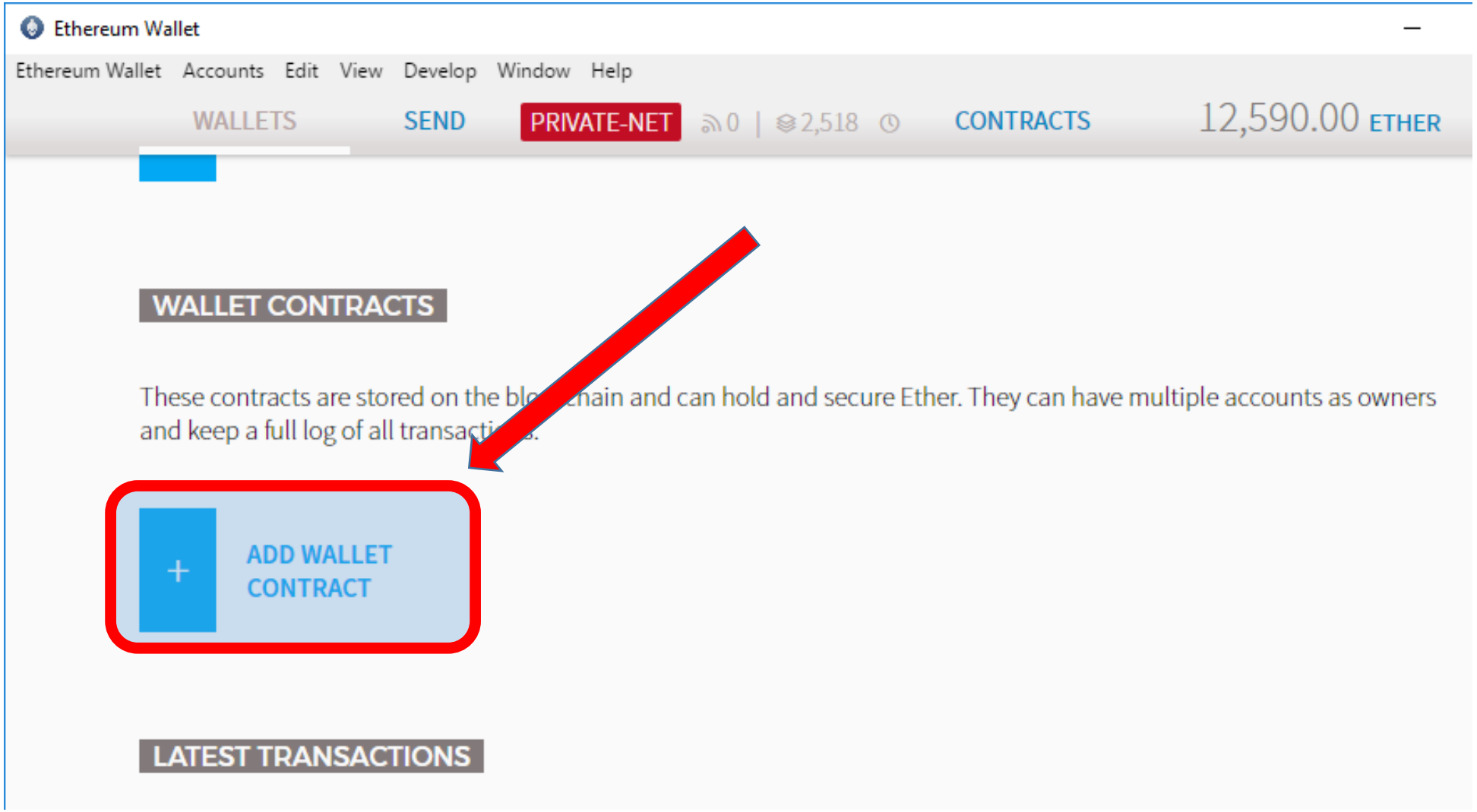
Smart Contract from Ethereum Wallet:

- So you can interact with the smart contract.



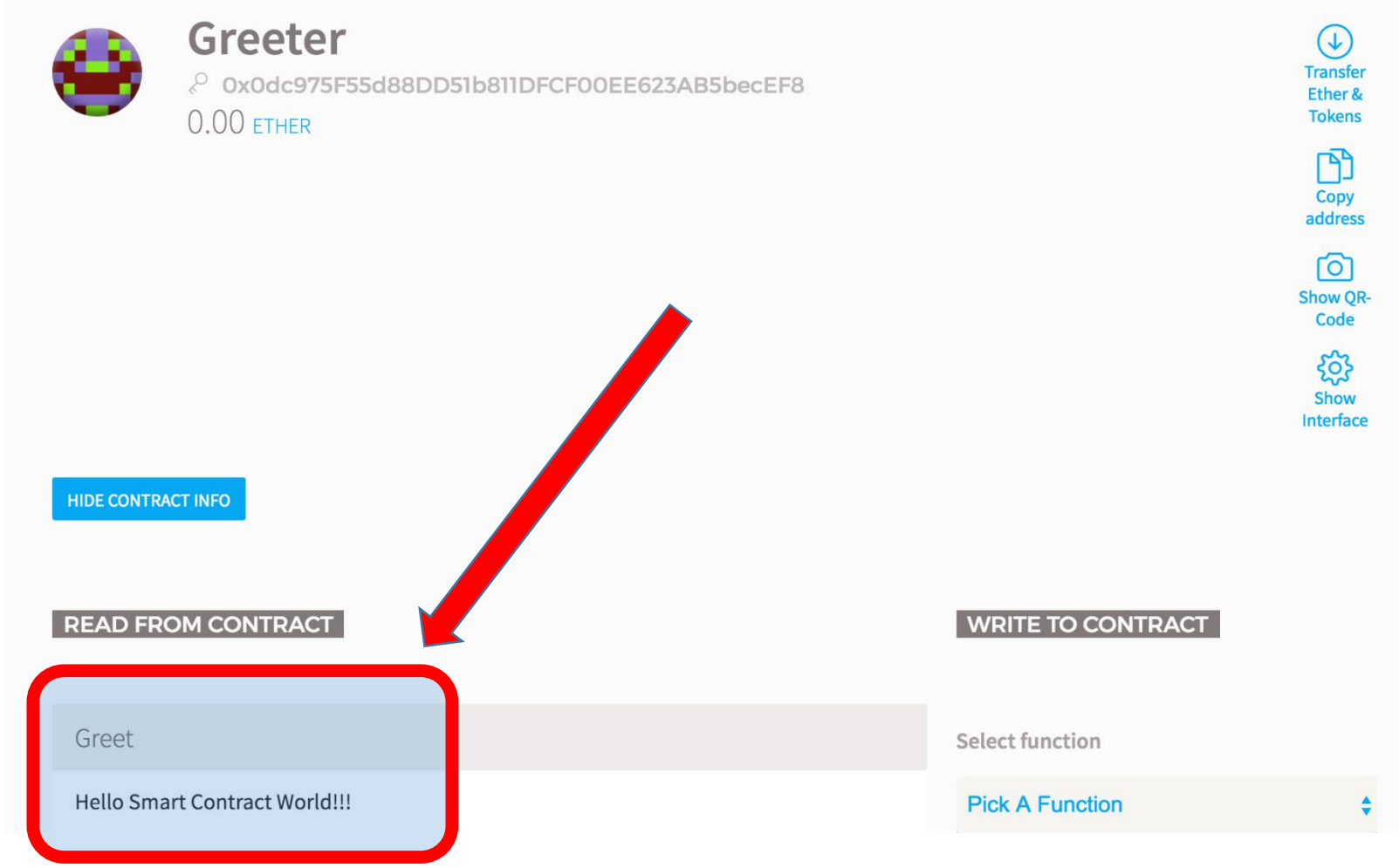
Smart Contract from Ethereum Wallet:

- From Wallet on Dev network, click “ADD WALLET CONTRACT”



Smart Contract from Ethereum Wallet:

- Another Sample Smart Contract
- Greeter run result Greeter.Greet() saying **“Hello Smart Contract World!!!”**



Smart Contract Development Info

- More information can be found:
  - https://www.ethereum.org/
  - https://www.ethereum.org/greeter
  - https://www.ethereum.org/token
  - https://remix.ethereum.org/
  - http://www.ethdocs.org/en/latest/
  - https://solidity.readthedocs.io/en/develop/
  - https://github.com/ethereum/go-ethereum
  - https://github.com/ethereum/go-ethereum/wiki/Private-network

  - http://ethfans.org/wikis/Home
  - http://wangxiaoming.com/blog/archives/ 汪晓明区块链
  - http://ethfans.org/wikis/%E6%99%BA%E8%83%BD%E5%90%88%E7%BA%A6
  - http://ethfans.org/wikis/Solidity-%E6%96%87%E6%A1%A3--%E7%AC%AC%E4%B8%80%E7%AB%A0

Thank You!

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