Bitcoin Transaction Malleability and MtGox

Christian Decker

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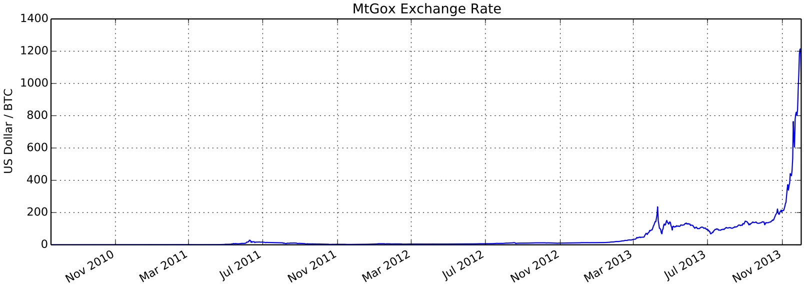
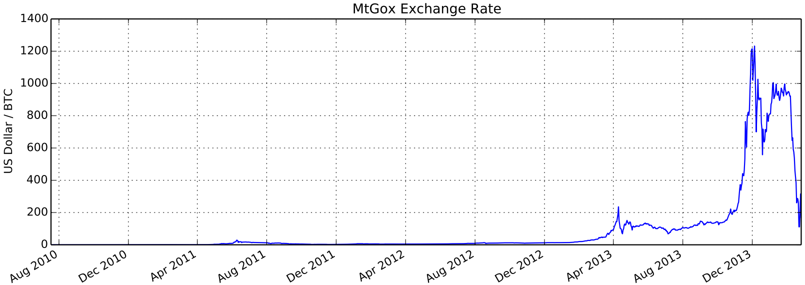
Exchanges


MtGox Exchange Rate
US Dollar / BTC
1400
1200
1000
800
600
400
200
0
Nov 2010
Mar 2011
Jul 2011
Nov 2011
Mar 2012
Jul 2012
Nov 2012
Mar 2013
Jul 2013
Nov 2013

Exchanges


MtGox Exchange Rate
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0
200
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Aug 2010
Dec 2010
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Dec 2012
Apr 2013
Aug 2013
Dec 2013

MT.GOX

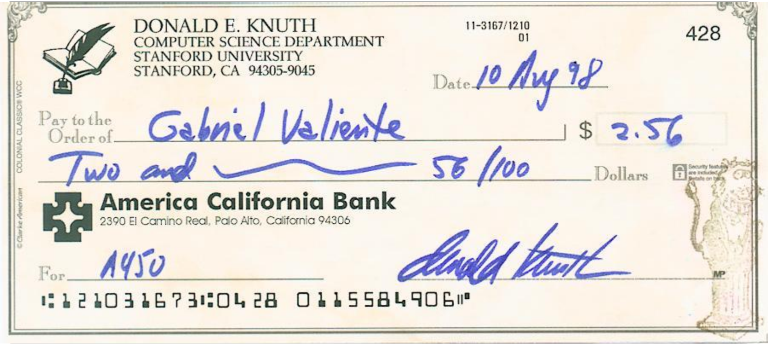
Addressing Transaction Malleability: MtGox has detected unusual activity on its Bitcoin wallets and performed investigations during the past weeks.

The MtGox Incident

- July 2010: First trade on MtGox
- 2011: Transaction malleability identified as low priority issue
- February 7, 2014: MtGox halts withdrawals
- February 10, 2014: MtGox cites transaction malleability as root cause
- February 28, 2014: MtGox files for bankruptcy

MtGox claims that 850,000 bitcoins (620 million USD) were lost due to transaction malleability.

Transactions



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11-3167/1210
01

428

Date 10 Aug 98

Pay to the Order of Gabriel Valiente $ 2.56

Two and 56/100 Dollars

Security features are included. Details on back.

America California Bank
2390 El Camino Real, Palo Alto, California 94306

For A450

Donald Knuth

MP

⑆121031673⑆0428 0115584906⑈

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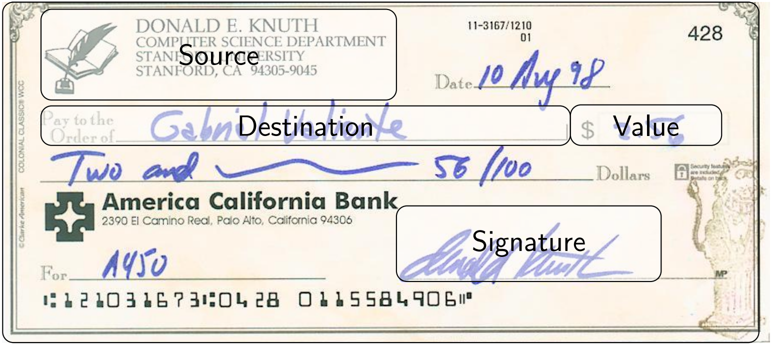
Transactions



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⑆121031673⑆0428 0115584906⑈

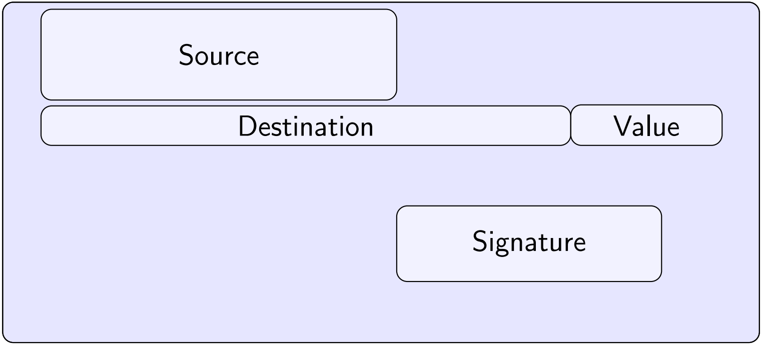
Source

Destination

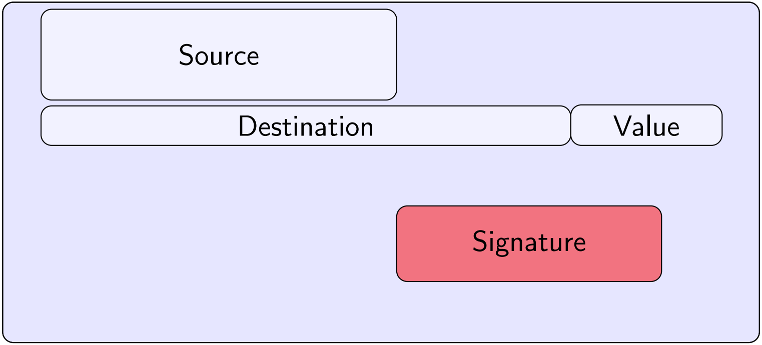
Value

Signature

Transactions



Transactions



Signatures

61 af bb 4d e9 f8 b8 74 86 1e

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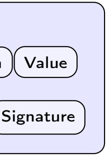
00 00 61 af bb 4d e9 f8 b8 74 86 1e

There are multiple ways to serialize a signature:

- Multiple push operations (1 byte, 2 byte, 4 byte)
- Non-canonical DER encodings
- Padding
- . . .

Doublespending



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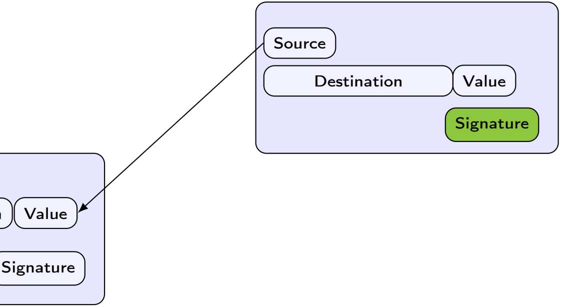

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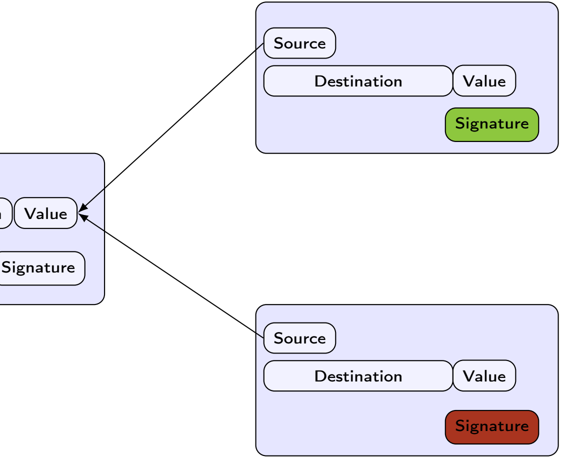

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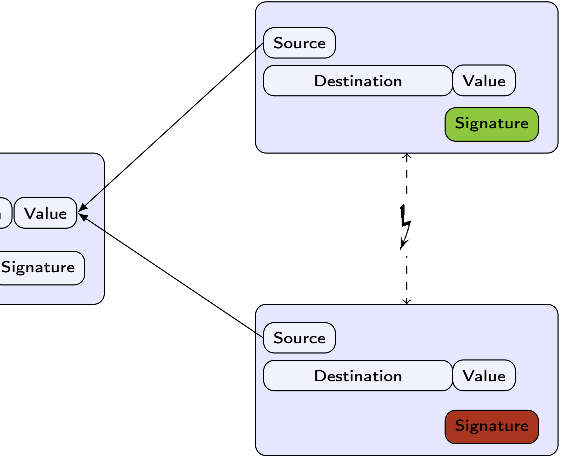
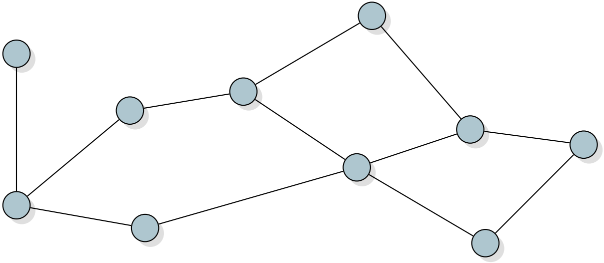


Transaction Conflicts



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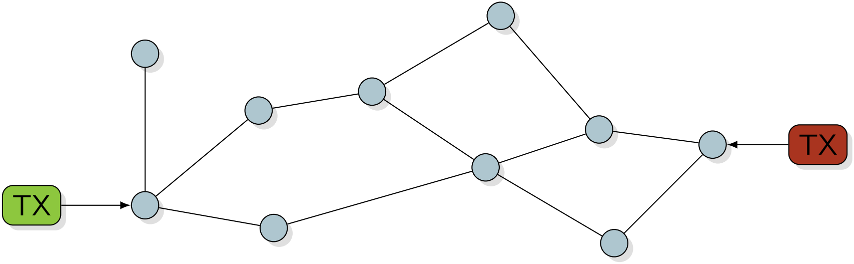

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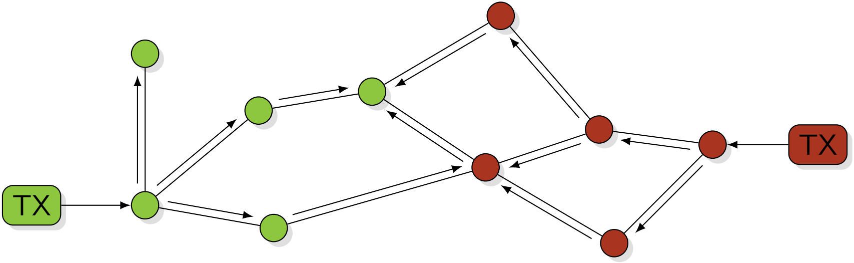

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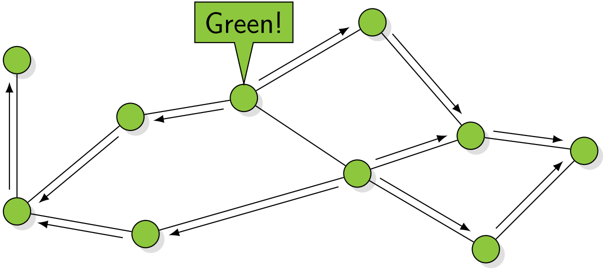
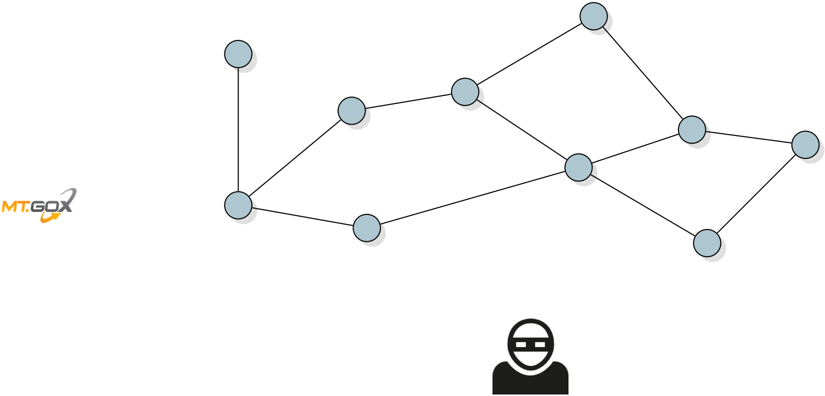


Transaction Malleability Attack



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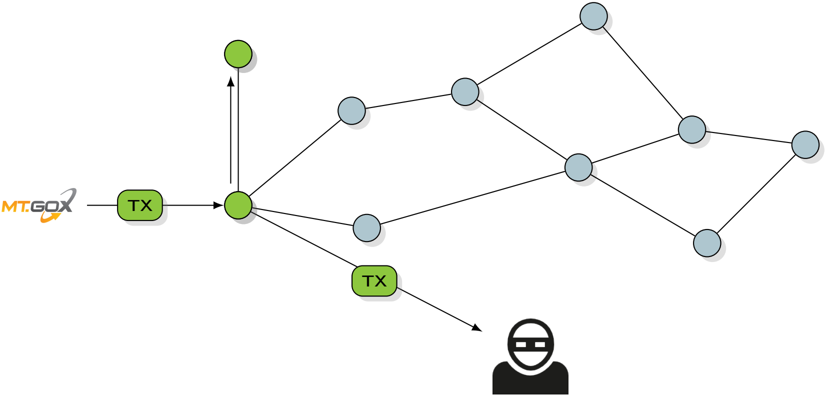

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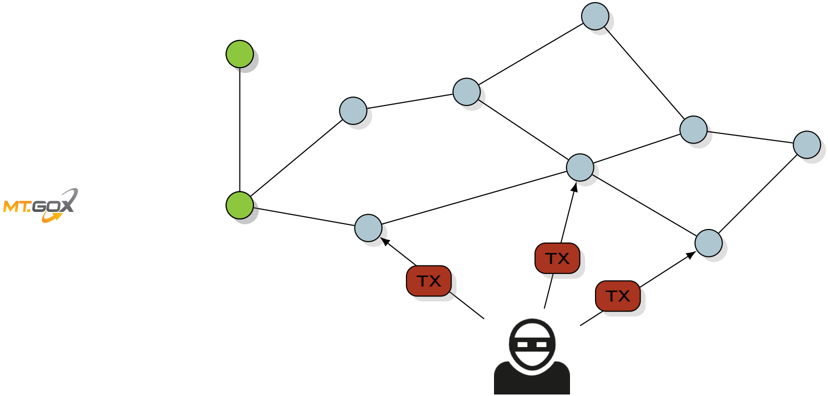

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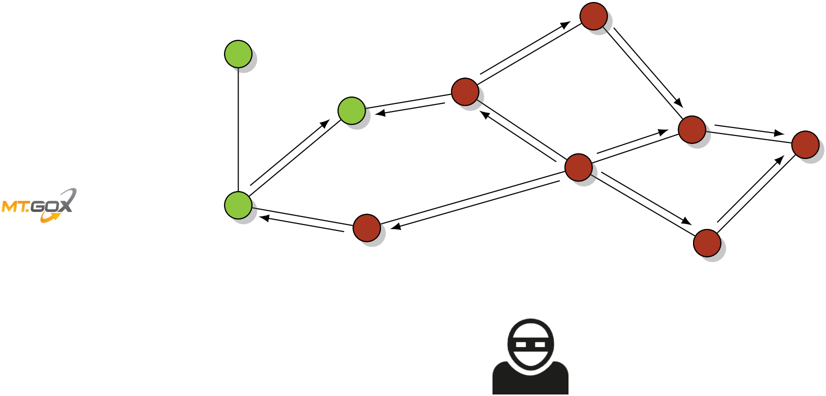

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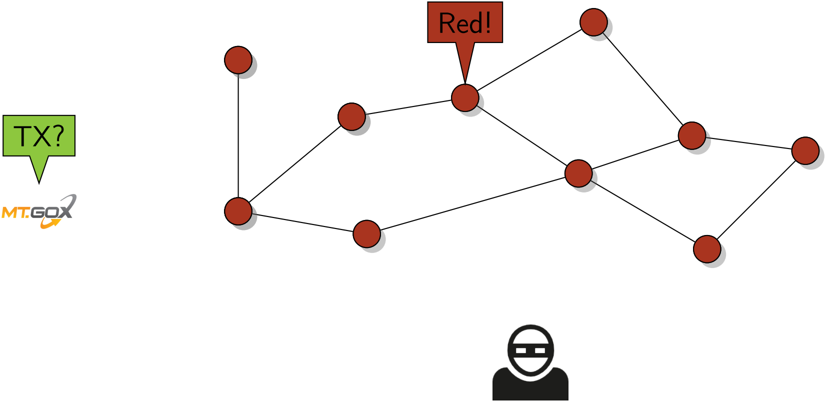

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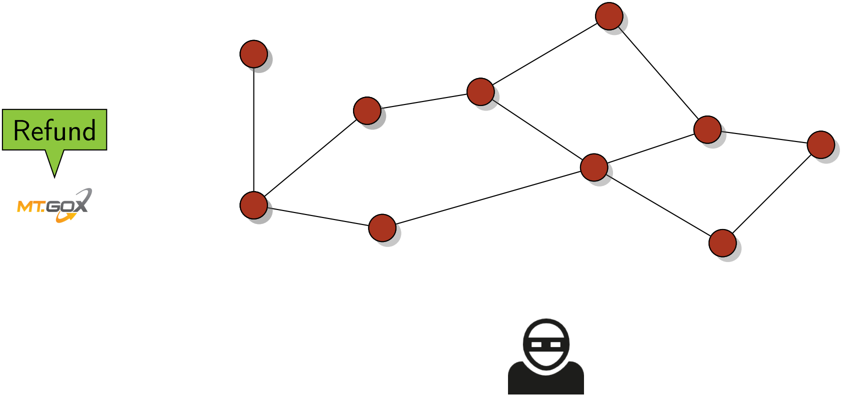

Data Gathering

Bitcoin can be monitored:

- Transactions are broadcast in the network;
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Connecting to a large sample allows collecting conflicts:

- Starting Jan. 2013 we collected transactions from the network;
- 1000 connections to random peers open;
- Network size 3,000 – 6,000 nodes;

Global Analysis

Conflict Set: set transactions that differ only in the signature.

- Total conflict sets: 35,202
- Conflict sets with one tx confirmed: 29,139
- Total involved bitcoins: 302,700 BTC

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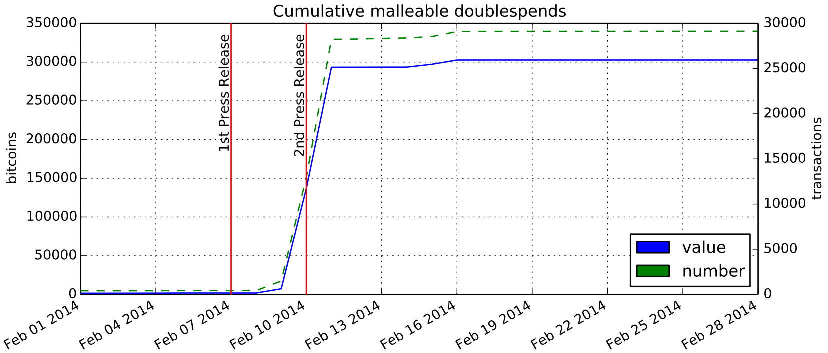
- Total conflict sets: 35,202
- Conflict sets with one tx confirmed: 29,139
- Total involved bitcoins: 302,700 BTC
- 28,595 sets involve OP_PUSHDATA2 opcode
- Of the above instances 21.36% resulted in the modified transaction being confirmed

Incident Timeline



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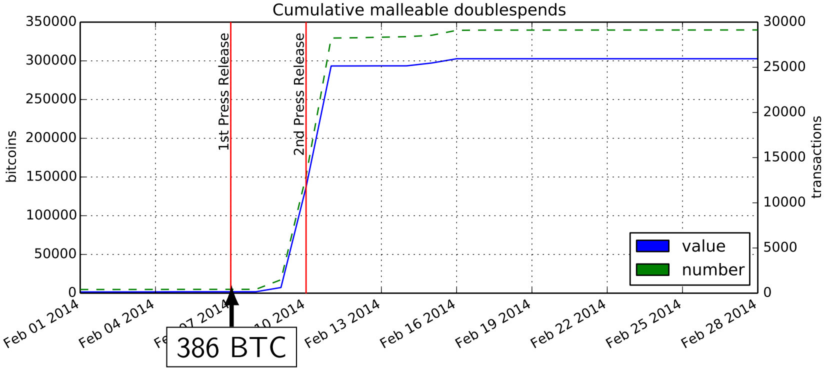
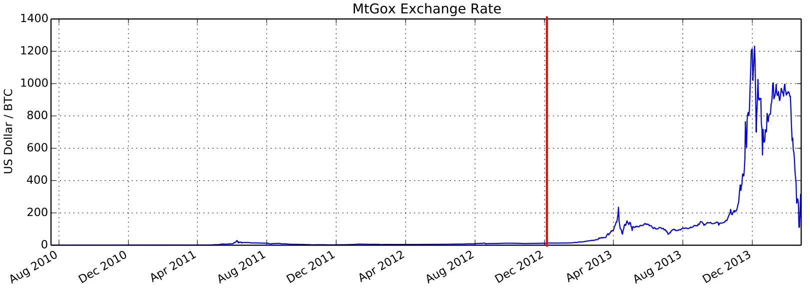
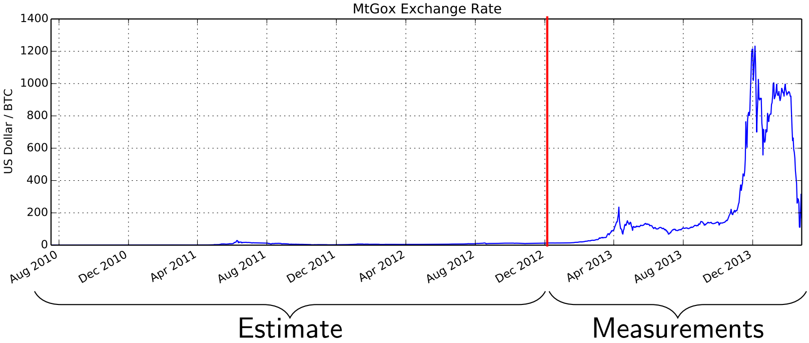


Beyond our Data



Measurements

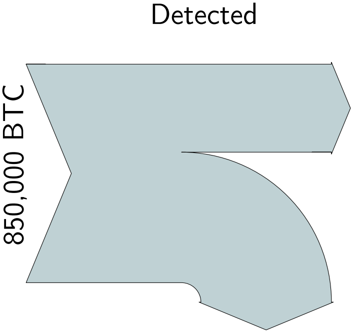
Beyond our Data



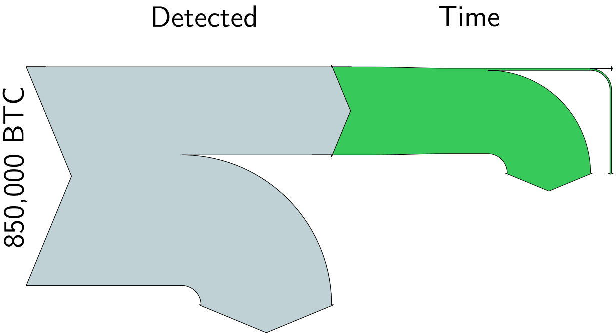
Estimate

Measurements

Conclusion



Conclusion



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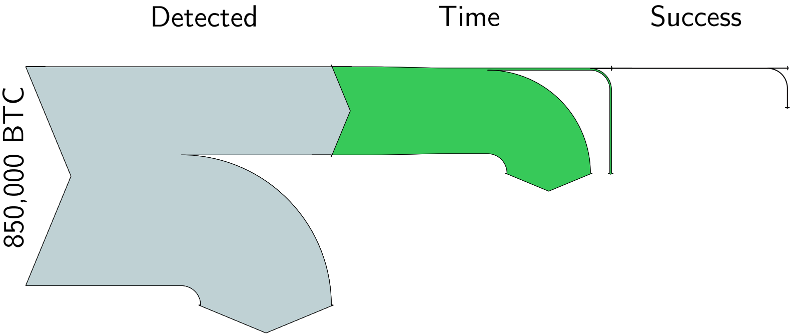

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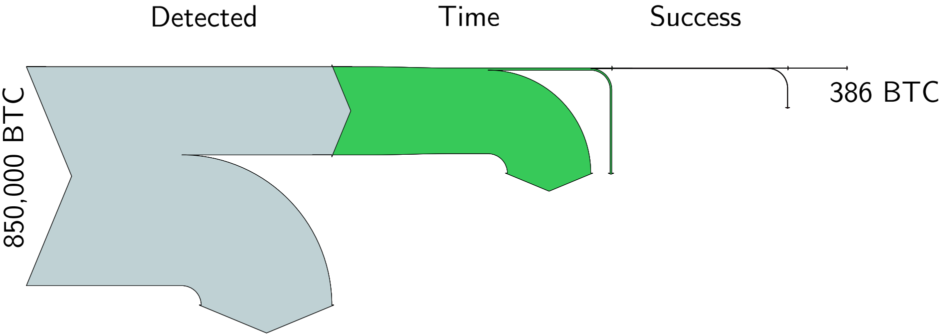

Thank you, questions?

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