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

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

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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

	0	
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	Тхі
		_
	95,810 sats to SmartFee	

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

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	10,000,000 sats to customer A	100,000,000 sats from CoinCompany Wallet
	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 n	8,000,000 sats to customer H	
Txid:	9,900,000 sats to customer I	
8	95,810 sats to SmartFee	

Step 2c:

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



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	Smort Eas koor
	8,000,000 sats to customer D	Smart ree keep
	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	Tx net fee rate: 13 sats/byte
	9,900,000 sats to customer I	Txid: ajpdxoef
	95,810 sats to SmartFee	80,000 sats to CoinCompany Wallet

Step 2c:

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

100,000,000 sats from CoinCompany Wallet	10,000,000 sats to customer A	
	11,000,000 sats to customer B	Note:
	12,000,000 sats to customer C	
	8,000,000 sats to customer D	The Batched Withdrawal Transaction never gets replaced
	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	Tx net fee rate: 13 sats/byte
	9,900,000 sats to customer I	Txid: ajpdxoef
	95,810 sats to SmartFee	80,000 sats to CoinCompany Wallet

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

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	The TXID of the b
	8,000,000 sats to customer D	It never gets re transaction
	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	Tx net fee rate: 13 sats/byte
_	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.

	ats to customer A	n t	100,000,000 sats from CoinCompany Wallet
	ats to customer B		
The Batched Wit	ats to customer C		
it does indeed	ts to customer D		
	ts to customer E		
4	ats to customer E		
	ats to customer F		
	ats to customer G		
Tx net fee rate: 13 sats/byte	ts to customer H		
Txid: ajpdxoef	ats to customer I		
80,000 sats to CoinCompany Wallet	s to SmartFee		

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

	10,000,000 sats to customer A	100,000,000 sats from CoinCompany Wallet
	11,000,000 sats to customer B	
Only the SmartF	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	
Tvid: aindvoof	9.900.000 sats to customer I	
	, ,	Г
80,000 sats to CoinCompany	95,810 sats to SmartFee	
vvallet		

Only the SmartFee CPFP transaction has opted in to RBF

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0,000 sats from ompany Wallet 10,000,000 sats to customer A	100,000,000 sats from CoinCompany Wallet
11,000,000 sats to customer B	
12,000,000 sats to customer C Only a sma	
8,000,000 sats to customer D SmartFee's pos	
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 Txid: ajpdxoef	
95,810 sats to SmartFee 80,000 sats to CoinCompany Wallet	ſ

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

	omer A	10,000,000 sats to custo	100,000,000 sats from CoinCompany Wallet
	omer B	11,000,000 sats to custo	
SmartFee's CPFI back t	omer C	12,000,000 sats to custo	
	omer D	8,000,000 sats to custo	
	omer E	9,000,000 sats to custo	
	omer E	10,000,000 sats to custo	
	omer F	10,000,000 sats to custo	
	omer G	12,000,000 sats to custo	
Tx net fee rate: 13 sats/byte	omer H	8,000,000 sats to custo	
Txid: ajpdxoef	omer I	9,900,000 sats to custo	
80,000 sats to CoinCompany Wallet	tFee	95,810 sats to Smart	

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

	 U	
	10,000,000 sats to customer A	100,000,000 sats from CoinCompany Wallet
	11,000,000 sats to customer B	
Dynaı c	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	8,000,000 sats to customer H	
Txid: ajpdxoef	9,900,000 sats to customer I	
80,000 sats	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

100 000 000 este ferm	[]	
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 sustamor 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	
	05.810 sats to SmartEco	

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

Tx net fee rate: 13 sats/byte

Txid: ajpdxoef

The CPFP transaction uses 109 bytes, which is an dditional cost, but almost negligible if batches are large.

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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
	8,000,000 sats to customer H	
	9,900,000 sats to customer I	Txio
		1
	95,810 sats to SmartFee	
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SmartFee can be incorporated with wallets that don't provide RBF support (BitGo, Fireblocks, etc).

Tx net fee rate: 13 sats/byte

Txid: ajpdxoef

More info and docs:

https://smartfee.live