Ethereum Workshop

An Introduction to Tools, Solidity & Smart Contracts

Preparation

Follow the instructions on:
http://bit.ly/2um6cGA

Agenda

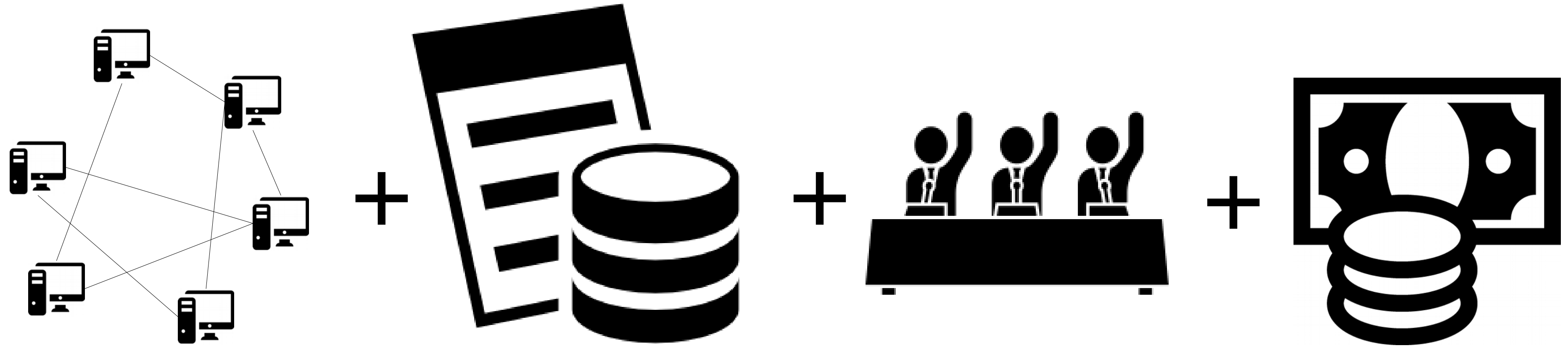
1) A brief introduction to Ethereum
2) Setting up a private blockchain
3) Interacting with the blockchain
4) Mist
5) Solidity & Smart Contracts
6) Remix IDE

Warning

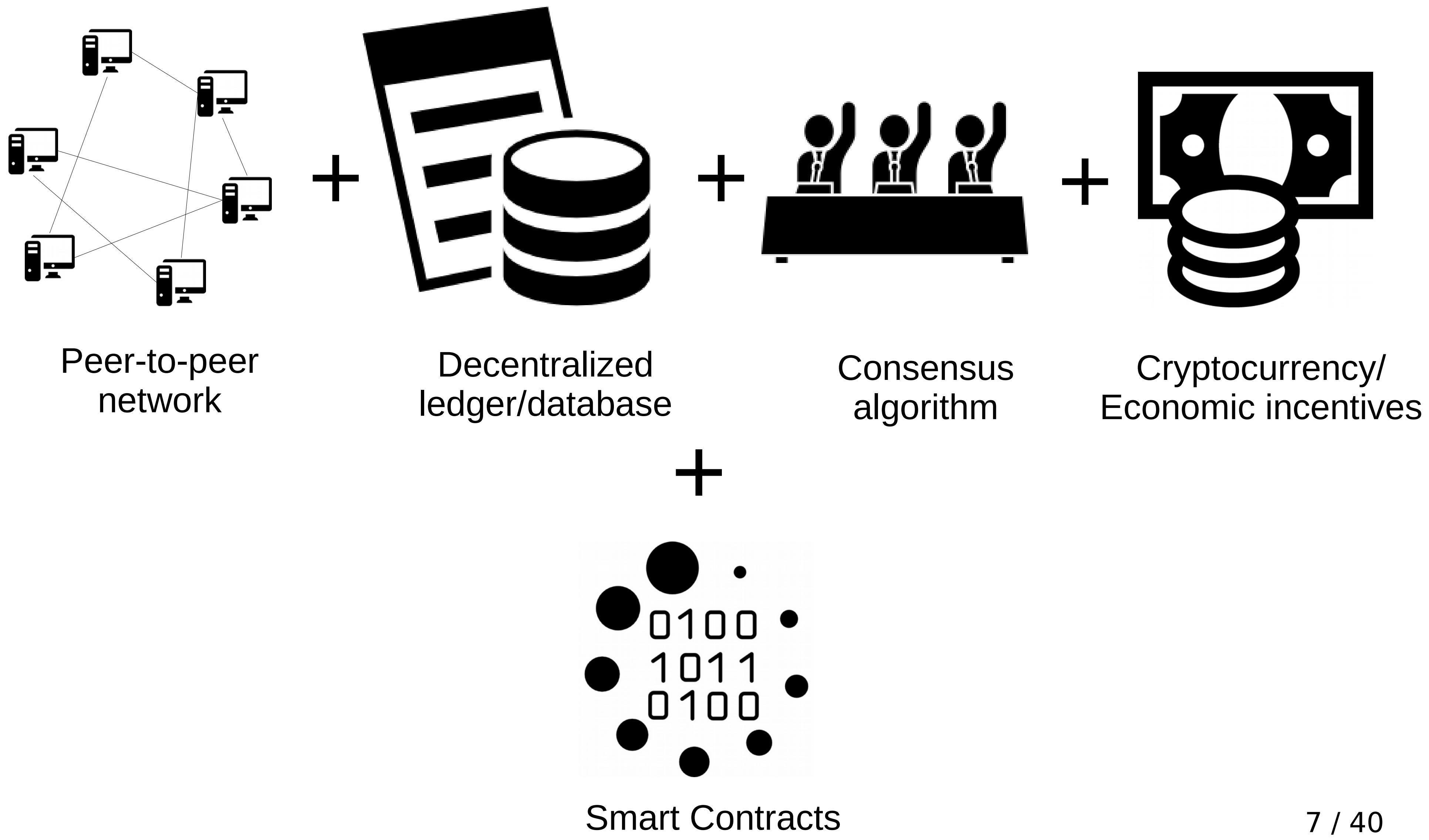
- Bleeding edge technology – Things might not work!
- Disable your Firewall or open port 30303 (UDP and TCP!)

1. A brief introduction to Ethereum

Blockchain Introduction


+
+
+
Peer-to-peer network
Decentralized ledger/database
Consensus algorithm
Cryptocurrency/ Economic incentives

Etherum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Cryptocurrency/ Economic incentives
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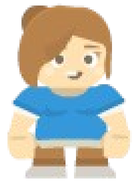
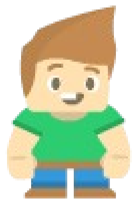
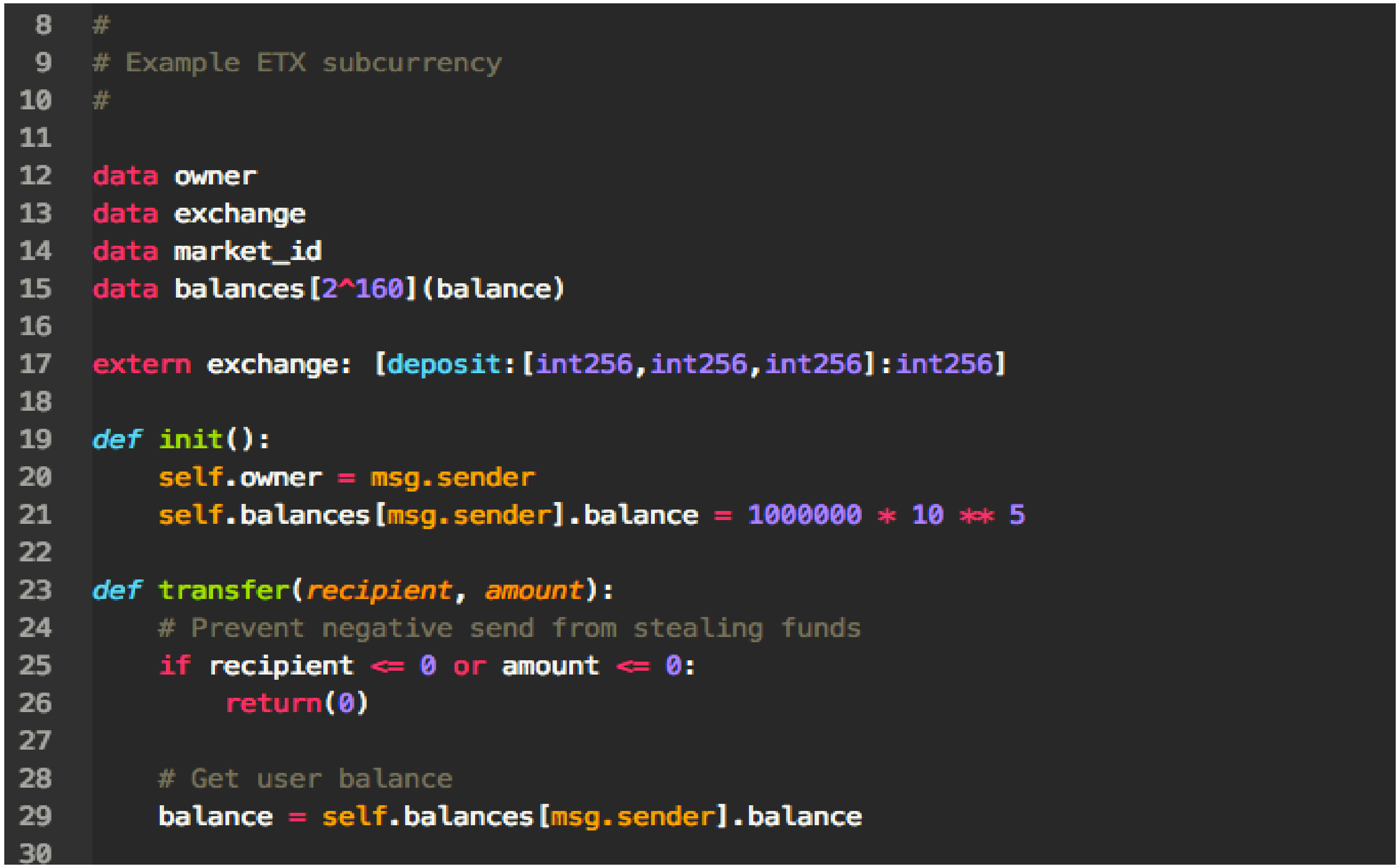
Smart Contracts

Why?

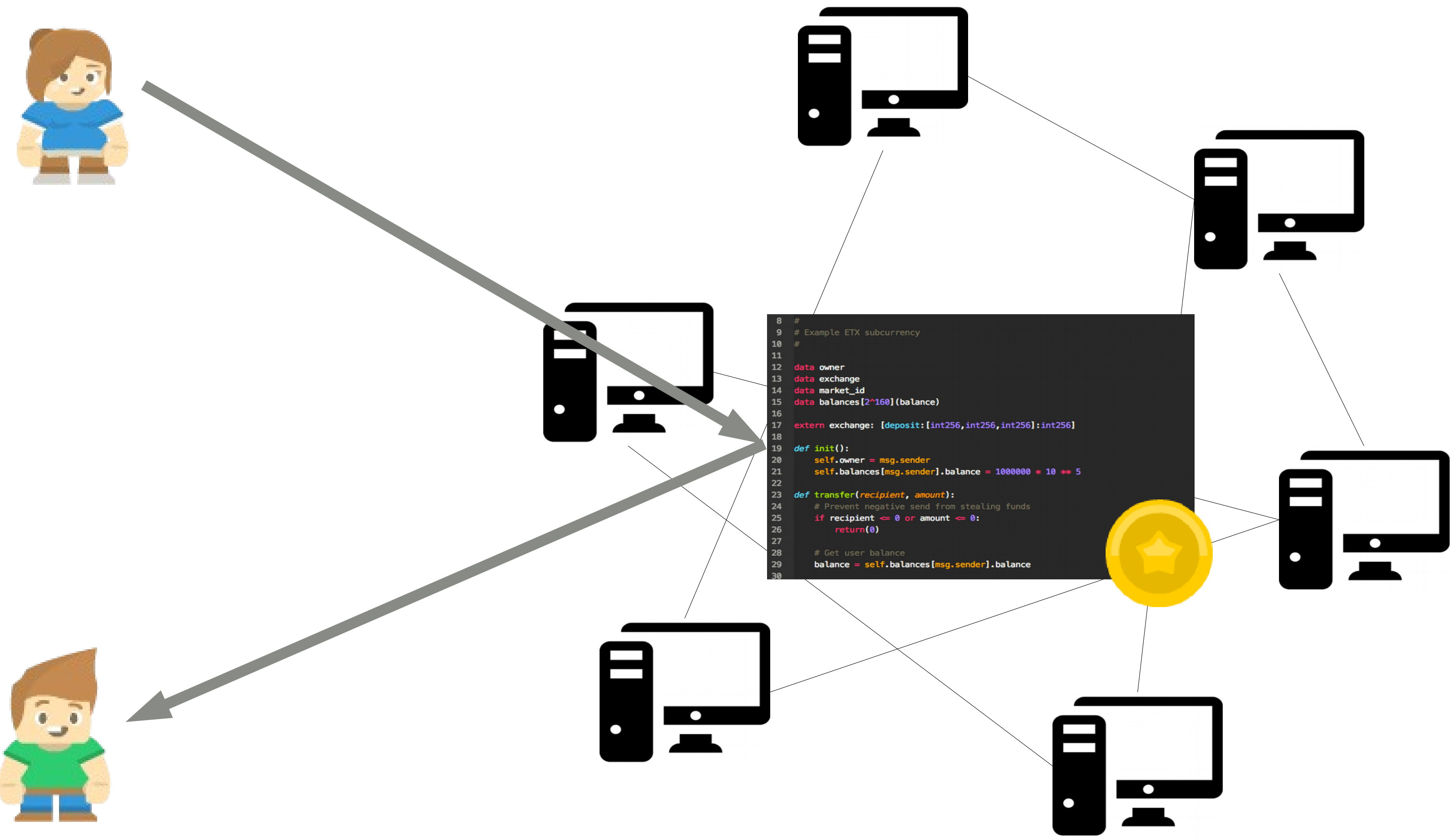






```
#
# Example ETX subcurrency
#

data owner
data exchange
data market_id
data balances[2^160](balance)

extern exchange: [deposit:[int256,int256,int256]:int256]

def init():
    self.owner = msg.sender
    self.balances[msg.sender].balance = 1000000 * 10 ** 5

def transfer(recipient, amount):
    # Prevent negative send from stealing funds
    if recipient <= 0 or amount <= 0:
        return(0)

    # Get user balance
    balance = self.balances[msg.sender].balance

```

Why?



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```

2. Setting up a private blockchain

Accounts

```
geth --datadir ~/.ethereum/workshop
account new
```

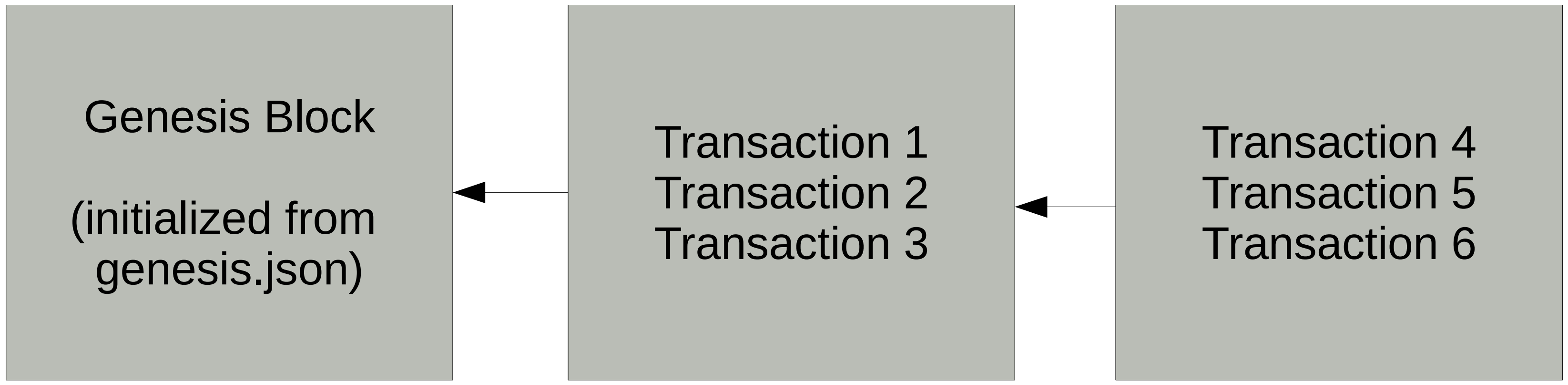
```
geth --datadir C:\Users\%HOMEPATH
%\workshop account new
```

geth – Go Ethereum client

--datadir <DIRECTORY> – Store all data here. Avoids conflicts with the public chain

account new – Create a new account

Blockchain Data Structure



https://ethereum.stackexchange.com/questions/2376/what-does-each-genesis-json-parameter-mean
https://ethereum.stackexchange.com/questions/15682/the-meaning-specification-of-config-in-genesis-json/15687#15687
https://ethereum.stackexchange.com/questions/5833/why-do-we-need-both-nonce-and-mixhash-values-in-a-block

Initialize the blockchain

```
geth --datadir ~/.ethereum/workshop
init genesis.json
```

```
geth --datadir C:\Users\%HOMEPATH
%\workshop init genesis.json
```

init <GENESIS FILE> – Initialize a new blockchain from a genesis file

Start a miner

```
> geth --datadir ~/.ethereum/workshop
--mine --networkid 1259
```

```
> geth --datadir C:\Users\%HOMEPATH
%\workshop --mine --networkid 1259
```

--mine – Make this blockchain node a miner

--networkid <NUMBER> – Unique identifier for this network

Start a console

- Start a new terminal/cmd window and run:

```
geth attach ipc:///
$HOME/.ethereum/workshop/geth.ipc
```

```
geth attach
```

attach <PATH> – Attach a console to a running geth instance using IPC

Plan B if it doesn‘t work

-
  ```
  geth --dev account new
  ```

  ```
  geth --dev --mine
  ```

  --dev – Developer mode: pre-configured private network – Cannot connect to other nodes

- In a new terminal/cmd window run:

```
geth attach
/tmp/ethereum_dev_mode/geth.ipc
```

```
geth attach
```

2. Interacting with the blockchain

admin API

- `admin.nodeInfo` – Gives us the enode id and a bunch of useful information
- `admin.peers` – Lists all connected nodes our node knows
- `admin.addPeer("enode://fc[...]03")` – Manually add another node

https://github.com/ethereum/go-ethereum/wiki/JavaScript-Console#management-api-reference

Enode URL

enode://797038b92a15ebfbcb181a2f68feb82
0fd3c69c63b8094b35c23cc378c0a645f73c08
31ab9b096301f30259b72436e82e2425f8683
b5f9e6214030f8942b929b@**[::]**:30303

Replace **[::]** with your IP address. Example:

enode://797038b92a15ebfbcb181a2f68feb82
0fd3c69c63b8094b35c23cc378c0a645f73c08
31ab9b096301f30259b72436e82e2425f8683
b5f9e6214030f8942b929b@**192.168.43.77**:
30303

personal API

- `personal.newAccount()` – Create a new account
- `personal.listAccounts` – List of all (local) accounts
- `personal.unlockAccount("0xc73[...]5b")` – Lists all connected nodes our node knows

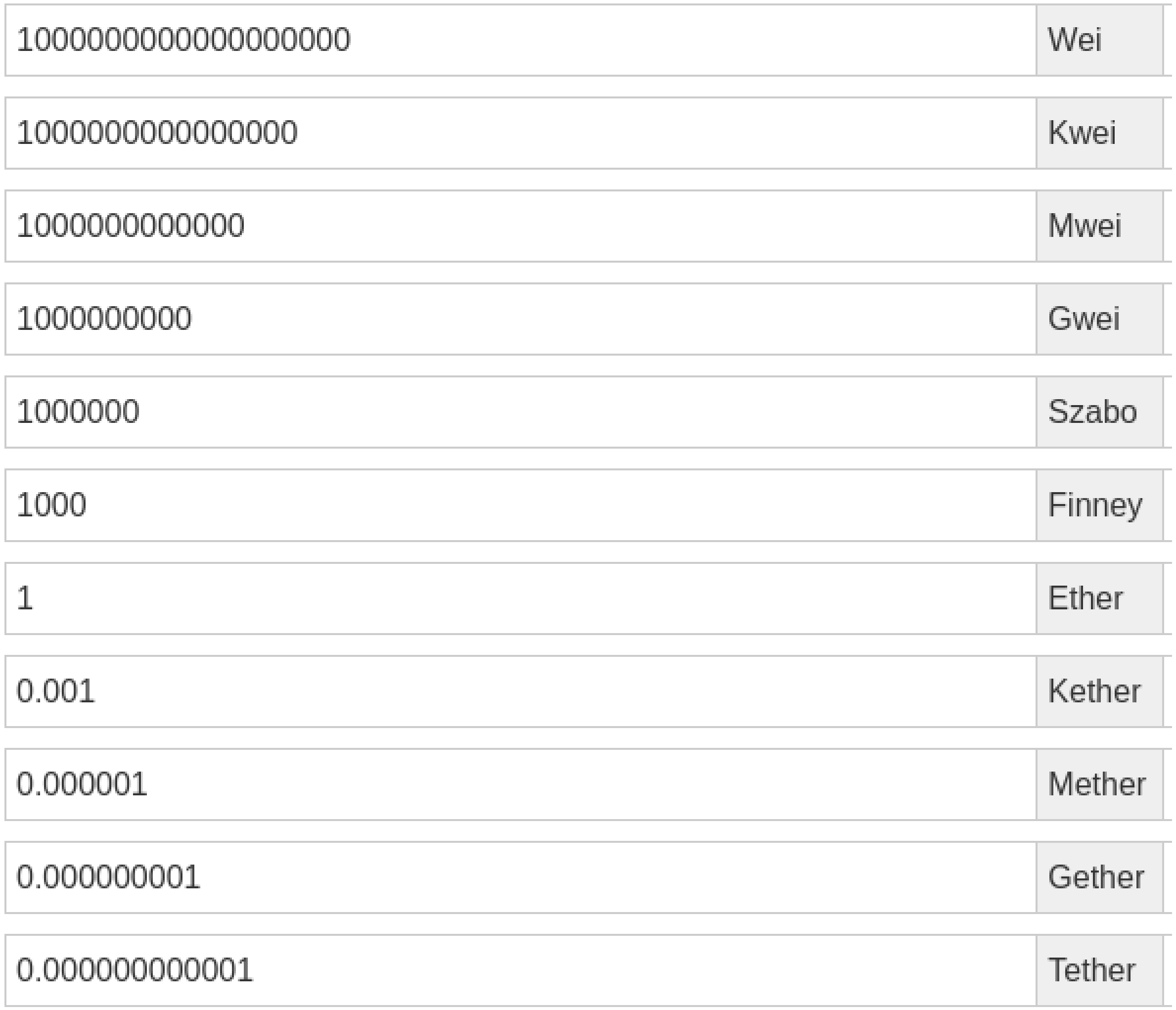
https://github.com/ethereum/go-ethereum/wiki/JavaScript-Console#management-api-reference

web3js

- `web3.eth.getBalance("0xc[...]5b")` – Get balance of account. This works for all accounts.

  https://github.com/ethereum/wiki/wiki/JavaScript-API#web3js-api-reference

Dealing with numbers



1000000000000000000	Wei
1000000000000000	Kwei
1000000000000	Mwei
1000000000	Gwei
1000000	Szabo
1000	Finney
1	Ether
0.001	Kether
0.000001	Mether
0.000000001	Gether
0.000000000001	Tether

https://converter.murkin.me/

Dealing with numbers

- `web3.fromWei(number, "ether")` – Converts from wei to ether
  https://github.com/ethereum/wiki/wiki/JavaScript-API#web3fromwei
- `web3.toWei(number, "ether")` – From ether to wei
  https://github.com/ethereum/wiki/wiki/JavaScript-API#web3towei
- `number.toString()` – Converts a bignumber to a human-readable string
  http://mikemcl.github.io/bignumber.js/
  https://github.com/ethereum/wiki/wiki/JavaScript-API#a-note-on-big-numbers-in-web3js

web3js

-
  ```
  web3.eth.sendTransaction(
  {"from": "0xc73e[...]2cfbc025b",
    "to": "0x00[...]00",
     "value": 111111
  })
  ```
  – Send wei from an address to another address

3. Mist

Starting Mist

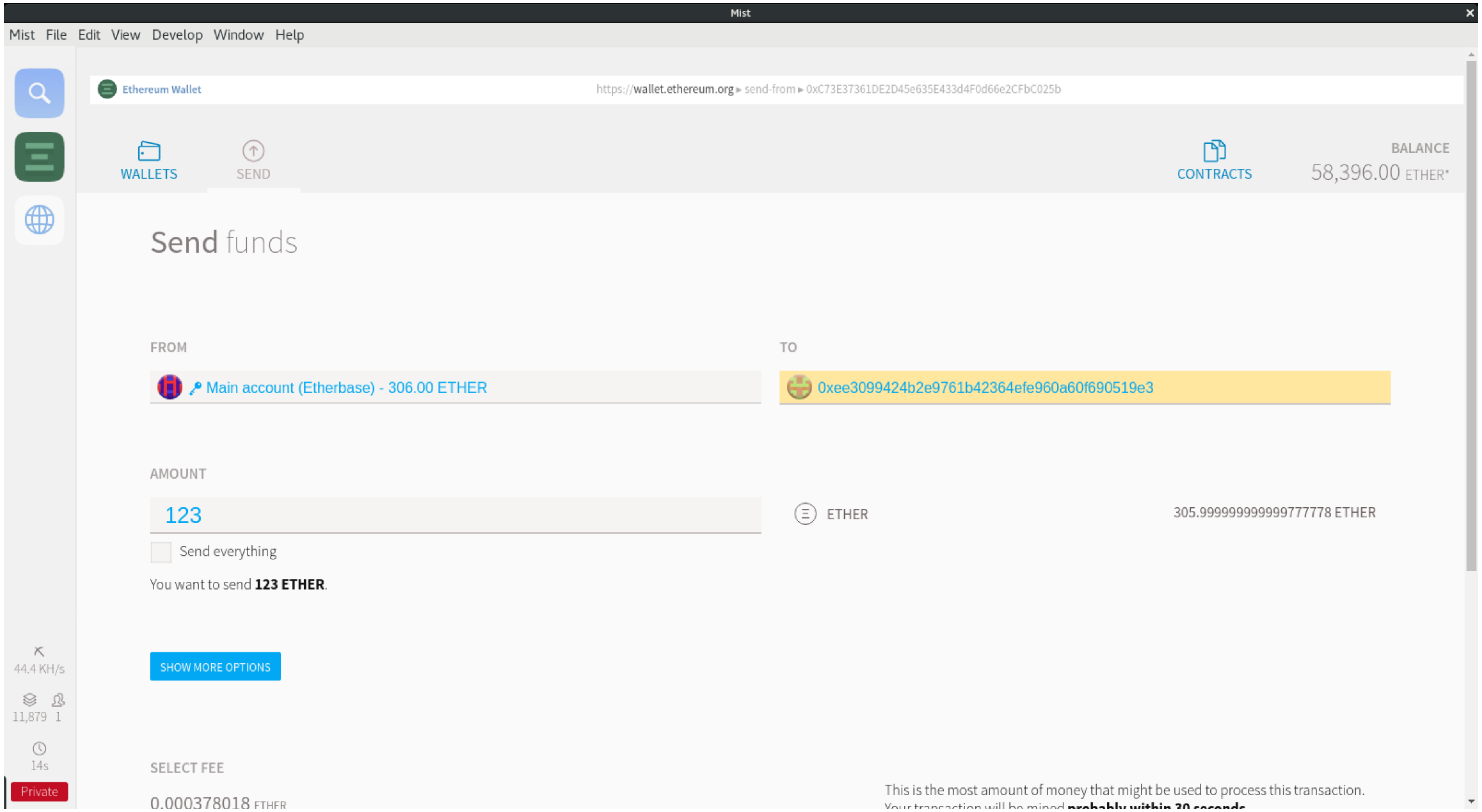
```
mist --rpc ~/.ethereum/workshop/geth.ipc
```

```
"C:\Program Files\Mist\Mist.exe"
--rpc \\.\pipe\geth.ipc
```

```
/
Applications/Mist.app/Contents/MacOS/Mis
t --rpc ~/.ethereum/workshop/geth.ipc
```

- **--rpc** – Path to node IPC socket file OR HTTP RPC hostport

Mist


Mist
Mist File Edit View Develop Window Help
Ethereum Wallet
https://wallet.ethereum.org ▸ send-from ▸ 0xC73E37361DE2D45e635E433d4F0d66e2CFbC025b
WALLETS
SEND
CONTRACTS
BALANCE
58,396.00 ETHER*
44.4 KH/s
11,879 1
14s
Private

Send funds

FROM

Main account (Etherbase) - 306.00 ETHER

TO

0xee3099424b2e9761b42364efe960a60f690519e3

AMOUNT

123

ETHER

305.999999999999777778 ETHER

Send everything

You want to send **123 ETHER**.

SHOW MORE OPTIONS

SELECT FEE

0.000378018 ETHER

This is the most amount of money that might be used to process this transaction.
Your transaction will be mined **probably within 30 seconds**.

4. Solidity & Smart Contracts

Smart Contracts

```
pragma solidity ^0.4.15;

contract MyCoin {
	mapping (address => uint) balances;

	function MyCoin() {
		balances[tx.origin] = 10000;
	}

	function sendCoin(address receiver, uint amount) returns(bool sufficient) {
		if (balances[msg.sender] < amount) return false;
		balances[msg.sender] -= amount;
		balances[receiver] += amount;
		return true;
	}

	function getBalance(address addr) returns(uint) {
		return balances[addr];
	}
}
```

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		return balances[addr];
	}
}
```
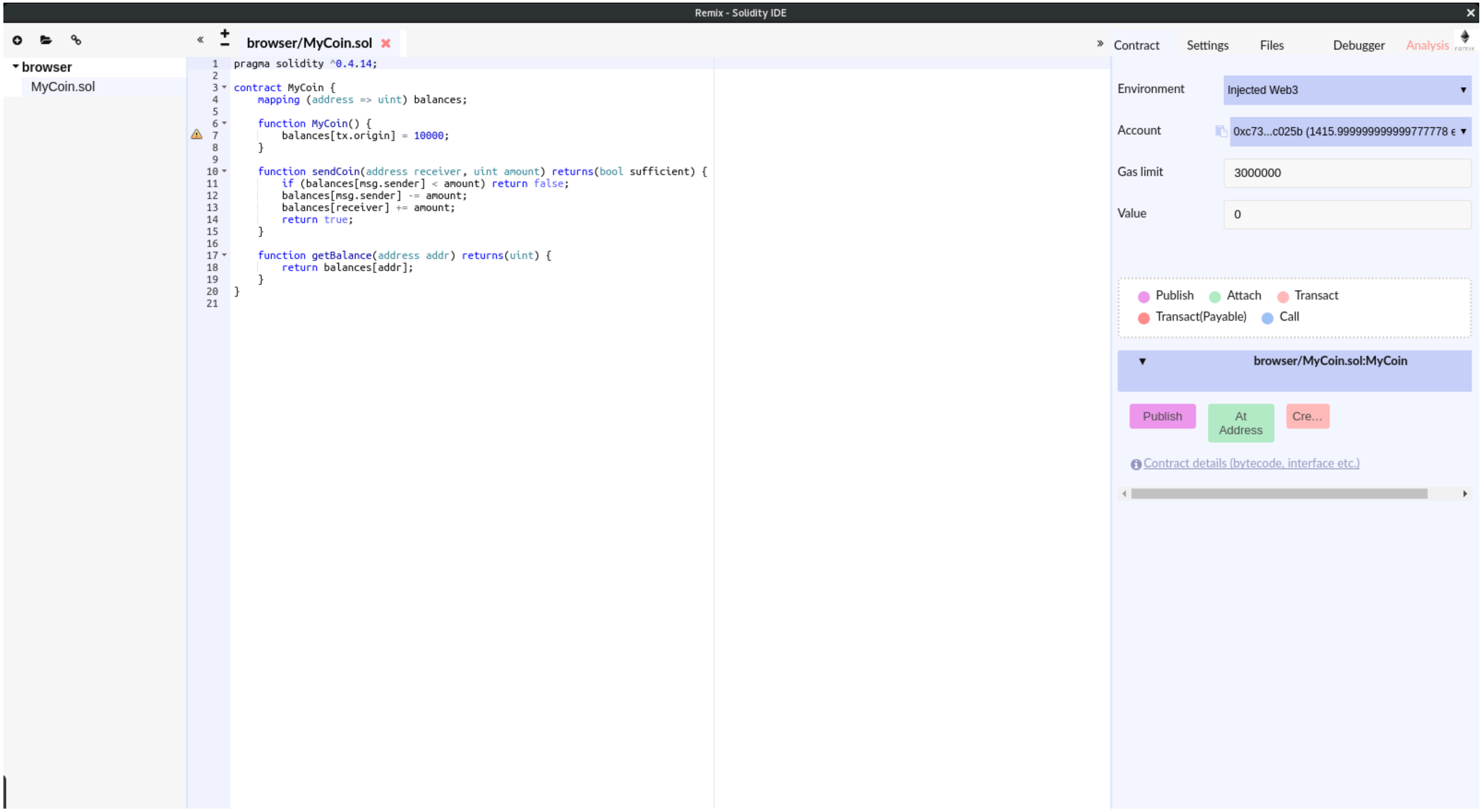

5. Remix IDE

Opening Remix

- In Mist choose Develop → Open Remix IDE
- ... or ...
- Open http://remix.ethereum.org/ in your browser

Remix



```
pragma solidity ^0.4.14;

contract MyCoin {
    mapping (address => uint) balances;

    function MyCoin() {
        balances[tx.origin] = 10000;
    }

    function sendCoin(address receiver, uint amount) returns(bool sufficient) {
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        return true;
    }

    function getBalance(address addr) returns(uint) {
        return balances[addr];
    }
}
```

Environment: Injected Web3

Account: 0xc73...c025b (1415.999999999999777778 e

Gas limit: 3000000

Value: 0

Publish
Attach
Transact
Transact(Payable)
Call
browser/MyCoin.sol:MyCoin
Publish
At Address
Cre...
Contract details (bytecode, interface etc.)

Questions?

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Backup Slides

Predefined network ids

0: Olympic – Deprecated test blockchain

1: Frontier/Homestead - Public blockchain

2: Morden – Deprecated test blockchain

3: Ropsten - Test blockchain

4: Rinkeby - Another test blockchain

Gas

- Gas is the internal price of transactions and computational use
- Each computational step has a fixed gas usage count:

  https://docs.google.com/spreadsheets/d/1m89CVujrQe5LAFJ8-YAUCcNK950dUzMQPMJBxRtGCqs/edit#gid=0
- Total cost = gasUsed * gasPrice
- Unused gas is returned to the sender
- If a transaction runs out of gas it gets reverted (This prevents endless-loops, etc)