low budget segwit safari

residency 2019

basics

- malleability fix

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    - attacks?

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  - nVersion|marker|flag|txins|txouts|witness|nLockTime

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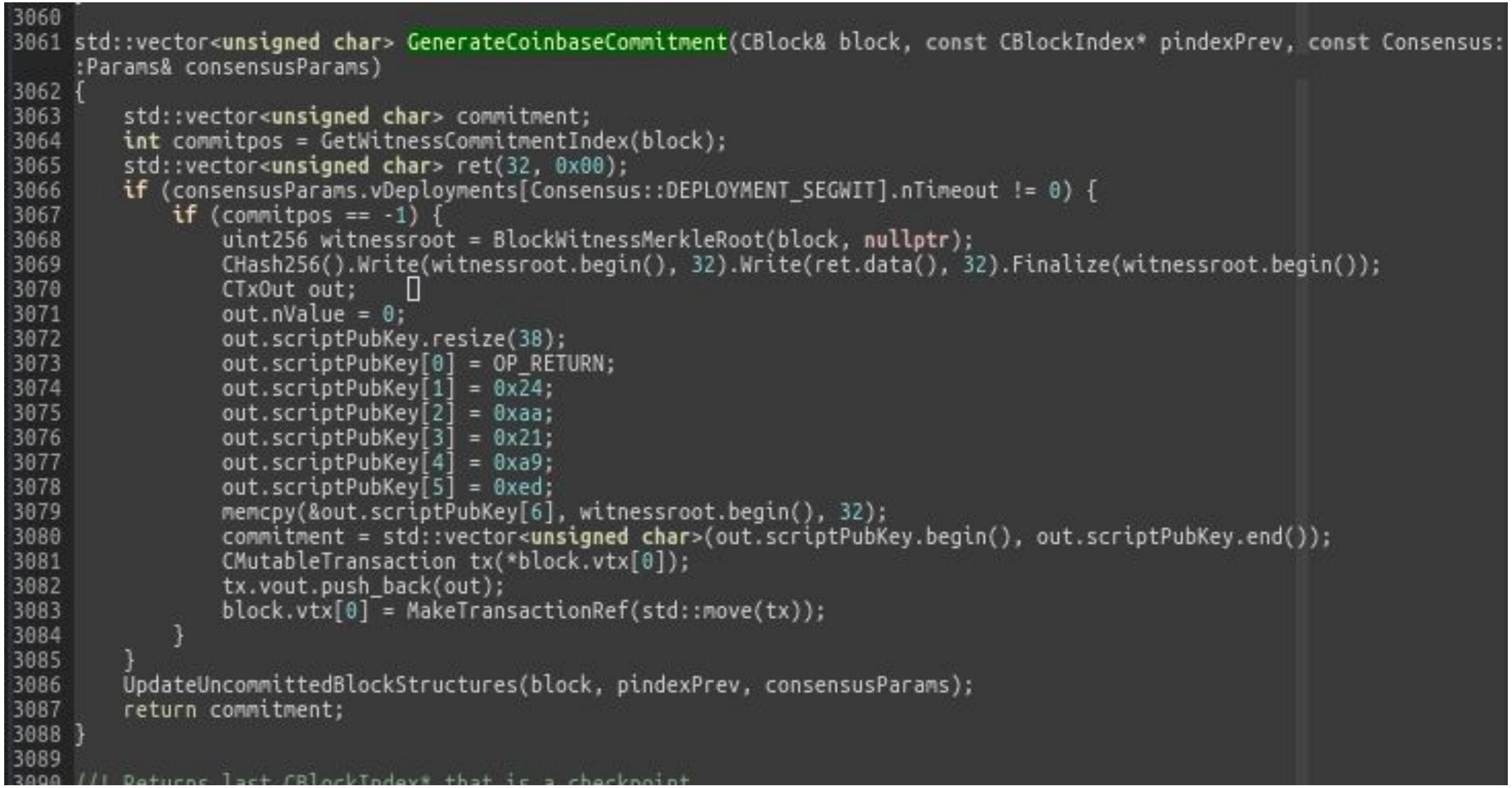
    - HASH160 <20 bytes> EQUAL vs OP_0 <32 bytes>
- script upgradeability
- block size increase
    - 4MB cap in theory, 1.6-2MB in practice

basics

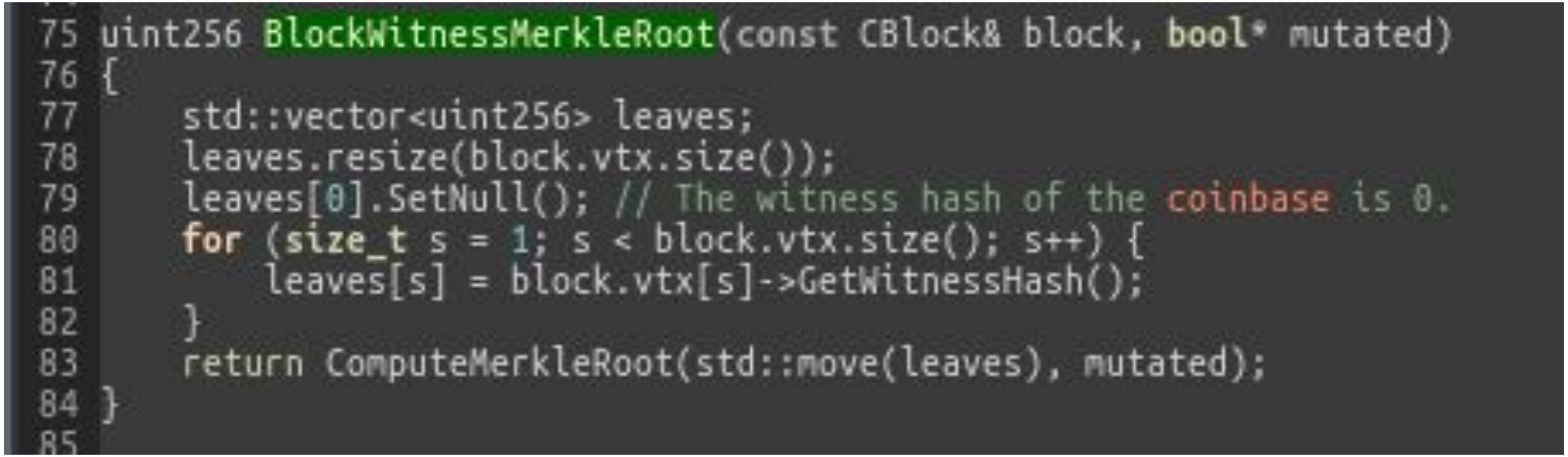
witness commitment in coinbase

src/validation.cpp



```cpp

std::vector<unsigned char> GenerateCoinbaseCommitment(CBlock& block, const CBlockIndex* pindexPrev, const Consensus::Params& consensusParams)
{
    std::vector<unsigned char> commitment;
    int commitpos = GetWitnessCommitmentIndex(block);
    std::vector<unsigned char> ret(32, 0x00);
    if (consensusParams.vDeployments[Consensus::DEPLOYMENT_SEGWIT].nTimeout != 0) {
        if (commitpos == -1) {
            uint256 witnessroot = BlockWitnessMerkleRoot(block, nullptr);
            CHash256().Write(witnessroot.begin(), 32).Write(ret.data(), 32).Finalize(witnessroot.begin());
            CTxOut out;
            out.nValue = 0;
            out.scriptPubKey.resize(38);
            out.scriptPubKey[0] = OP_RETURN;
            out.scriptPubKey[1] = 0x24;
            out.scriptPubKey[2] = 0xaa;
            out.scriptPubKey[3] = 0x21;
            out.scriptPubKey[4] = 0xa9;
            out.scriptPubKey[5] = 0xed;
            memcpy(&out.scriptPubKey[6], witnessroot.begin(), 32);
            commitment = std::vector<unsigned char>(out.scriptPubKey.begin(), out.scriptPubKey.end());
            CMutableTransaction tx(*block.vtx[0]);
            tx.vout.push_back(out);
            block.vtx[0] = MakeTransactionRef(std::move(tx));
        }
    }
    UpdateUncommittedBlockStructures(block, pindexPrev, consensusParams);
    return commitment;
}

//! Returns last CBlockIndex* that is a checkpoint
```

src/consensus/merkle.cpp



```cpp
uint256 BlockWitnessMerkleRoot(const CBlock& block, bool* mutated)
{
    std::vector<uint256> leaves;
    leaves.resize(block.vtx.size());
    leaves[0].SetNull(); // The witness hash of the coinbase is 0.
    for (size_t s = 1; s < block.vtx.size(); s++) {
        leaves[s] = block.vtx[s]->GetWitnessHash();
    }
    return ComputeMerkleRoot(std::move(leaves), mutated);
}
```

basics

witness programs

p2wpkh

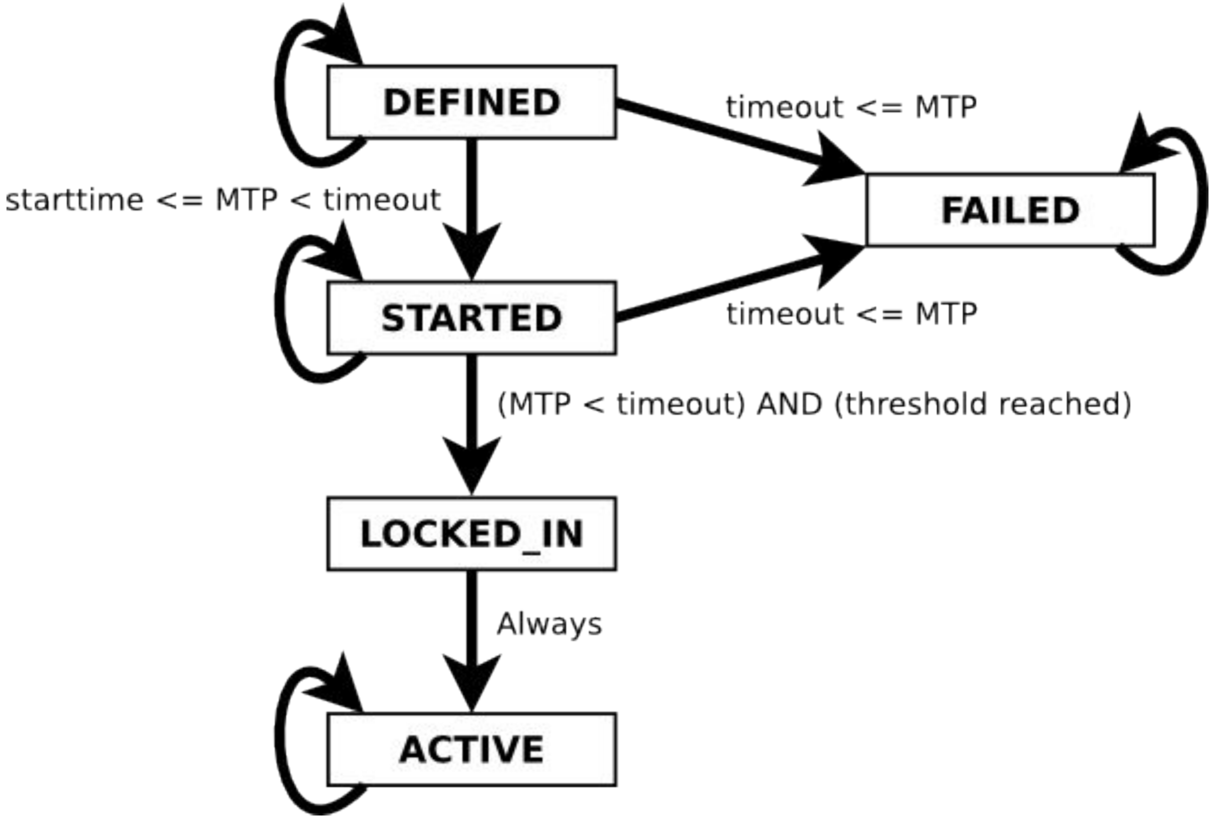
```
witness:      <signature> <pubkey>
scriptSig:    (empty)
scriptPubKey: 0 <20-byte-key-hash>
              (0x0014{20-byte-key-hash})
```

p2wsh

```
witness:      0 <signature1> <1 <pubkey1> <pubkey2> 2 CHECKMULTISIG>
scriptSig:    (empty)
scriptPubKey: 0 <32-byte-hash>
              (0x0020{32-byte-hash})
```

activation

bip9



from bip9 (https://github.com/bitcoin/bips/blob/master/bip-0009.mediawiki)

activation

bip148

```
// Check if Segregated Witness is Locked In
bool IsWitnessLockedIn(const CBlockIndex* pindexPrev, const Consensus::Params& params)
{
    LOCK(cs_main);
    return (VersionBitsState(pindexPrev, params, Consensus::DEPLOYMENT_SEGWIT,
versionbitscache) == THRESHOLD_LOCKED_IN);
}

// BIP148 mandatory segwit signalling.
int64_t nMedianTimePast = pindex->GetMedianTimePast();
if ( (nMedianTimePast >= 1501545600) &&  // Tue 01 Aug 2017 00:00:00 UTC
     (nMedianTimePast <= 1510704000) &&  // Wed 15 Nov 2017 00:00:00 UTC
     (!IsWitnessLockedIn(pindex->pprev, chainparams.GetConsensus()) &&  // Segwit is not
locked in
      !IsWitnessEnabled(pindex->pprev, chainparams.GetConsensus())) )   // and is not active.
{
    bool fVersionBits = (pindex->nVersion & VERSIONBITS_TOP_MASK) == VERSIONBITS_TOP_BITS;
    bool fSegbit = (pindex->nVersion & VersionBitsMask(chainparams.GetConsensus(),
Consensus::DEPLOYMENT_SEGWIT)) != 0;
    if (!(fVersionBits && fSegbit)) {
        return state.DoS(0, error("ConnectBlock(): relayed block must signal for segwit,
please upgrade"), REJECT_INVALID, "bad-no-segwit");
    }
  }
```

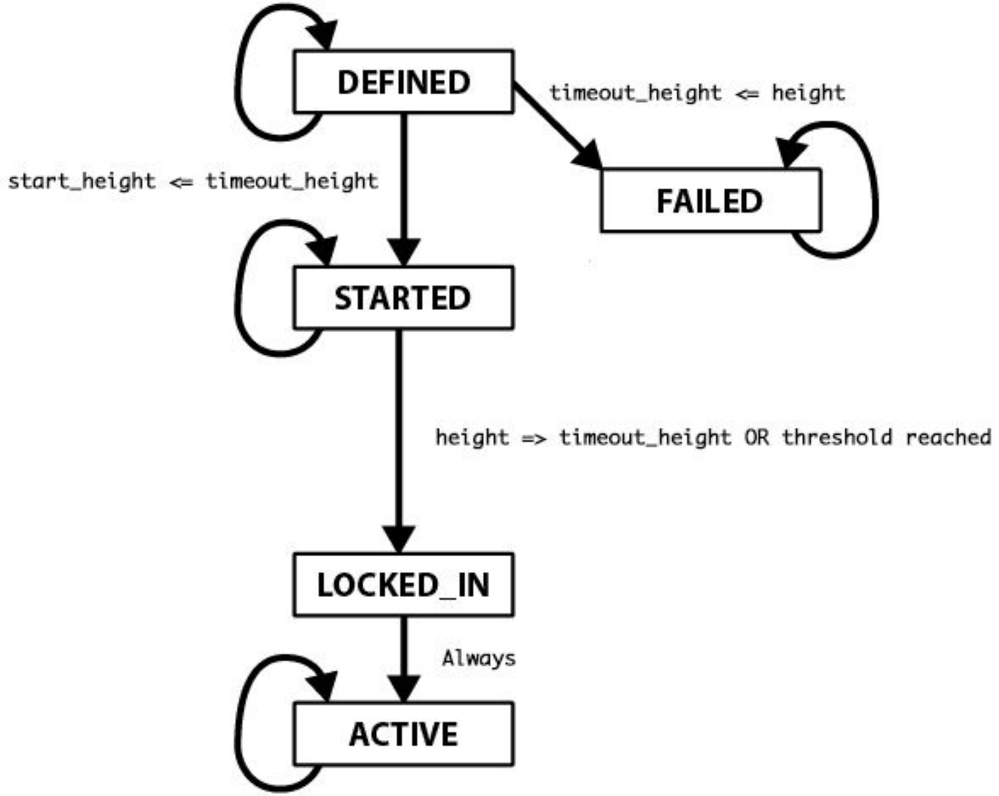
"BIP 148 would introduce a new consensus rule that softforks out non-segwit signalling blocks in some time period. I reject this consensus rule as both arbitrary and needlessly disruptive. Bitcoin's primary purpose is to reach consensus on the state of a shared ledger, and even though I think the Bitcoin network ought to adopt segwit, I don't think that concern trumps the goal of not splitting the network."

sdaftuar

https://lists.linuxfoundation.org/pipermail/bitcoin-dev/2017-May/014377.html

activation

bip8

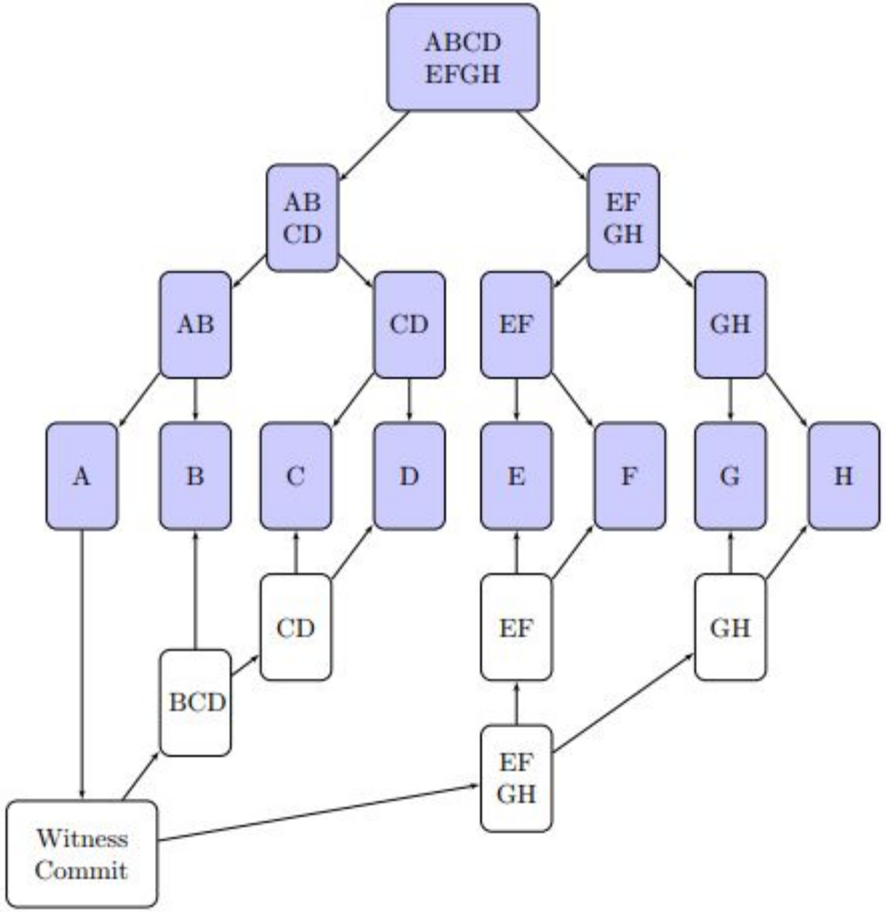

DEFINED
timeout_height <= height
FAILED
start_height <= timeout_height
STARTED
height => timeout_height OR threshold reached
LOCKED_IN
Always
ACTIVE

from bip9 (https://github.com/bitcoin/bips/blob/master/bip-0008.mediawiki)

activation

bip91

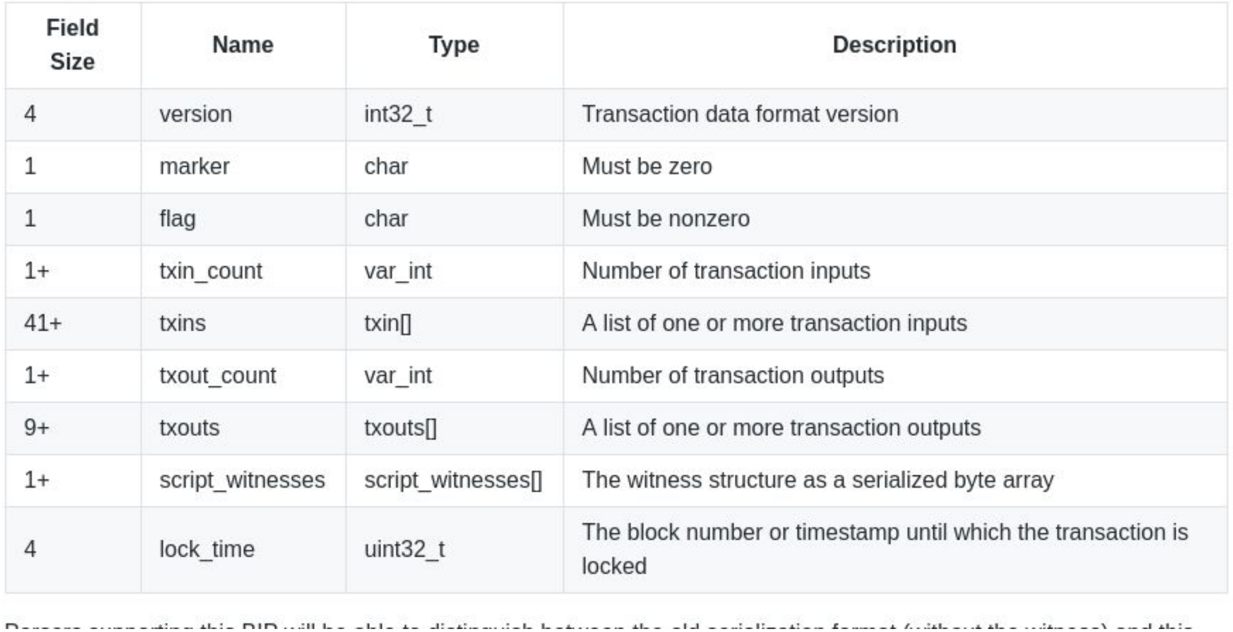
(c)overt asicboost



from jeremy rubin (http://www.mit.edu/~jlrubin//public/pdfs/Asicboost.pdf)

peer relations

new serialization format (bip144)

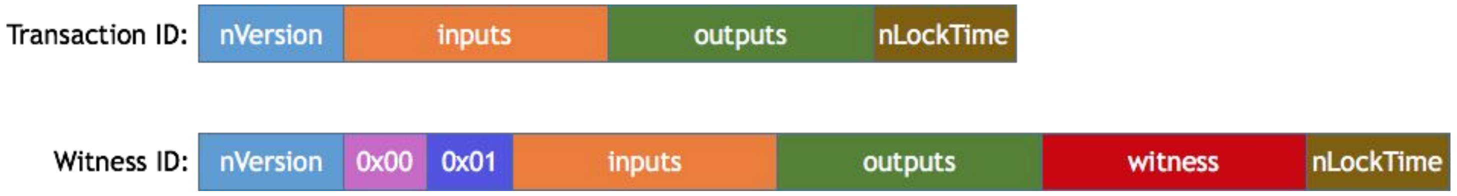


Field Size	Name	Type	Description
4	version	int32_t	Transaction data format version
1	marker	char	Must be zero
1	flag	char	Must be nonzero
1+	txin_count	var_int	Number of transaction inputs
41+	txins	txin[]	A list of one or more transaction inputs
1+	txout_count	var_int	Number of transaction outputs
9+	txouts	txouts[]	A list of one or more transaction outputs
1+	script_witnesses	script_witnesses[]	The witness structure as a serialized byte array
4	lock_time	uint32_t	The block number or timestamp until which the transaction is locked

Parsers supporting this BIP will be able to distinguish between the old serialization format (without the witness) and this

https://github.com/bitcoin/bips/blob/master/bip-0144.mediawiki

a note on hashes



"Transaction hashes used in the transaction merkle tree and txin outpoints are always computed using the old non-witness serialization."

Somewhat deceptive - witness txs don't include txin scriptSig (signature) data

https://github.com/bitcoin/bips/blob/master/bip-0144.mediawiki

peer relations

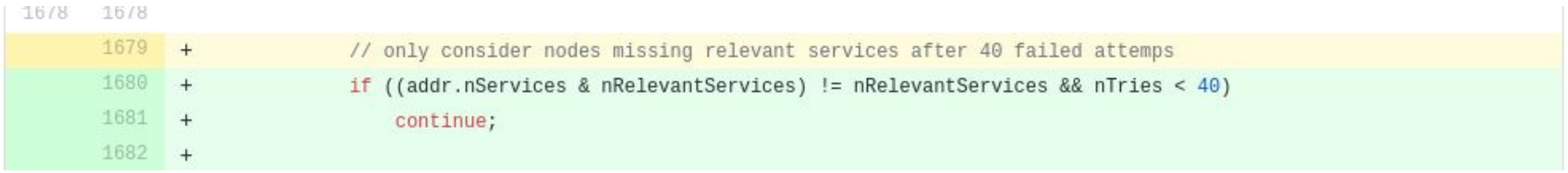
new messages (getdata):

- MSG_WITNESS_TX
- MSG_WITNESS_BLOCK

peer relations

```
git grep NODE_WITNESS
```

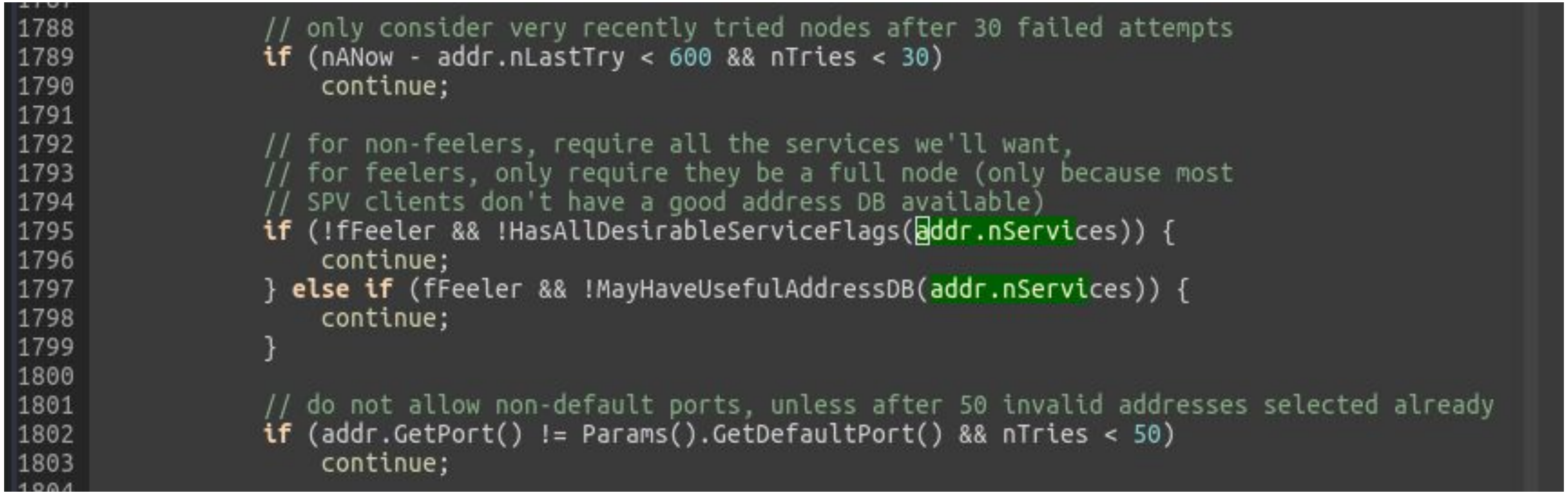
connecting to relevant services (then)



```
+        // only consider nodes missing relevant services after 40 failed attemps
+        if ((addr.nServices & nRelevantServices) != nRelevantServices && nTries < 40)
+            continue;
+
```

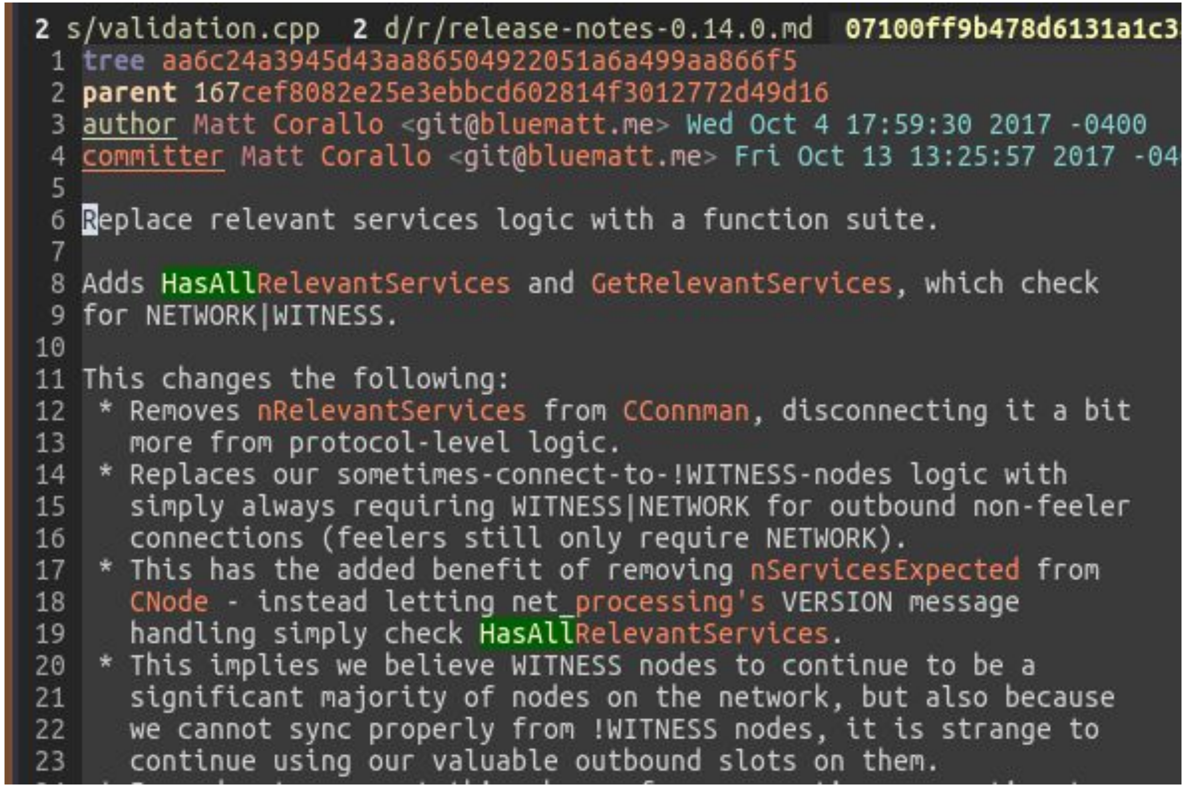
https://github.com/bitcoin/bitcoin/pull/8149/commits/b8a97498df1e83f8dcc49bc3fa4344f9e9799242#diff-9a82240fe7dfe86564178691cc57f2f1R1679

connecting to relevant services (now)

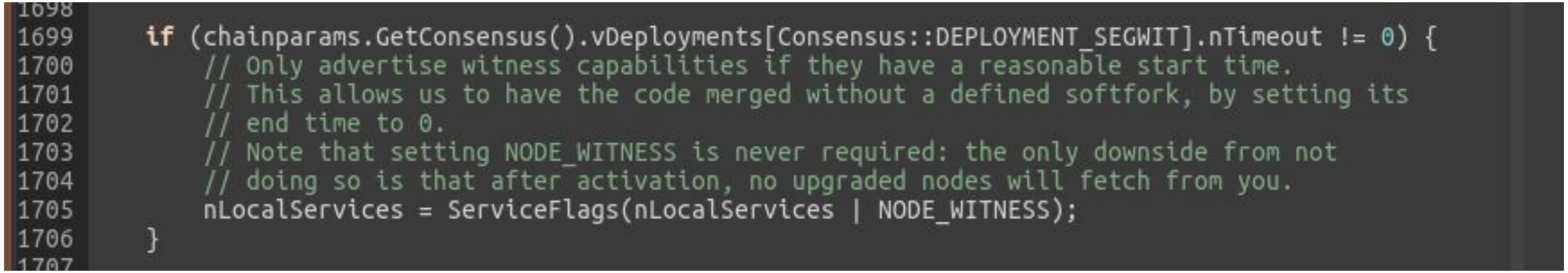


```
        // only consider very recently tried nodes after 30 failed attempts
        if (nANow - addr.nLastTry < 600 && nTries < 30)
            continue;

        // for non-feelers, require all the services we'll want,
        // for feelers, only require they be a full node (only because most
        // SPV clients don't have a good address DB available)
        if (!fFeeler && !HasAllDesirableServiceFlags(addr.nServices)) {
            continue;
        } else if (fFeeler && !MayHaveUsefulAddressDB(addr.nServices)) {
            continue;
        }

        // do not allow non-default ports, unless after 50 invalid addresses selected already
        if (addr.GetPort() != Params().GetDefaultPort() && nTries < 50)
            continue;
```

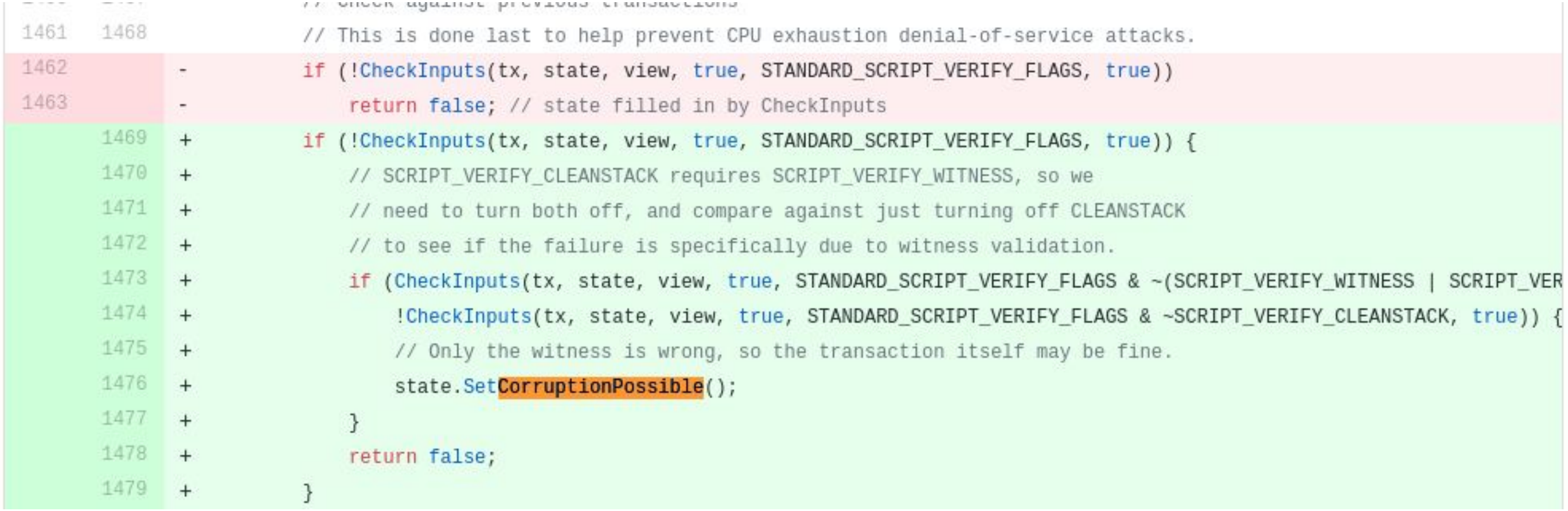
rationale



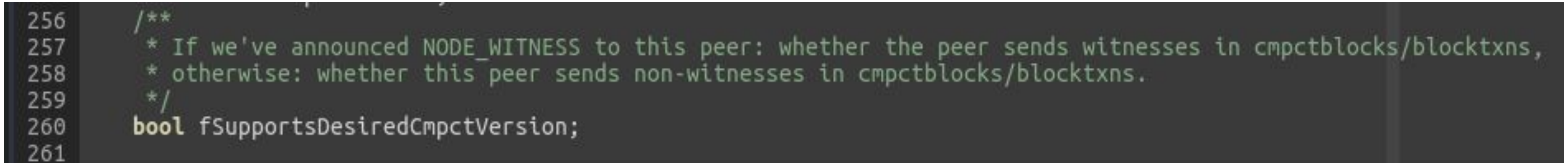
```
2 s/validation.cpp  2 d/r/release-notes-0.14.0.md  07100ff9b478d6131a1c3
tree aa6c24a3945d43aa86504922051a6a499aa866f5
parent 167cef8082e25e3ebbcd602814f3012772d49d16
author Matt Corallo <git@bluematt.me> Wed Oct 4 17:59:30 2017 -0400
committer Matt Corallo <git@bluematt.me> Fri Oct 13 13:25:57 2017 -04

Replace relevant services logic with a function suite.

Adds HasAllRelevantServices and GetRelevantServices, which check
for NETWORK|WITNESS.

This changes the following:
 * Removes nRelevantServices from CConnman, disconnecting it a bit
   more from protocol-level logic.
 * Replaces our sometimes-connect-to-!WITNESS-nodes logic with
   simply always requiring WITNESS|NETWORK for outbound non-feeler
   connections (feelers still only require NETWORK).
 * This has the added benefit of removing nServicesExpected from
   CNode - instead letting net_processing's VERSION message
   handling simply check HasAllRelevantServices.
 * This implies we believe WITNESS nodes to continue to be a
   significant majority of nodes on the network, but also because
   we cannot sync properly from !WITNESS nodes, it is strange to
   continue using our valuable outbound slots on them.
```



```
    if (chainparams.GetConsensus().vDeployments[Consensus::DEPLOYMENT_SEGWIT].nTimeout != 0) {
        // Only advertise witness capabilities if they have a reasonable start time.
        // This allows us to have the code merged without a defined softfork, by setting its
        // end time to 0.
        // Note that setting NODE_WITNESS is never required: the only downside from not
        // doing so is that after activation, no upgraded nodes will fetch from you.
        nLocalServices = ServiceFlags(nLocalServices | NODE_WITNESS);
    }
```



```
         // Check against previous transactions
         // This is done last to help prevent CPU exhaustion denial-of-service attacks.
-        if (!CheckInputs(tx, state, view, true, STANDARD_SCRIPT_VERIFY_FLAGS, true))
-            return false; // state filled in by CheckInputs
+        if (!CheckInputs(tx, state, view, true, STANDARD_SCRIPT_VERIFY_FLAGS, true)) {
+            // SCRIPT_VERIFY_CLEANSTACK requires SCRIPT_VERIFY_WITNESS, so we
+            // need to turn both off, and compare against just turning off CLEANSTACK
+            // to see if the failure is specifically due to witness validation.
+            if (CheckInputs(tx, state, view, true, STANDARD_SCRIPT_VERIFY_FLAGS & ~(SCRIPT_VERIFY_WITNESS | SCRIPT_VER
+                !CheckInputs(tx, state, view, true, STANDARD_SCRIPT_VERIFY_FLAGS & ~SCRIPT_VERIFY_CLEANSTACK, true)) {
+                // Only the witness is wrong, so the transaction itself may be fine.
+                state.SetCorruptionPossible();
+            }
+            return false;
+        }
```



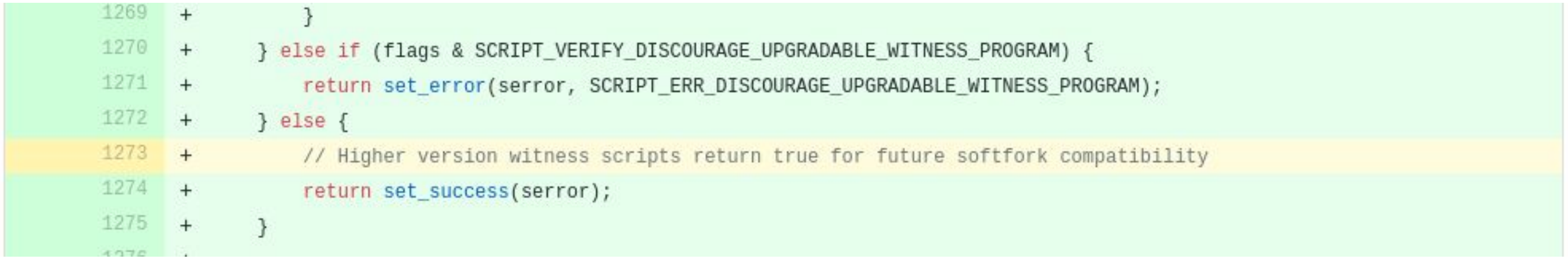
```
    /**
     * If we've announced NODE_WITNESS to this peer: whether the peer sends witnesses in cmpctblocks/blocktxns,
     * otherwise: whether this peer sends non-witnesses in cmpctblocks/blocktxns.
     */
    bool fSupportsDesiredCmpctVersion;

```

extensibility

extensibility

script versioning

src/script/interpreter.cpp

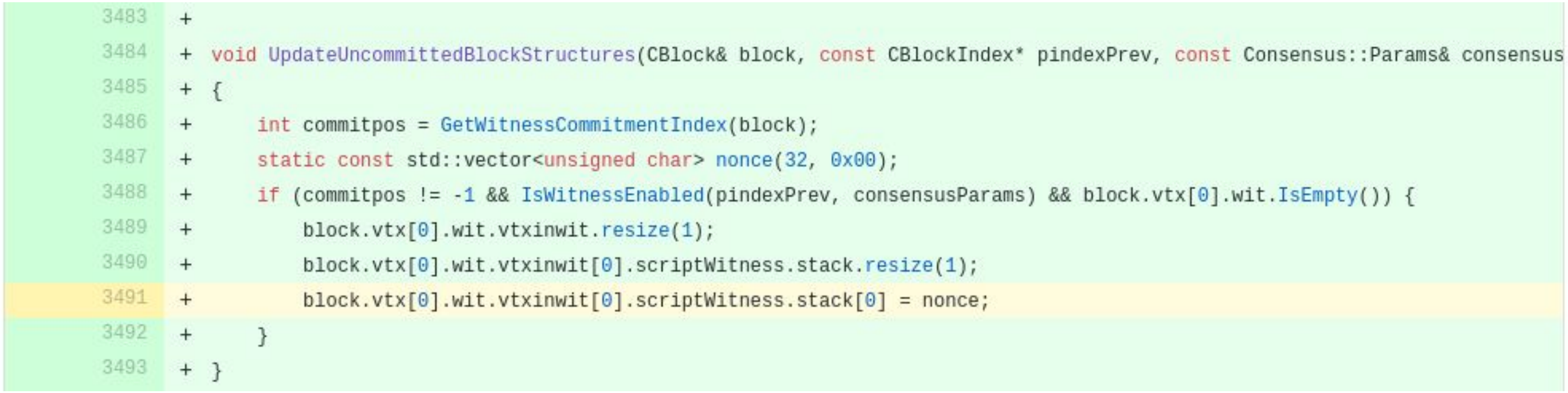


```
1269 +          }
1270 +      } else if (flags & SCRIPT_VERIFY_DISCOURAGE_UPGRADABLE_WITNESS_PROGRAM) {
1271 +          return set_error(serror, SCRIPT_ERR_DISCOURAGE_UPGRADABLE_WITNESS_PROGRAM);
1272 +      } else {
1273 +          // Higher version witness scripts return true for future softfork compatibility
1274 +          return set_success(serror);
1275 +      }
```

https://github.com/bitcoin/bitcoin/pull/8149/commits/449f9b8debcceb61a92043bc7031528a53627c47#diff-be2905e2f5218ecdbe4e55637dac75f3R1273 extensibility

unused coinbase commitment

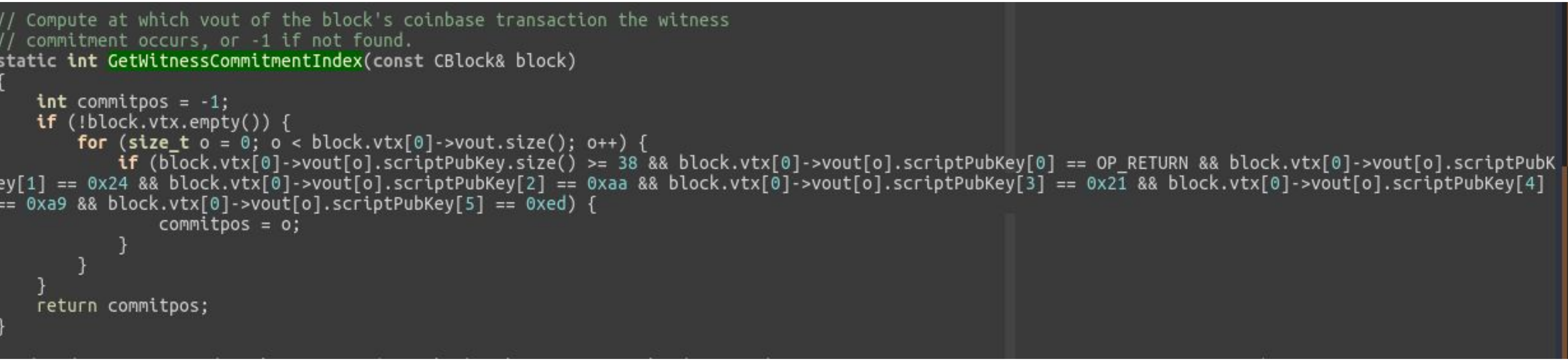
src/validation.cpp



```
3483 +
3484 + void UpdateUncommittedBlockStructures(CBlock& block, const CBlockIndex* pindexPrev, const Consensus::Params& consensus
3485 + {
3486 +     int commitpos = GetWitnessCommitmentIndex(block);
3487 +     static const std::vector<unsigned char> nonce(32, 0x00);
3488 +     if (commitpos != -1 && IsWitnessEnabled(pindexPrev, consensusParams) && block.vtx[0].wit.IsEmpty()) {
3489 +         block.vtx[0].wit.vtxinwit.resize(1);
3490 +         block.vtx[0].wit.vtxinwit[0].scriptWitness.stack.resize(1);
3491 +         block.vtx[0].wit.vtxinwit[0].scriptWitness.stack[0] = nonce;
3492 +     }
3493 + }
```

https://github.com/bitcoin/bitcoin/pull/8149/commits/8b49040854be2e26b66366aeae1cba4716f93d93#diff-7ec3c68a81efff79b6ca22ac1f1eabbaR3491

the worst line in segwit



```
// Compute at which vout of the block's coinbase transaction the witness
// commitment occurs, or -1 if not found.
static int GetWitnessCommitmentIndex(const CBlock& block)
{
    int commitpos = -1;
    if (!block.vtx.empty()) {
        for (size_t o = 0; o < block.vtx[0]->vout.size(); o++) {
            if (block.vtx[0]->vout[o].scriptPubKey.size() >= 38 && block.vtx[0]->vout[o].scriptPubKey[0] == OP_RETURN && block.vtx[0]->vout[o].scriptPubK
ey[1] == 0x24 && block.vtx[0]->vout[o].scriptPubKey[2] == 0xaa && block.vtx[0]->vout[o].scriptPubKey[3] == 0x21 && block.vtx[0]->vout[o].scriptPubKey[4]
== 0xa9 && block.vtx[0]->vout[o].scriptPubKey[5] == 0xed) {
                commitpos = o;
            }
        }
    }
    return commitpos;
}
```

cmon man that’s 354 characters

j/k pieter thanks for segwit

but for real
maybe let’s do 120col

questions

questions

was segwit the right change?

questions

what’s involved in schnorr/taproot upgrade?

questions

what’s a likely deployment mechanism?

links

- segwit PR (rebased): https://github.com/bitcoin/bitcoin/pull/8149
- Peter Todd’s code review: https://petertodd.org/2016/segwit-consensus-critical-code-review
- BIPs 141-144: you’ll read ‘em multiple times
- test/functional/test_framework/messages.py: quick ref for message formats

it's my 30th birthday
come to Madison Sq Park
have some red wine
make unqualified statements
about consensus critical code