

Tracking Ransomware End-to-end

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CHAINALYSIS



Ransomware causes financial damages

A screenshot of the top portion of an Ars Technica article. The header features the 'ars TECHNICA' logo on the left, a search icon, a menu icon, and a 'SIGN IN' link with a dropdown arrow on the right. Below the header, the article is categorized under 'RISK ASSESSMENT' in green text. The main title is 'Two more healthcare networks caught up in outbreak of hospital ransomware' in large black font. A sub-headline reads 'New server-targeting malware hitting healthcare targets with unpatched websites.' The author and date are listed as 'SEAN GALLAGHER - 3/29/2016, 4:11 PM' in red text.

ars TECHNICA 🔍 ☰ SIGN IN ▾

RISK ASSESSMENT —

Two more healthcare networks caught up in outbreak of hospital ransomware

New server-targeting malware hitting healthcare targets with unpatched websites.

SEAN GALLAGHER - 3/29/2016, 4:11 PM

Ransomware causes financial damages

ars TECHNICA 🔍 ☰ SIGN IN ▾

RISK ASSESSMENT —

Two more healthcare networks hit by ransomware in outbreak of hospital attacks

New server-targeting malware hitting health websites.

SEAN GALLAGHER - 3/29/2016, 4:11 PM

BBC Sign in News Sport Weather Shop Earth Tra

NEWS

Home Video World US & Canada UK Business Tech Science Magazin

Technology

University pays \$20,000 to ransomware hackers

🕒 8 June 2016 | Technology



Ransomware causes financial damages

The image is a screenshot of a news article from NPR. At the top, there is a navigation bar with the 'ars TECHNICA' logo, a search icon, a menu icon, and a 'SIGN IN' button. Below this is another navigation bar with the 'npr' logo and links for 'set station', 'news', 'arts & life', 'music', 'programs', 'shop', and a user profile icon. The main content area features the word 'AMERICA' in a small font, followed by a large headline: 'Time Is Running Out For Atlanta In Ransomware Attack'. To the left of the headline are social media sharing icons for Facebook, Twitter, and a square icon. Below the headline is the date and time: 'March 28, 2018 · 6:14 PM ET'. A large, bold sub-headline reads 'University pays \$20,000 to ransomware hackers'. At the bottom of the article, there is a timestamp '8 June 2016' and the category 'Technology'. On the right side, there is a vertical sidebar with a search icon and a 'Magazin' link.

ars TECHNICA

RISK ASSES

Two r
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New serve
websites.

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AMERICA

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Magazin

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University pays \$20,000 to ransomware
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8 June 2016 | Technology

Ransomware causes financial damages

The image shows a screenshot of the Ars Technica website. The top navigation bar includes the 'ars TECHNICA' logo, a search icon, a menu icon, and a 'SIGN IN' button. Below the navigation bar, there are several article teasers. One prominent article is titled 'Two more he...' and 'in outbreak'. Another article is titled 'New server-targeting m...' and 'websites.' by SEAN GALLAGHER, dated 3/29/2016. A large orange rectangular box is overlaid on the center of the page, containing two white text questions: 'How much ransomware revenue?' and 'How to shut down ransomware?'. Below the orange box, a headline is partially visible: 'University pays \$20,000 to ransomware hackers'. At the bottom of the page, there is a timestamp '8 June 2016' and the category 'Technology'. A share icon is visible in the bottom right corner.

ars TECHNICA

RISK ASSESS n p r set station news arts & life music programs shop

Two more he
in outbreak

New server-targeting m
websites.

SEAN GALLAGHER - 3/29/2016 4:11

How much ransomware revenue?

How to shut down ransomware?

University pays \$20,000 to ransomware
hackers

8 June 2016 | Technology

How typical ransomware works

1. Distribution

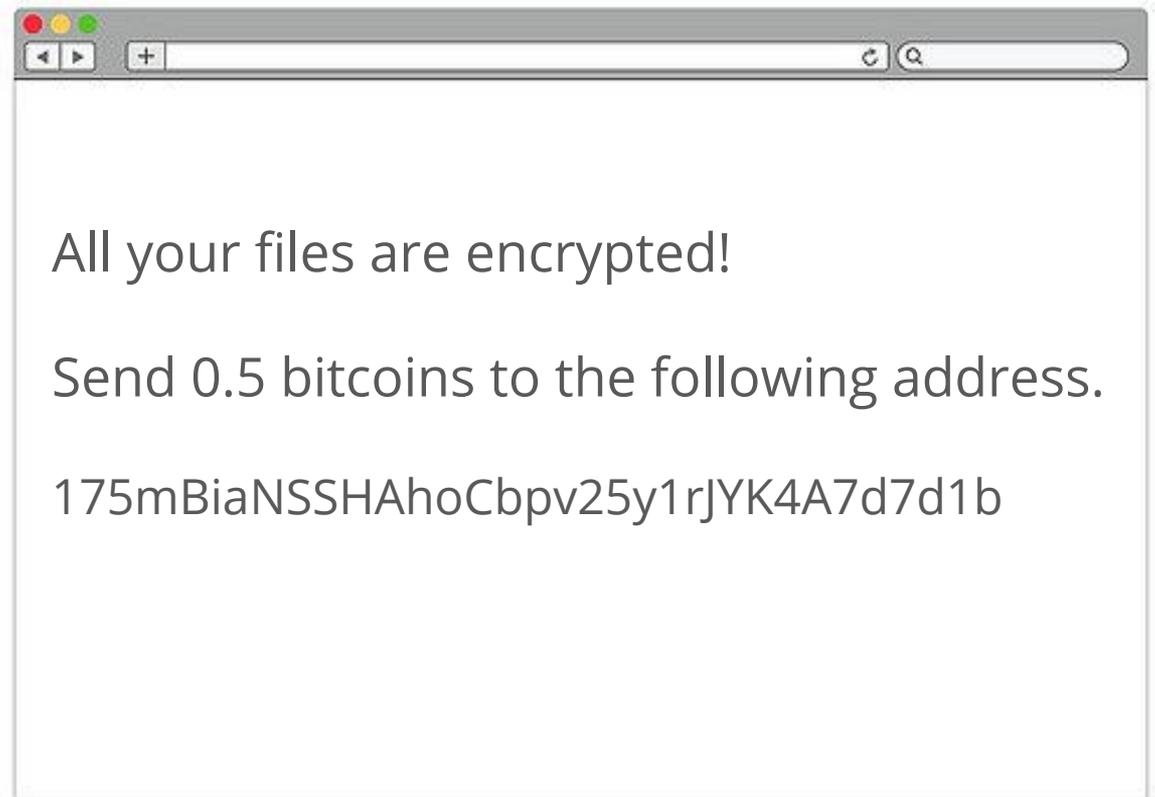
Spam, compromised websites, etc

How typical ransomware works

1. Distribution
2. Infection

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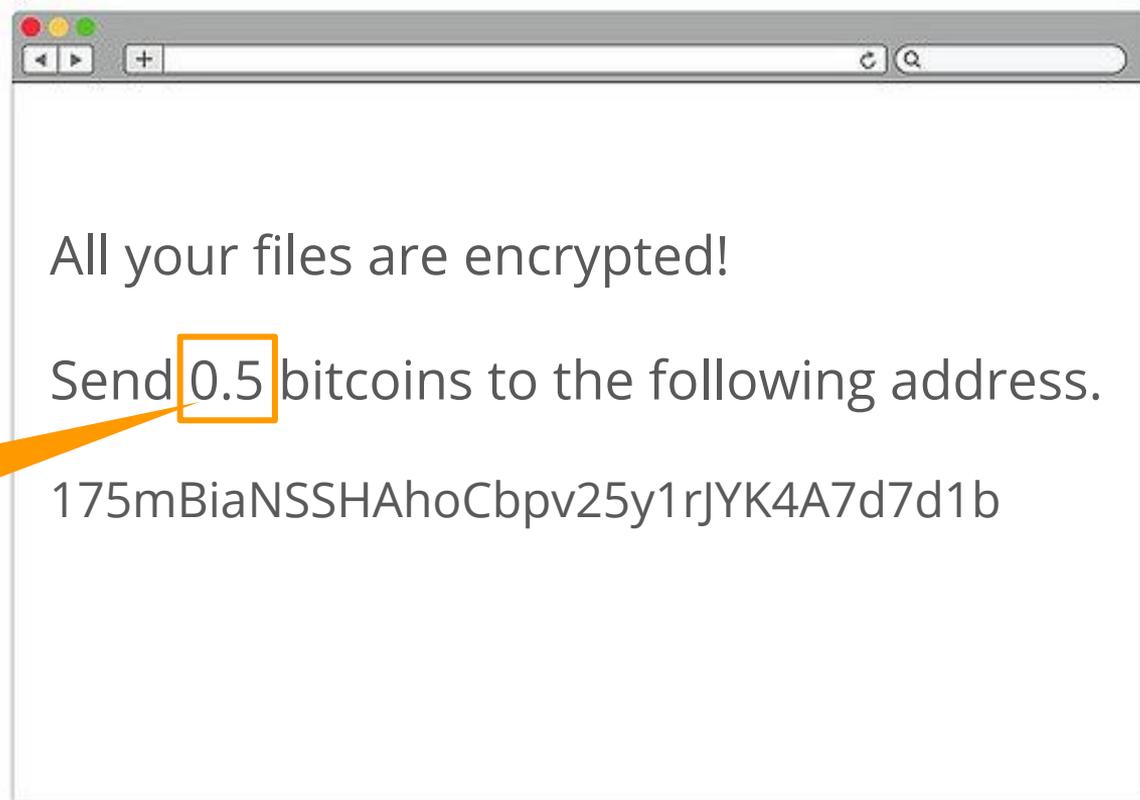


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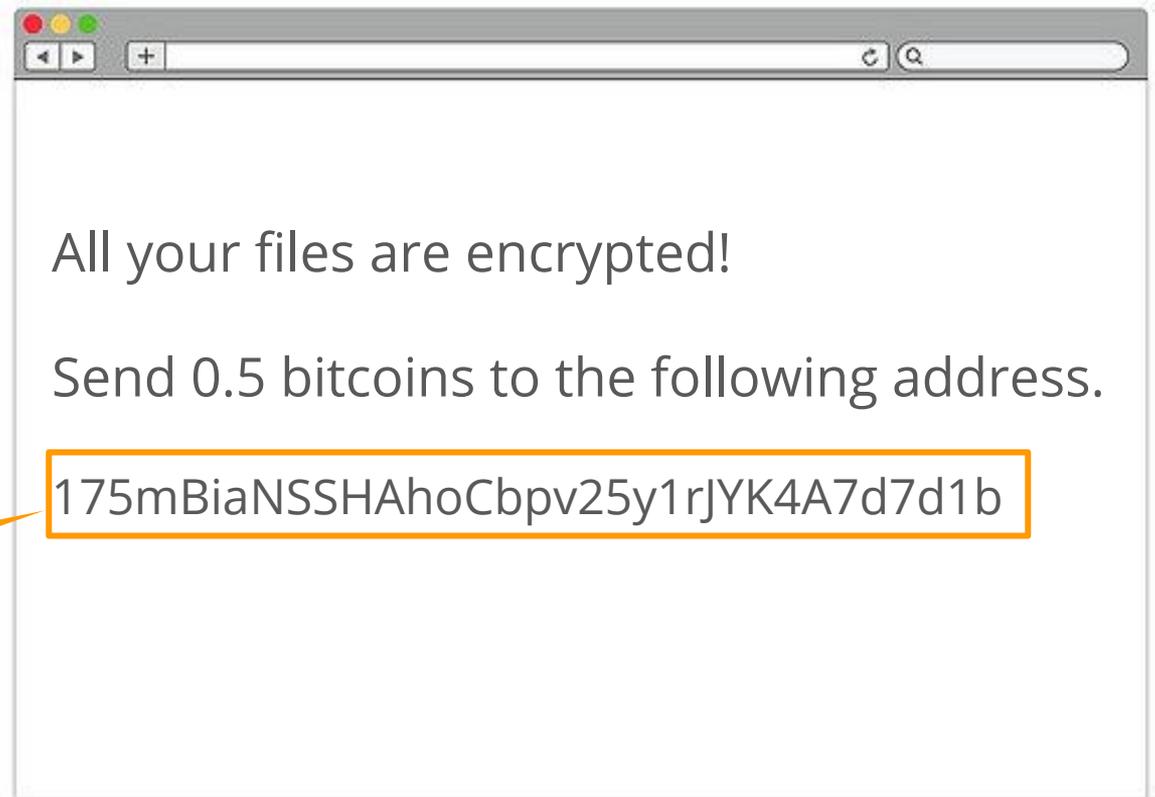
Cerber: median ~\$1,000

Locky: median ~\$1,800



How typical ransomware works

1. Distribution
2. Infection



unique ransom
wallet address

How typical ransomware works



Victim's money

1. Distribution
2. Infection
3. Victim pays bitcoins

How typical ransomware works

1. Distribution
2. Infection
3. Victim pays bitcoins



How typical ransomware works

1. Distribution
2. Infection
3. Victim pays bitcoins



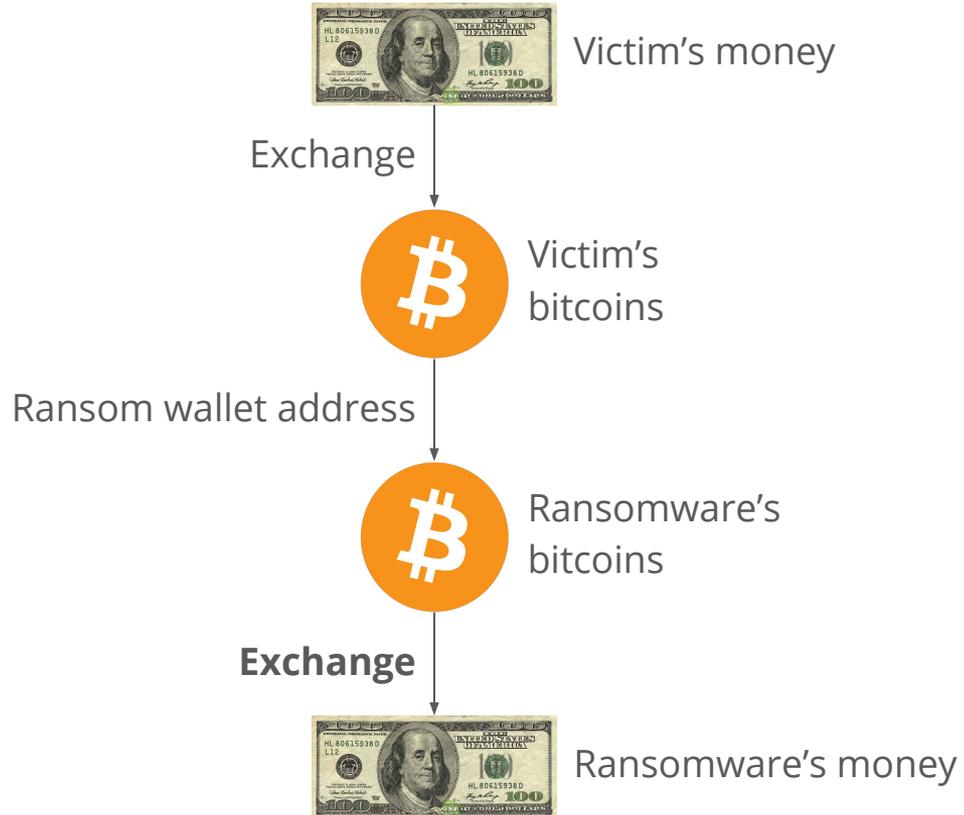
How typical ransomware works

1. Distribution
2. Infection
3. Victim pays bitcoins
4. Decryption



How typical ransomware works

1. Distribution
2. Infection
3. Victim pays bitcoins
4. Decryption
5. Criminal liquidates
bitcoins



Research questions

How to estimate the total ransom paid (or revenue)?

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How to identify chokepoints?

Overview of results

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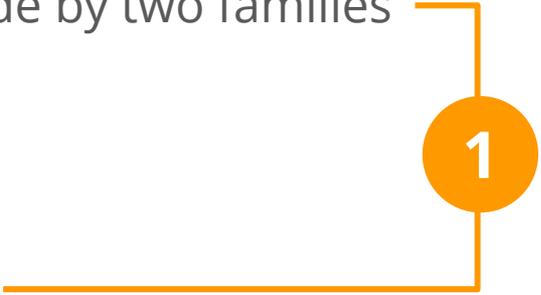
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1

2

1

Blockchain Analysis

Methodology: Follow the money

1. Identify known victims

Methodology: Follow the money

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2. Infer unknown victims

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1. Identify known victims
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3. Estimate total ransom

Methodology: Follow the money

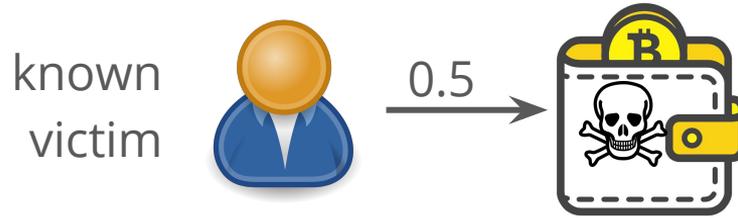
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4. Identify exchanges

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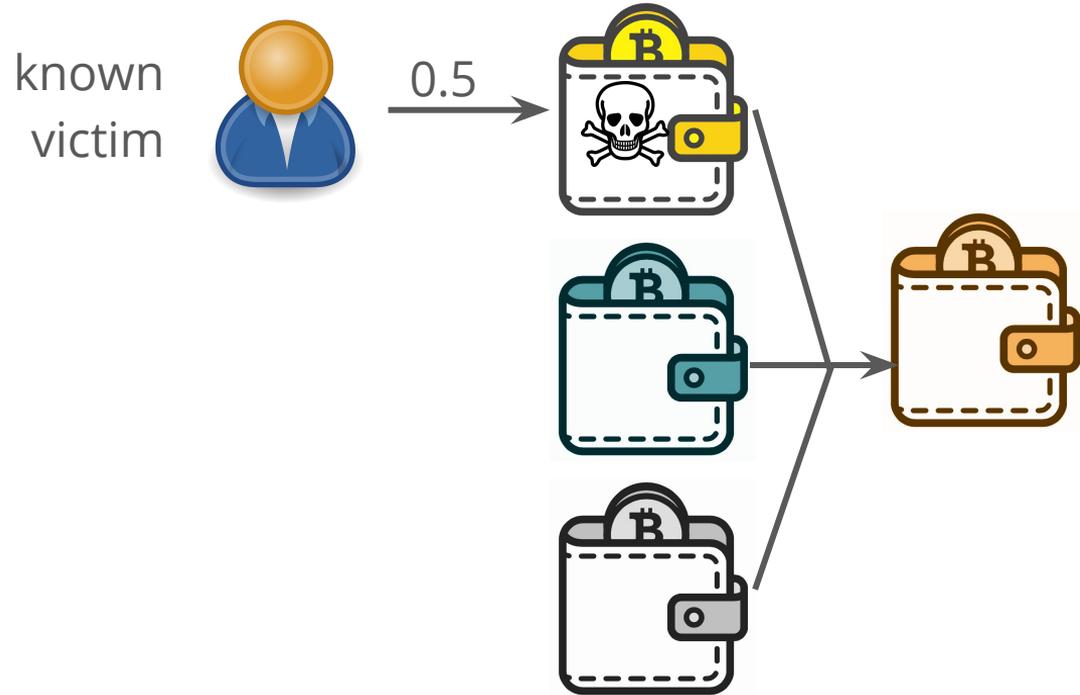
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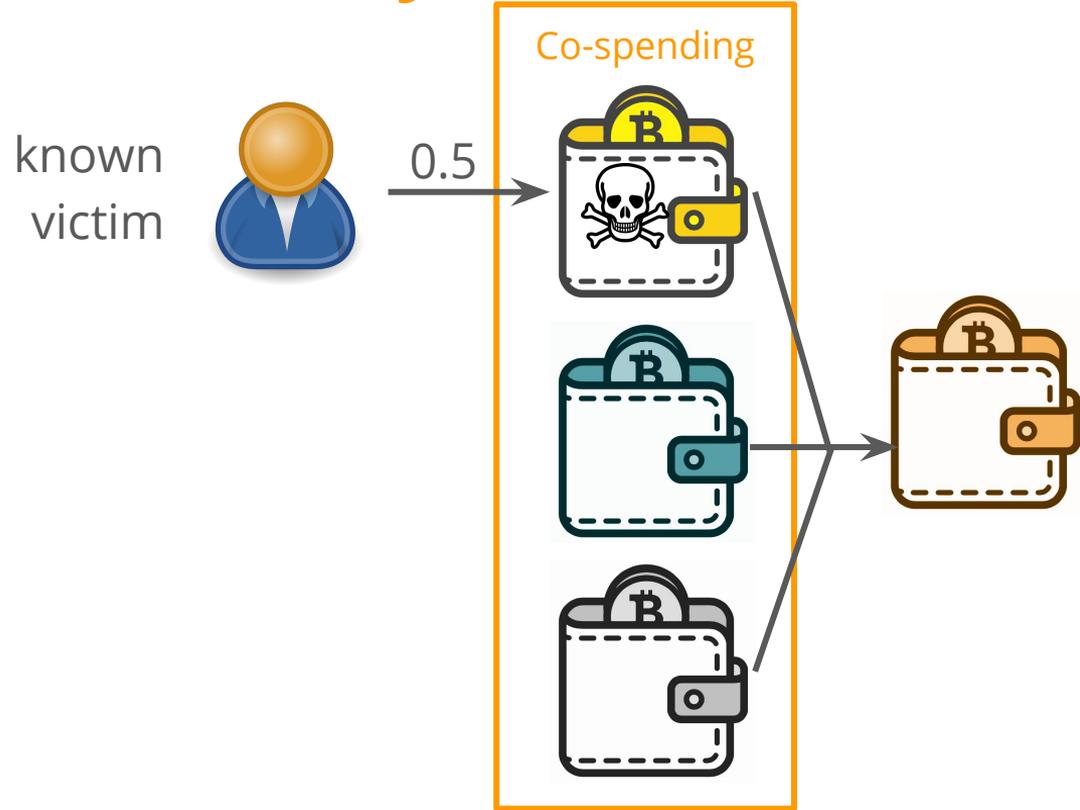
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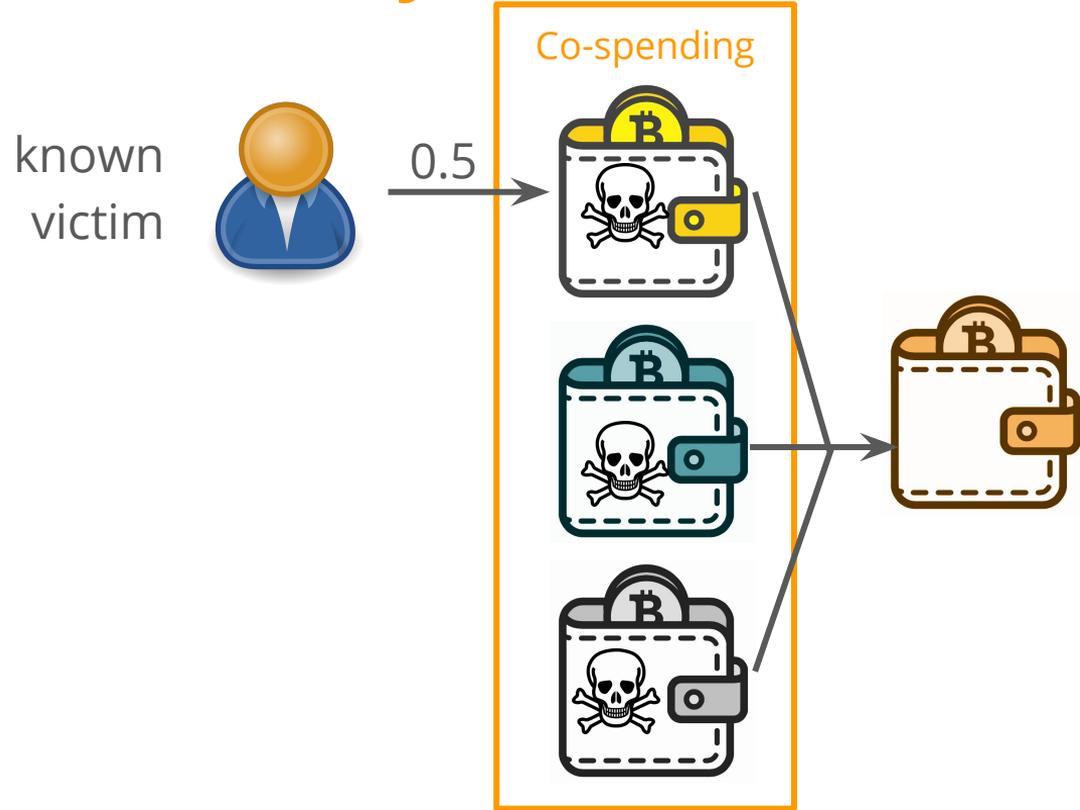
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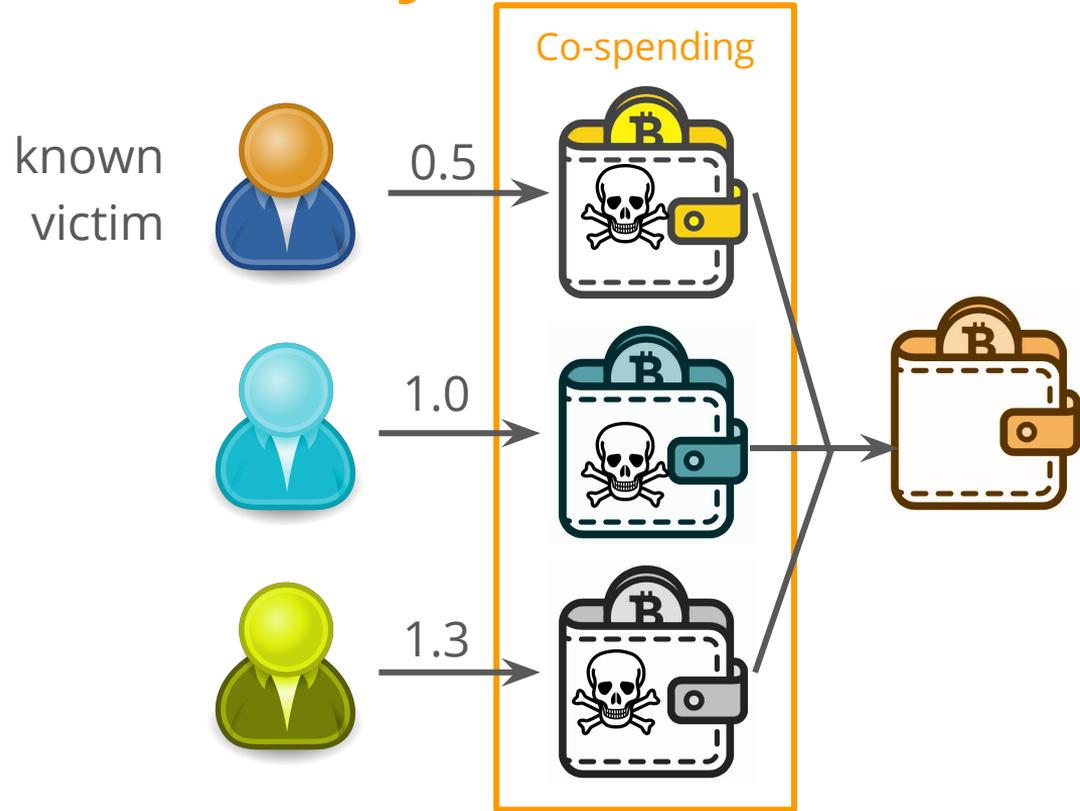
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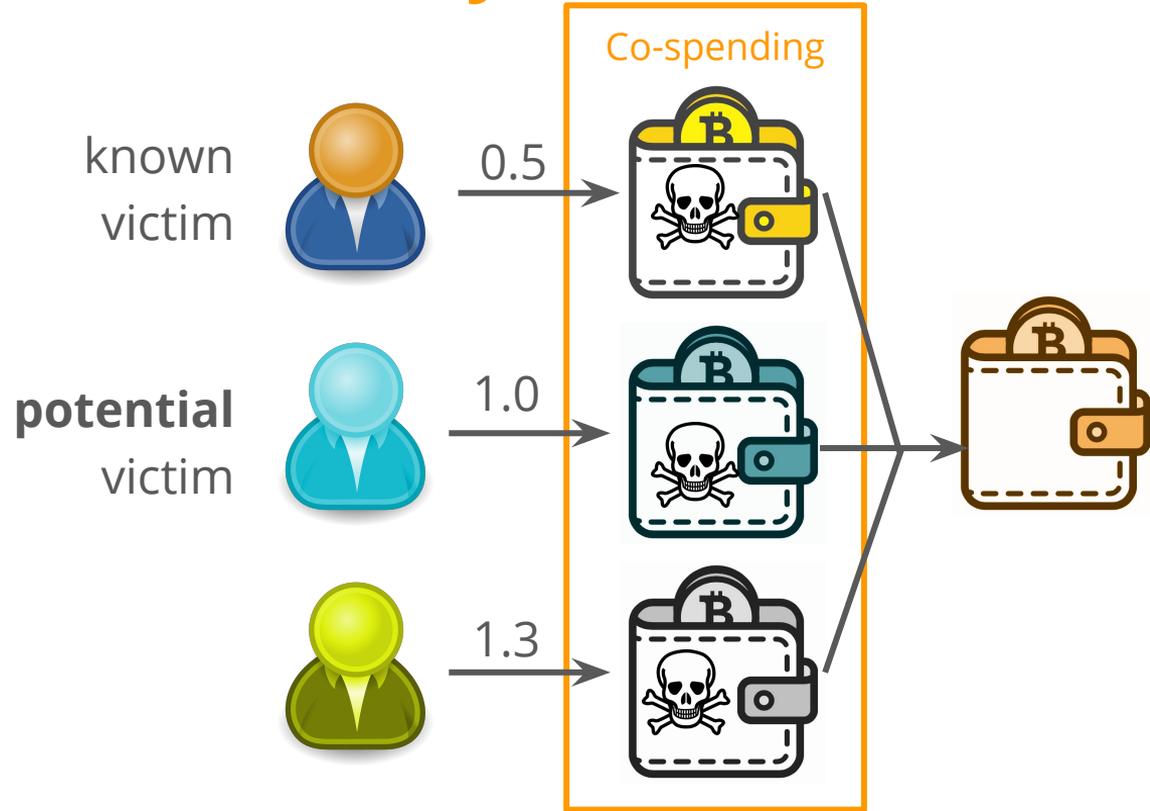
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artificial
"victim"



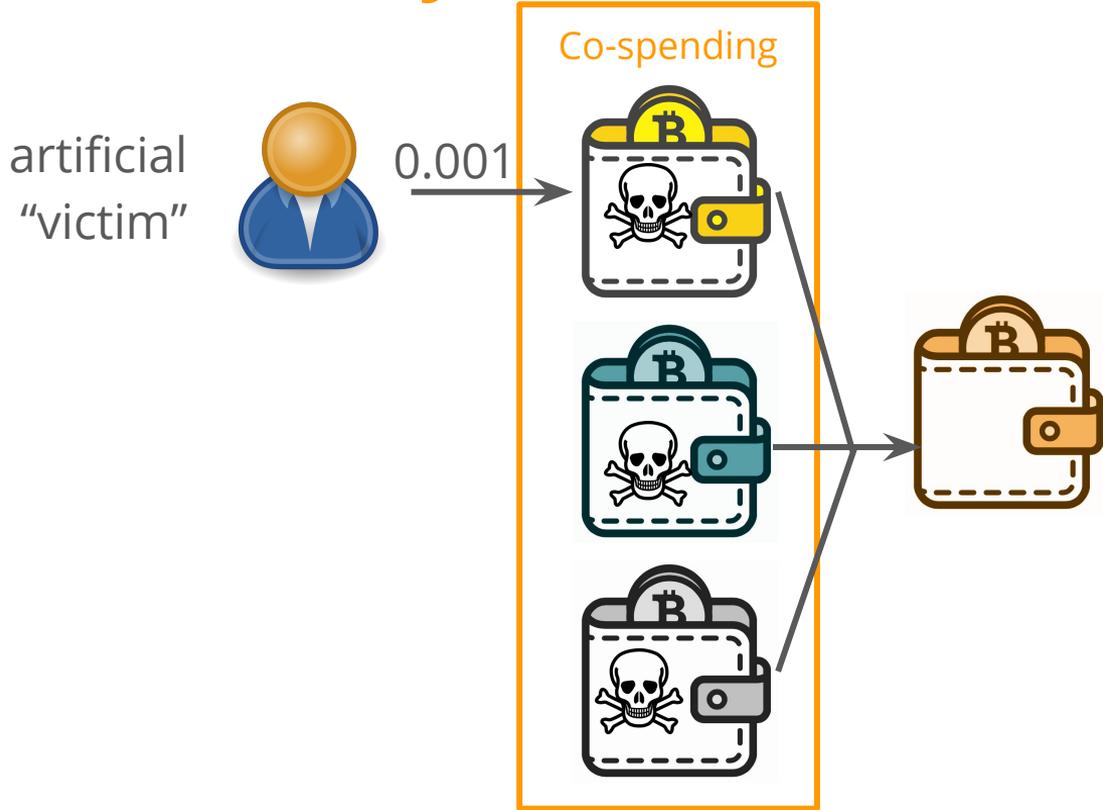
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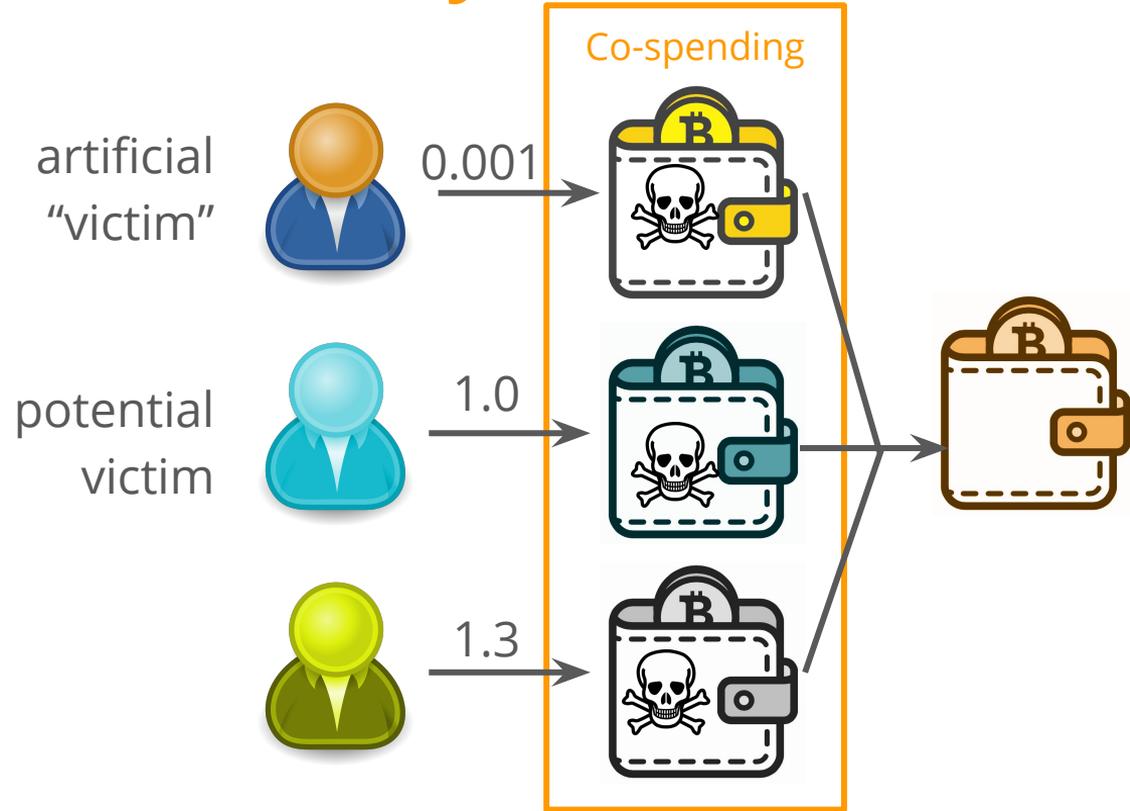
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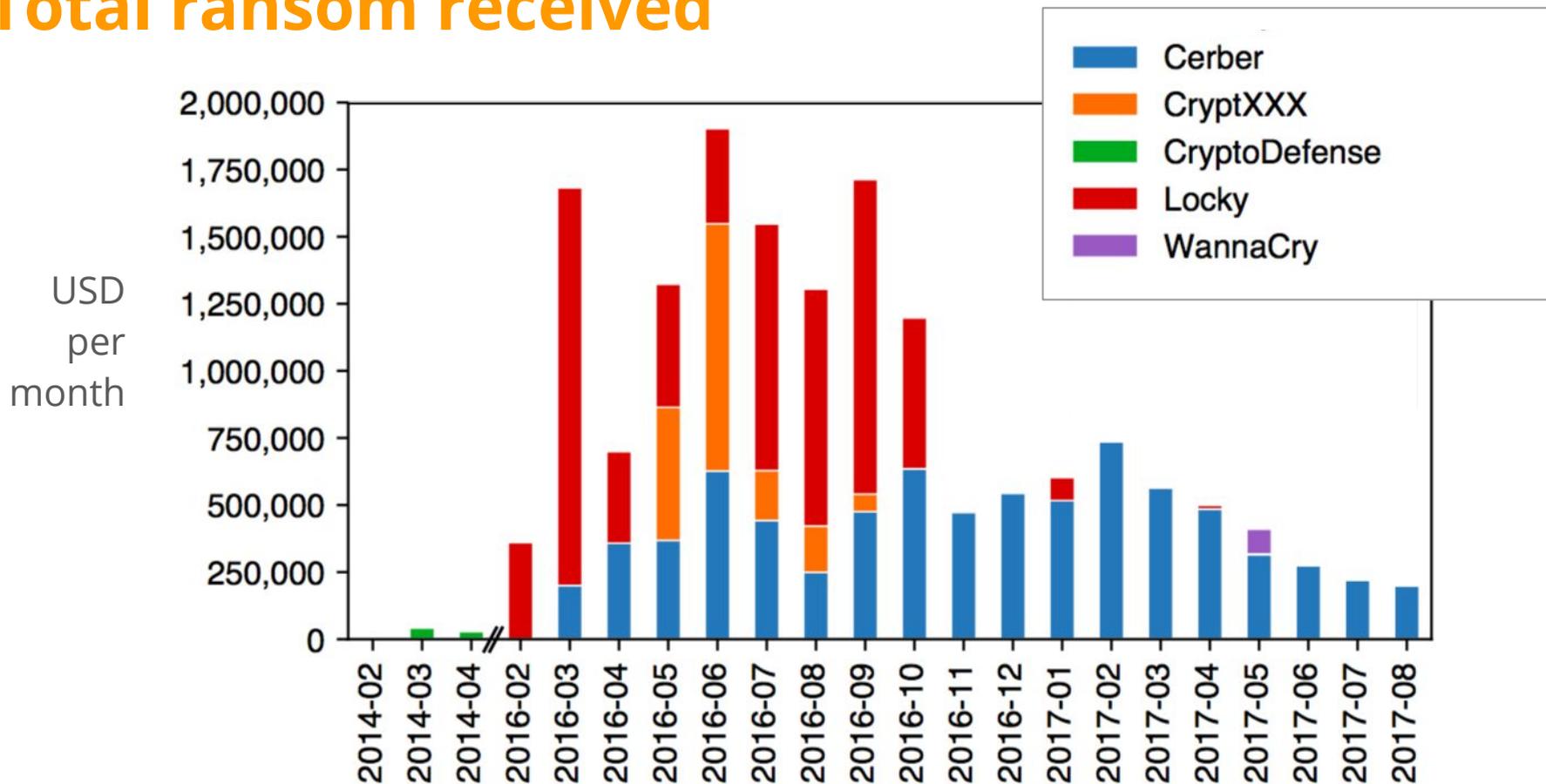


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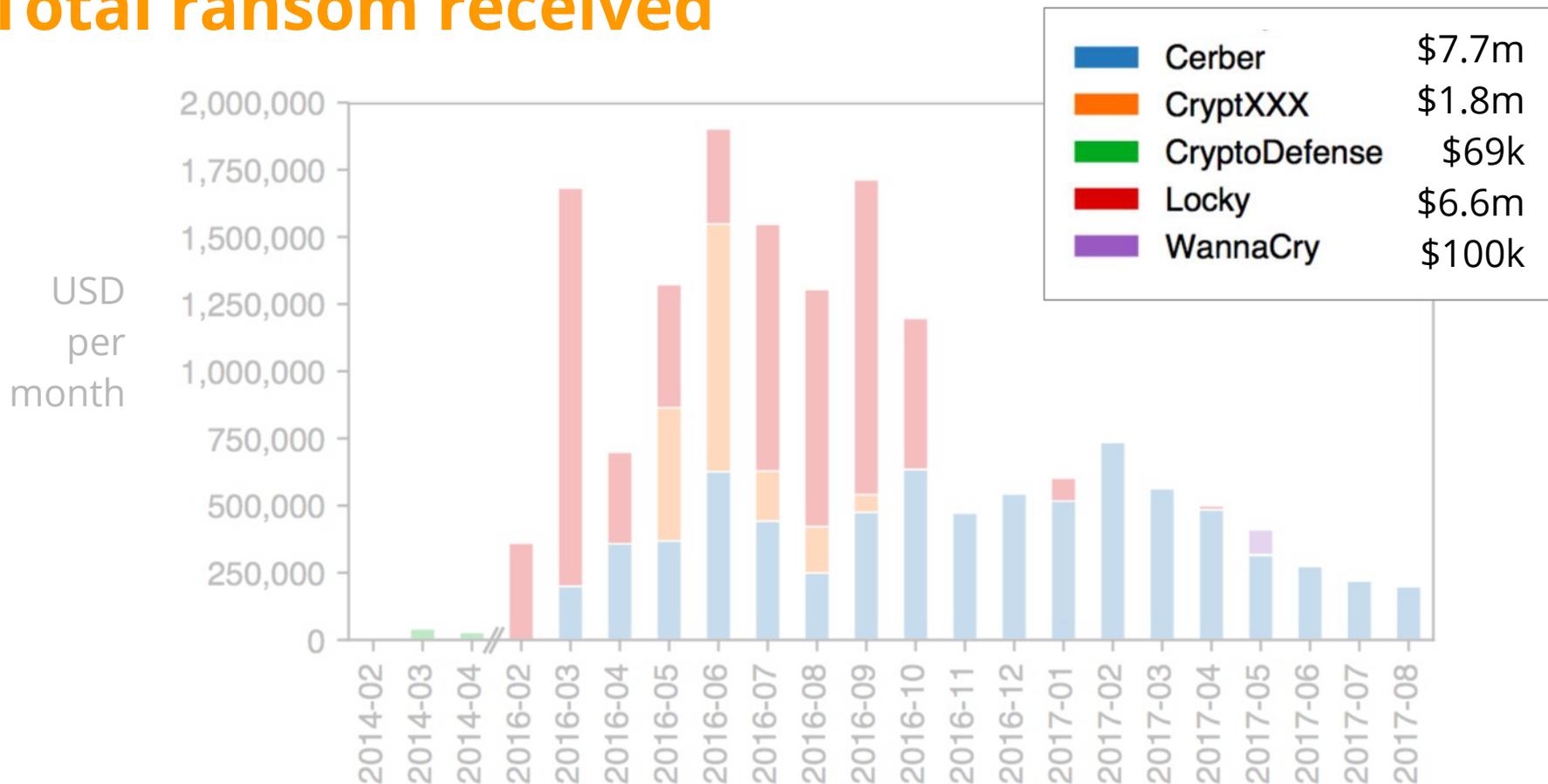
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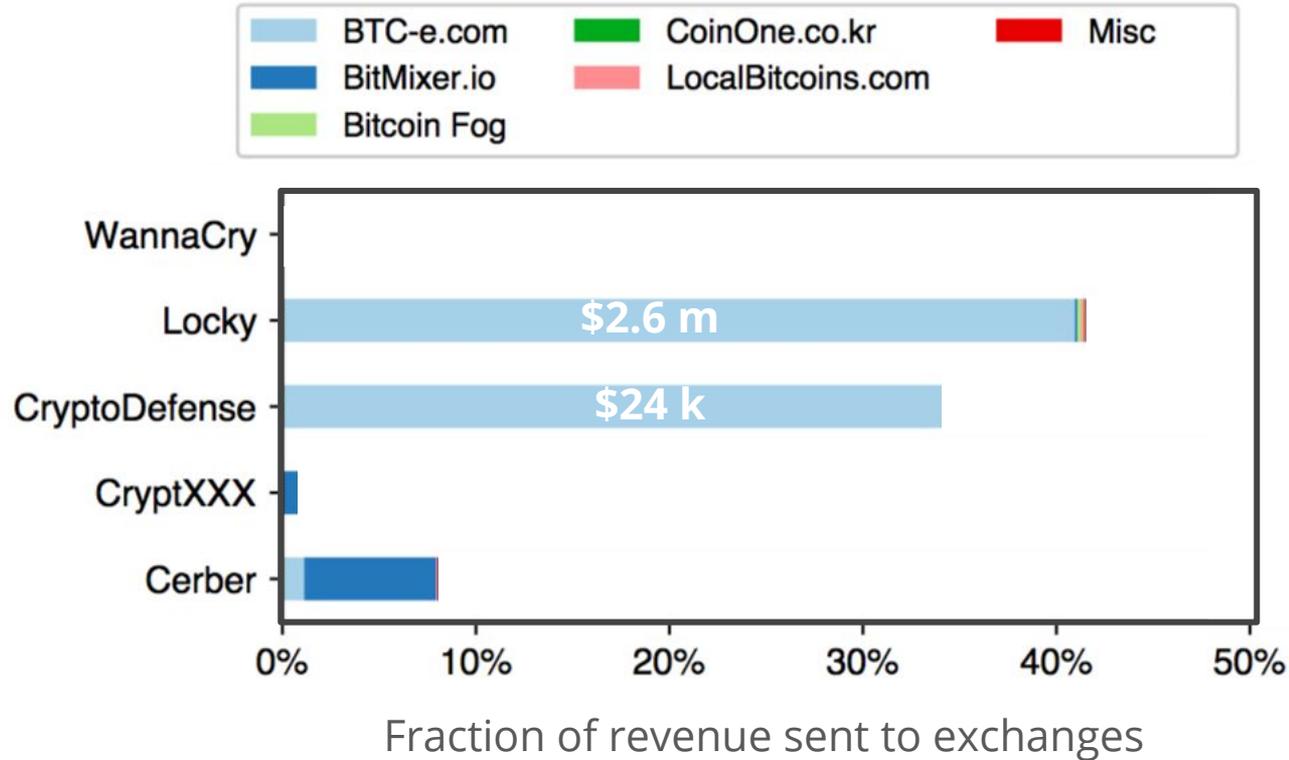
Total ransom received



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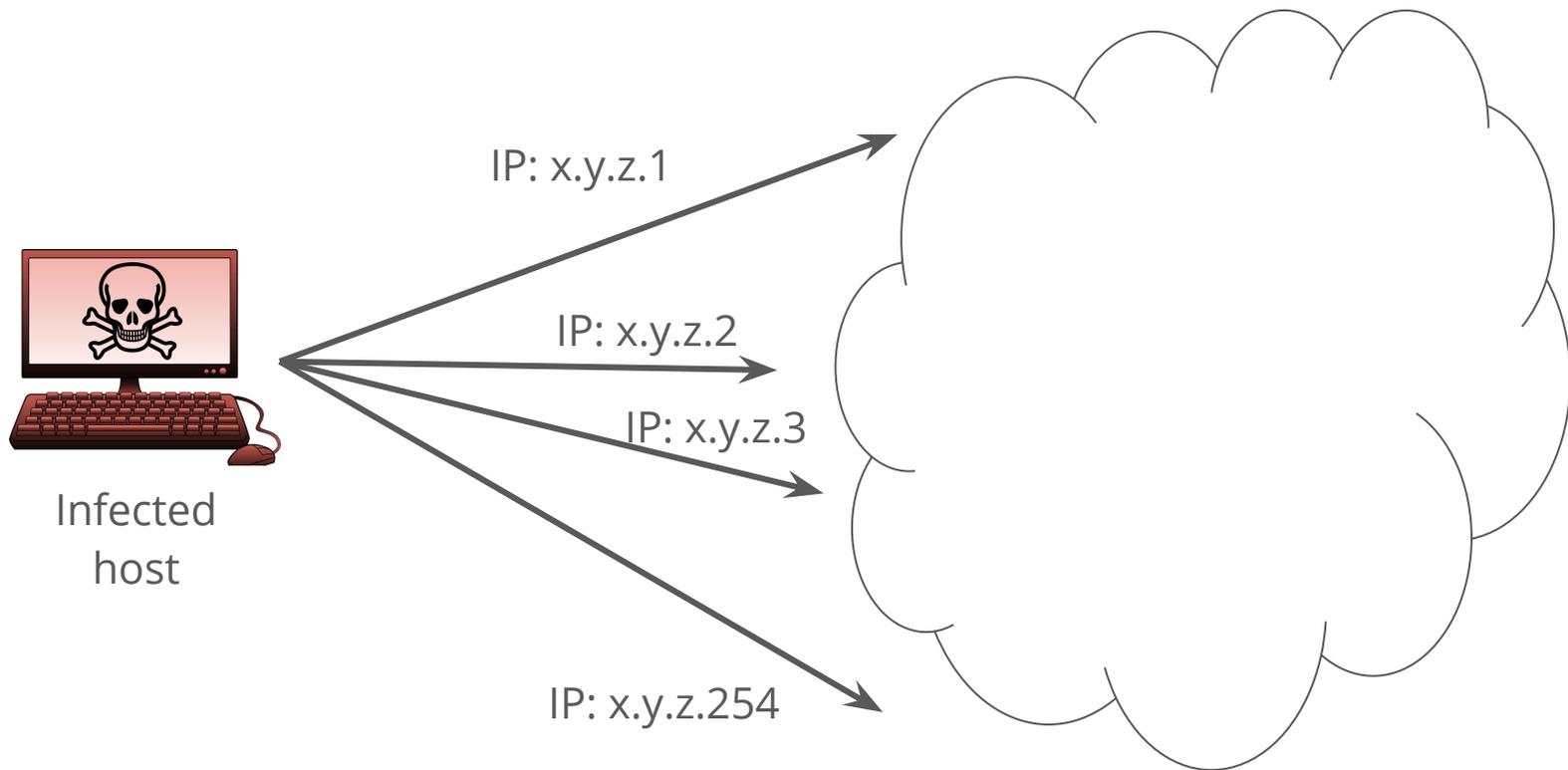
Potential liquidation at exchanges



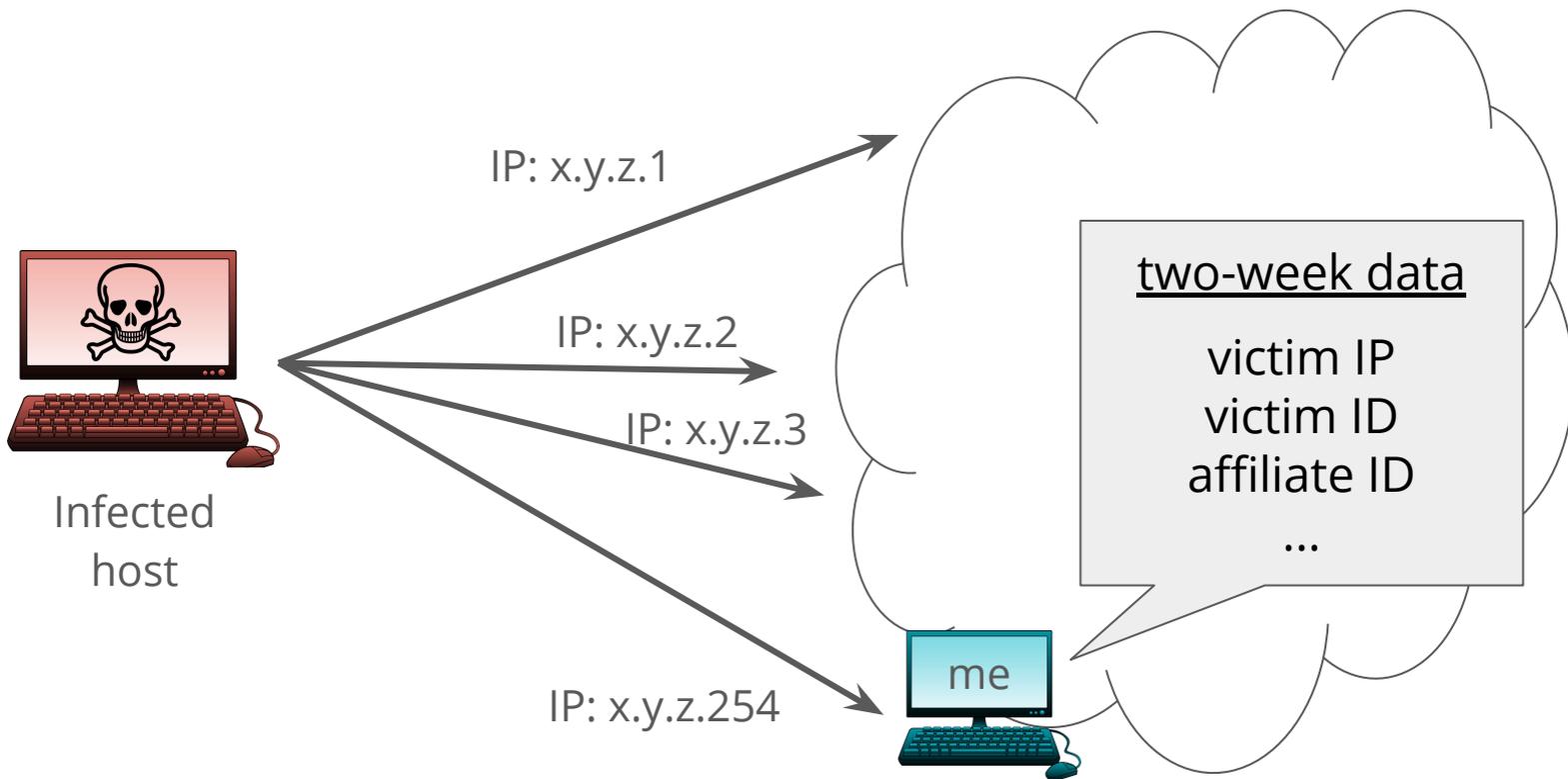
2

Reverse Engineering Cerber's C&C

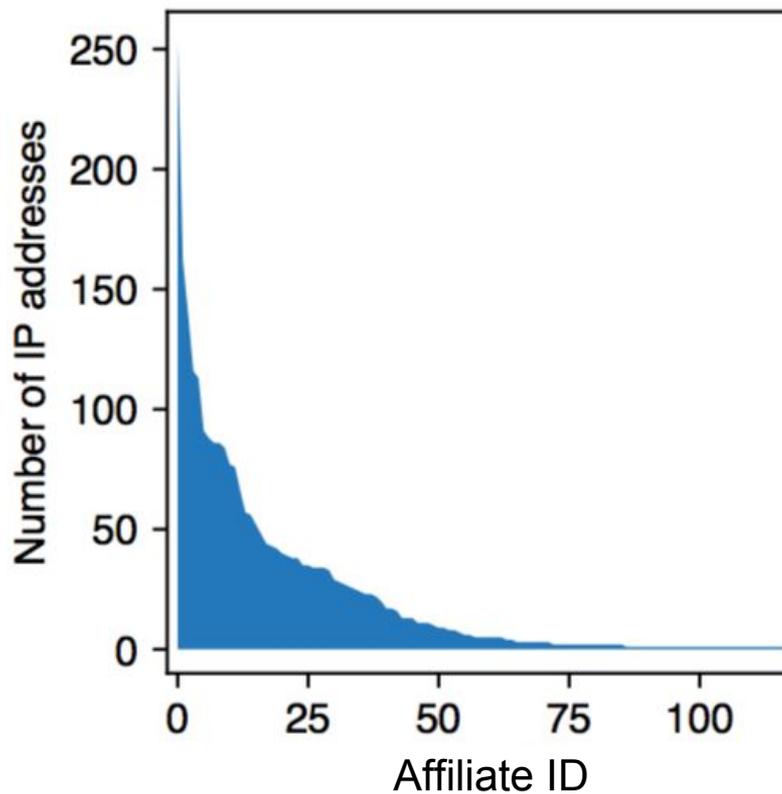
Cerber's outbound UDP traffic



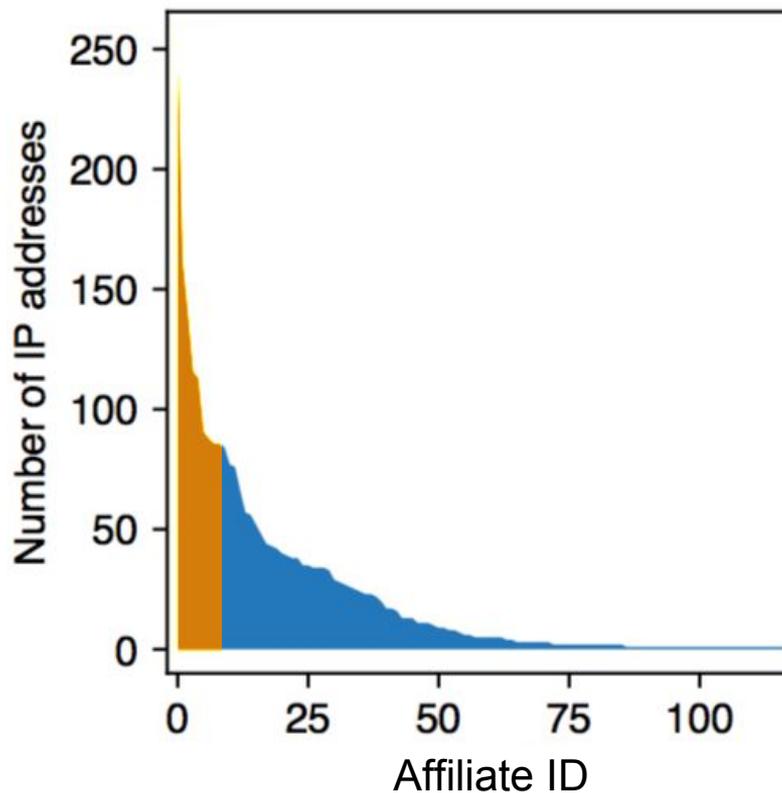
Cerber's outbound UDP traffic



Number of infected IP addr per affiliate



3% of affiliates caused 50% of infected IPs





Summary

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Key Methods

Tracked ransom payments for 10 ransomware families using co-spending wallet addr

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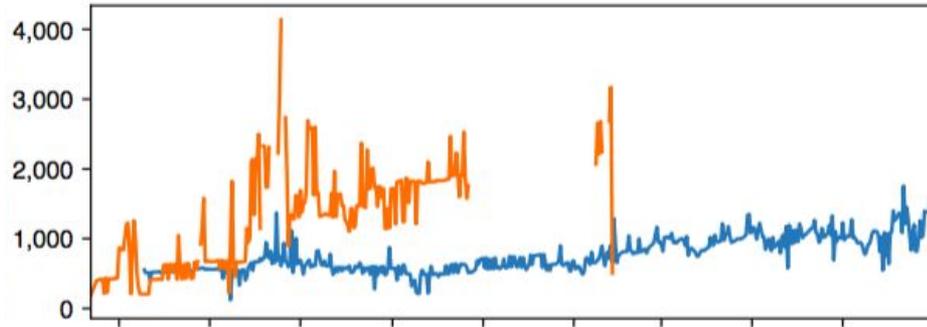
Possible chokepoints: exchanges and affiliates



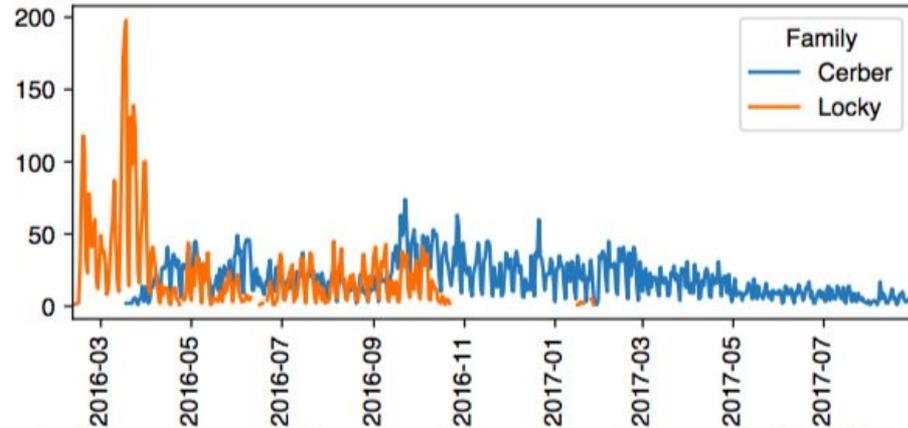
Appendix

Ransom payments over time

Median ransom amount per day (USD)



Number of payments per day



Potentially missing Locky's ransom payments

