mas.s62
lecture 6
wallets and SPV

2018-02-26

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schedule stuff

pset02 due Wednesday 28th at 23:59

mine one block onto server, submit to github

Wednesday class:

Guest lecturer Ethan Heilman will explain P2P network implementation

today

wallet operation

coin selection

SPV walkthrough

node types and problems

last time: sync

get software, connect

get headers

get blocks

replay history

arrive at utxo set

what about my money

how to pay people?

how to get paid?

software that manages this is called a "wallet"

wallet function

send and receive money

simple right?

need to receive money before you can send, so start with that

Receive address

Most output scripts are pay to pubkey hash (P2PKH)

The opcodes are all the same, with only the hash changing.

Address standard for hashes in ascii, e.g: 1F8f12E4uJDiTRLdPy1oze6aoh2o8yJCSJ

Receive address

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addresses on servers

keep a bunch of addresses on server

keep private keys offline

list of addresses can run out

pubkey generation without privkey?

BIP32 simplified

pubkey P, randomizer r

privkey p

$$A = P + hash(r,1)*G$$

$$a = p + hash(r,1)$$

BIP32 simplified

Can put pubkey and random data on server

server can make addresses as needed

observers can't link the addresses

revealing P and r would allow linking addresses but not stealing funds

Request payment

Hey, want this jacket? Send a coin to 1F8f12E...

(Note that Bitcoin does not attempt to solve the fair exchange problem; payments are not contingent on delivery of goods)

atomic swaps, HTLCs, zkCP, etc notwithstanding

have I gotten paid?

Add your pubkey hashes to a list

For every transaction, look at every output script

If the script matches your PKH script, you got money!

wallet utxo list

Keep track of received payments

Save all the utxos to disk

txid:index, amount, which key, height

next, spend them

wallet utxo list

you want to send 6 coins somewhere; find utxos totalling over 6, use them as inputs, then add outputs

884d:0 (5 coins)	1BobAddr2zKLw amount: 6 coins
b427:1 (3 coins)	1AliceChange392 amount: 2 coins

coin selection

2 inputs, 2 outputs

what would work better...?

884d:0 (5 coins)	1BobAddr2zKLw amount: 6 coins
b427:1 (3 coins)	1AliceChange392 amount: 2 coins

coin selection

1 input, 1 output

Half the size, half the fee

a273:3 (6 coins)	1BobAddr2zKLw amount: 6 coins

coin selection

A tricky problem (NP-hard) but heuristics work OK in practice

What are we optimizing for?

coin selection

optimize for:

minimize number of inputs used...

easy! Just pick biggest utxos

coin selection

optimize for:

minimize number of inputs used...
easy! Just pick biggest utxos

Want to minimize inputs next time as well; Ideally eliminate change output

coin selection

privacy concerns:

Using 2 utxos in the same tx 'links' them; people can see that it's probably the same entity

maximum anonymity:

coin selection

privacy concerns:

Using 2 utxos in the same tx 'links' them; people can see that it's probably the same entity

maximum anonymity:

Always 1 input txs! (tons of txs)

losing money

just because you signed a tx doesn't mean your money's gone

broadcast? got into a block?

Listen for your own utxos getting spent in every block

losing money

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broadcast? got into a block?

Listen for your own utxos getting spent in every block

(same wallet on multiple computers)

intermission

0xff seconds to walk around, check on pset miner, etc

note that current pset high scores can be obtained by

```
$ nc hubris.media.mit.edu 6299
```

(seems not to work on MIT wifi)

wallets without bitcoin

We've talked about running bitcoin: syncing headers, checking signatures, building utxo set

But can you use bitcoin without doing this?

wallets without bitcoin

We've talked about running bitcoin: syncing headers, checking signatures, building utxo set

But can you use bitcoin without doing this?

Get someone else to do it!

full node

what was just called bitcoin many call a "full node"

Also possible are "lite nodes" or "SPV nodes"

SPV

simplified payment verification

mentioned in whitepaper

can verify work without much data

SPV howto

connect, get headers, verify

tell node all your addresses

for each header, ask if you gained or lost utxos

verify merkle proof of response txs

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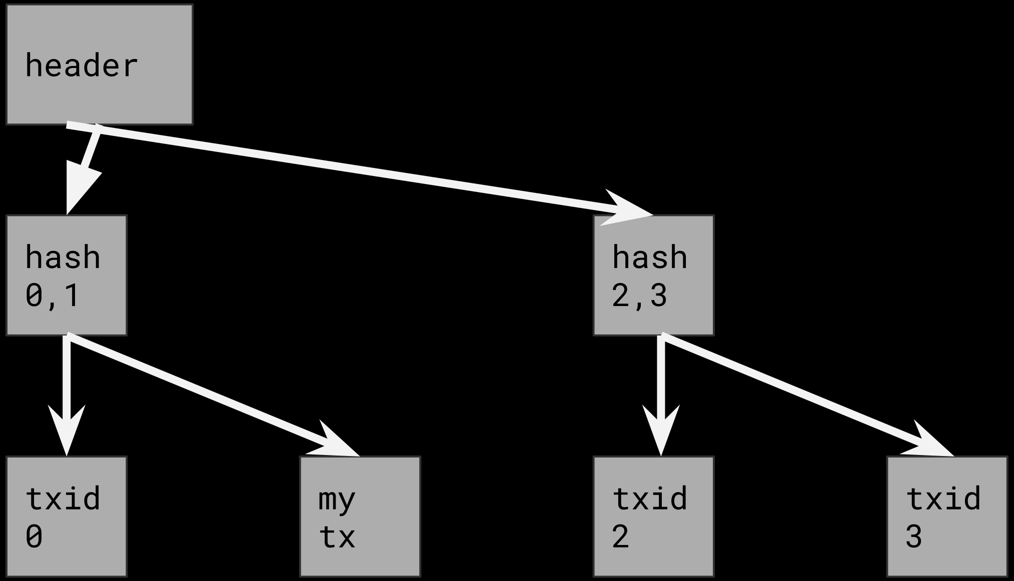
Merkle verification

Provide siblings up to top;

my tx must be in there



SPV problems

connect, get headers, verify

this is the same as for full nodes, so that's OK

SPV problems

tell node all your addresses

wait what?! Tell all your addresses?

Node needs to know what txs to send you. If they send all, no savings

Bloom filters; poor privacy

Block based filters are better

SPV problems

for each header, ask if you gained or lost utxos

any possible problems here?

SPV problems

for each header, ask if you gained or lost utxos

easy to lie by omission

mitigate by connecting to more nodes

... but then share your addresses with even more people!

SPV howto

verify merkle proof of response txs

merkle proofs are quick

but prove inclusion, not exclusion

SPV and beyond

So SPV sounds pretty bad and I think I'll stick to my full node.

But I gotta ask, is there something worse than SPV?

... asking for a friend.

Not even SPV (NESPV)

Websites, phone wallets

Send all your addresses, ask if you have utxos

Server responds that you do. Cool.

Build txs, sign, send to server.

NESPV issues

Any potential problems?

NESPV issues

Any potential problems?

Server can:

say you got paid when you didn't

say you lost money when you didn't

If in browser, even more fun

Further

API based wallets sound real bad.

But we can do worse, right?

Someone else's coins

Don't even have keys. Just have a website where they run a node* / wallet and owe you money/

Tends to end badly.

Always misses the point.

*guess which kind. OK maybe don't.

trade offs

	Full node	SPV	API query	Hold my key
network	170GB	50MB	1MB	1MB ?
storage	4GB	50MB	0B	0B
speed	hours	seconds	1 sec	0
privacy	OK	poor	poor	none
security	OK	medium	poor	none

wallets are fun

still big usability issues

interesting problems all around

Have fun with Ethan on Wednesday,
good luck w/ pset!