SmartFee Dynamic Fee Bumping

Technical Deep Dive

Problem:

Bitcoin fee estimation is unreliable due to random nature of block intervals

- Estimate too low and transactions get stuck

- Estimate too high and you overpay

Solution:

RBF (Replace-By-Fee)

- Can dynamically increase fee as needed to get into next block at minimum fee

Problem:

Normal implementations of RBF have some issues

- Confusing customer experience when withdrawal transaction is replaced

- Scary customer experience when some external wallets don't show RBF transactions until they confirm

- Wallets like BitGo/Fireblocks do not have native RBF support

Solution:

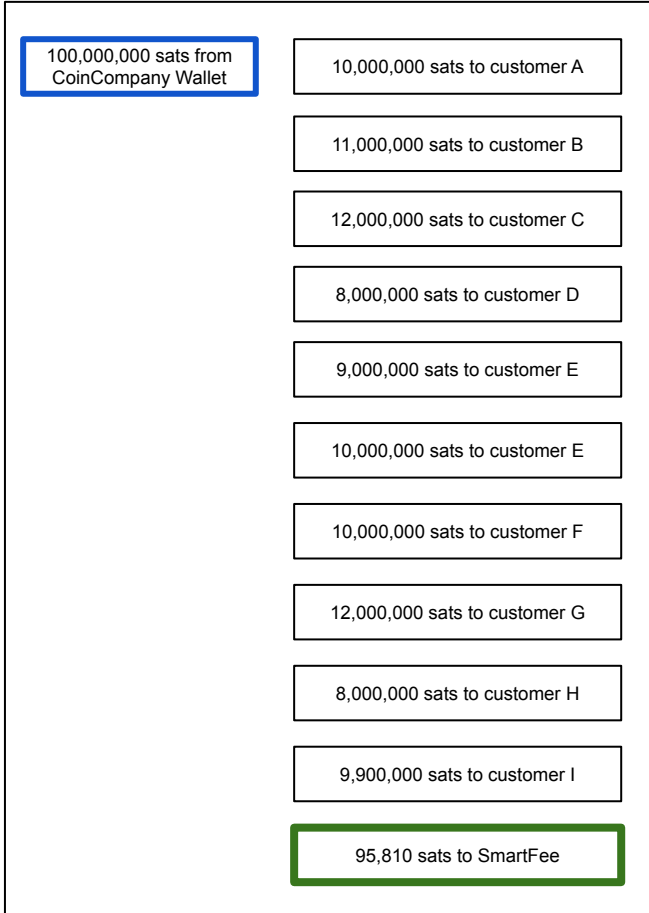SmartFee Dynamic Fee Bumping provides the benefits of RBF without the drawbacks

How it works

Scenario:

CoinCompany is a large retail bitcoin exchange

- Uses a BitGo hot wallet

- Services high volume of customer withdrawals

- Batches withdrawals

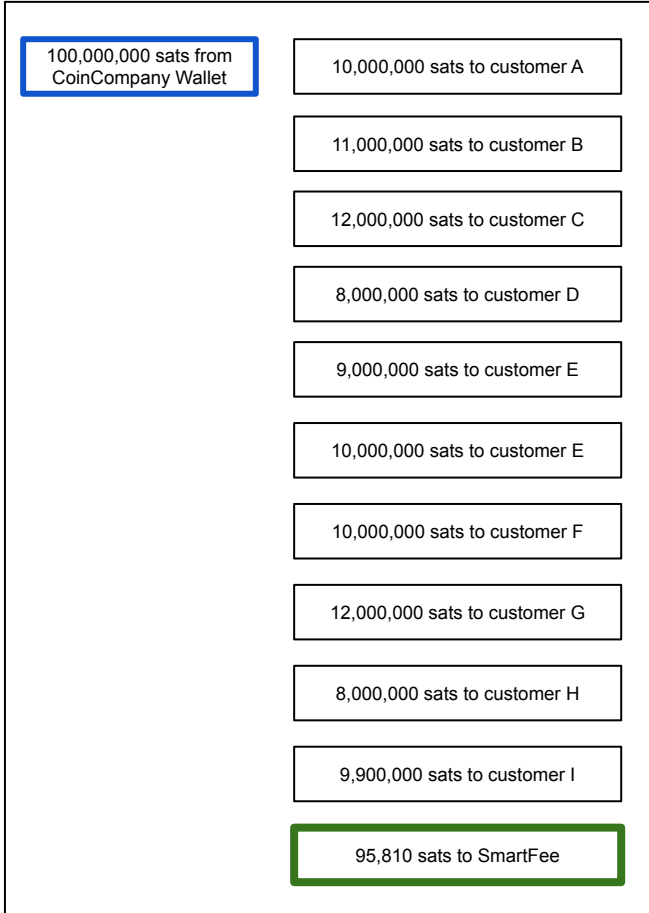- Uses SmartFee to optimize transaction fees and confirmation speed

Txid: abcdefg

100,000,000 sats from CoinCompany Wallet	10,000,000 sats to customer A
	11,000,000 sats to customer B
	12,000,000 sats to customer C
	8,000,000 sats to customer D
	9,000,000 sats to customer E
	10,000,000 sats to customer E
	10,000,000 sats to customer F
	12,000,000 sats to customer G
	8,000,000 sats to customer H
	9,900,000 sats to customer I
	95,810 sats to SmartFee

Step 1:

CoinCompany creates a normal batched withdrawal from their hot wallet with 1 additional output to a SmartFee address
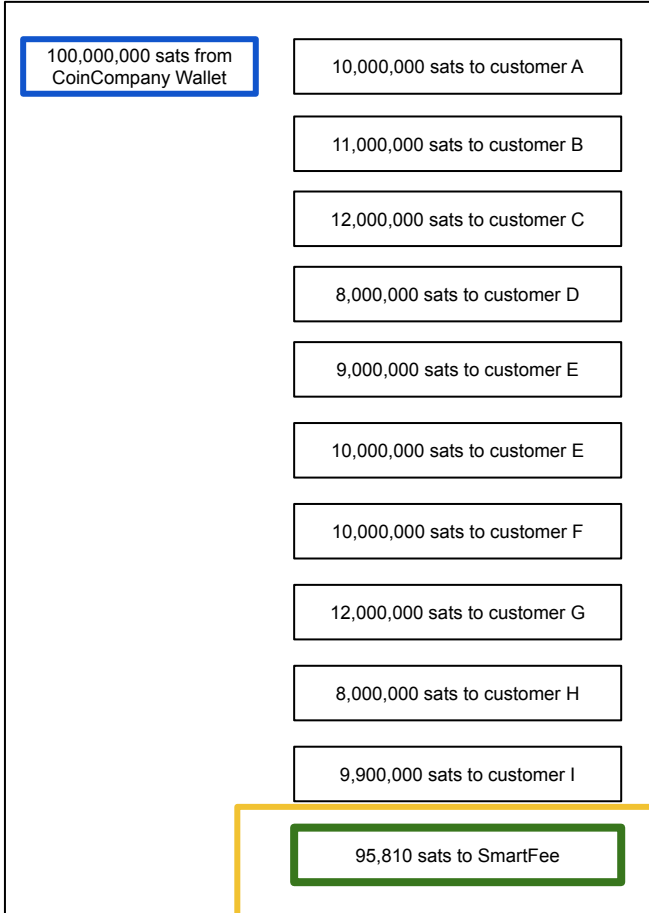
Tx net fee rate: 10 sats/byte

Txid: abcdefg

100,000,000 sats from CoinCompany Wallet

10,000,000 sats to customer A

11,000,000 sats to customer B

12,000,000 sats to customer C

8,000,000 sats to customer D

9,000,000 sats to customer E

10,000,000 sats to customer E

10,000,000 sats to customer F

12,000,000 sats to customer G

8,000,000 sats to customer H

9,900,000 sats to customer I

95,810 sats to SmartFee

Step 2a:

SmartFee monitors the transaction and the mempool, continuously calculating what the minimum fee rate of the next block will be

Tx net fee rate: 10 sats/byte

Txid: abcdefg

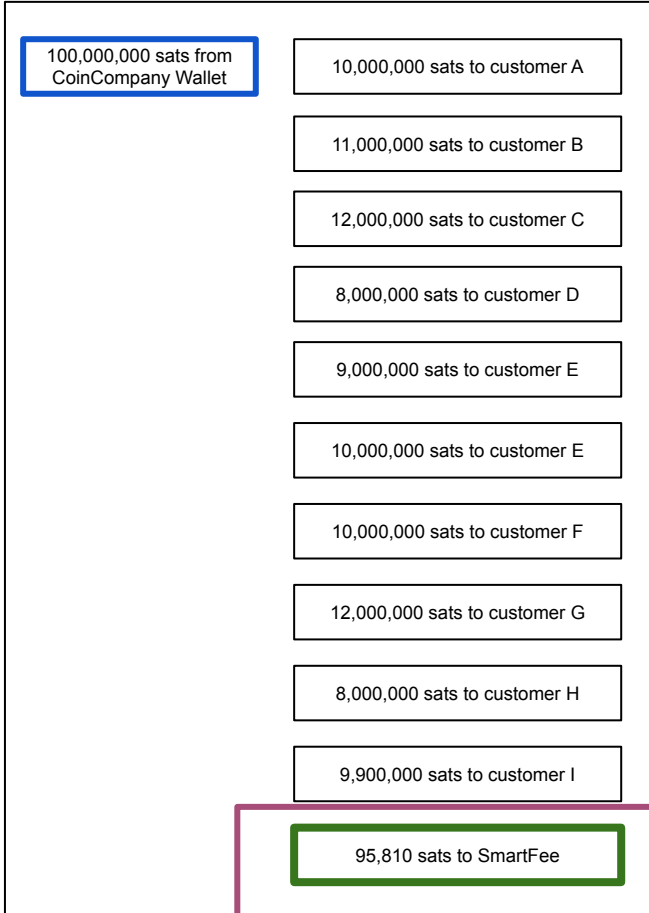|	
100,000,000 sats from CoinCompany Wallet	10,000,000 sats to customer A
	11,000,000 sats to customer B
	12,000,000 sats to customer C
	8,000,000 sats to customer D
	9,000,000 sats to customer E
	10,000,000 sats to customer E
	10,000,000 sats to customer F
	12,000,000 sats to customer G
	8,000,000 sats to customer H
	9,900,000 sats to customer I

Step 2b:

When the mempool grows, SmartFee appends a replaceable CPFP transaction to bump up the net fee of the withdrawal to ensure it will still get into the next block

Tx net fee rate: 11 sats/byte

Txid: jklmnop

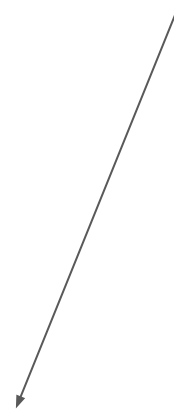|	
95,810 sats to SmartFee	90,000 sats to CoinCompany Wallet

Txid: abcdefg

100,000,000 sats from CoinCompany Wallet	10,000,000 sats to customer A
	11,000,000 sats to customer B
	12,000,000 sats to customer C
	8,000,000 sats to customer D
	9,000,000 sats to customer E
	10,000,000 sats to customer E
	10,000,000 sats to customer F
	12,000,000 sats to customer G
	8,000,000 sats to customer H
	9,900,000 sats to customer I

Step 2c:

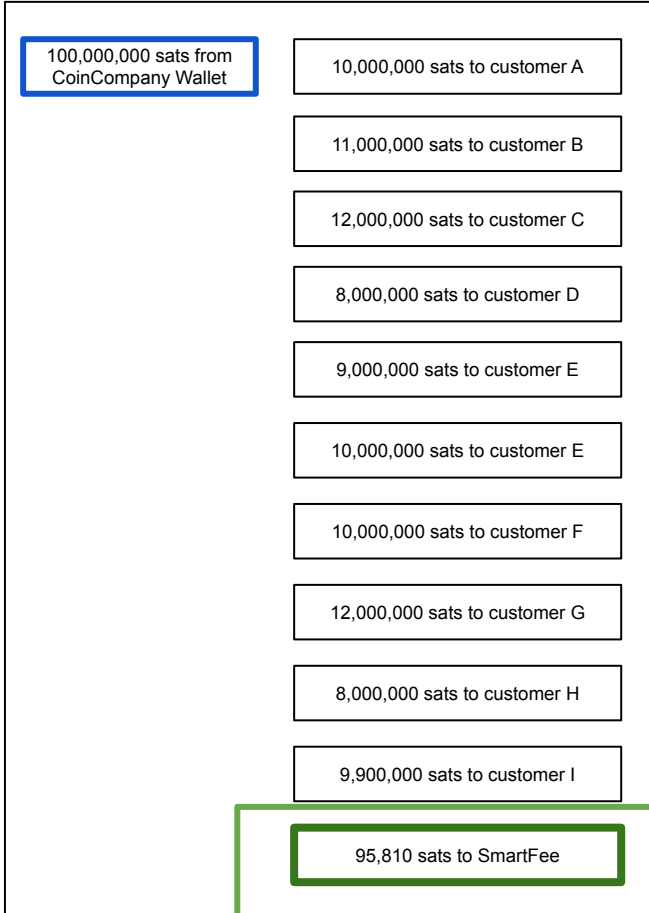**As the mempool grows more, SmartFee replaces the CPFP tx with a higher fee CPFP tx**

Tx net fee rate: 12 sats/byte

Txid: qrstuvwx

95,810 sats to SmartFee
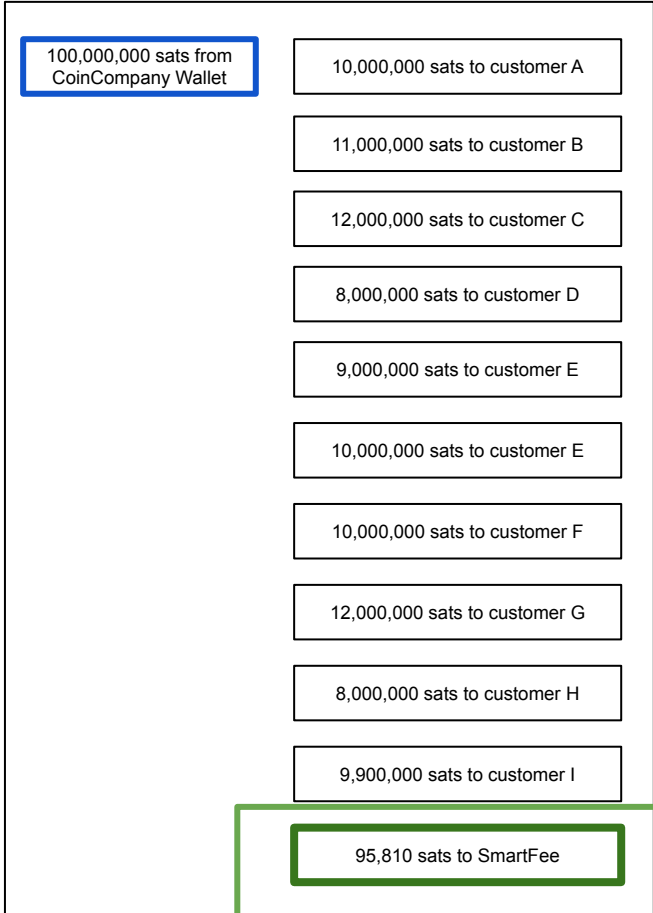
85,000 sats to CoinCompany Wallet

Txid: abcdefg

100,000,000 sats from CoinCompany Wallet	

10,000,000 sats to customer A

11,000,000 sats to customer B

12,000,000 sats to customer C

8,000,000 sats to customer D

9,000,000 sats to customer E

10,000,000 sats to customer E

10,000,000 sats to customer F

12,000,000 sats to customer G

8,000,000 sats to customer H

9,900,000 sats to customer I

Tx net fee rate: 13 sats/byte

95,810 sats to SmartFee

Txid: ajpdxoef

80,000 sats to CoinCompany Wallet

Step 2c:

Smart Fee keeps replacing the CPFP tx as many times as needed

Txid: abcdefg

| 100,000,000 sats from CoinCompany Wallet | 10,000,000 sats to customer A |

11,000,000 sats to customer B

12,000,000 sats to customer C

8,000,000 sats to customer D

9,000,000 sats to customer E

10,000,000 sats to customer E

10,000,000 sats to customer F

12,000,000 sats to customer G

8,000,000 sats to customer H

9,900,000 sats to customer I

95,810 sats to SmartFee

Tx net fee rate: 13 sats/byte

Txid: ajpdxoef

80,000 sats to CoinCompany Wallet

Note:

The Batched Withdrawal Transaction never gets replaced

Txid: abcdefg

100,000,000 sats from CoinCompany Wallet	10,000,000 sats to customer A
	11,000,000 sats to customer B
	12,000,000 sats to customer C
	8,000,000 sats to customer D
	9,000,000 sats to customer E
	10,000,000 sats to customer E
	10,000,000 sats to customer F
	12,000,000 sats to customer G
	8,000,000 sats to customer H
	9,900,000 sats to customer I
	95,810 sats to SmartFee
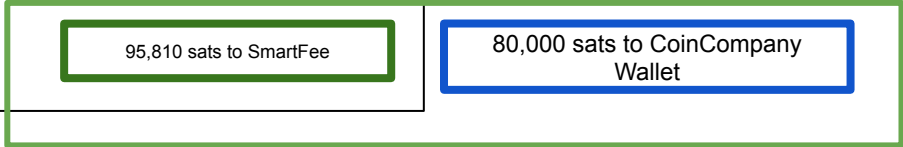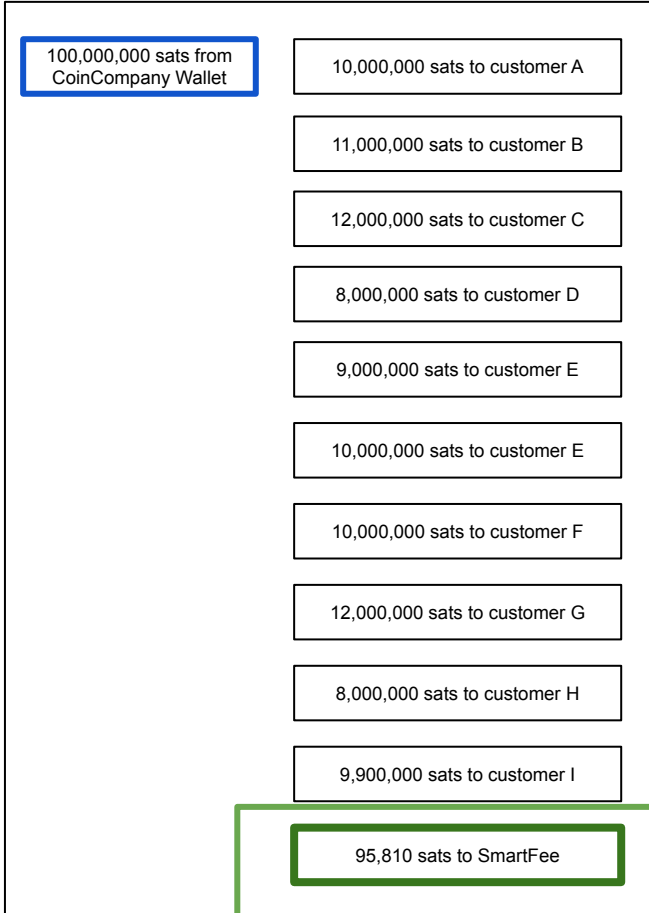
Step 3:

Transaction confirms in the next block at the minimum possible fee rate

Tx net fee rate: 13 sats/byte
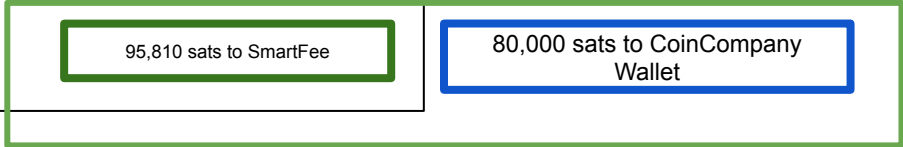
Txid: ajpdxoef

80,000 sats to CoinCompany Wallet

Txid: abcdefg

100,000,000 sats from
CoinCompany Wallet

10,000,000 sats to customer A

11,000,000 sats to customer B

12,000,000 sats to customer C

8,000,000 sats to customer D

9,000,000 sats to customer E

10,000,000 sats to customer E

10,000,000 sats to customer F

12,000,000 sats to customer G

Tx net fee rate: 13 sats/byte

8,000,000 sats to customer H

9,900,000 sats to customer I
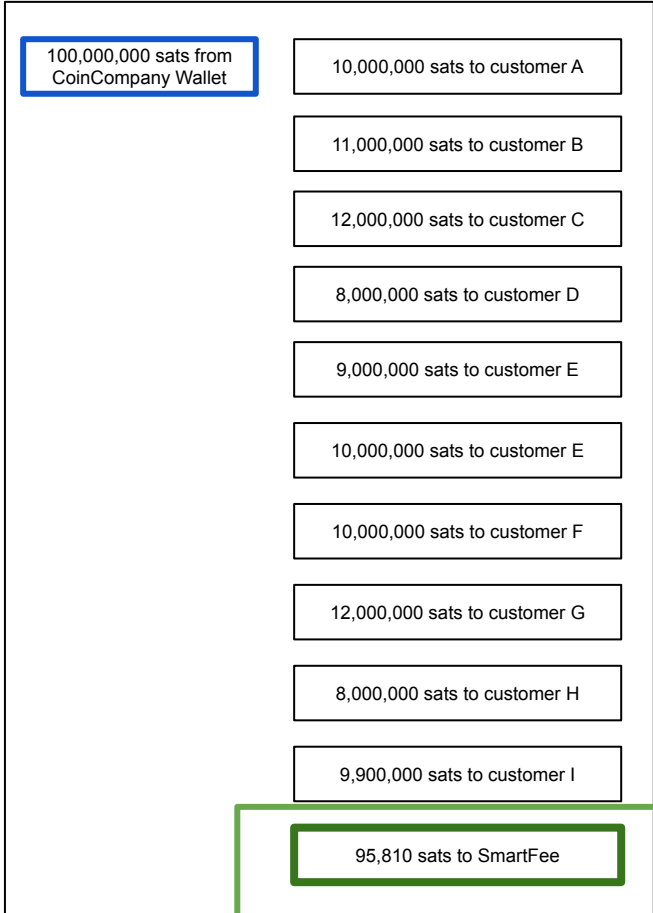
Txid: ajpdxoef

95,810 sats to SmartFee

80,000 sats to CoinCompany
Wallet

**The TXID of the batched withdrawal never changes.
It never gets replaced. Customer never sees the
transaction change from their perspective.**

Txid: abcdefg

100,000,000 sats from
CoinCompany Wallet

10,000,000 sats to customer A

11,000,000 sats to customer B

12,000,000 sats to customer C

8,000,000 sats to customer D

9,000,000 sats to customer E

10,000,000 sats to customer E

10,000,000 sats to customer F

12,000,000 sats to customer G

8,000,000 sats to customer H

9,900,000 sats to customer I

95,810 sats to SmartFee

The Batched Withdrawal is NOT opted in to RBF, so it does indeed show up in external wallets even when unconfirmed

Tx net fee rate: 13 sats/byte
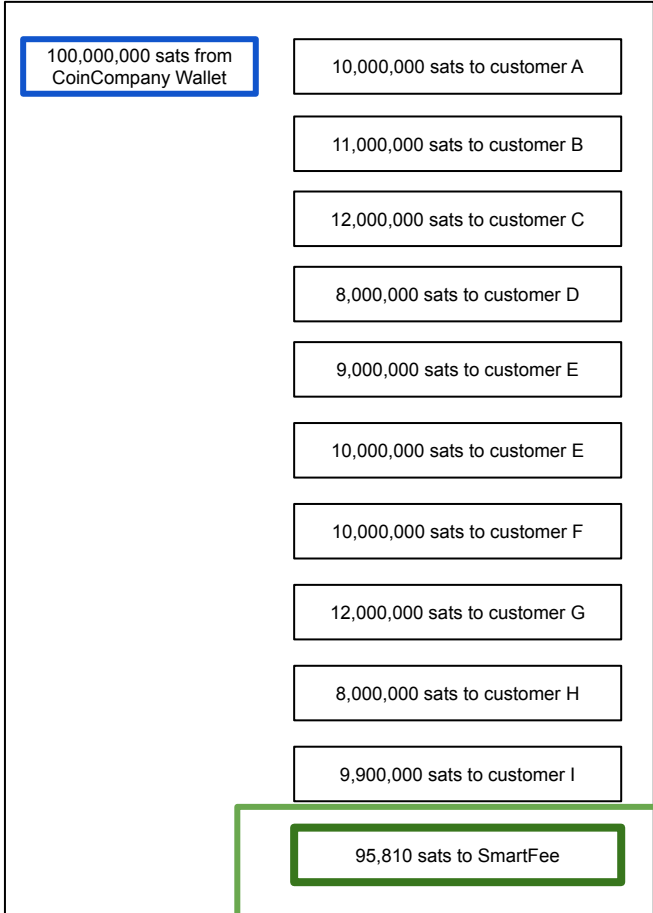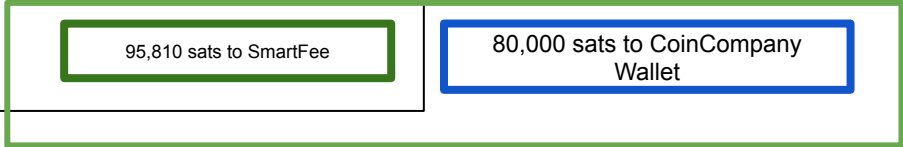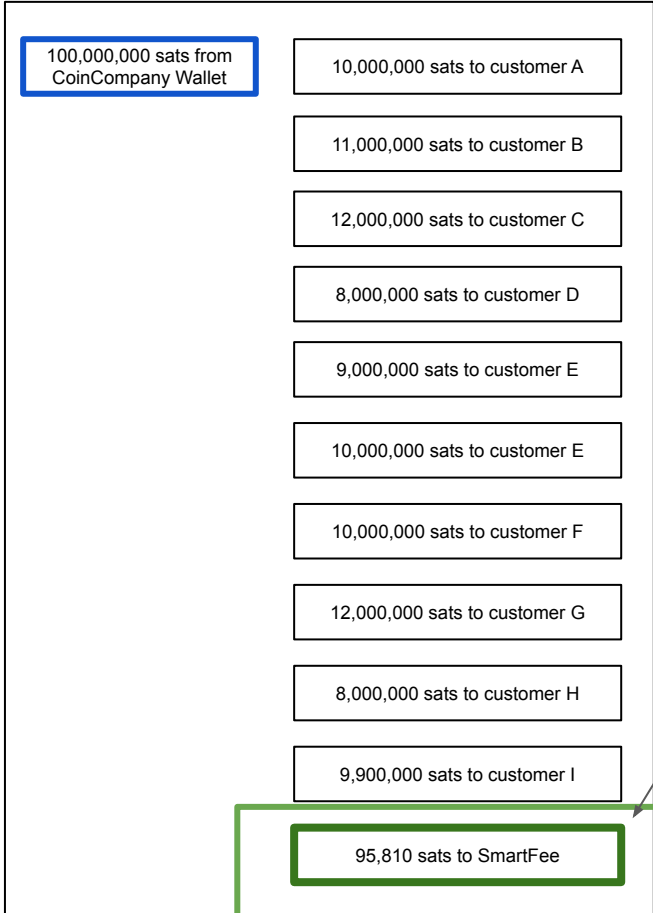
Txid: ajpdxoef

80,000 sats to CoinCompany Wallet

Txid: abcdefg

100,000,000 sats from CoinCompany Wallet	10,000,000 sats to customer A
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	12,000,000 sats to customer C
	8,000,000 sats to customer D
	9,000,000 sats to customer E
	10,000,000 sats to customer E
	10,000,000 sats to customer F
	12,000,000 sats to customer G
	8,000,000 sats to customer H
	9,900,000 sats to customer I
	95,810 sats to SmartFee
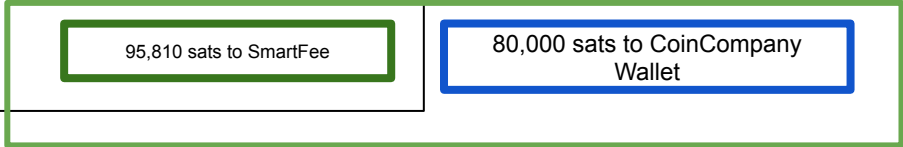
Only the SmartFee CPFP transaction has opted in to RBF

Tx net fee rate: 13 sats/byte

Txid: ajpdxoef

80,000 sats to CoinCompany Wallet

Txid: abcdefg

100,000,000 sats from CoinCompany Wallet

10,000,000 sats to customer A

11,000,000 sats to customer B

12,000,000 sats to customer C

8,000,000 sats to customer D

9,000,000 sats to customer E

10,000,000 sats to customer E

10,000,000 sats to customer F

12,000,000 sats to customer G

8,000,000 sats to customer H

9,900,000 sats to customer I

95,810 sats to SmartFee

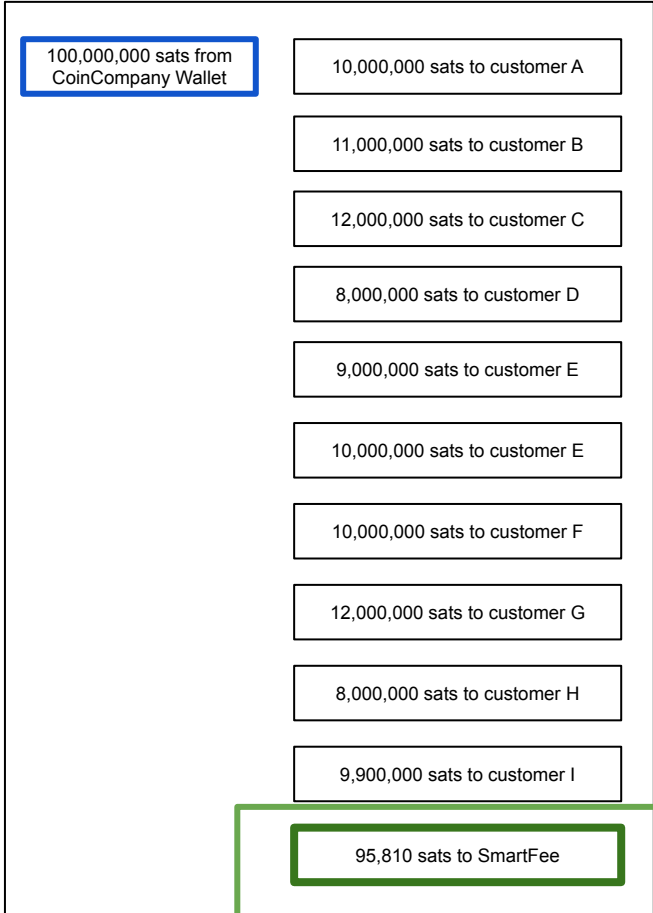**Only a small amount of funds are ever in SmartFee's possession at any time (just that single small output)**

Tx net fee rate: 13 sats/byte

Txid: ajpdxoef

80,000 sats to CoinCompany Wallet

Txid: abcdefg

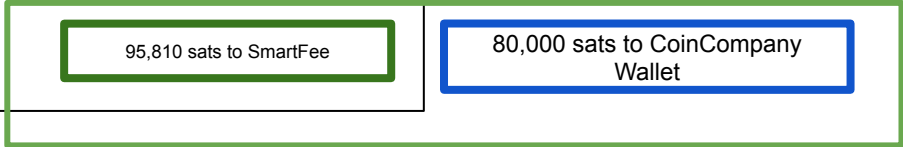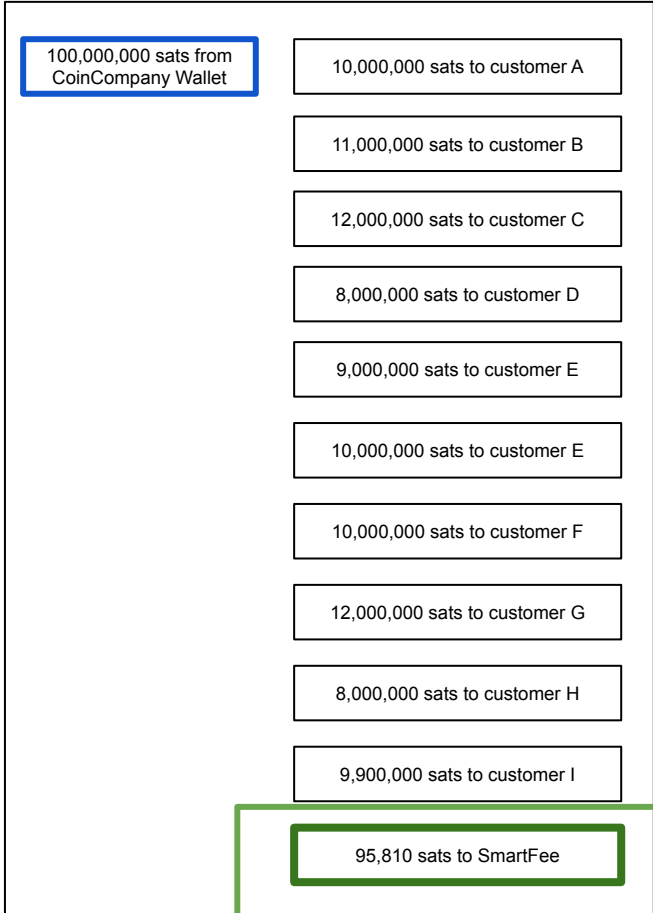|	
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	8,000,000 sats to customer D
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	10,000,000 sats to customer E
	10,000,000 sats to customer F
	12,000,000 sats to customer G
	8,000,000 sats to customer H
	9,900,000 sats to customer I
	95,810 sats to SmartFee

SmartFee's CPFP transaction sends the funds right back to CoinCompany's wallet

Tx net fee rate: 13 sats/byte

Txid: ajpdxoef

80,000 sats to CoinCompany Wallet

Txid: abcdefg

100,000,000 sats from CoinCompany Wallet

10,000,000 sats to customer A

11,000,000 sats to customer B

12,000,000 sats to customer C

8,000,000 sats to customer D

9,000,000 sats to customer E

10,000,000 sats to customer E

10,000,000 sats to customer F

12,000,000 sats to customer G

8,000,000 sats to customer H
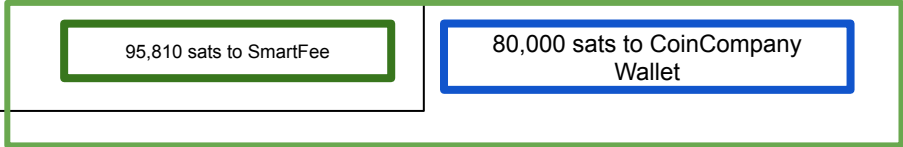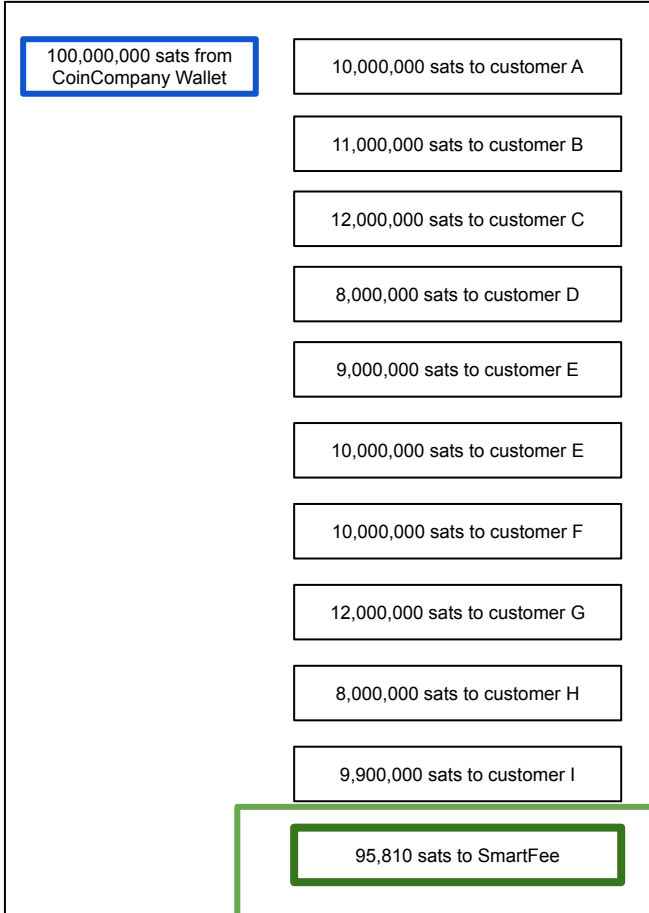
9,900,000 sats to customer I

95,810 sats to SmartFee

Dynamic Fee Bumping provides reliable next-block confirmations at the minimum net fee rate.
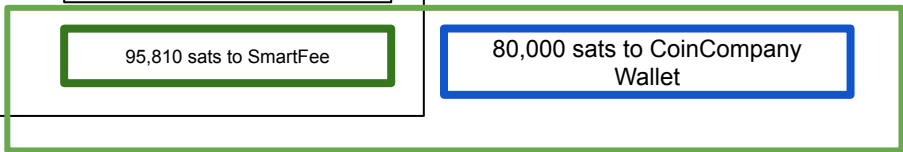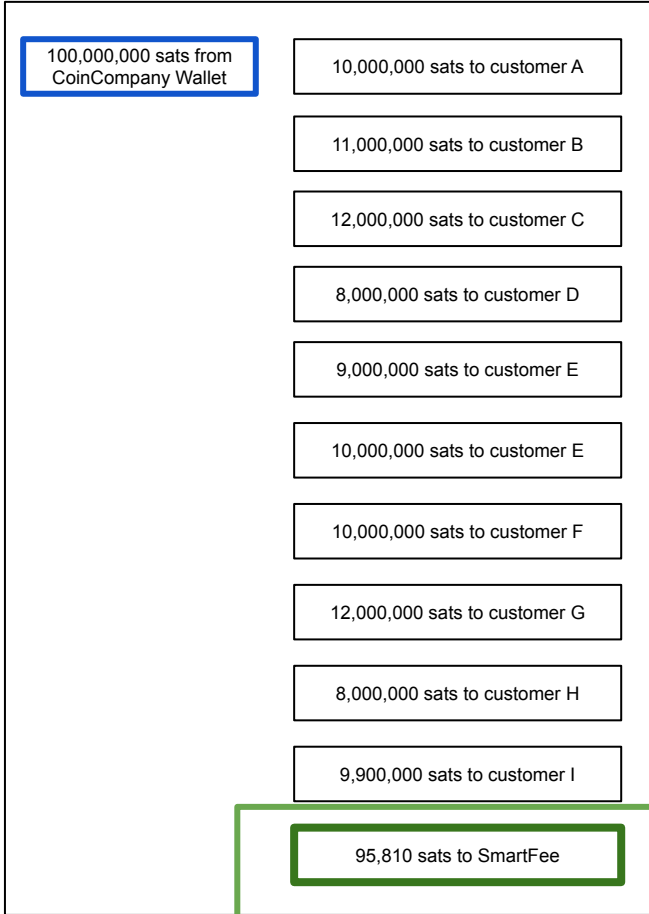
Tx net fee rate: 13 sats/byte

Txid: ajpdxoef

80,000 sats to CoinCompany Wallet

Txid: abcdefg

100,000,000 sats from CoinCompany Wallet	10,000,000 sats to customer A
	11,000,000 sats to customer B
	12,000,000 sats to customer C
	8,000,000 sats to customer D
	9,000,000 sats to customer E
	10,000,000 sats to customer E
	10,000,000 sats to customer F
	12,000,000 sats to customer G
	8,000,000 sats to customer H
	9,900,000 sats to customer I
	95,810 sats to SmartFee

SmartFee's solution provides the benefits of typical RBF without some of the drawbacks

Tx net fee rate: 13 sats/byte

Txid: ajpdxoef

80,000 sats to CoinCompany Wallet

Txid: abcdefg

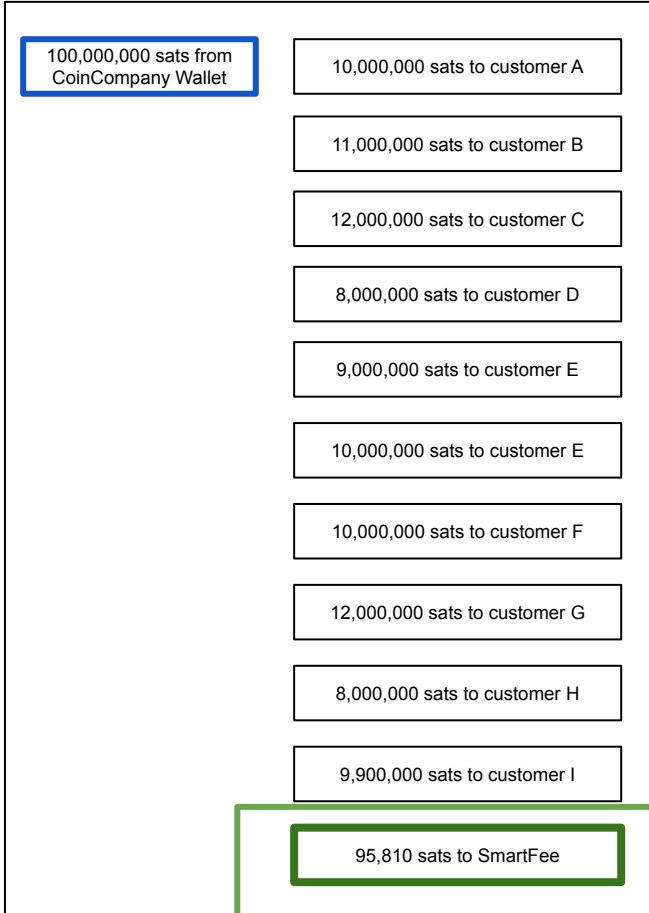|	
100,000,000 sats from CoinCompany Wallet	10,000,000 sats to customer A
	11,000,000 sats to customer B
	12,000,000 sats to customer C
	8,000,000 sats to customer D
	9,000,000 sats to customer E
	10,000,000 sats to customer E
	10,000,000 sats to customer F
	12,000,000 sats to customer G
	8,000,000 sats to customer H
	9,900,000 sats to customer I
	95,810 sats to SmartFee

The CPFP transaction uses 109 bytes, which is an additional cost, but almost negligible if batches are large.
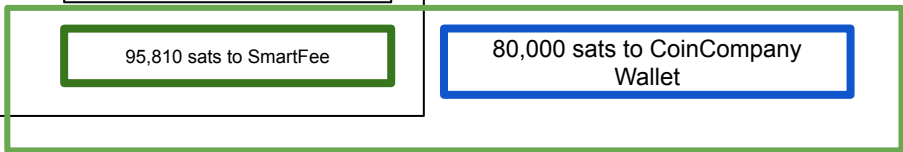
Tx net fee rate: 13 sats/byte

Txid: ajpdxoef

80,000 sats to CoinCompany Wallet

Txid: abcdefg

100,000,000 sats from CoinCompany Wallet	10,000,000 sats to customer A
	11,000,000 sats to customer B
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	10,000,000 sats to customer E
	10,000,000 sats to customer F
	12,000,000 sats to customer G
	8,000,000 sats to customer H
	9,900,000 sats to customer I
	95,810 sats to SmartFee

SmartFee can be incorporated with wallets that don't provide RBF support (BitGo, Fireblocks, etc).

Tx net fee rate: 13 sats/byte

Txid: ajpdxoef

80,000 sats to CoinCompany Wallet

More info and docs:

https://smartfee.live