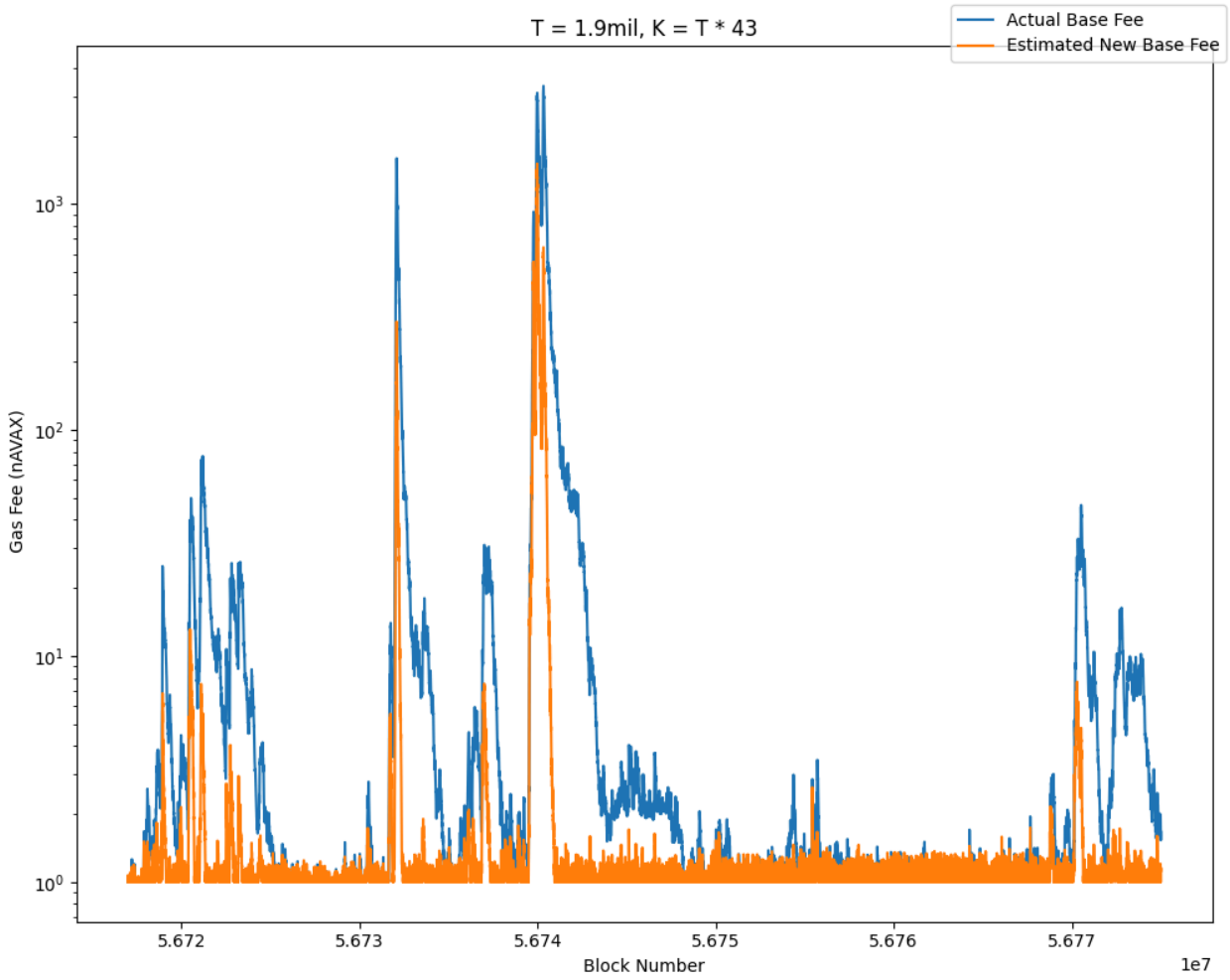
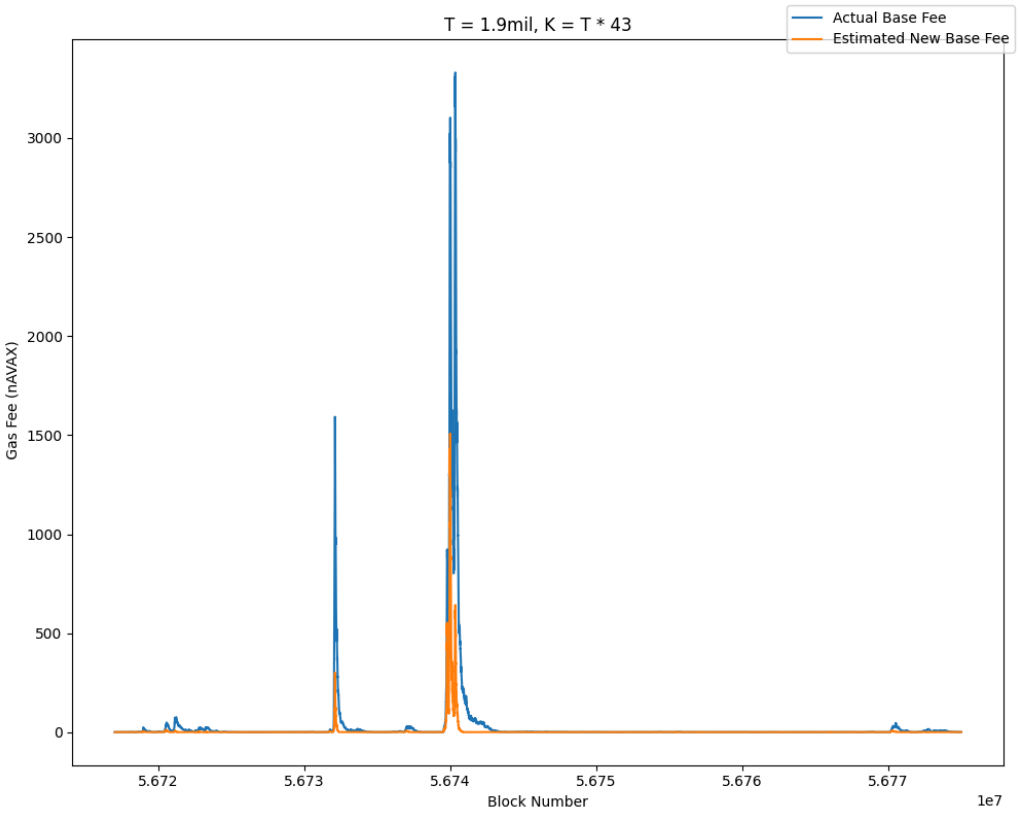
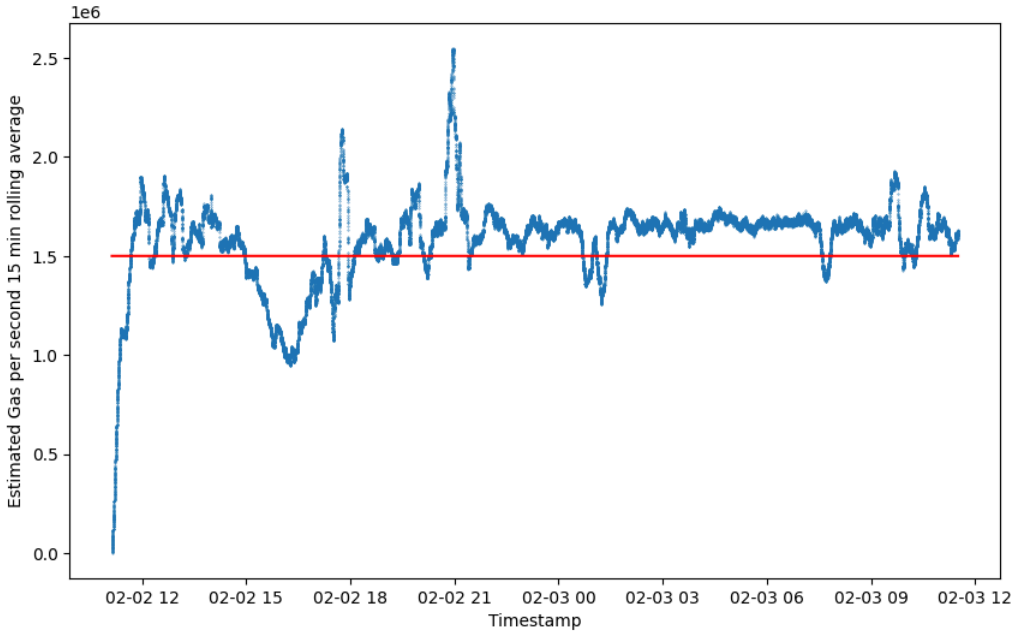
ACP-176 Experiment Results

Historical Comparisons



There was a very high gas fee spike on February 2, 2025, in which Avalanche maintained higher than average fees despite load decreasing to normal levels (look above for log-scaled, below for linear-scaled). An easy way to begin a comparison is to use this historical data.





Observations:

- Actual base fees remain high for up to an hour after original spike because some accounts are willing to pay them.

- Actual mechanism does not converge to gas target, but instead consumes much more gas than expected.
- New mechanism parameters used estimates from sustained high load for comparison.

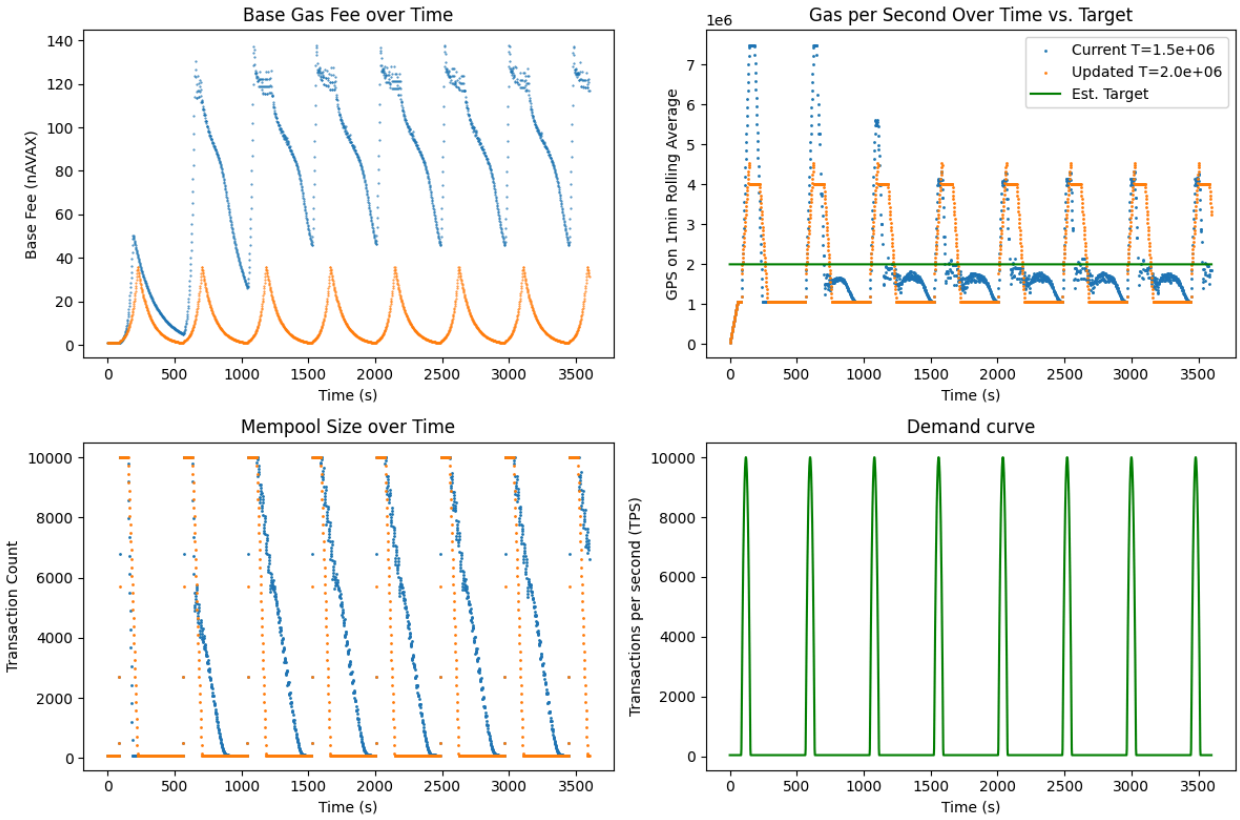
Flaws:

- Comparing gas targets is difficult, since the old mechanism sustains gas consumption at different levels depending on demand.
- The data only includes accepted transactions. Thus, we cannot see how dropped transactions due to low price would have effected the gas fee, nor can the market respond to a different gas fee.

Old vs. New Simulations

Small Mempool

Parameters:
Target for old mechanism = 15 million gas in 10 seconds (averages 2 million gas per second during experiment)
Target for new mechanism = 2 million gas per second
Transactions randomly sampled from normal distribution with mean=100nAVAX, std=10nAVAX
Mempool cap = 10000 transactions
Peak Demand = 1000 transactions per second
Valley Demand = 50 transactions per second
Blocks are proposed every 2 seconds.

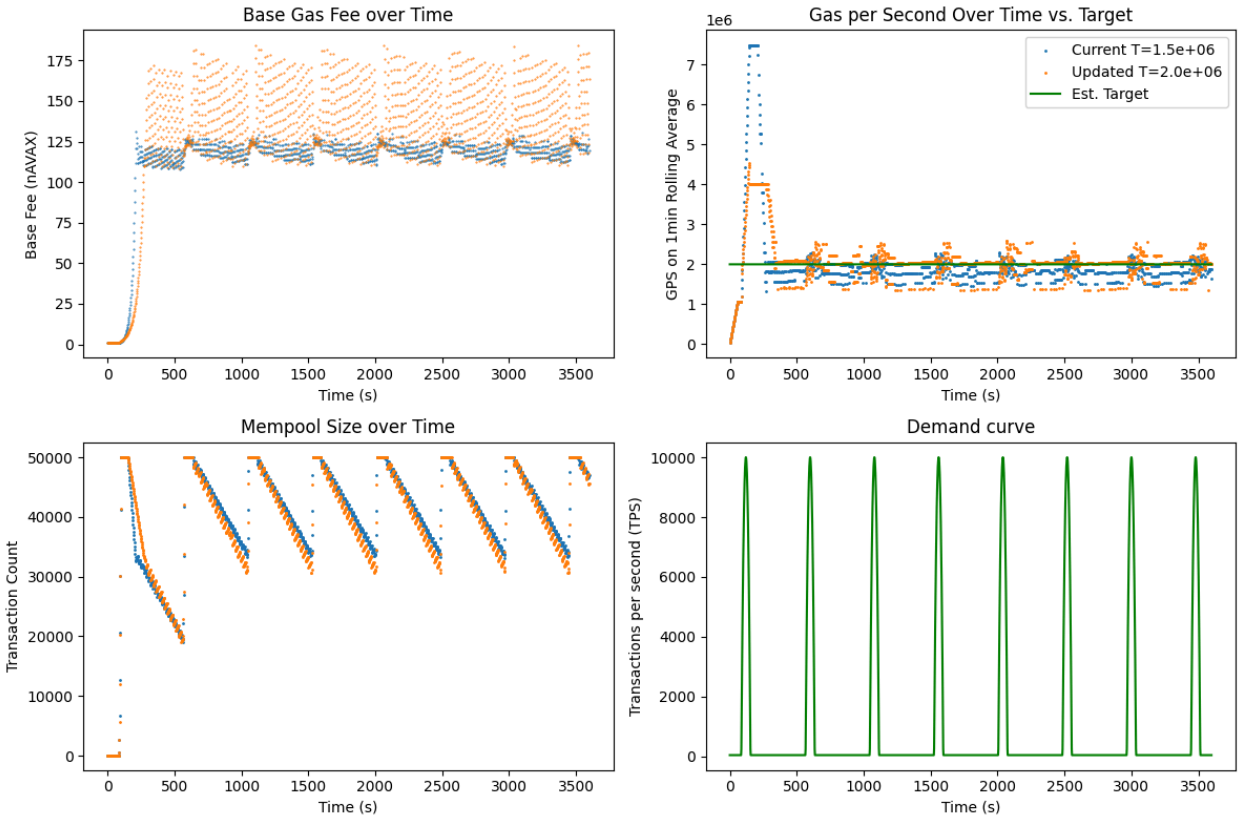


Observations:

- Average Gas Per Second matches closely, despite different targets
- Both mechanisms completely empty the mempool between demand spikes
- New mechanism sustains higher-than-target load through demand spike with exponential fee increases until mempool begins to empty. Fees lower at exponential rate.
- Old mechanism spikes fees much higher on demand, and requires sustained low demand to lower base fees at approximately linear rate.

Large mempool

Parameters:
Same as above, except mempool size is 50k transactions.



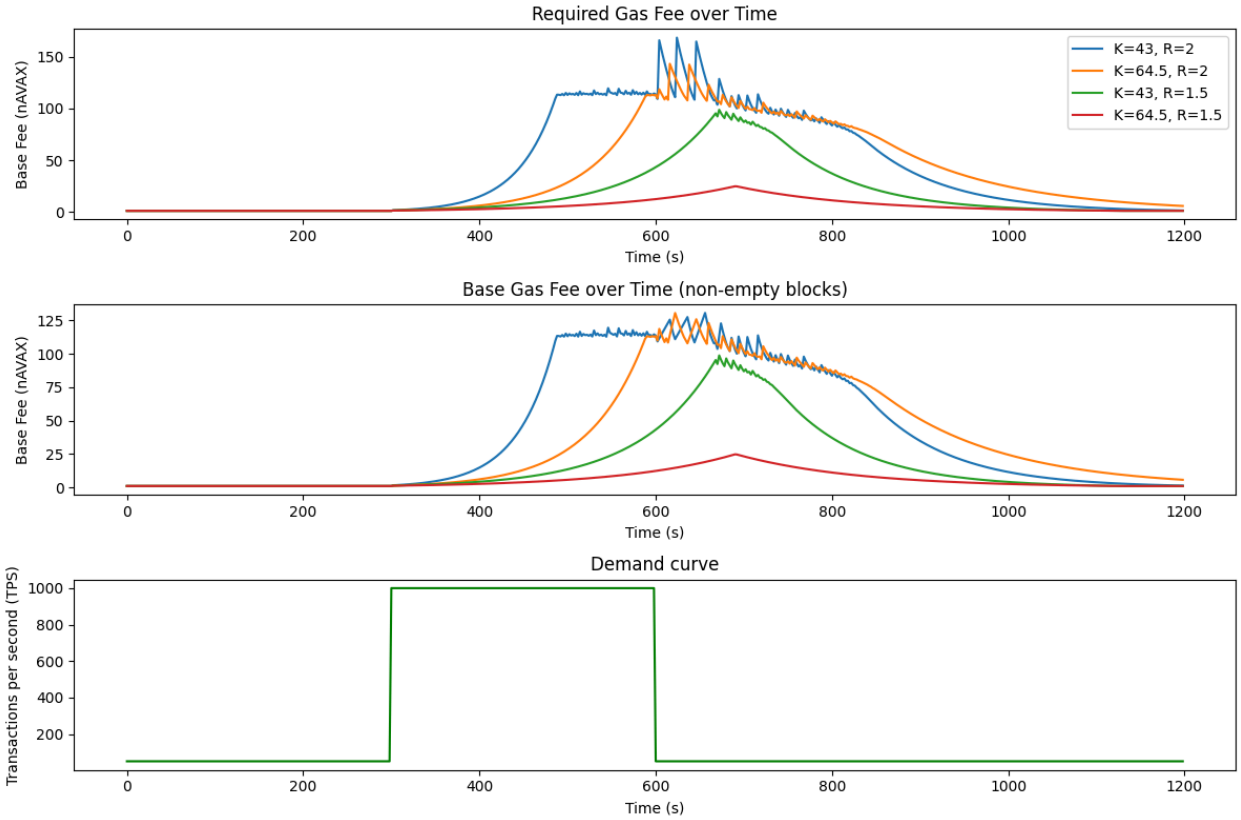
Observations:

- With sustained full mempool, base gas fees with new mechanism form sawtooth pattern due to large variations in block sizes. When the gas fees lower at first, very few transactions can be included. However, due to sampling from normal distribution and exponential fee reductions, a very large block is proposed as soon as gas fees dip close towards the mean of the sampling distribution. This causes the gas fee to instantly spike.
- The old mechanism maintains slightly more stable base gas fees due to the windowing mechanism.
- The mempool never completely clears, removing the ability for either mechanism to respond to the low demand.

Likely Flaw to this experiment:

- When the gas fee is sustained above 100 nAVAX, in the real world, many accounts would either raise their maximum fee, or more likely, not submit their transaction until the fee lowers. This would result in a more sustained demand curve with less variation in block size.
- The mempool is much smaller in reality than 50k transactions and removes old pending transactions.

Parameter Comparison Simulations



Uses similar parameters to above.
Observations:

- As mempool skews from accepting high transactions, we see the fee spike, much like in previous simulations with a large mempool.
- With the standard of K=43, R=2 (for ratios used in ACP-176), we can see that the red graph is likely not reactive enough - we can likely only raise the K ratio or lower the R ratio, but not both to any extreme extent.
- Changing the K ratio the rate at which fees increase and decrease. However, changing the R ratio (below 2) only changes the rate at which fees increase.
- Removing empty blocks more accurately displays the gas fee at any time.