BCH Scaling Research Summary

Introduction

During the spring and summer of 2022, the Bitcoin Verde team tested a variety of applications used on the Bitcoin Cash network in an effort to identify any challenges that might be faced in a 256 MB block scenario. As the project progressed, updates were posted to this Bitcoin Cash Research page. The applications tested were:

- Bitcoin Cash Node (BCHN)
- Fulcrum
- Blockbook
- Bitcore Node
- ASICseer Pool

In order to perform these tests a testing tool was created that has two modes: mining and emitting. The mining mode generates a fork of the BCH blockchain that contains blocks with varying numbers of transactions and varying numbers of inputs and outputs. The emitting mode loads the pre-mined blocks from disk and sends them to a node configured to receive them. Additionally, the emitter was capable of sending a block then, over time, sending transactions that would appear in the next block to be sent, better mimicking real-world scenarios. For each application, we ran "0p" and "90p" tests, in which 0% and 90%, respectively, of the transactions from the next block would be sent before the block itself was sent.

For the majority of the tests, a forked version of BCHN (modified slightly to accept the test chain) was sent the blocks for processing. The application under test was then connected to this BCHN node and set up to process the blocks however it normally would. For the purposes of testing ASICseer Pool (and any future mining software) a simple stratum client was created to receive and log stratum messages coming from the pool software.

After running each test, log files from the testing tool, BCHN, and any other included applications, were collected. Data was extracted from these log files using bash scripts, which output CSVs. Those CSVs were then fed into spreadsheets where further processing and analysis could take place. Application-specific methods, scripts, log files, and other data can be found here.

Results

BCHN

BCHN generally performed well, though some issues were identified. A 256 MB block reorg resulted in 2-3 times longer processing times than similar blocks. This led to reorg processing times at or above 60 seconds, pointing to a potential issue for mining should 256 MB blocks become common.

Separately, an anomaly with the "Fan Out" blocks, 185 MB blocks composed of transactions each with 26 outputs, every fifth block would take significantly longer. In the case of the Fulcrum test, BCHN took several minutes to process these blocks (compared to roughly 15 seconds for otherwise identical blocks). The root cause of this issue appears to have been a dbcache size set too low. Using more typical values minimized the issue and setting it to 16000 was reported to remove the issue entirely.

Fulcrum

A number of issues were encountered while testing Fulcrum, resulting in many variations of the test being run. This is in part due to it being the first major test of an application, so some of this was due to working out issues with the testing methodology.

Ultimately, however, we were unable to complete a 0p test. In the 90p test, Fulcrum had issues processing "Steady State 1" and "Fan In" blocks, taking over 20 minutes on average to process the blocks in each category. These are the blocks which contain transactions spending large numbers of inputs (25 and 64 per transaction, respectively). In contrast, the "Fan Out" blocks, which have 1 input per transaction but 26 output) were processed in 29 seconds on average. These blocks are also slightly smaller, but not enough to explain these findings.

Blockbook

For Blockbook, a 0p test was also unsuccessful for unknown reasons. We ultimately determined that Blockbook was waiting to receive transactions before it would do what we were expecting. As a result, we ran a "1p" test (1% of transactions sent before the block) instead of the normal 0p test.

The 1p results were fairly consistent within each category, with "Fan Out" blocks taking much longer than the other block types (17.5 minutes on average). The 90p results were similar for

"Fan Out" blocks but much worse elsewhere, with seemingly random results even within each category. The reasons for this are still somewhat unclear. For more details, see this progress update.

Bitcore Node

Bitcore Node was the only application tested that we were unable to test completely. We were able to sync test-specific blocks, but the test failed once we reached the first large block (185 MB). After unsuccessfully searching the source code for relevant limits and trying different configuration options, we eventually decided to abandon the test. For more details, see this progress update.

ASICseer Pool

ASICseer Pool was, unsurprisingly, able to quickly react to new blocks being mined.

There were idiosyncrasies in other data that potentially warrant further investigation, but broadly speaking it performed well.

Future Considerations

The work completed as a part of this research is intended to be a foundation for future testing and analysis. All of the source code, data, and analysis is available to public use. Some of the results found as a part of this effort have already been recreated and expanded upon by members of the BCH community, and we hope that this continues. Reproduction of these tests to ensure nothing of import was missed (or misinterpreted) is critical.

In addition, there are many other applications used across the BCH landscape which could be tested using similar methods. In many cases, this may be possible with minimal modifications. However, it may be necessary in some cases to develop additional tools or methods for testing application types that were not included in this research. Similarly, it could be beneficial to create an alternate test chain with more blocks, or blocks with different transaction compositions.

In the short term, this research may help optimize applications and streamline processes taking place on the BCH network. Over time, especially as new proposals emerge that would lead to larger blocks, this research vision may become increasingly focused, allowing a more trusted and seamless transition into the future of BCH.