Intro to Blockchain/Decentralized App Development

A primer on Ethereum

By Marc Lijour

February 27, 2018

The world-first Free/Libre Open Source and Crowdfunded R&Hub focusing on Blockchain and related technologies

Who am I?

https://www.linkedin.com/in/marclijour/

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Access these slides

http://bit.ly/2CKK5x3

or find by date:

https://github.com/marclijour/presentations

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5 Private blockchain experiment

Ethereum

Ethereum is a **decentralized platform that runs smart contracts**: applications that run exactly as programmed without any possibility of downtime, censorship, fraud or third party interference.
— https://ethereum.org

A short history of Ethereum

Key Milestones:

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- (October 16, 2017) Launch of Metropolis (vByzantium) –version 3
- (2017) ETH goes from \$7 to more than \$700 (100x increase)

Check the nice infographic (Invezz, 2017).

More information:
- a “prehistory” of the Ethereum protocol (Buterin, 2017).
- the official *Ethereum White Paper*.

Store of value

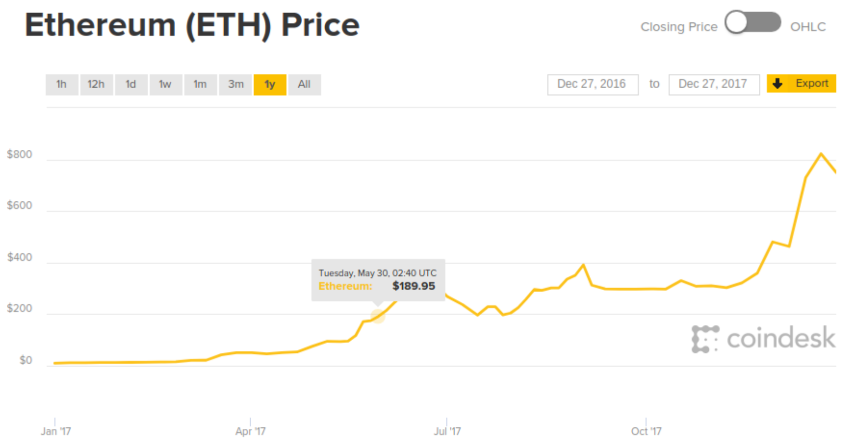

Figure: ETH price (Coindesk, 2017)

Decentralization

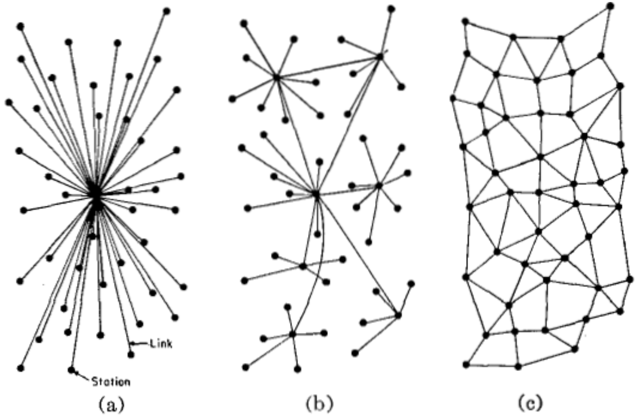

Fig. 1—(a) Centralized. (b) Decentralized. (c) Distributed networks.

Client Types

- Full node

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Client Types

- Full node
- Light node

Client Types

- Full node
- Light node
- Something in between (e.g. “fast” for geth)

Disk Space

Full Archive Ethereum node

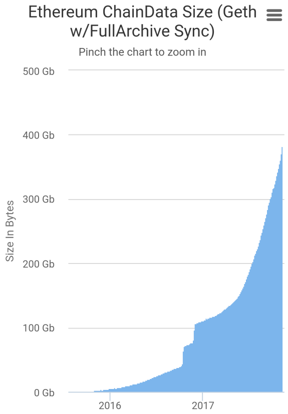


Figure: Miners need a lot of space (Reddit, 2017)

Disk Space
Ethereum vs. Bitcoin

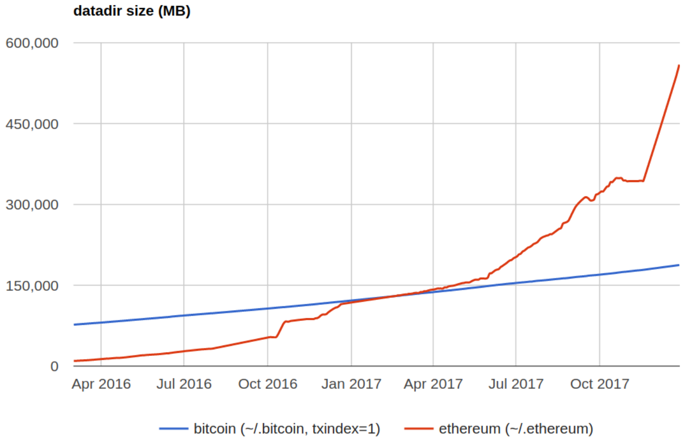


Figure: Disk space used by Geth (`fast`) vs. Bitcoin (Daniel, 2017)

Disk Space

With Geth `--syncmode fast` (default mode)

This mode initializes a ∼20 GB database, then turns in full node.

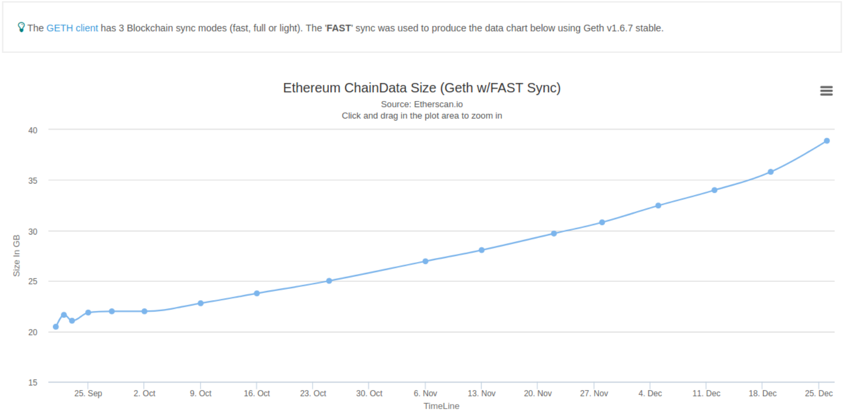
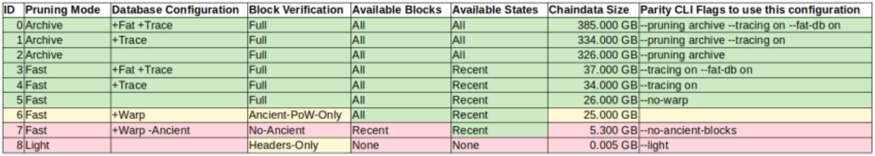

The GETH client has 3 Blockchain sync modes (fast, full or light). The '**FAST**' sync was used to produce the data chart below using Geth v1.6.7 stable.

Figure: Disk space used by Geth (in fast mode) (Etherscan, 2017)

Disk Space

Parity allows for continuous state trie pruning

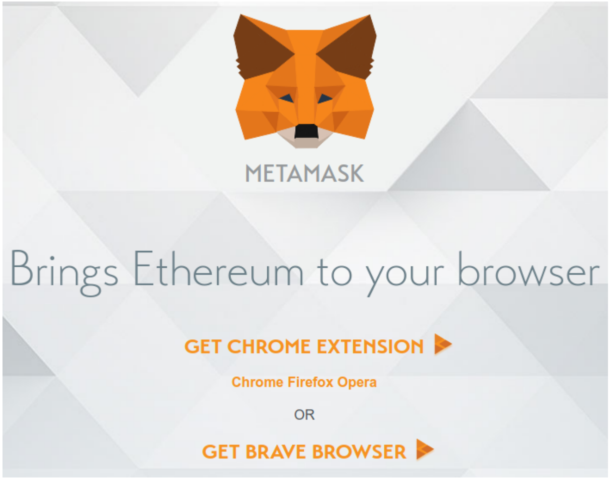
In green, the configuration running as *full node*.
A light client can fit in ∼5 MB.



ID	Pruning Mode	Database Configuration	Block Verification	Available Blocks	Available States	Chaindata Size	Parity CLI Flags to use this configuration
0	Archive	+Fat +Trace	Full	All	All	385.000 GB	--pruning archive --tracing on --fat-db on
1	Archive	+Trace	Full	All	All	334.000 GB	--pruning archive --tracing on
2	Archive		Full	All	All	326.000 GB	--pruning archive
3	Fast	+Fat +Trace	Full	All	Recent	37.000 GB	--tracing on --fat-db on
4	Fast	+Trace	Full	All	Recent	34.000 GB	--tracing on
5	Fast		Full	All	Recent	26.000 GB	--no-warp
6	Fast	+Warp	Ancient-PoW-Only	All	Recent	25.000 GB	
7	Fast	+Warp -Ancient	No-Ancient	Recent	Recent	5.300 GB	--no-ancient-blocks
8	Light		Headers-Only	None	None	0.005 GB	--light

Figure: Disk space used by Parity (Afri, 2017)

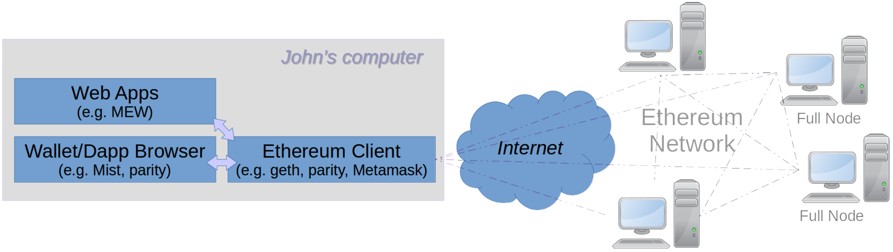
Metamask



https://metamask.io

Practical Applications

for personal or business use



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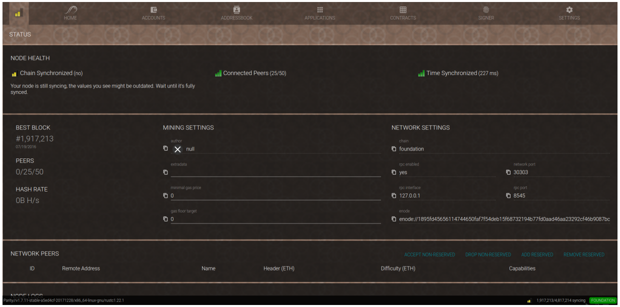
Sizing up

1) Ethereum Node, Wallet, historical data, Smart Contracts, and Dapps:
   - Linux machine (Ubuntu 16.04 / Linux Mint 18.x –until April 2021)
   - Parity (or Geth)
   - A Solidity compiler

2) Developer light setup: (works on ChromeOS)
   - Chrome browser (or Chromium) –any OS
   - Metamask Extension
   - Remix IDE

3) Developer Pro setup:
   - truffle

Parity



NODE HEALTH

Chain Synchronized (no)

Your node is still syncing, the values you see might be outdated. Wait until it's fully synced.

Connected Peers (25/50)

Time Synchronized (227 ms)

BEST BLOCK
#1,917,213
07/19/2016

PEERS
0/25/50

HASH RATE
0B H/s

MINING SETTINGS

author: null

extradata:

minimal gas price: 0

gas floor target: 0

NETWORK SETTINGS

chain: foundation

rpc enabled: yes

network port: 30303

rpc interface: 127.0.0.1

rpc port: 8545

enode: enode://1895fd45656114744650faf7f54deb15f68732194b77fd0aad46aa23292cf46b9087bc

NETWORK PEERS

ID	Remote Address	Name	Header (ETH)	Difficulty (ETH)	Capabilities

NODE LOGS

Parity//v1.7.11-stable-a5ed4cf-20171228/x86_64-linux-gnu/rustc1.22.1

1,917,213/4,817,214 syncing FOUNDATION

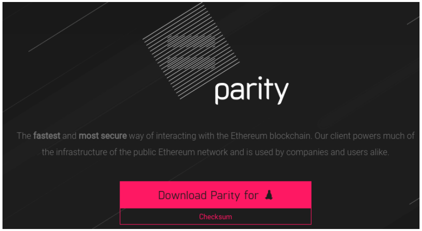
Figure: The Parity client syncing

- Typical Account Management, multi-sig, hardware support
- Access Dapps directly (e.g. app to create an ERC-20 token)
- Code editor and Solidity compiler for smart contracts
- Fast and reliable (written in Rust)
- Most OS, Docker images; and compliant with JSON-RPC API

Lab 1: set up a full Development Environment

Installing Parity

Installing Parity



The **fastest** and **most secure** way of interacting with the Ethereum blockchain. Our client powers much of the infrastructure of the public Ethereum network and is used by companies and users alike.

https://www.youtube.com/watch?v=WNT2O6xyDmM (Windows-based, 16 min)

1. Go to https://www.parity.io
2. Download the relevant binaries, e.g. on Linux:
3. Check the checksum: `$ md5sum parity_1.7.11_amd64.deb`
4. Install: `$ sudo dpkg -i parity_1.7.11_amd64.deb`
5. Check the version: `$ parity -v`

Run Parity on the Kovan Testnet

```
$ parity --light --testnet
2017-12-28 23:38:25  Starting Parity/v1.7.11-stable-a5ed4cf-20171228/x86_64-linux-gnu/rustc1.22.1
2017-12-28 23:38:25  Keys path /home/marc/.local/share/io.parity.ethereum/keys/Kovan
2017-12-28 23:38:25  DB path /home/marc/.local/share/io.parity.ethereum/chains/kovan/db/9bf388941c25ea98
2017-12-28 23:38:25  Path to dapps /home/marc/.local/share/io.parity.ethereum/dapps
2017-12-28 23:38:25  Running in experimental Light Client mode.
...
```

Then go to http://localhost:8180 (or http://web3.site if online), and follow the instructions.

- After reading the legal terms and conditions, you can create your first account.
- Click on the top left-most logo (yellow bars) to see the status of your node.
- **It may take days to sync!**

Try running your first Dapp

Follow the tutorial at https://wiki.parity.io/Deploying-Dapps-to-Parity-Wallet (using chevdor's dapp generator and yeoman)

On Linux Ubuntu, make sure you have npm, and make a soft link to node before running `init.sh`:

```
$ sudo apt install npm
$ sudo ln -s /usr/bin/nodejs /usr/bin/node
$ ./init.sh
```

Lab 1 (b): set up a full Development Environment

Installing Geth

Installing Geth

Instructions (all OSes) at https://github.com/ethereum/go-ethereum/wiki/Building-Ethereum.
Ubuntu/Mint: https://github.com/ethereum/go-ethereum/wiki/Installation-Instructions-for-Ubuntu

```
$ sudo apt-get install software-properties-common
$ sudo add-apt-repository -y ppa:ethereum/ethereum
$ sudo apt-get update
```

Run the first line to install the full suite (geth, bootnode, evm, disasm, rlpdump, ethtest), or the second line for geth only:

```
$ sudo apt-get install ethereum
$ sudo apt-get install geth
```

Create a new account, and you should be ready to run geth:

```
$ geth account new
$ geth
```

Installing a Solidity Compiler

Provided the previous steps were completed:

```
$ sudo apt-get install solc
$ which solc
```

And in geth, to let it know where solc can be found:

```
$ admin.setSolc("/usr/bin/solc")
```

Now test the code by following the instructions at
https://github.com/ethereum/go-ethereum/wiki/Contract-Tutorial

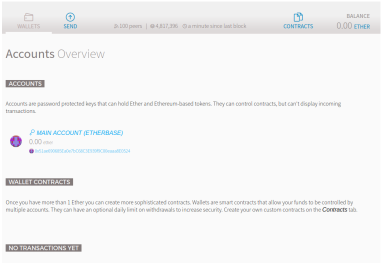
Code Editor

- Vim
- Vim Solidity
- Vim Syntastic

And you still need a wallet

Options:

- Mist Browser (beta) (featured on the right, see also the recent security warning re. Chromium)
- MyEtherWallet (MEW) supports advanced features including hardware wallets



Accounts Overview

ACCOUNTS

Accounts are password protected keys that can hold Ether and Ethereum-based tokens. They can control contracts, but can't display incoming transactions.

MAIN ACCOUNT (ETHERBASE)
0.00 ether
0x51ae690685Ea0e7bC68C3E939f9C00eaaa8E0524

WALLET CONTRACTS

Once you have more than 1 Ether you can create more sophisticated contracts. Wallets are smart contracts that allow your funds to be controlled by multiple accounts. They can have an optional daily limit on withdrawals to increase security. Create your own custom contracts on the *Contracts* tab.

NO TRANSACTIONS YET

Mist Browser (beta)
https://wallet.ethereum.org
Try on Chrome vs Firefox

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Let's have some fun!

Install MetaMask

Follow step by step:

1. Install the Chrome/Chromium extension
2. Watch the intro on Youtube
3. Create an account
4. Switch to the Ropsten Testnet (top-left in MetaMask)
5. Fill your account with Ether from https://faucet.metamask.io

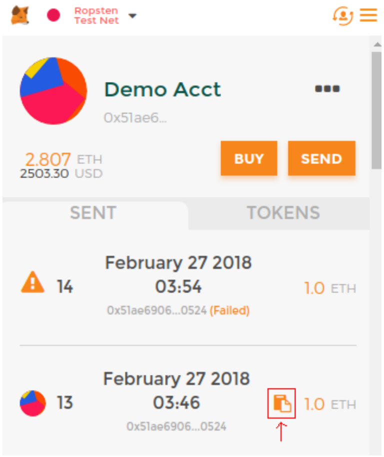
https://metamask.io

Try sending ETH to yourself with Metamask

1. Make sure you're on Ropsten, with some ETH from the faucet
2. Click on "Send" and fill:
   - Account: paste your own address (same account)
   - Amount: 1 ETH
   - Transaction data: convert some text in HEX format with https://www.asciitohex.com, remove all spaces and write it with a 0x prefix (e.g. 0x497427732074696d6520746f2072756e)
3. Click on "Next"
4. Use a gas price $>$ 30 (the higher the faster)
5. Confirm the transaction

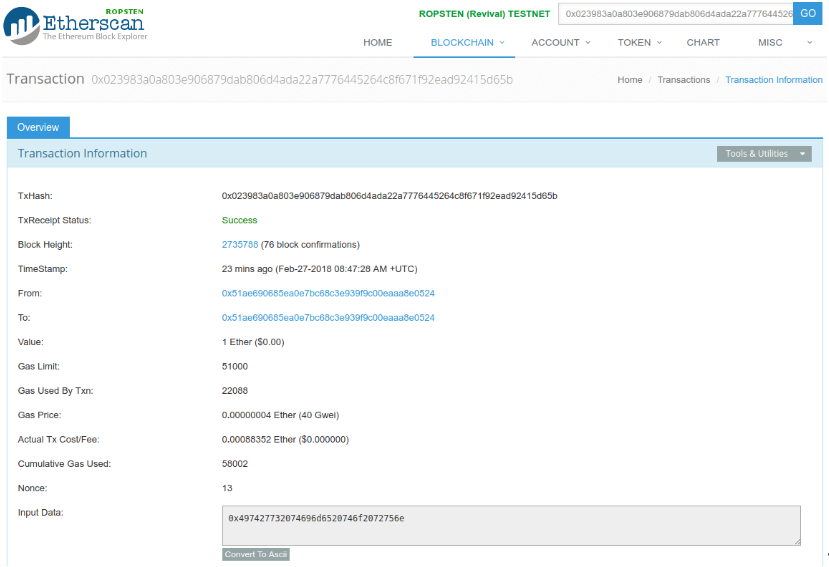
Check the transaction on Etherscan

Copy the transaction #



Check the transaction on Etherscan

and click on "Convert to Ascii"


ROPSTEN
Etherscan
The Ethereum Block Explorer
ROPSTEN (Revival) TESTNET
0x023983a0a803e906879dab806d4ada22a777644526
GO
HOME
BLOCKCHAIN
ACCOUNT
TOKEN
CHART
MISC
Home / Transactions / Transaction Information
Overview
Tools & Utilities
Convert To Ascii

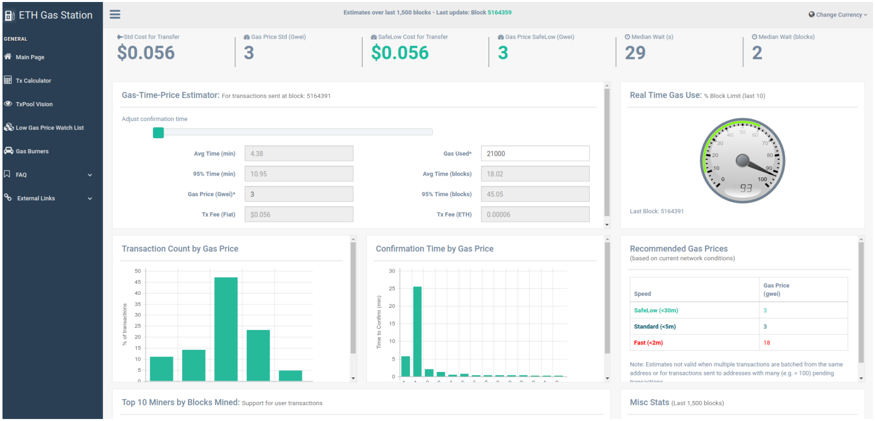
Transaction 0x023983a0a803e906879dab806d4ada22a7776445264c8f671f92ead92415d65b

Transaction Information

TxHash:	0x023983a0a803e906879dab806d4ada22a7776445264c8f671f92ead92415d65b
TxReceipt Status:	Success
Block Height:	2735788 (76 block confirmations)
TimeStamp:	23 mins ago (Feb-27-2018 08:47:28 AM +UTC)
From:	0x51ae690685ea0e7bc68c3e939f9c00eaaa8e0524
To:	0x51ae690685ea0e7bc68c3e939f9c00eaaa8e0524
Value:	1 Ether ($0.00)
Gas Limit:	51000
Gas Used By Txn:	22088
Gas Price:	0.00000004 Ether (40 Gwei)
Actual Tx Cost/Fee:	0.00088352 Ether ($0.000000)
Cumulative Gas Used:	58002
Nonce:	13
Input Data:	0x497427732074696d6520746f2072756e

A note about gas price

https://ethgasstation.info



ETH Gas Station

GENERAL

- Main Page
- Tx Calculator
- TxPool Vision
- Low Gas Price Watch List
- Gas Burners
- FAQ
- External Links

Estimates over last 1,500 blocks - Last update: Block 5164359

Change Currency

Std Cost for Transfer	Gas Price Std (Gwei)	SafeLow Cost for Transfer	Gas Price SafeLow (Gwei)	Median Wait (s)	Median Wait (blocks)
$0.056	3	$0.056	3	29	2

Gas-Time-Price Estimator: For transactions sent at block: 5164391

Adjust confirmation time

Avg Time (min)	4.38	Gas Used*	21000
95% Time (min)	10.95	Avg Time (blocks)	18.02
Gas Price (Gwei)*	3	95% Time (blocks)	45.05
Tx Fee (Fiat)	$0.056	Tx Fee (ETH)	0.00006

Real Time Gas Use: % Block Limit (last 10)

Last Block: 5164391

Transaction Count by Gas Price

Confirmation Time by Gas Price

Recommended Gas Prices
(based on current network conditions)

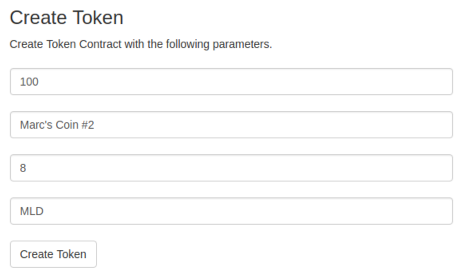
Speed	Gas Price (gwei)
SafeLow (<30m)	3
Standard (<5m)	3
Fast (<2m)	18

Note: Estimates not valid when multiple transactions are batched from the same address or for transactions sent to addresses with many (e.g. > 100) pending transactions

Top 10 Miners by Blocks Mined: Support for user transactions

Misc Stats (Last 1,500 blocks)

Create your own (ERC-20) token


Create Token

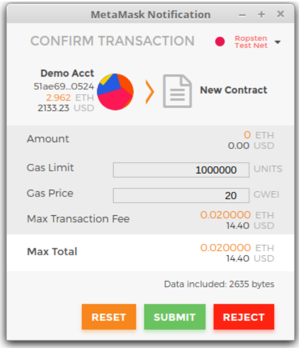
Create Token Contract with the following parameters.

100

Marc's Coin #2

8

MLD



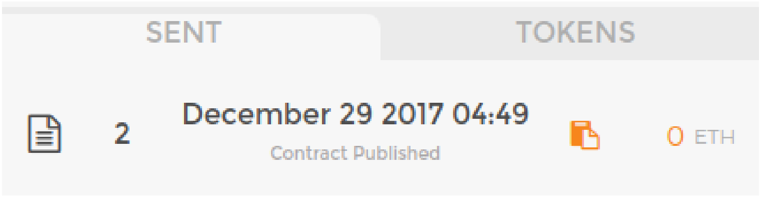
Demo Acct
51ae69...0524
2.962 ETH
2133.23 USD
New Contract

Amount	0 ETH 0.00 USD
Gas Limit	1000000 UNITS
Gas Price	20 GWEI
Max Transaction Fee	0.020000 ETH 14.40 USD
Max Total	0.020000 ETH 14.40 USD

Data included: 2635 bytes

1. Use the Token Factory Dapp at https://tokenfactory.surge.sh/#/factory
2. MetaMask will pop up (see picture above)
3. Submit the transaction (on the Ropsten Testnet)
4. Check your transaction on https://ropsten.etherscan.io

Check your Smart Contract


SENT TOKENS

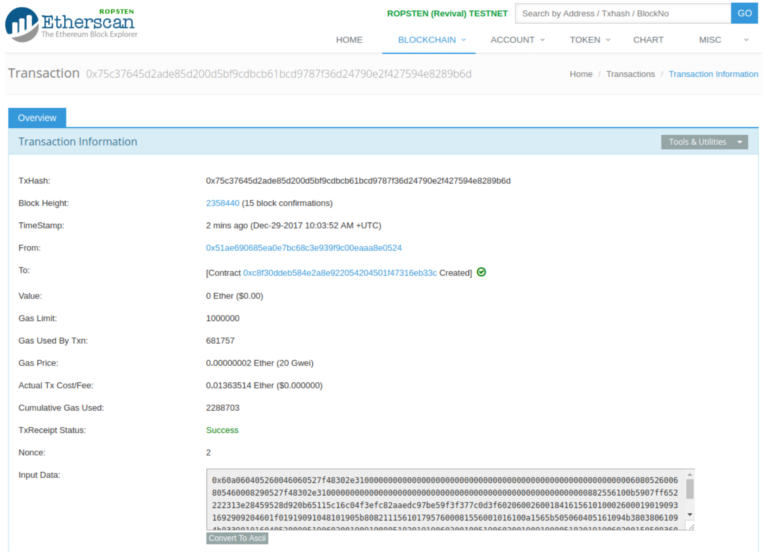
2 December 29 2017 04:49

Contract Published

0 ETH

1. Select the "Sent" tab
2. Check the orange Copy icon (Tx Hash)
3. Click on "Contract Published"
4. That should bring you to Etherscan (see next page)

Verify the status of your transaction on Etherscan


ROPSTEN
Etherscan
The Ethereum Block Explorer
ROPSTEN (Revival) TESTNET
Search by Address / Txhash / BlockNo
GO
HOME
BLOCKCHAIN
ACCOUNT
TOKEN
CHART
MISC

Transaction 0x75c37645d2ade85d200d5bf9cdbcb61bcd9787f36d24790e2f427594e8289b6d

Home / Transactions / Transaction Information

Overview

Transaction Information

Tools & Utilities

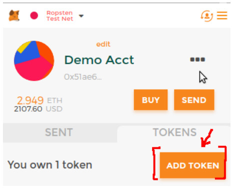
TxHash:	0x75c37645d2ade85d200d5bf9cdbcb61bcd9787f36d24790e2f427594e8289b6d
Block Height:	2358440 (15 block confirmations)
TimeStamp:	2 mins ago (Dec-29-2017 10:03:52 AM +UTC)
From:	0x51ae690685ea0e7bc68c3e939f9c00eaaa8e0524
To:	[Contract 0xc8f30ddeb584e2a8e922054204501f47316eb33c Created] ✓
Value:	0 Ether ($0.00)
Gas Limit:	1000000
Gas Used By Txn:	681757
Gas Price:	0.00000002 Ether (20 Gwei)
Actual Tx Cost/Fee:	0.01363514 Ether ($0.000000)
Cumulative Gas Used:	2288703
TxReceipt Status:	Success
Nonce:	2
Input Data:	

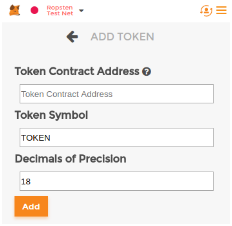
```
0x60a060405260046060527f48302e3100000000000000000000000000000000000000000000000000000006080526006
805460008290527f48302e310000000000000000000000000000000000000000000000000000000882556100b5907ff652
222313e28459528d920b65115c16c04f3efc82aaedc97be59f3f377c0d3f60206002600184161561010002600019019093
1692909204601f01919091048101905b8082111561017957600081556001016100a1565b505060405161094b3803806109
```

Convert To Ascii

Transaction Information: note the "To" line with your contract address

Watch your Token



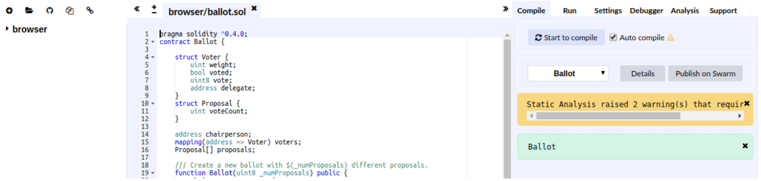


1. Click on the “Add Token” button
2. Wait for the next window (picture on the right)
3. Copy your contract address (from Etherscan)
4. Go back to your Token Factory tab, which should show an UI to interact with your contract or go to the URL: https://tokenfactory.surge.sh/#/token/0x... (replace 0x... by your contract address)
5. Move coins around
6. In MetaMask, click on your token to check the tx on Etherscan

Too easy?

Let's code it in Solidity like the pros!

Coding your first ERC-20 Smart Contract



```
pragma solidity ^0.4.0;
contract Ballot {

    struct Voter {
        uint weight;
        bool voted;
        uint8 vote;
        address delegate;
    }
    struct Proposal {
        uint voteCount;
    }

    address chairperson;
    mapping(address => Voter) voters;
    Proposal[] proposals;

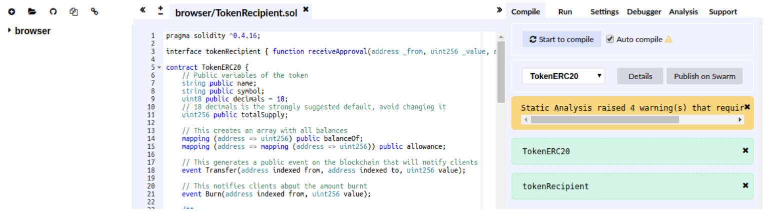
    /// Create a new ballot with $(_numProposals) different proposals.
    function Ballot(uint8 _numProposals) public {
```

```
Static Analysis raised 2 warning(s) that requir
```

1. Open the Remix IDE at https://remix.ethereum.org
2. Close the ballot file
3. Create a new file named TokenRecipient.sol
4. Copy the code from https://ethereum.org/token (second white box, under "The Code", starting with "pragma")
5. Switch to the "Run" tab (top-right bar, after Compile)

Reference:
ERC-20 Token Standard

Compiling Successfully



```
pragma solidity ^0.4.16;

interface tokenRecipient { function receiveApproval(address _from, uint256 _value, a

contract TokenERC20 {
    // Public variables of the token
    string public name;
    string public symbol;
    uint8 public decimals = 18;
    // 18 decimals is the strongly suggested default, avoid changing it
    uint256 public totalSupply;

    // This creates an array with all balances
    mapping (address => uint256) public balanceOf;
    mapping (address => mapping (address => uint256)) public allowance;

    // This generates a public event on the blockchain that will notify clients
    event Transfer(address indexed from, address indexed to, uint256 value);

    // This notifies clients about the amount burnt
    event Burn(address indexed from, uint256 value);

    /**
```

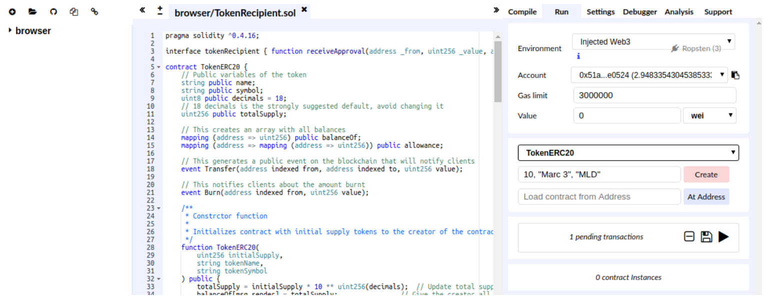
```
Static Analysis raised 4 warning(s) that requir
```

```
TokenERC20
```

```
tokenRecipient
```

1. Two green boxes should show on the right
2. TokenERC20 is the name of the contract (class)
3. tokenRecipient is the name of the interface
4. Switch to the “Run” tab (top right)

Submitting the Smart Contract



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    /**
     * Constrctor function
     *
     * Initializes contract with initial supply tokens to the creator of the contrac
     */
    function TokenERC20(
        uint256 initialSupply,
        string tokenName,
        string tokenSymbol
    ) public {
        totalSupply = initialSupply * 10 ** uint256(decimals);  // Update total supp
        balanceOf[msg.sender] = totalSupply;                // Give the creator all
```

Environment: Injected Web3 — Ropsten (3)

Account: 0x51a...e0524 (2.9483354304538533

Gas limit: 3000000

Value: 0 wei

TokenERC20

10, "Marc 3", "MLD" — Create

Load contract from Address — At Address

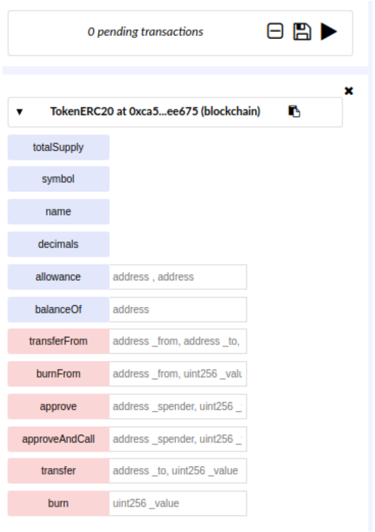
1 pending transactions

0 contract Instances

1. Under the dropdown showing "TokenERC20", add a number (total amount of tokens to issue) and two strings (the latter is the token symbol)
2. Add enough gas (top right, try 30)
3. Click Create and check whether MetaMask needs confirmation

Interacting with the contract

1. A new interface will pop up on the bottom right corner of the IDE


0 pending transactions
TokenERC20 at 0xca5...ee675 (blockchain)
totalSupply
symbol
name
decimals
allowance
address , address
balanceOf
address
transferFrom
address _from, address _to,
burnFrom
address _from, uint256 _valu
approve
address _spender, uint256 _
approveAndCall
address _spender, uint256 _
transfer
address _to, uint256 _value
burn
uint256 _value

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2 Setting a Development Machine

3 Hands-on Transactions & Smart Contracts

4 Developing with Truffle

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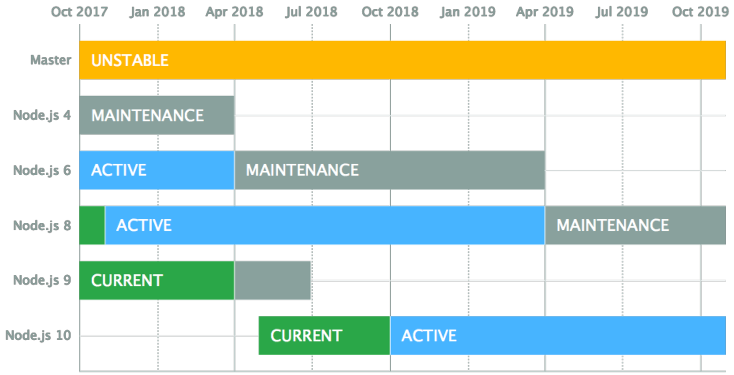
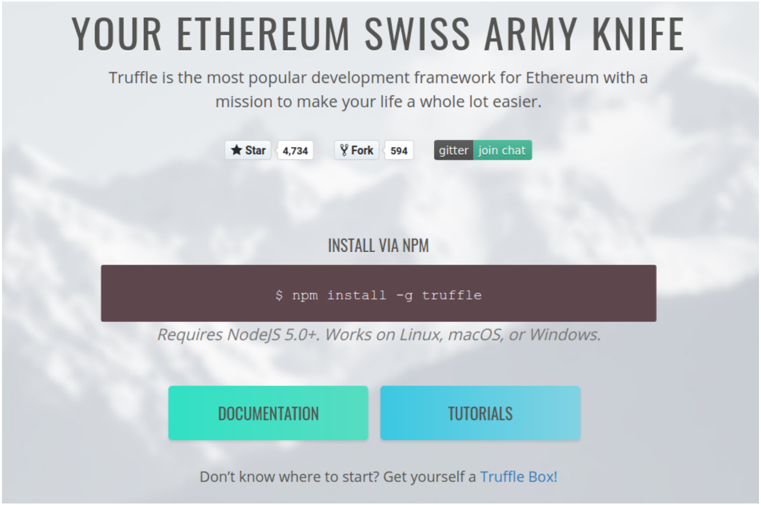
Required dependency: node.js > 5

Install version 8 –in LTS maintenance until December 2019.
Run a script from https://nodejs.org/en/download/package-manager/



Installing Truffle


YOUR ETHEREUM SWISS ARMY KNIFE

Truffle is the most popular development framework for Ethereum with a mission to make your life a whole lot easier.

INSTALL VIA NPM

```
$ npm install -g truffle
```

Requires NodeJS 5.0+. Works on Linux, macOS, or Windows.

Don't know where to start? Get yourself a Truffle Box!

Let's build our first Dapp with Truffle

http://truffleframework.com/tutorials/pet-shop

Let's build an ERC20 Token Contract with Truffle

http://truffleframework.com/tutorials/robust-smart-contracts-with-openzeppelin

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COLLIDER·X

Private Blockchain

Let's create our own
permission-based private
Blockchain
based on Ethereum!

Create a PoA chain with Parity

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- Less computationally intensive, more secure for small networks, faster
- The Kovan test network, Hyperledger and Ripple run on a PoA
- Parity supports two PoA consensus algorithm: Aura, and Tendermint (experimental)
- Let's follow Parity's Demo PoA tutorial
- Simple Hands-on at https://github.com/marclijour/parity-poa-tutorial

Parity's Demo PoA tutorial

Objectives:

1. Setup two connected nodes on one machine (for demo)
2. Gain familiarity with Parity (UI and command line)
3. Gain a better understanding of diverse types of blockchain (public/private, permissionless/permission-based) and different types of consensus algorithms

Parity's Demo PoA tutorial

Step 1: download the files

This tutorial assumes than you have installed Parity. Instructions are shown for a machine running Linux Ubuntu. The first step consists in cloning the GitHub repo in your machine. You'll run command from within that directory.

```
$ git clone https://github.com/marclijour/parity-poa-tutorial.git
```

Parity's Demo PoA tutorial

Step 2: create nodes and accounts

From the "parity-poa-tutorial" directory, open two terminals and type one line in each:

```
$ parity --config node0.starthere
$ parity --config node1.starthere
```

Open another console and run these scripts:

```
$ ./create_first_authority_address_on_node0.sh
$ ./create_second_authority_address_on_node1.sh
$ ./create_user__address_on_node0.sh
```

Parity's Demo PoA tutorial

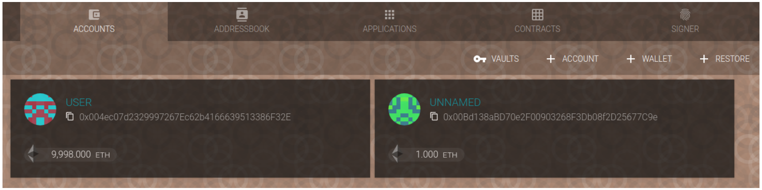
Step 3: start the chain on PoA

In two separate terminals, restart parity with this new configuration.

```
$ parity --config node0.toml
$ parity --config node1.toml
```

Parity's Demo PoA tutorial – Step 4: setup the Parity UI

Open two different windows or tabs in your browser for node 0 (at http://localhost:8181) and node 1 (at http://localhost:8182).



USER
0x004ec07d2329997267Ec62b4166639513386F32E
9,998.000 ETH

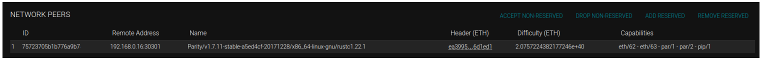
UNNAMED
0x00Bd138aBD70e2F00903268F3Db08f2D25677C9e
1.000 ETH

Restore the accounts as above:
- on node 0: `node0` (password = node0), and `user` (password = user)
- on node 1: `node1` (password = node1)

Parity's Demo PoA tutorial

Step 4: connect the nodes with each other

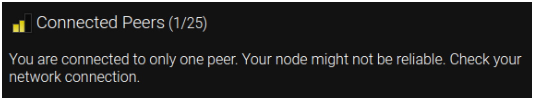
Check the console were you started node 0, and look for the Public Node URL. It should ressemble something like this: `enode://<long hash>@<IP Address>:<Port Number>`


NETWORK PEERS

ACCEPT NON-RESERVED DROP NON-RESERVED ADD RESERVED REMOVE RESERVED

	ID	Remote Address	Name	Header (ETH)	Difficulty (ETH)	Capabilities
1	75723705b1b776a9b7	192.168.0.16:30301	Parity/v1.7.11-stable-a5ed4cf-20171228/x86_64-linux-gnu/rustc1.22.1	ea3995....6d1ed1	2.0757224382177246e+40	eth/62 - eth/63 - par/1 - par/2 - pip/1

Go to the Status tab (the leftmost tab) in the Web UI for node 1, and look for the Network Peers section. Click on ADD RESERVED, and copy the URL (including enode://).


Connected Peers (1/25)

You are connected to only one peer. Your node might not be reliable. Check your network connection.

Check the console output and the Web UI. Both should acknowledged another peer (1/25 Peers instead of 0/25 Peers).

Parity's Demo PoA tutorial

Step 5: send transactions

Run the following scripts and watch the balance for each account in the Web UIs.

```
$ send_from_user_to_node0_account.sh
$ send_from_user_to_node1_account.sh
```

You can also try in a separate console, where you can read the JSON-formatted response.

```
$check_balance_in_node0_account.sh
$check_balance_in_node1_account.sh
```

Parity's Demo PoA tutorial

Step 6: add nodes to the network

Run parity with the right chain specification and let other nodes know (by adding them by enode URL). You just need the demo-spec.json file to get started.

```
$ parity --chain demo-spec.json
```

It's the beginning of a rewarding journey...

Next Steps and Recommended Readings

- Starting on Blockchain: key learning resources
- Fairly exhaustive references from Andreessen Horowitz
- Parity Wiki (e.g. Token Deployment)
- Ethereum White Paper and Wiki
- MOOCs: Udemy (Solidity), edX (Hyperledger)
- Building Blockchain Projects: Building decentralized Blockchain applications with Ethereum and Solidity by Narayan Prusty (2017) *–check the section on Proof of Authority (PoA)*

Thank you!

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Twitter: @marclijour

References

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