Chainalysis

FEBRUARY 2024

The 2024 Crypto Crime Report

The latest trends in ransomware, scams, hacking, and more

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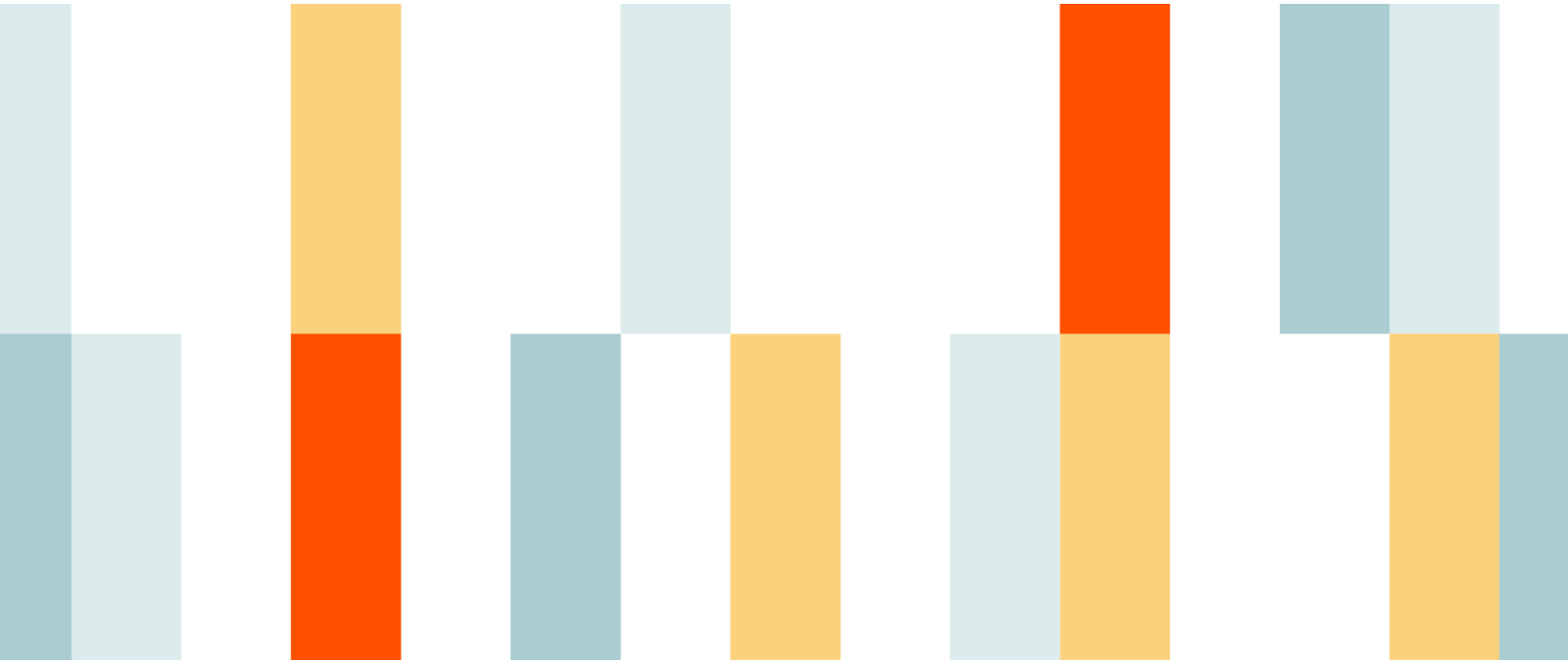
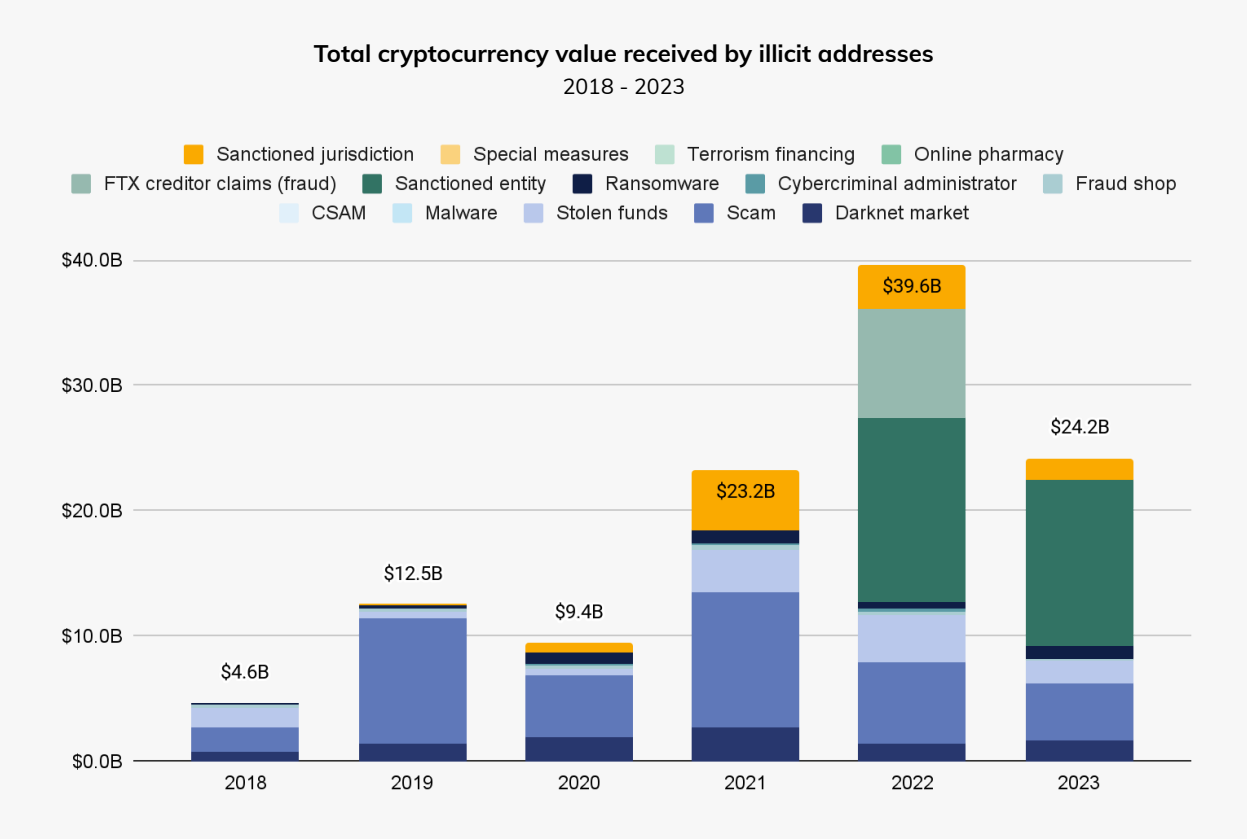


Introduction

Illicit Activity Down as Scamming and Stolen Funds Fall, But Ransomware and Darknet Markets See Growth

2023 was a year of recovery for cryptocurrency, as the industry rebounded from the scandals, blowups, and price declines of 2022. With crypto assets rebounding and market activity growing over the course of 2023, many believe that crypto winter is ending, and a new growth phase may soon be upon us.

But what did all of that mean for crypto crime? Let's look at the high-level trends.



2023 saw a significant drop in value received by illicit cryptocurrency addresses, to a total of $24.2 billion. As always, we have to caveat by saying that these figures are lower bound estimates based on inflows to the illicit addresses we've identified today. One year from now, these totals will almost certainly be higher, as we identify more illicit addresses and incorporate their historic activity into our estimates. For instance, when we published our Crypto Crime Report last year, we estimated $20.6 billion worth of illicit transaction volume for 2022. One year later, our updated estimate for 2022 is $39.6 billion. Much of that growth came from the identification of previously unknown, highly active addresses hosted by sanctioned

services, as well as our addition of transaction volume associated with services in sanctioned jurisdictions to our illicit totals.

Another key reason the new total is so much higher, besides the identification of new illicit addresses: We're now counting the $8.7 billion in creditor claims against FTX in our 2022 figures. In last year's report, we said that we would hold off on including transaction volumes associated with FTX and other firms that collapsed that year under allegedly fraudulent circumstances in our illicit totals until legal processes played out. Since then, a jury has convicted FTX's former CEO of fraud.

Typically, we only include measurable on-chain activity in our estimates for illicit activity. In the case of FTX, it's impossible to use on-chain data alone to measure the scope of the fraudulent activity, as there's no way to isolate illegitimate movements of user funds. As such, we believe the $8.7 billion in creditor claims against FTX is the best estimate to include. Given the size and impact of the FTX situation, we are treating it as an exception to our usual on-chain methodology. If courts convict in similar, ongoing cases, we plan to include their activity in our illicit transaction data as well in the future.

All other totals exclude revenue from non-crypto native crime, such as conventional drug trafficking in which crypto is used as a means of payment. Such transactions are virtually indistinguishable from licit transactions in on-chain data. Of course, law enforcement with off-chain context can still investigate these flows using Chainalysis solutions. In cases where we're able to confirm such information, we count the transactions as illicit in our data, but there are almost certainly many instances where that isn't the case, and therefore the numbers wouldn't be reflected in our totals.

CHAINALYSIS ESTIMATES

How big was crypto crime in 2023?

$24.2 B

received by illicit addresses

0.34%

of total on-chain transaction volume

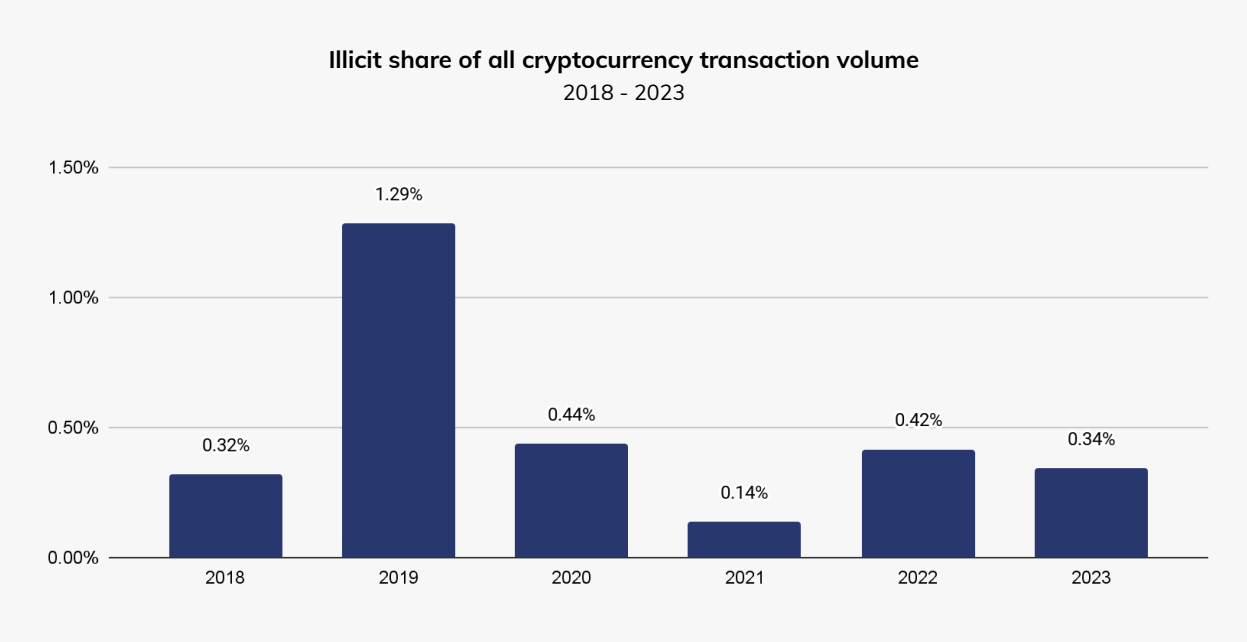
Estimates of illicit transaction activity DO include:

- ✓ Funds sent to addresses we've identified as illicit
- ✓ Funds stolen in crypto hacks

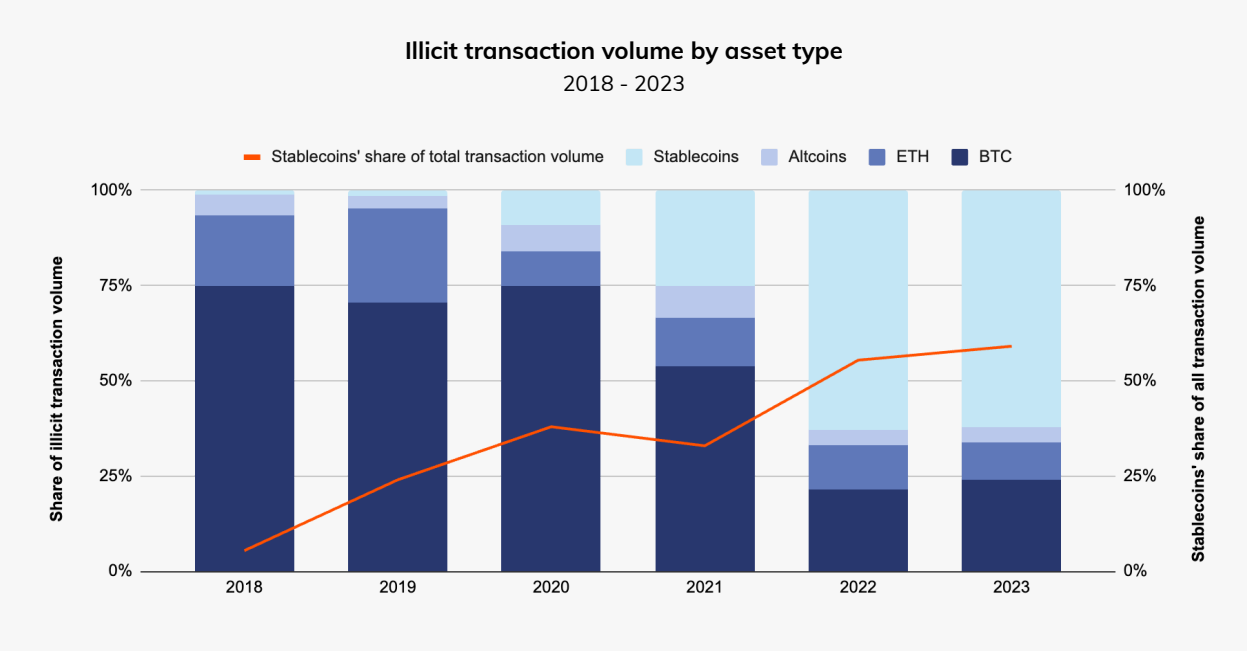
Estimates of illicit transaction activity DO NOT include:

- x Funds sent to addresses we have not yet identified as illicit. Why? Because we don't know that they're illicit yet. But we update our numbers on a rolling basis as we make more identifications.
- x Funds derived from non-crypto native crime, except for cases brought to our attention by customers. Why? Because these transactions are impossible to identify as illicit without more information.
- x Funds associated with crypto platforms accused of fraud, absent convictions in court. Why? Because only a judge and jury can make that determination.
- x Transaction volume associated with potential market manipulation. Why? Because our research heuristics are designed to catch suspected instances of market manipulation based on on-chain behavior, but aren't definitive.
- x Funds associated with crypto money laundering. Why? Because our goal here is to calculate total revenue from illicit activity, based on inflows to illicit addresses. We share the total value laundered on-chain in the report's money laundering section, calculated based on the value sent from illicit addresses to off-ramping services. Including money laundering totals here based on outflows would effectively be double counting, and artificially inflate our estimates of on-chain criminal activity.

In addition to the reduction in absolute value of illicit activity, our estimate for the share of all crypto transaction volume associated with illicit activity also fell, to 0.34% from 0.42% in 2022.[1]

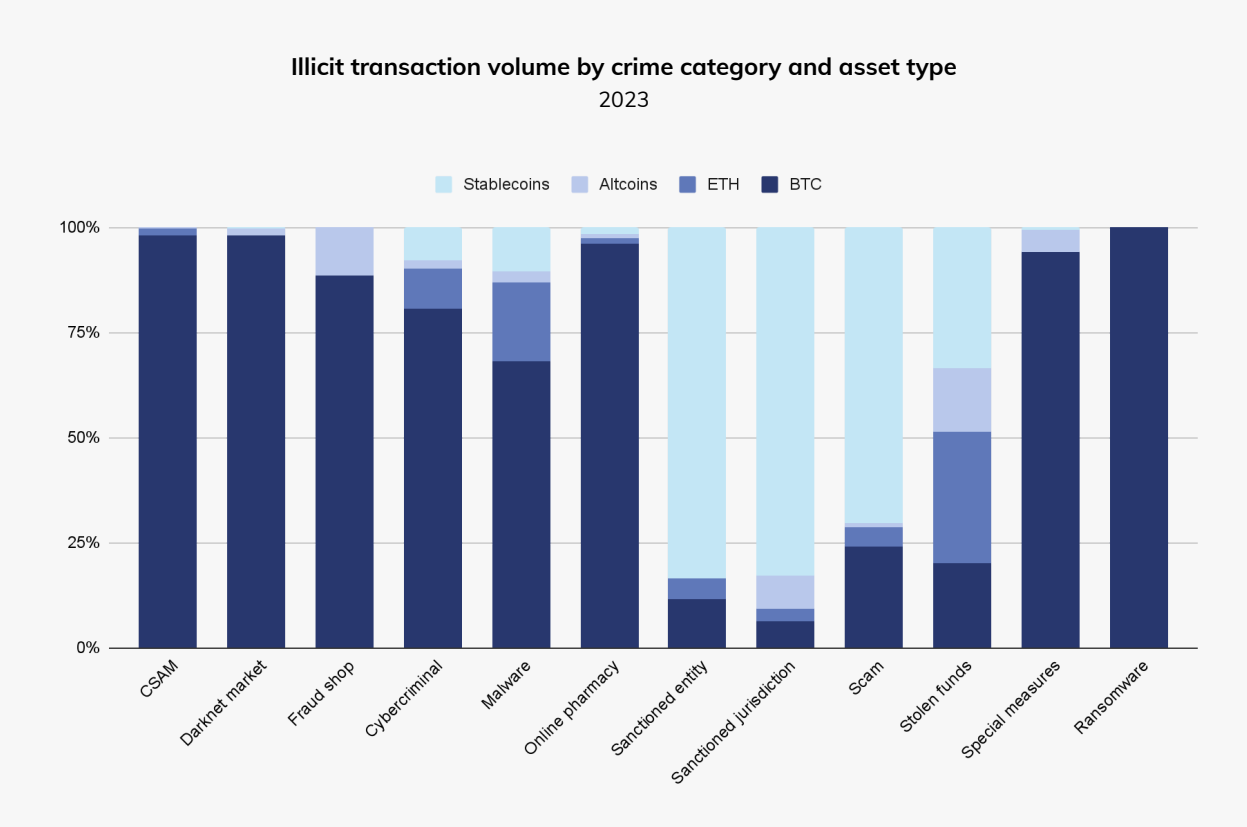


We're also seeing a shift in the types of assets involved in cryptocurrency-based crime.



[1] Transaction volume is a measure of all economic activity, a proxy for funds changing hands. We remove peel chains, internal service transactions, change, and any other type of transaction that would not count as an economic transaction between distinct economic actors.

Through 2021, Bitcoin reigned supreme as the cryptocurrency of choice among cybercriminals, likely due to its high liquidity. But that's changed over the last two years, with stablecoins now accounting for the majority of all illicit transaction volume. This change also comes alongside recent growth in stablecoins' share of all crypto activity overall, including legitimate activity. However, stablecoin dominance isn't the case for all forms of cryptocurrency-based crime.



Some forms of illicit cryptocurrency activity, such as darknet market sales and ransomware extortion, still take place predominantly in Bitcoin.[2] Others, like scamming and transactions associated with sanctioned entities, have shifted to stablecoins. Those also happen to be the biggest forms of crypto crime by transaction volume, thereby driving the larger trend. Sanctioned entities, as well as those operating in sanctioned jurisdictions or involved with terrorism financing, also have a greater incentive to use stablecoins, as they may face more challenges accessing the U.S. dollar through traditional means, but still want to benefit from the stability it provides. However, stablecoin issuers can freeze funds when they become aware of their illicit use, as Tether recently did with addresses linked to terrorism and warfare in Israel and Ukraine.

Below, we'll look at three key trends that defined crypto crime in 2023 and will be important to watch moving forward.

[2] These estimates do not include privacy coins like Monero.

Scamming and stolen funds down big

Crypto scamming and hacking revenue both fell significantly in 2023, with total illicit revenue for each down 29.2% and 54.3% respectively.

As we discuss later in our scams section, many crypto scammers have now adopted romance scam tactics, targeting individuals and building relationships with them in order to pitch them on fraudulent investing opportunities, rather than advertising them far and wide, which often makes them more difficult to uncover. Although the FBI has published data showing that reports of crypto investment scams in the U.S. has been increasing year over year through 2022, our on-chain metrics suggest scamming revenues globally have been trending down since 2021. We believe this aligns with the long-standing trend that scamming is most successful when markets are up, exuberance is high, and people feel like they are missing out on an opportunity to get rich quickly. Of course, the impact of romance scams on individual victims is devastating and should not be understated. And while increased reporting – at least in the U.S. – is a good sign, we still believe insights into romance scams in particular suffer from underreporting. We hypothesize that the true damage of scamming is greater than what reporting to the FBI and our on-chain metrics show, but overall, scamming is down, given broader market dynamics.

Crypto hacking, on the other hand, is much more difficult for criminals to hide, as industry observers can quickly spot the unusual outflows from a given service or protocol when a hack occurs. As we'll discuss later, the decline in stolen funds is driven largely by a sharp dropoff in DeFi hacking. That dropoff could represent the reversal of a disturbing, long-term trend, and may signify that DeFi protocols are improving their security practices. That said, stolen funds metrics are heavily outlier-driven, and one large hack could again shift the trend.

Ransomware and darknet market activity on the rise

Ransomware and darknet markets, on the other hand, are two of the most prominent forms of crypto crime that saw revenues rise in 2023, in contrast with overall trends. The growth of ransomware revenue is disappointing following the sharp declines we covered last year, and suggests that perhaps ransomware attackers have adjusted to organizations' cybersecurity improvements, a trend we first reported earlier this year.

Similarly, this year's growth in darknet market revenue also comes after a 2022 decline in revenue. That decline was driven largely by the shutdown of Hydra, which was once the world's most dominant market by far, capturing over 90% of all darknet market revenue at its peak. While no single market has yet emerged to take its place, the sector as a whole is rebounding, with total revenue climbing back towards its 2021 highs.

Transactions with sanctioned entities drive the vast majority of illicit activity

Perhaps the most obvious trend that emerges when looking at illicit transaction volume is the prominence of sanctions-related transactions. Sanctioned entities and jurisdictions together accounted for a combined

$14.9 billion worth of transaction volume in 2023, which represents 61.5% of all illicit transaction volume we measured on the year. Most of this total is driven by cryptocurrency services that were sanctioned by the U.S. Department of the Treasury's Office of Foreign Assets Control (OFAC), or are located in sanctioned jurisdictions, and can continue to operate because they're in jurisdictions where U.S. sanctions are not enforced.

While those services can and have been used for nefarious purposes, it also means that some of that $14.9 billion in sanctions-related transaction volume includes activity from average crypto users who happen to reside in those jurisdictions. For example, Russia-based exchange Garantex, which was sanctioned by OFAC and OFSI in the U.K. for its facilitation of money laundering on behalf of ransomware attackers and other cybercriminals, was one of the biggest drivers of transaction volume associated with sanctioned entities in 2023. Garantex continues to operate because Russia does not enforce U.S. sanctions. So, does that mean all of Garantex's transaction volume is associated with ransomware and money laundering? No. Nevertheless, exposure to Garantex introduces serious sanctions risk for crypto platforms subject to U.S. or U.K. jurisdiction, which means those platforms must remain ever-more vigilant and screen for exposure to Garantex in order to be compliant.

Ransomware

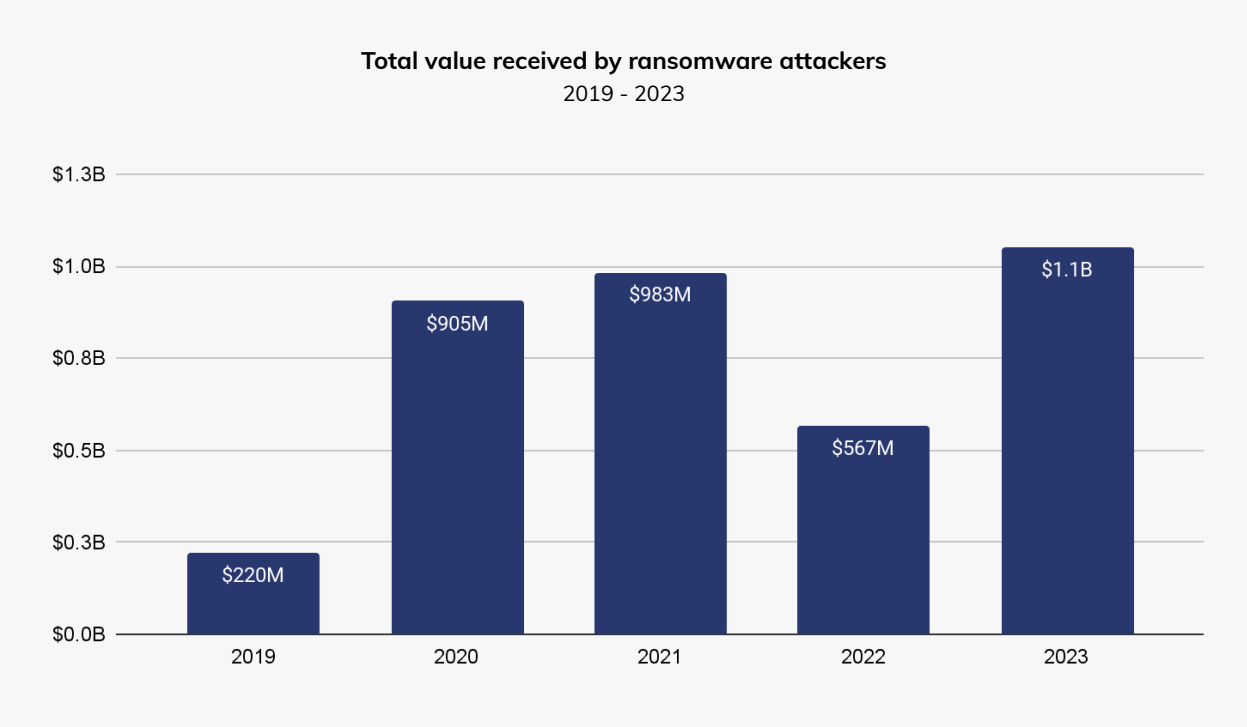
Ransomware Payments Exceed $1 Billion in 2023, Hitting Record High After 2022 Decline

In 2023, ransomware actors intensified their operations, targeting high-profile institutions and critical infrastructure, including hospitals, schools, and government agencies. Major ransomware supply chain attacks were carried out exploiting the ubiquitous file transfer software MOVEit, impacting companies ranging from the BBC to British Airways. As a result of these attacks and others, ransomware gangs reached an unprecedented milestone, surpassing $1 billion in extorted cryptocurrency payments from victims.

Last year's developments highlight the evolving nature of this cyber threat and its increasing impact on global institutions and security at large.

2023: A watershed year for ransomware

2023 marks a major comeback for ransomware, with record-breaking payments and a substantial increase in the scope and complexity of attacks — a significant reversal from the decline observed in 2022, which we forewarned in our Mid-Year Crime Update.



Ransomware payments in 2023 surpassed the $1 billion mark, the highest ever observed. Although 2022 saw a decline in ransomware payment volume, the overall trend line from 2019 to 2023 indicates that ransomware is an escalating problem. Keep in mind that this number does not capture the economic impact of productivity loss and repair costs associated with attacks. This is evident in cases like the ALPHV-BlackCat and Scattered Spider's bold targeting of MGM resorts. While MGM did not pay the ransom, it estimates damages cost the business over $100 million.

The ransomware landscape is not only prolific but continually expanding, making it challenging to monitor every incident or trace all ransom payments made in cryptocurrencies. It is important to recognize that our figures are conservative estimates, likely to increase as new ransomware addresses are discovered over time. For instance, our initial reporting for 2022 in last year's crime report showed $457 million in ransoms, but this figure has since been revised upward by 24.1%.

Looking back at 2022: An anomaly, not a trend

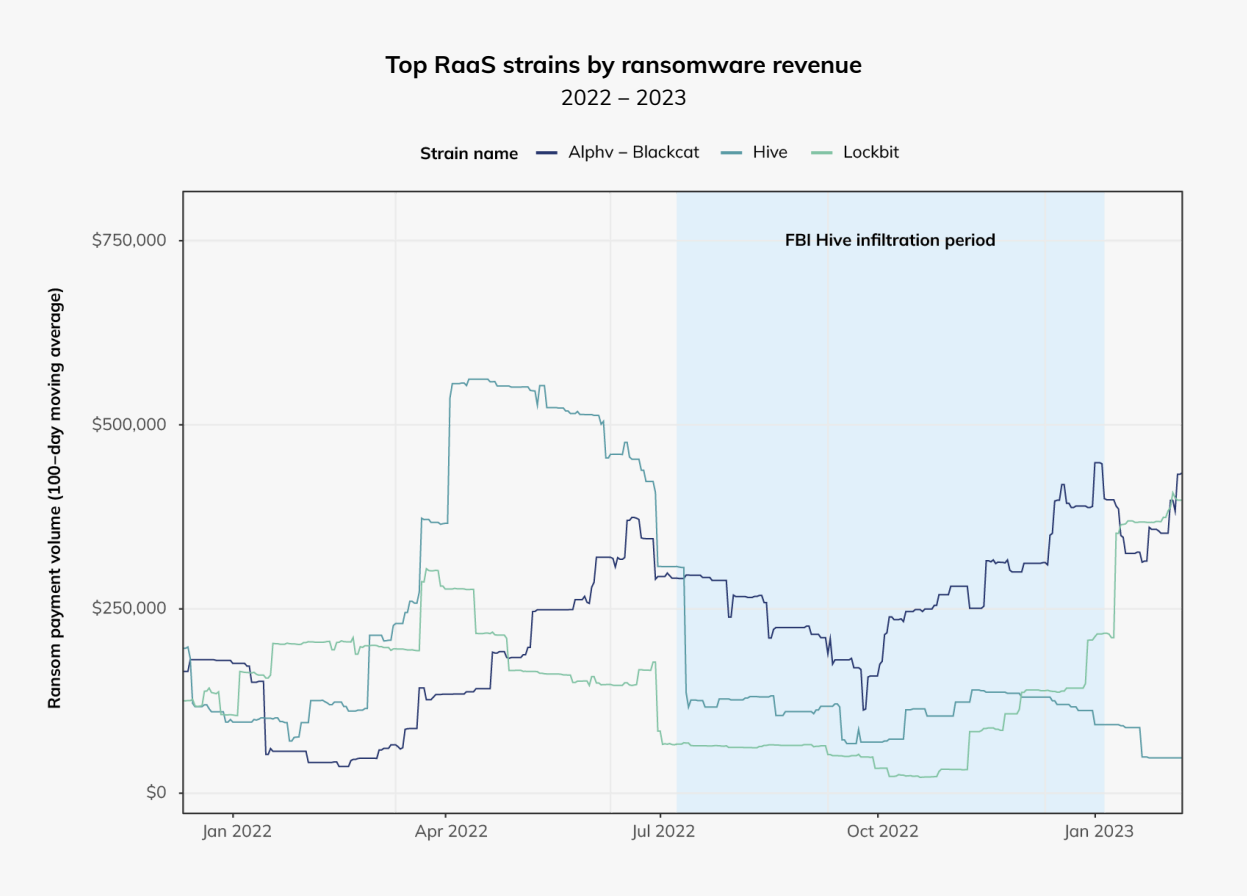
Several factors likely contributed to the decrease in ransomware activity in 2022, including geopolitical events like the Russian-Ukrainian conflict. This conflict not only disrupted the operations of some cyber actors but also shifted their focus from financial gain to politically motivated cyberattacks aimed at espionage and destruction.

As we noted in our 2023 Crypto Crime Report, other factors that played a role in this downturn included a reluctance among some Western entities to pay ransoms to certain strains due to potential sanctions risks. Conti in particular faced issues, suffering from reported links to sanctioned Russian intelligence agencies, exposure of the organization's chat logs, and overall internal disarray. This led to a decrease in their activities and contributed to the overall reduction in ransomware incidents in 2022. But researchers have noted that many ransomware actors linked to Conti have continued to migrate or launch new strains, making victims more willing to pay.

Another significant factor in the reduction of ransomware in 2022 was the successful infiltration of the Hive ransomware strain by the Federal Bureau of Investigation (FBI), as announced by the Department of Justice early in 2023. Our analysis highlights the substantial impact of this single enforcement action.

Law enforcement takes on ransomware: The Hive intervention

During the infiltration of Hive, the FBI was able to provide decryption keys to over 1,300 victims, effectively removing the need for ransom payments. The FBI estimates that this intervention prevented approximately $130 million in ransom payments to Hive. But the impact of this intervention extends further than that. Total tracked ransomware payments for 2022 currently stand at just $567 million, indicating the ransom payments prevented by the Hive infiltration significantly altered the ransomware landscape as a whole last year.



Furthermore, the FBI's $130 million reduced payment estimate may not tell the whole story of just how successful the Hive infiltration was. That figure only looks directly at ransoms averted through the provision of decryptor keys, but does not account for knock-on effects. The Hive infiltration also most likely affected the broader activities of Hive affiliates, potentially lessening the number of additional attacks they could carry out, even using strains other than Hive.

During the six months the FBI infiltrated Hive, total ransomware payments across all strains hit $290.35 million. But our statistical models estimate an expected total of $500.7 million during that time period, based on attacker behavior in the months before and after the infiltration — and that's a conservative estimate. Based on that figure, we believe the Hive infiltration may have averted at least $210.4 million in ransomware payments.

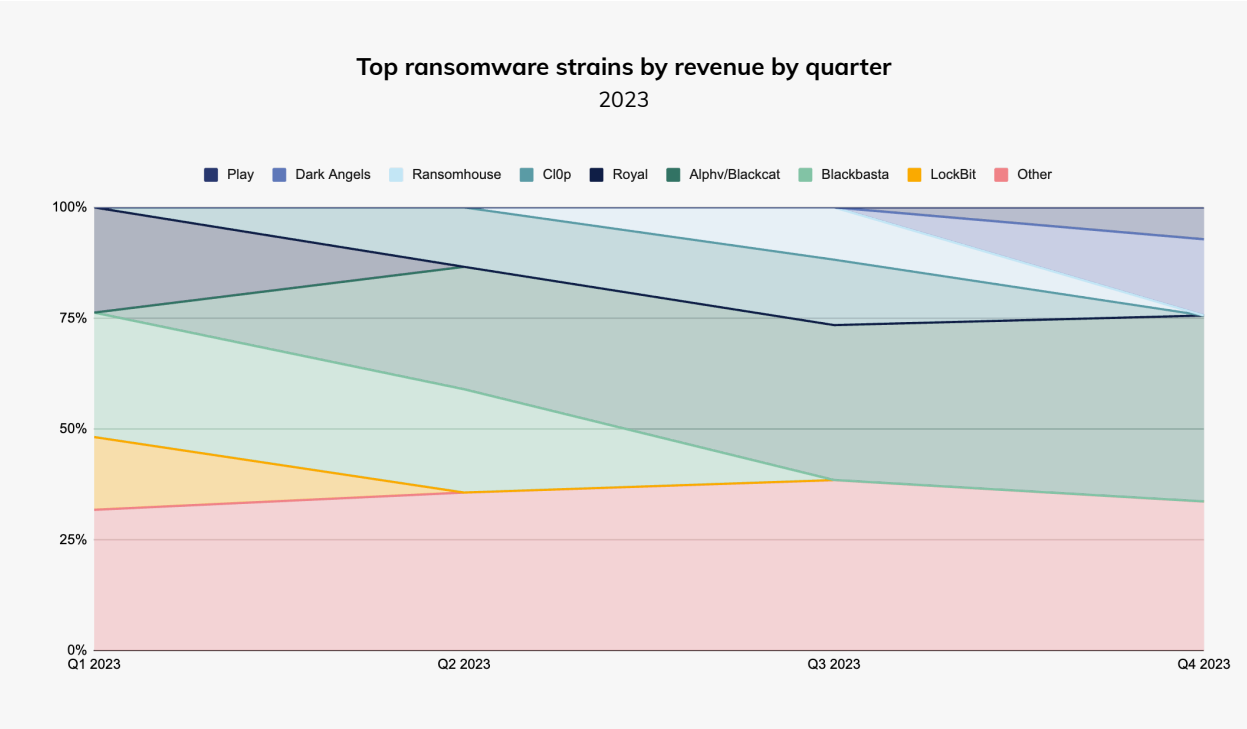
FBI's Tampa Division Special Agent in Charge, David Walker, provided further insights into the importance of the infiltration. "The Hive investigation is an example of a gold standard for deploying the key services model." Said Walker. "The FBI continues to see, through its investigations and victim engagements, the significant positive impact actions such as the Hive takedown have against cyber threat actors. We will continue to take proactive disruptive measures against adversaries."

Ransomware resurges: 2023 threat landscape

In 2023, the ransomware landscape saw a major escalation in the frequency, scope, and volume of attacks.

Ransomware attacks were carried out by a variety of actors, from large syndicates to smaller groups and individuals — and experts say their numbers are increasing. Allan Liska, Threat Intelligence Analyst at cybersecurity firm Recorded Future, notes, “A major thing we’re seeing is the astronomical growth in the number of threat actors carrying out ransomware attacks.” Recorded Future reported 538 new ransomware variants in 2023, pointing to the rise of new, independent groups.

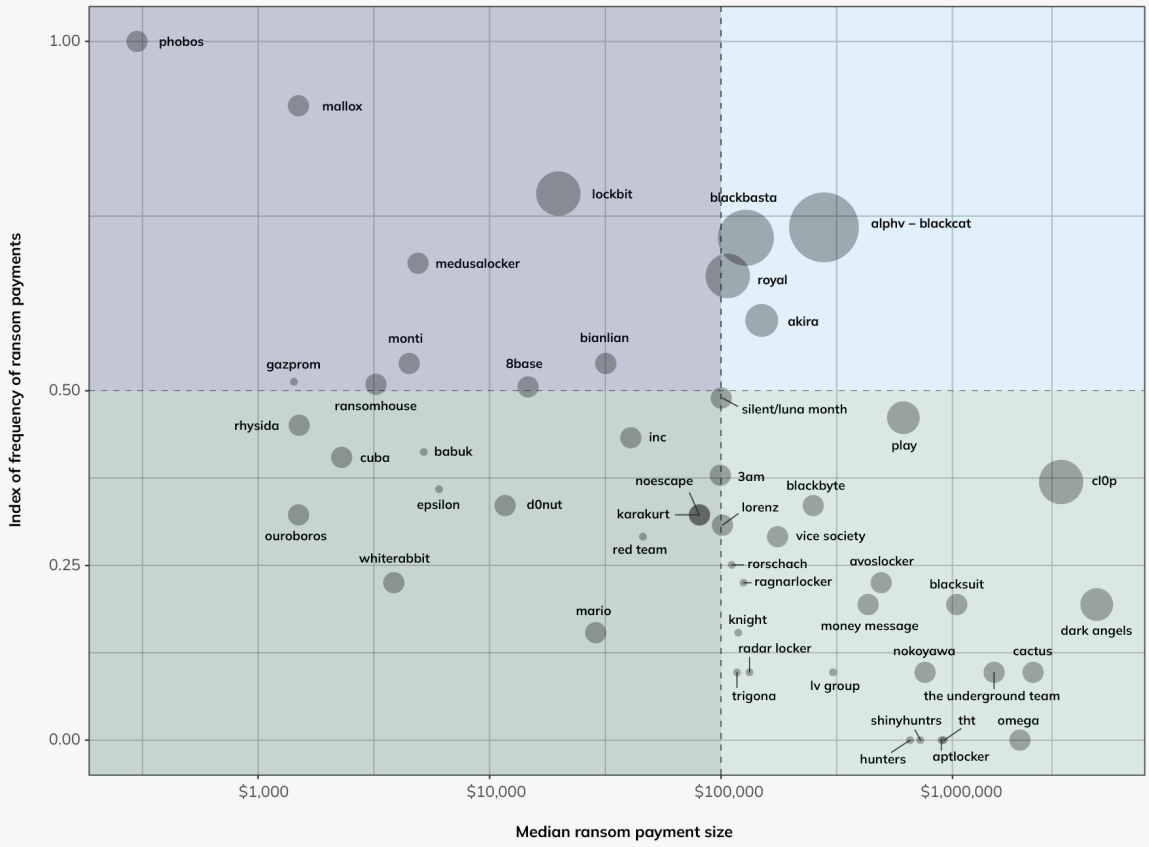
We can see some of that variety on the graph below, which shows the most active ransomware strains by quarter for 2023.



We can also see significant differences in the victimization strategies of the top ransomware strains on the chart below, which plots each strain’s median ransom size versus its frequency of successful attacks. The chart also illustrates numerous new entrants and offshoots in 2023, who we know often reuse existing strains’ code. This suggests an increasing number of new players, attracted by the potential for high profits and lower barriers to entry.

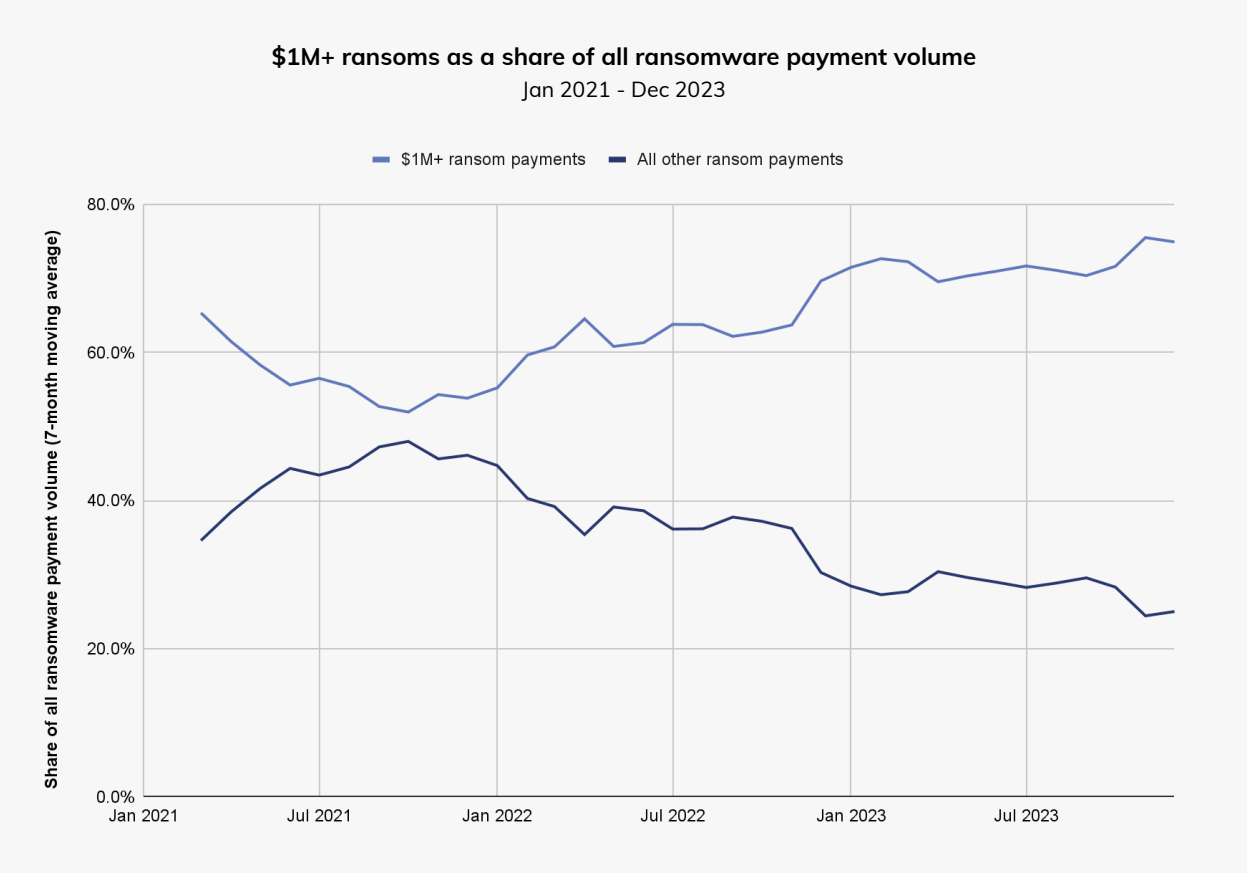
Top 50 ransomware strains by median payment size and payment frequency

Note: Bubble size denotes total 2023 ransom inflows



Some strains, like Cl0p, exemplify the “big game hunting” strategy, carrying out fewer attacks than many other strains, but collecting large payments with each attack. As we’ll explore later, Cl0p leveraged zero-day vulnerabilities that allowed it to extort many large, deep-pocketed victims en masse, spurring the strain’s operators to embrace a strategy of data exfiltration rather than encryption.

Overall, big game hunting has become the dominant strategy over the last few years, with a bigger and bigger share of all ransomware payment volume being made up of payments of $1 million or more.



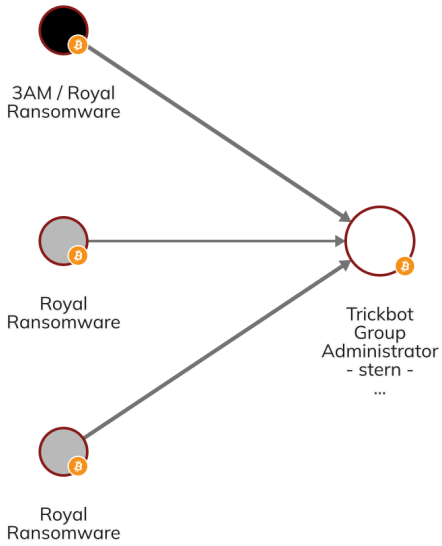
Other strains, like Phobos, have adopted the Ransomware as a Service (RaaS) model, in which outsiders known as affiliates can access the malware to carry out attacks, and in exchange pay the strain's core operators a cut of the ransom proceeds. Phobos simplifies the process for less technically sophisticated hackers to execute ransomware attacks, leveraging the typical encryption process that is the hallmark of ransomware. Despite targeting smaller entities and demanding lower ransoms, the RaaS model is a force multiplier, enabling the strain to carry out a large quantity of these smaller attacks.

ALPHV-BlackCat is also a RaaS strain like Phobos, but is more selective in the affiliates it allows to use its malware, actively recruiting and interviewing potential candidates for their hacking capabilities. This enables the group to attack bigger targets for larger sums.

It's also important to keep in mind that rebranding and overlapping strain usage remains prevalent for ransomware attackers. As we've covered previously, ransomware administrators often rebrand or launch new strains, while affiliates often switch strains or work for multiple simultaneously. Rebrands often allow ransomware attackers to distance themselves from strains publicly linked to sanctions or that have incurred too much scrutiny. Rebrands and affiliate switching can also allow attackers to hit the same victims twice under different strain names.

Fortunately, blockchain analysis makes it possible to identify ransomware rebrands, by showing on-chain links between wallets of seemingly disparate strains. We can see an example on the Chainalysis Reactor

graph below, which shows links between the Trickbot administrator known as Stern, Royal ransomware, and its newer iteration known as 3am.



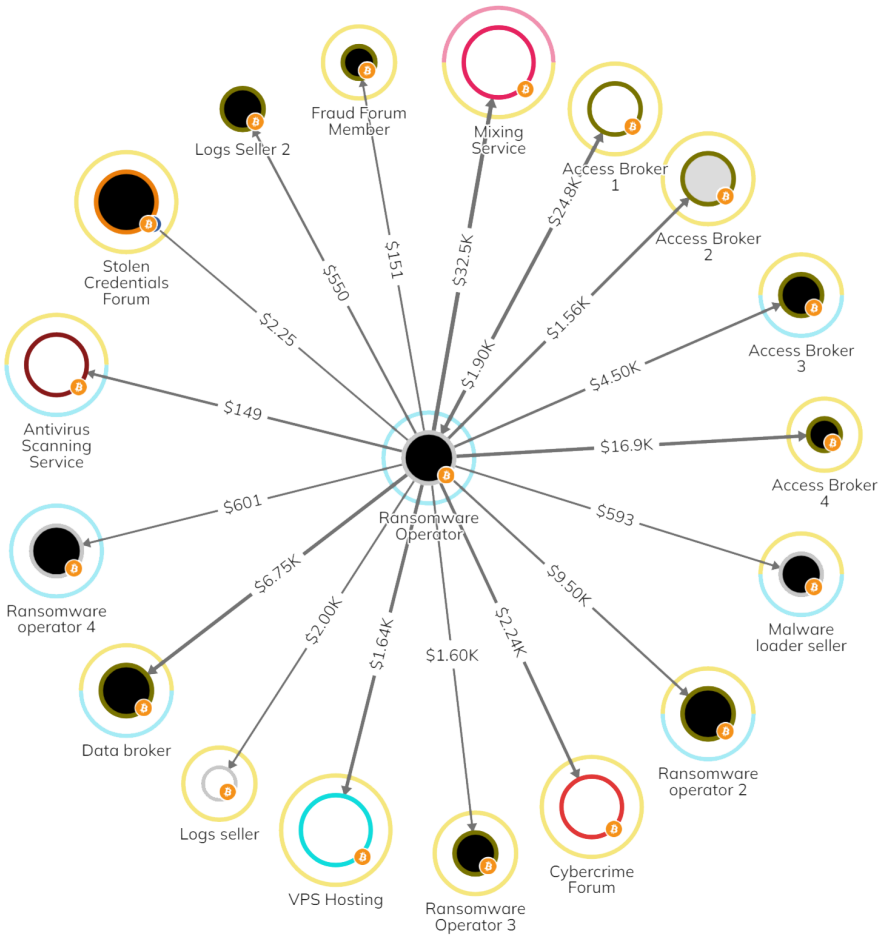
The frequency of rebranding, especially among actors behind the biggest and most notorious strains, is an important reminder that the ransomware ecosystem is smaller than the large number of strains would make it appear.

The spread of Ransomware-as-a-Service (RaaS) and availability of hacking tools have made it easier to launch attacks

The growth of initial access brokers (IABs) has made it easier for bad actors to carry out ransomware attacks. As their name would suggest, IABs penetrate the networks of potential victims, then sell that access to ransomware attackers for as little as a few hundred dollars. We found a correlation between inflows to IAB wallets and an upsurge in ransomware payments, suggesting monitoring IABs could provide early warning signs and allow for potential intervention and mitigation of attacks.

IABs combined with off-the-shelf RaaS, means that much less technical skill is required to carry out a successful ransomware attack. Andrew Davis, General Counsel at Kivu Consulting, a firm specializing in cybersecurity incident response, told us more about this trend. “The increase in attack volume can be attributed to the affiliate model's ease of access and the adoption of ransomware-as-a-service, a disturbingly effective business model for cybercriminals,” said Davis.

We can see examples of this activity on the following Reactor graph, which shows a ransomware operator sending funds to several IABs and other purveyors of tools useful for ransomware attacks.



The ransomware actors depicted above have executed attacks that have brought in millions of dollars.

CASE STUDY

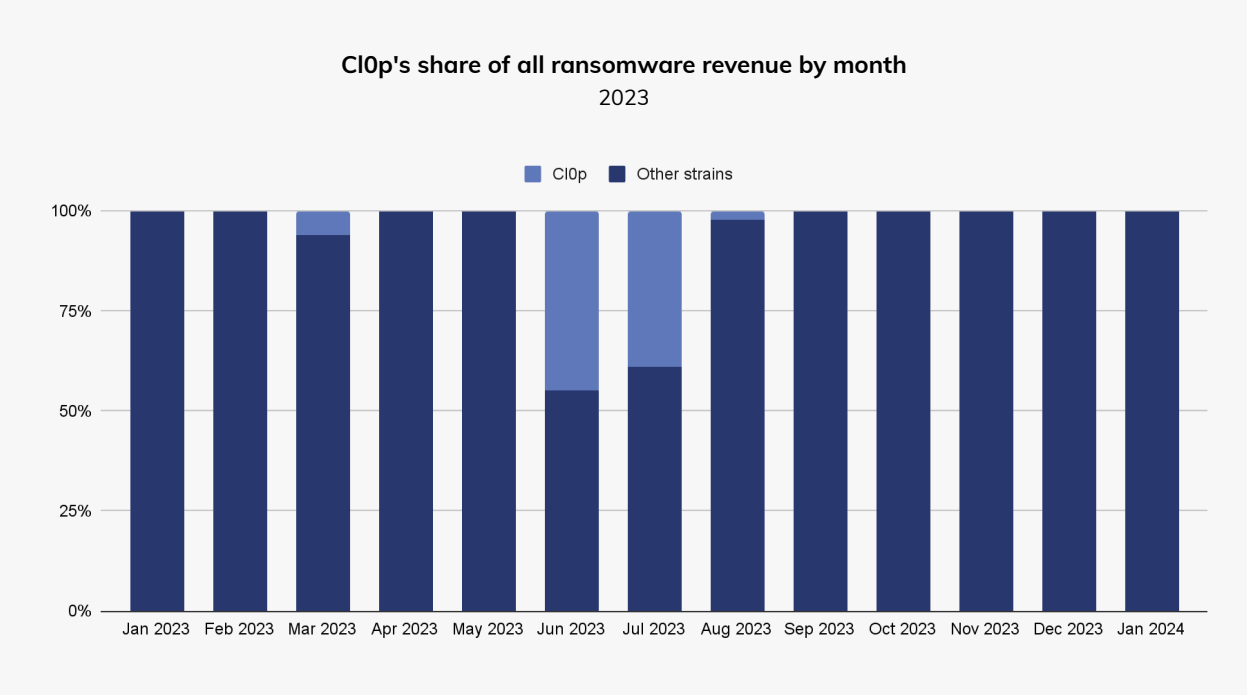
Cl0p: How zero-day attacks enable big game hunting

2023 was remarkable for the number of high-impact ransomware incidents that utilized zero-day vulnerabilities, which are particularly beneficial for threat actors because they leverage security gaps before developers have the opportunity to create and distribute a fix. Zero-day exploits can be even more damaging if they affect software that is ubiquitous but not well-known to end users who are the ultimate victims of an attack, usually because the software is used primarily by vendors serving those end users.

Cl0p's most notorious attack of 2023 was its exploitation of the MOVEit zero-day. MOVEit is a file transfer software used by many IT and cloud applications, so this vulnerability exposed the data of hundreds of organizations and millions of individuals at once. "Many victims of the MOVEit exploitation did not know that they were affected because they were not aware that they were exposed to the software," said Allan Liska of Recorded Future.

Beginning in May of 2023, Cl0p began exploiting the MOVEit vulnerability, enabling the group to target a huge number of victims. With so many targets, encrypting data and distributing decryptor keys to those who pay becomes logistically impractical. Data exfiltration – stealing data without blocking access and threatening to release it to the public – proves to be a more efficient tactic and hedges against possible decryptors foiling the attack. Lizzie Cookson, Senior Director of Incident Response at Coveware, comments on this tactic. "Encryption requires more expertise, resources, and a specific type of victim landscape," said Cookson. "Exfiltration requires less dwell time, less experience and skill to execute and can often be accomplished without malicious software."

Cl0p's MOVEit campaign allowed it to become for a time the most prominent strain in the entire ecosystem, amassing over $100 million in ransom payments and accounting for 44.8% of all ransomware value received in June, and 39.0% in July.

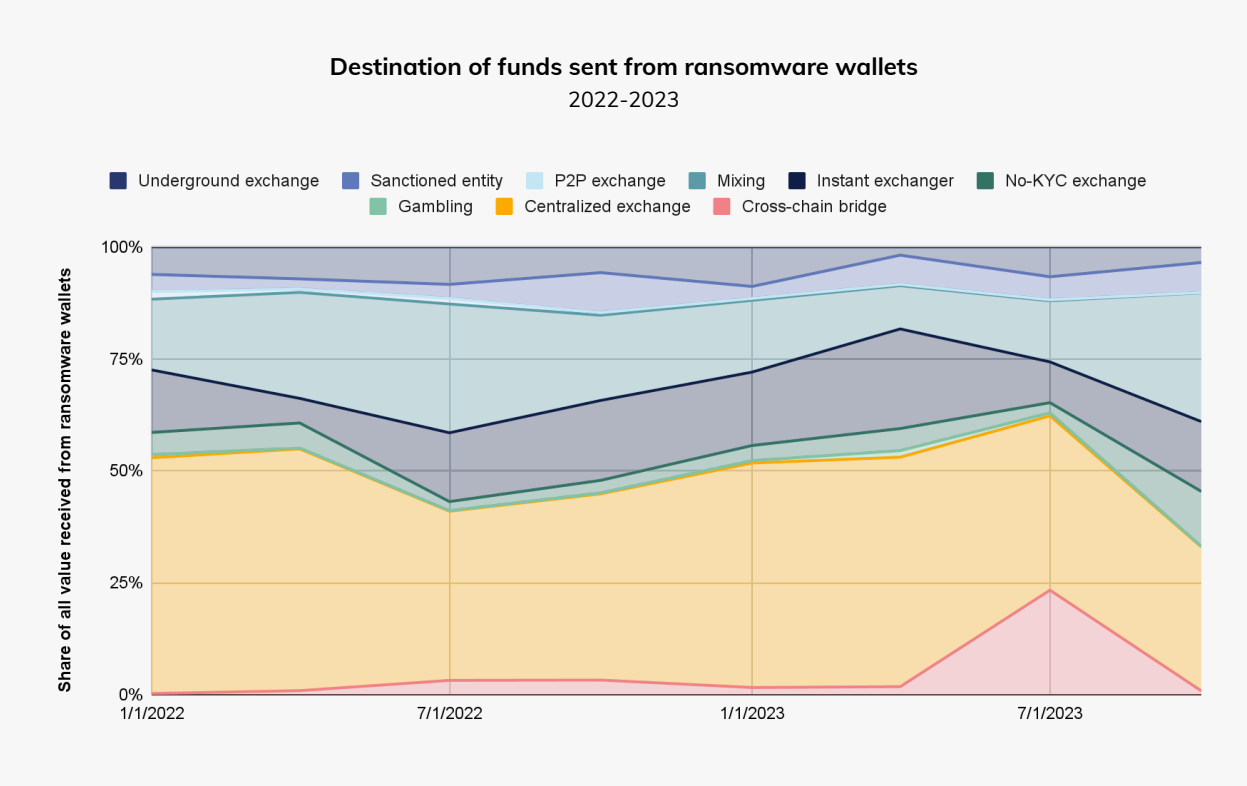


In addition to being extremely lucrative, Cl0p's MOVEit campaign shows that leaner extortion efforts can still get victims to pay.

Ransomware off-ramping: Where do the funds go?

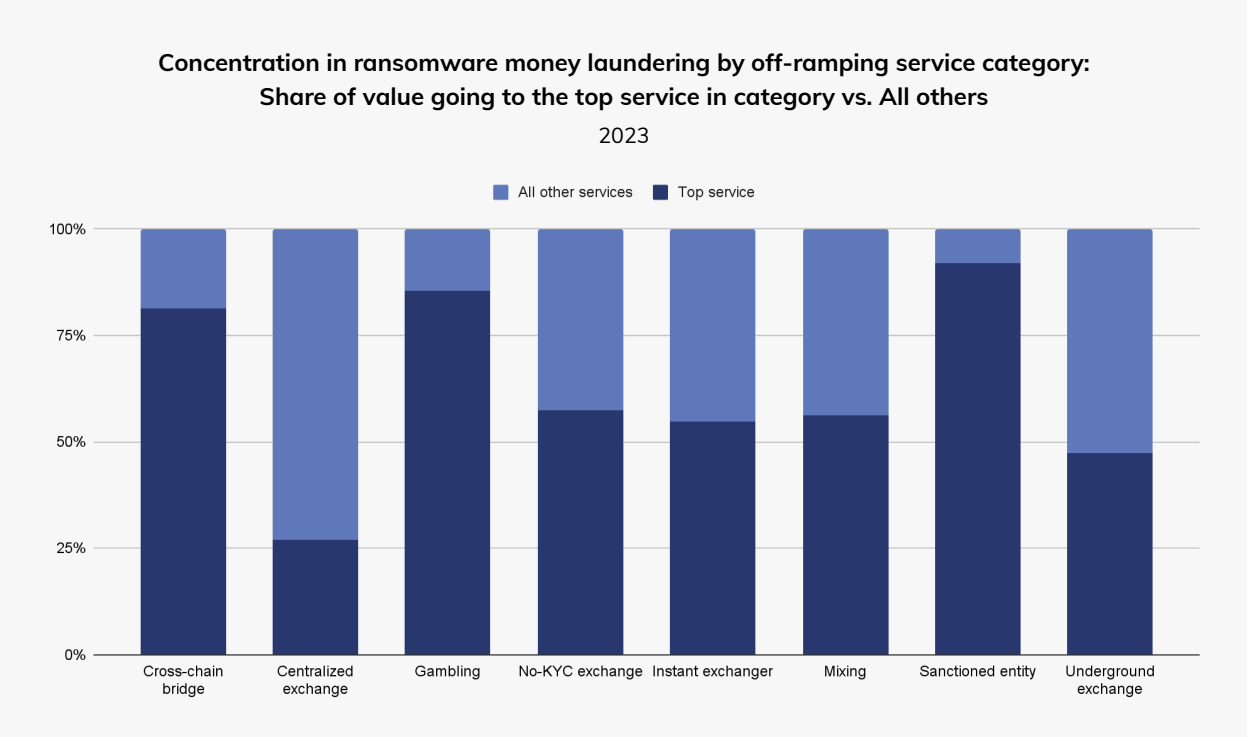
Analyzing the movement of ransomware funds provides essential insights into the methods and services used by threat actors, enabling law enforcement to target and disrupt their financial networks and infrastructure.

It is important to keep in mind that threat actors may take weeks, months, or even years to launder their proceeds from ransomware, and so some of the laundering observed in 2023 is from attacks that occurred well into the past.



Centralized exchanges and mixers have consistently represented a substantial share of transactions, suggesting they are preferred methods for laundering ransomware payments. However, this year saw the embrace of new services for laundering, including bridges, instant exchangers, and gambling services. We assess that this is a result of takedowns disrupting preferred laundering methods for ransomware, some services' implementation of more robust AML/KYC policies, and also as an indication of new ransomware actors' unique laundering preferences.

We also see significant concentration in the specific services within each category that ransomware actors turn to for laundering.



Exchanges showed the lowest level of concentration, while gambling services, cross-chain bridges, and sanctioned entities showed the highest levels of concentration. Mixers, no-KYC exchanges, and underground exchanges were in the middle, with roughly half of all funds sent to each category from ransomware wallets went to one service. Mixer concentration may have increased as a result of the Chipmixer takedown, which eliminated a popular option for ransomware attackers. In general, this overconcentration may expose ransomware actors to bottlenecks that make them vulnerable, as law enforcement could significantly disrupt operations by taking down a relatively small number of services.

Lessons from 2023

The ransomware landscape underwent significant changes in 2023, marked by shifts in tactics and affiliations among threat actors, as well as the continued spread of RaaS strains and swifter attack execution, demonstrating a more efficient and aggressive approach. The movement of affiliates highlighted the fluidity within the ransomware underworld and the constant search for more lucrative extortion schemes.

Threat actors continue to innovate and adapt to regulatory changes and law enforcement actions, but 2023 also saw significant victories in the fight against ransomware with collaboration between international law enforcement, affected organizations, cybersecurity firms, and blockchain intelligence. Lizzie Cookson of Coveware pointed out, "The Hive takedown and the BlackCat disruption are both great examples of how the FBI has been prioritizing victims' assistance, helping victims and imposing costs on bad actors." Andrew Davis of Kivu Consulting also noted an uptick in proactive engagement from law enforcement, indicating a stronger, more determined approach to aiding victims and tracking down cybercriminals.

Money Laundering

Money Laundering Activity Spread Across More Service Deposit Addresses in 2023, Plus New Tactics from Lazarus Group

The goal of money laundering is to obscure the criminal origins of funds so that they can be accessed and spent. In the context of cryptocurrency-based crime, that generally means moving funds to services where they can be converted into cash, while often taking extra steps to conceal where the funds came from. Our on-chain analysis of crypto money laundering therefore focuses on two distinct groups of services and on-chain entities:

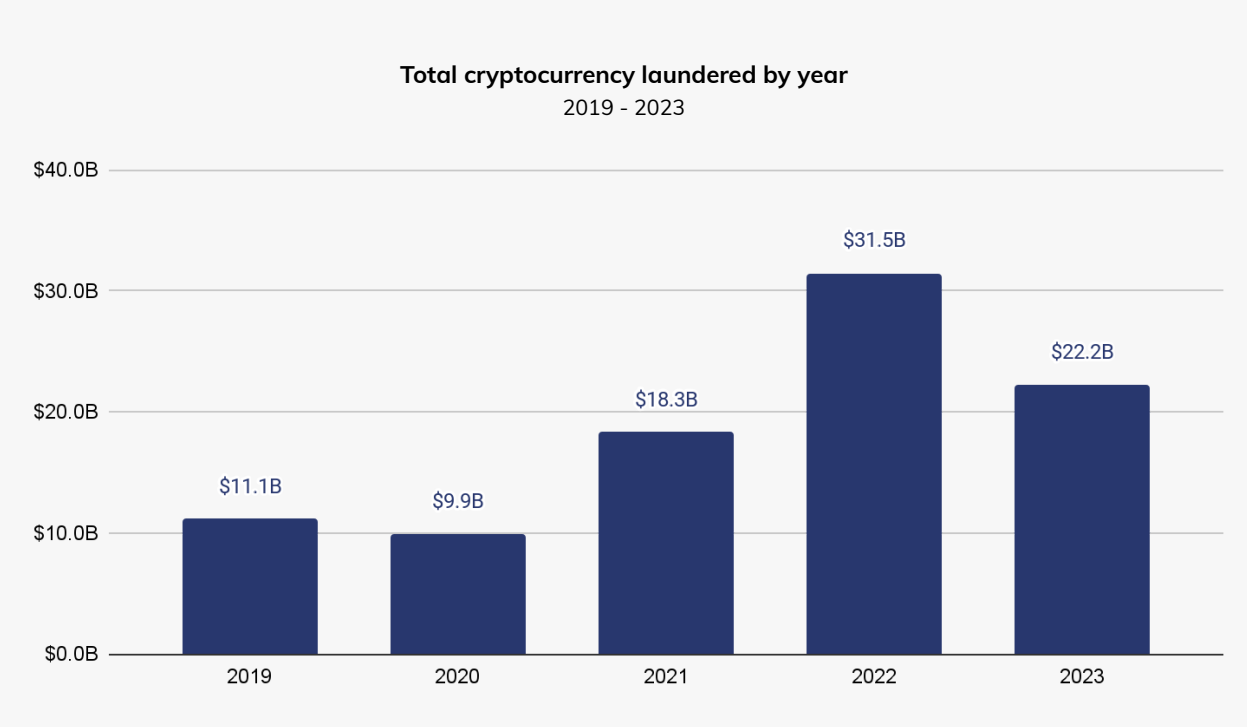
- **Intermediary services and wallets.** This category includes personal wallets, mixers, instant exchangers, various types of DeFi protocols, and other services both legitimate and illicit. Crypto criminals generally use services in this category to hold funds, or to obfuscate their criminal origins, often by obscuring the on-chain link between their source address and their current address.
- **Fiat off-ramping services.** This category includes any service where cryptocurrency can be converted into fiat currency, the most common being centralized exchanges. However, it can also include P2P exchanges, gambling services, and crypto ATMs. It's also important to consider nested services that operate using the infrastructure of centralized exchanges and allow for fiat off-ramping, such as many OTC trade desks.

It's important to remember that all of these services have different capabilities and options when it comes to addressing money laundering. Centralized exchanges, for instance, have much more control in that they can freeze funds coming from suspicious or illicit sources. DeFi protocols, however, generally don't have this option, as they run autonomously and don't take custody of users' funds. Of course, DeFi protocols' decentralized nature also means that blockchain analysts can generally trace funds moving through DeFi protocols to their next stop, which isn't the case with centralized services. And of course, illicit services purposely facilitating money laundering can generally be stopped only through law enforcement operations or other legal processes. It's also important to keep in mind that token issuers can play a positive role as well. Stablecoins like USDT and USDC, for instance, have functionalities allowing them to freeze assets held by addresses associated with crime.

With that in mind, let's look at the key crypto money laundering trends of 2023.

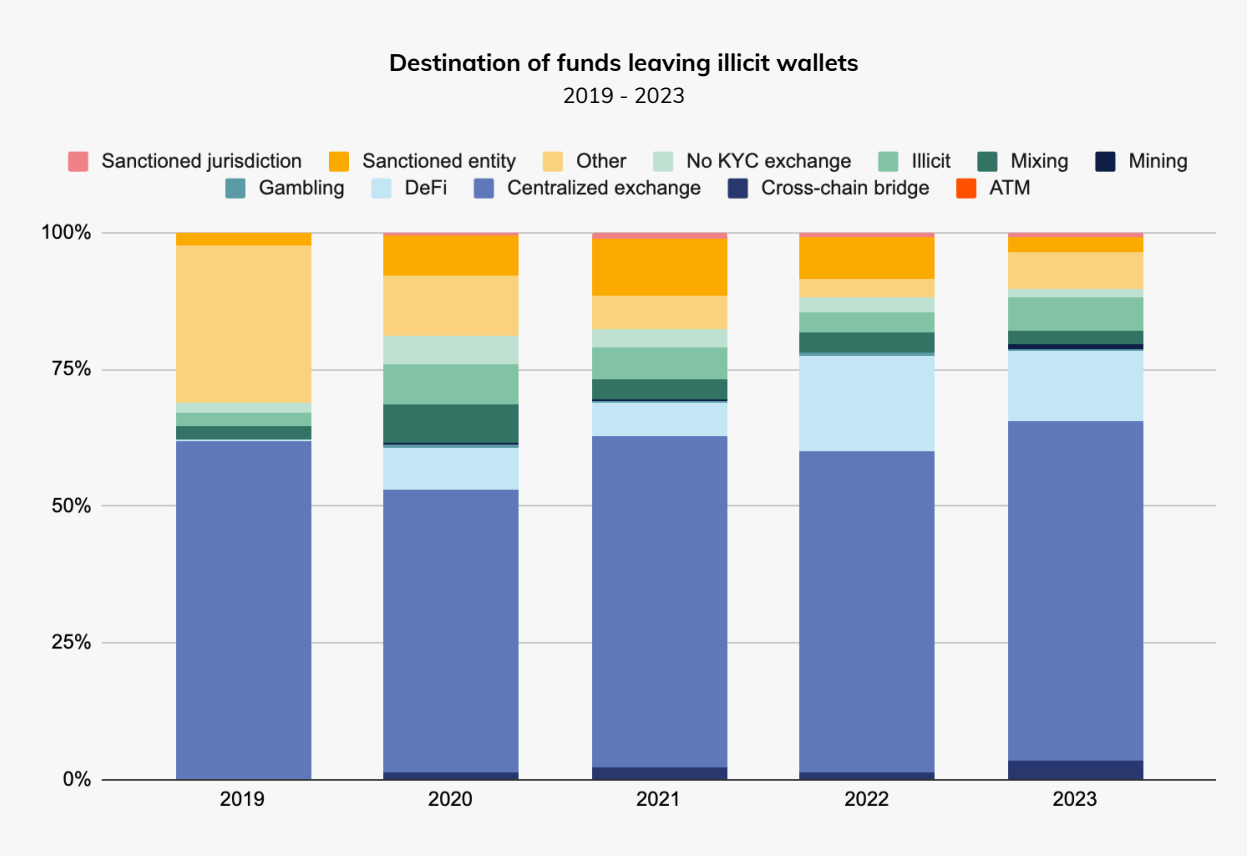
2023 crypto money laundering: Key trends

In 2023, illicit addresses sent $22.2 billion worth of cryptocurrency to services, which is a significant decrease from the $31.5 billion sent in 2022. Some of this drop may be attributed to an overall decrease in crypto transaction volume, both legitimate and illicit. However, the drop in money laundering activity was steeper, at 29.5%, compared to the 14.9% drop in total transaction volume.

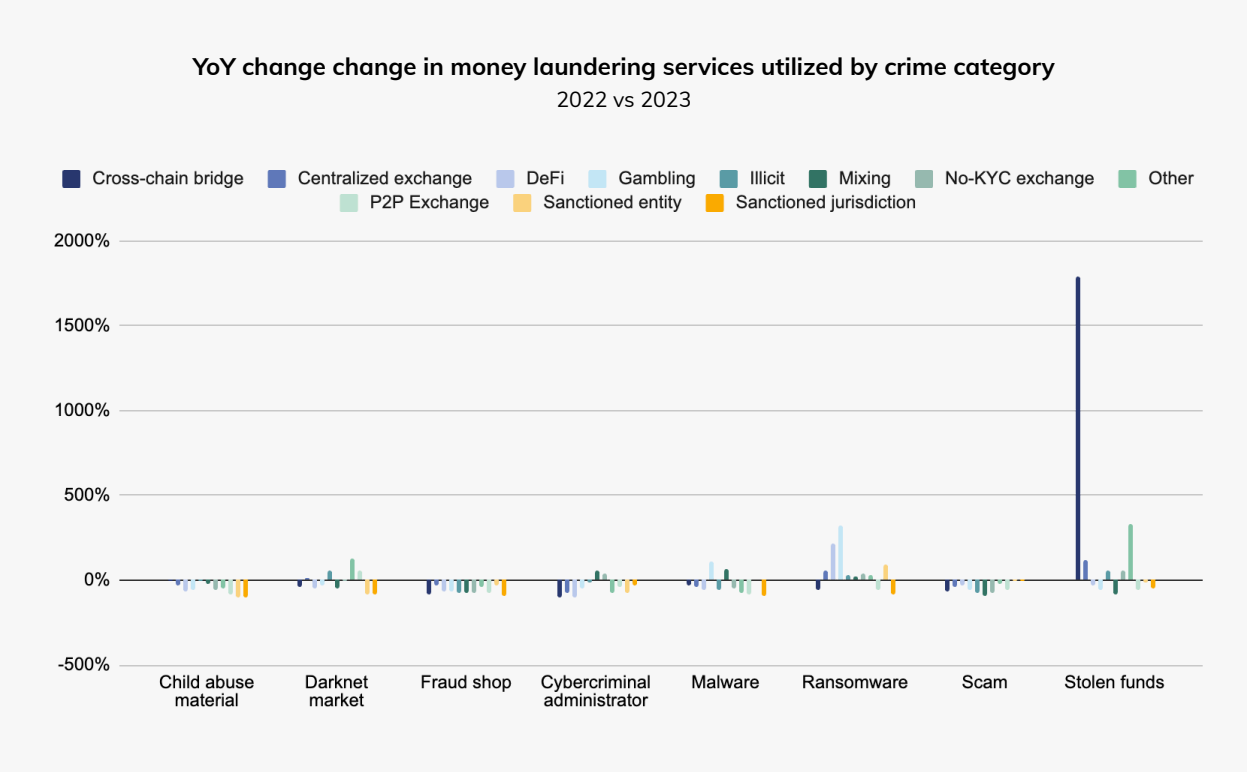


Overall, centralized exchanges remain the primary destination for funds sent from illicit addresses, at a rate that has remained relatively stable over the last five years. Over time, the role of illicit services has shrunk, while the share of illicit funds going to DeFi protocols has grown. We attribute this primarily to the overall growth of DeFi generally during the time period, but must also note that DeFi's inherent transparency generally makes it a poor choice for obfuscating the movement of funds.

2023 mostly resembled 2022 in terms of the breakdown of service types used for money laundering, but we did see a slight decrease in the share of illicit funds moving to illicit service types, and an increase in funds moving to gambling services and bridge protocols.

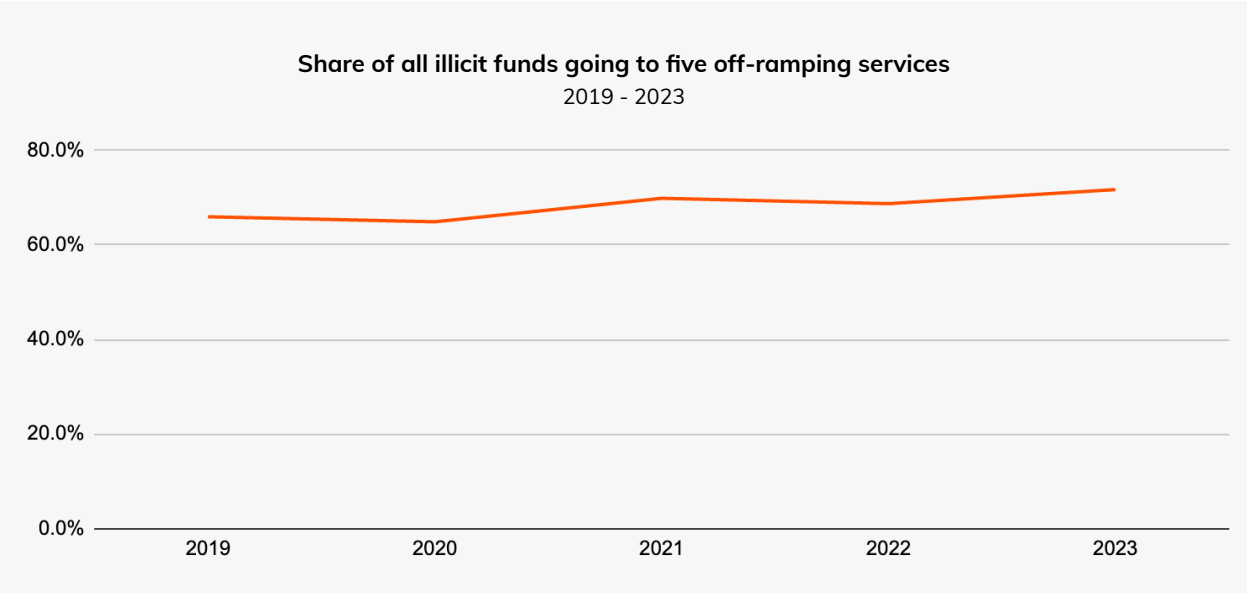


However, if we zoom in to look at how specific types of crypto criminals laundered money, we can see that there was in fact significant change in some areas. Most notably, we saw a huge increase in the volume of funds sent to blockchain bridges from addresses associated with stolen funds, a trend we'll examine in greater detail later. We also observed a substantial increase in funds sent from ransomware to gambling platforms, and in funds sent to bridges from ransomware wallets.

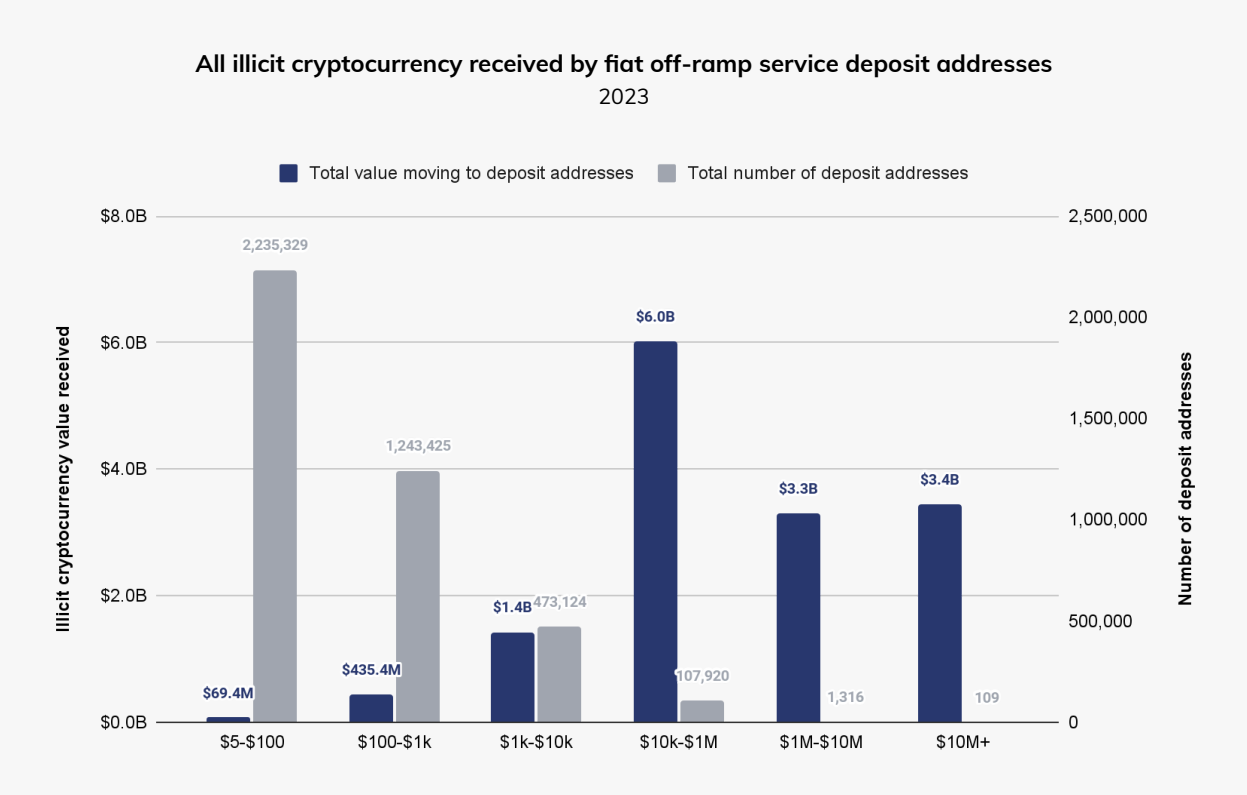


Money laundering concentration at fiat off-ramps

Fiat off-ramping services are important because they're where criminals can convert their crypto into cash — the culmination of the money laundering process. While there are thousands of off-ramping services in operation, most money laundering activity is concentrated to a select few services. Of all illicit funds sent to off-ramping services in 2023, 71.7% went to just five services, up slightly from 68.7% in 2022.



We can also go one level deeper and examine money laundering concentration at the deposit address level. Deposit addresses are addresses at centralized services associated with individual users — you can think of them as akin to bank accounts. Examining money laundering activity at the deposit address level therefore lets us get a better sense of the individuals or nested services most directly responsible for the majority of crypto money laundering activity. Looking at things through this lens, we can see that money laundering actually became less concentrated at the deposit address level in 2023, even as it became slightly more concentrated at the service level.



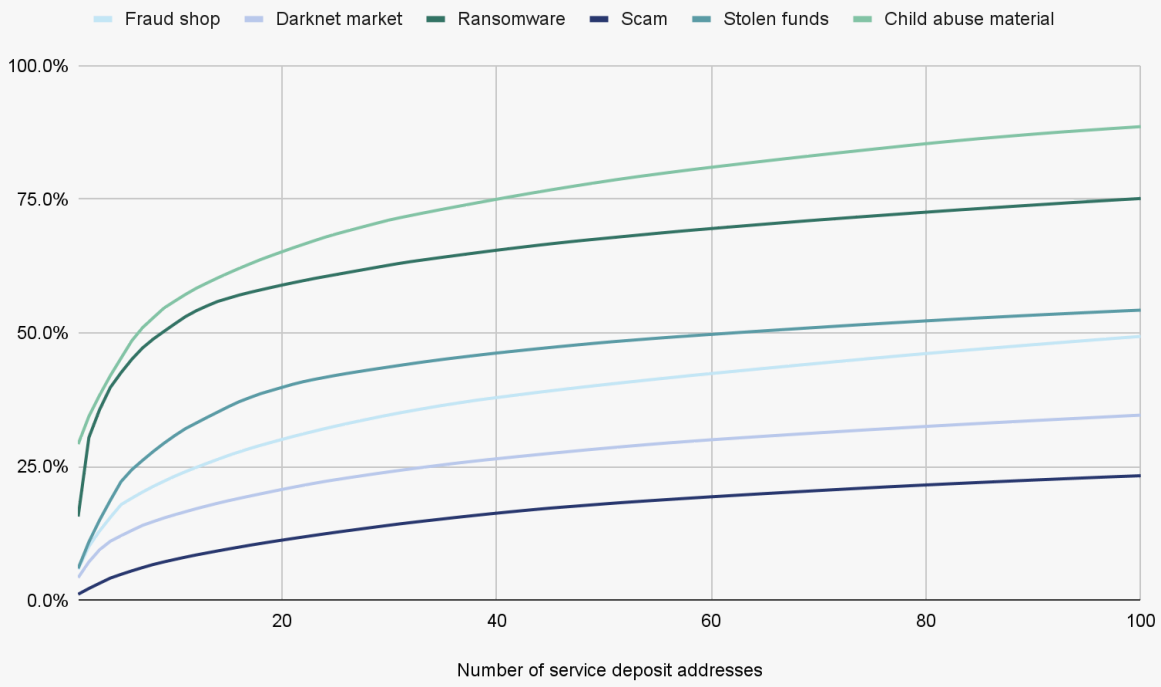
How to read this graph: This graph shows service deposit addresses bucketed by how much total illicit cryptocurrency each address received individually in 2023. Each grey bar represents the number of deposit addresses in the bucket, while each blue bar represents the total illicit cryptocurrency value received by all deposit addresses in the bucket. Using the first bucket as an example, we see that 2,235,329 deposit addresses received between $5 and $100 worth of illicit cryptocurrency, and together all of those deposit addresses received a total of $69.4 million worth of illicit cryptocurrency.

In 2023, 109 exchange deposit addresses received over $10 million worth of illicit cryptocurrency each, and collectively, they received $3.4 billion in illicit cryptocurrency. While that still represents significant concentration, in 2022, only 40 addresses received over $10 million in illicit crypto, for a collective total of just under $2.0 billion. In 2022, just 542 deposit addresses received over $1 million in illicit cryptocurrency, for a total of $6.3 billion, which was over half of all illicit value received by centralized exchanges that year. In 2023, 1,425 deposit addresses received over $1 million in illicit cryptocurrency, for a total of $6.7 billion, which accounts for just 46% of all illicit value received by exchanges for the year.

However, it's also worth noting that money laundering concentration differs by criminal type. For instance, CSAM vendors and ransomware operators show a high degree of concentration — just seven deposit

addresses account for 51.0% of all value received from CSAM vendors by exchanges, while for ransomware, just nine addresses account for 50.3%. On the other side of the spectrum, scams and darknet markets show much less concentration. Forms of crypto crime displaying higher concentration may be more vulnerable to law enforcement, as their money laundering activity relies on comparatively fewer services that can be disrupted.

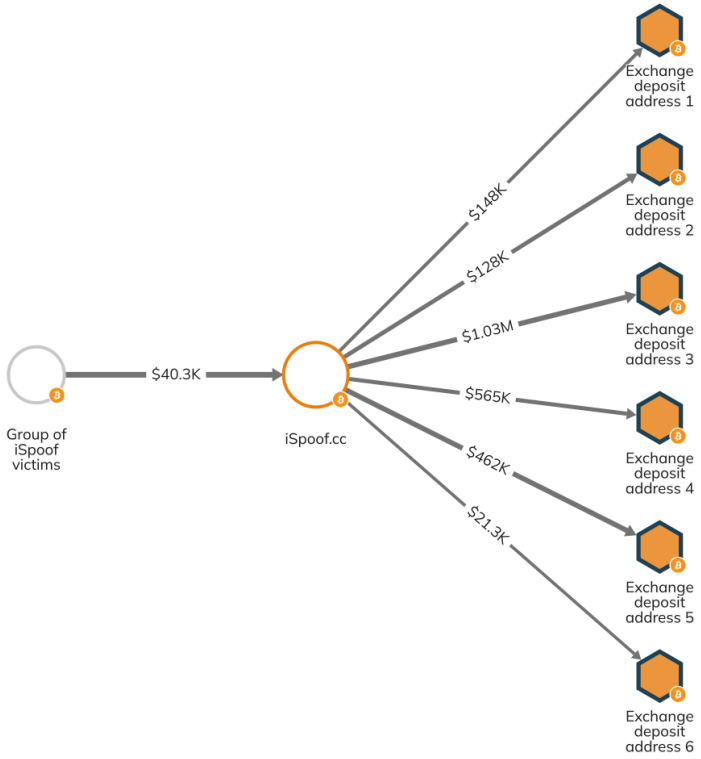
Money laundering concentration by crime type:
Share of total illicit value received by top deposit addresses
2023



Overall, it's possible that crypto criminals are diversifying their money laundering activity across more nested services or deposit addresses in order to better conceal it from law enforcement and exchange compliance teams. Spreading the activity across more addresses may also be a strategy to lessen the impact of any one deposit address being frozen for suspicious activity. As a result, fighting crypto crime via the targeting of money laundering infrastructure may require greater diligence and understanding of interconnectedness through on-chain activity than in the past, as the activity is more diffuse.

Money laundering tactics changing: Most sophisticated crypto criminals utilizing bridges and mixers

A big share of crypto money laundering activity is relatively unsophisticated, and consists of bad actors simply sending funds directly to exchanges. We can see this on the Chainalysis Reactor graph below, which shows the now-defunct phone number spoofing service iSpoof — which facilitated over £100 million in scamming activity before being shut down by law enforcement — sending millions in Bitcoin directly to a group of deposit addresses at a centralized exchange.



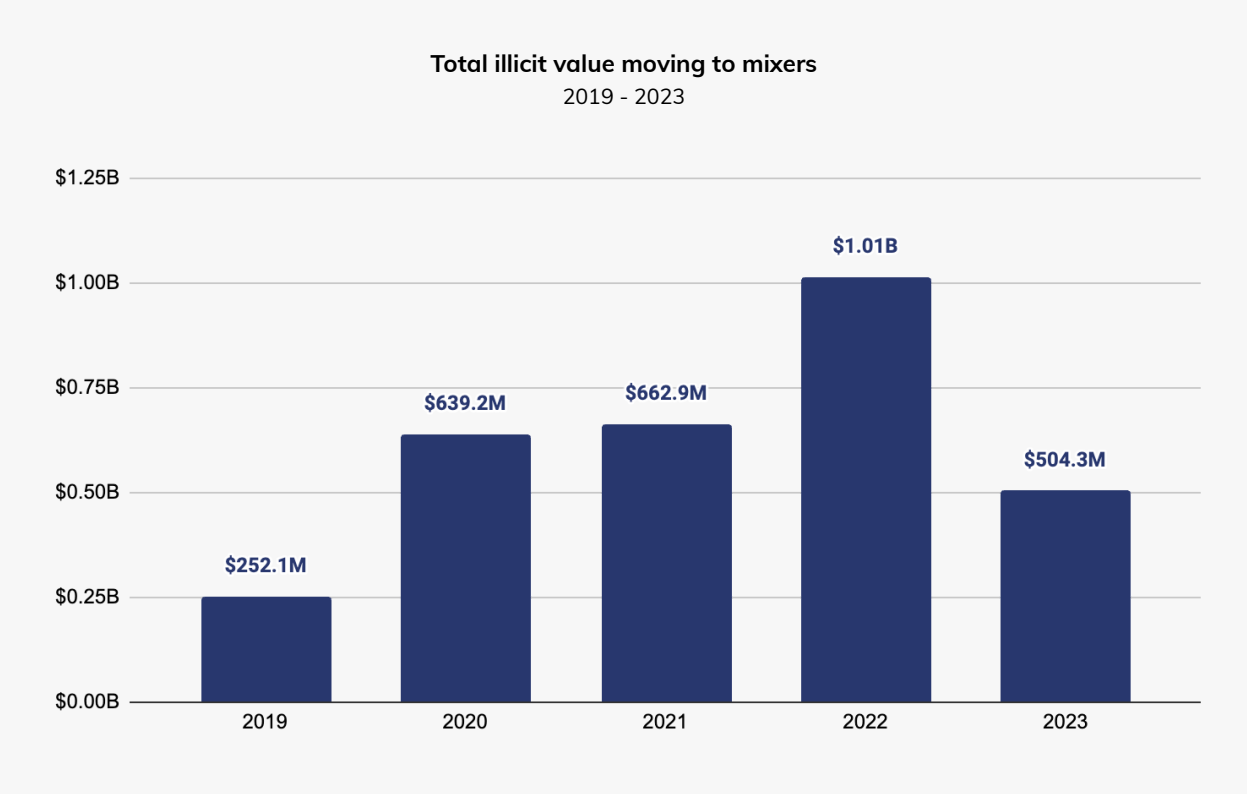
However, crypto criminals with more sophisticated on-chain laundering skill sets —such as the notorious North Korean cybercriminals associated with hacking gangs like Lazarus Group — tend to utilize a greater variety of crypto services and protocols. Below, we'll look at two important ways sophisticated bad actors adjusted their money laundering strategy, illustrated through examples from Lazarus Group:

- Use of a new mixer following Sinbad's takedown and OFAC designation
- Chain hopping via cross-chain bridges

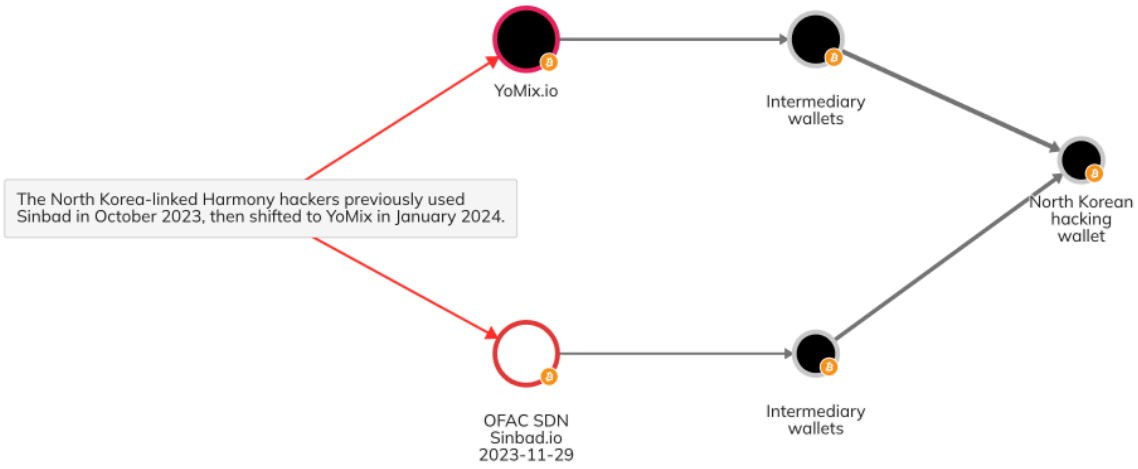
Let's take a closer look at both.

New mixer: YoMix takes over for Sinbad

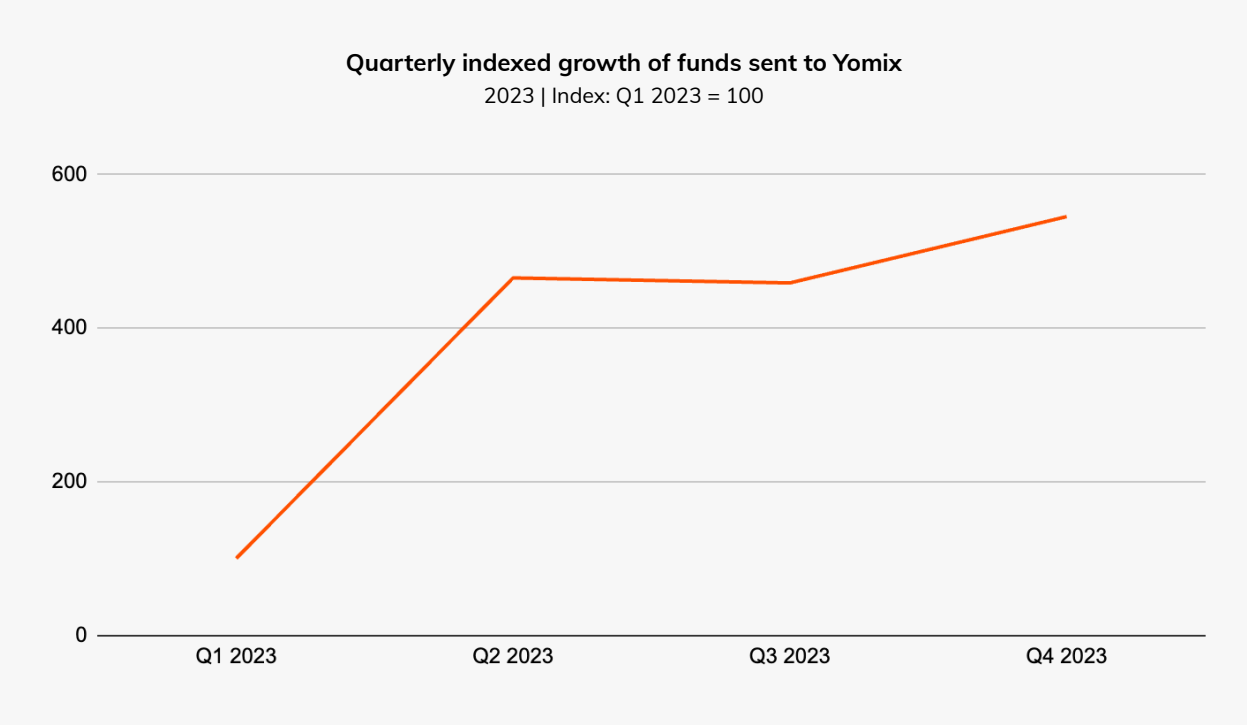
Overall, 2023 saw a decline in funds sent to mixers from illicit addresses, from $1.0 billion in 2022 to $504.3 million in 2023.



Much of this is likely due to law enforcement and regulatory efforts, such as the sanctioning and shutdown of mixer Sinbad in November 2023. But sophisticated cybercriminal groups like Lazarus Group have adapted their mixer usage. As we covered in last year's Crypto Crime Report, Sinbad became a preferred mixer for North Korea-affiliated hackers in 2022, soon after the sanctioning of Tornado Cash, which had previously been the go-to for these sophisticated cybercriminals. With Sinbad out of the picture, Bitcoin-based mixer YoMix has acted as a replacement. We can see an example of this on the Reactor graph below, which shows a wallet associated with North Korean hacking activity receiving funds from YoMix, whereas it had previously received funds from Sinbad.



Overall, YoMix saw huge growth in 2023, with inflows growing by more than 5x over the course of the year.

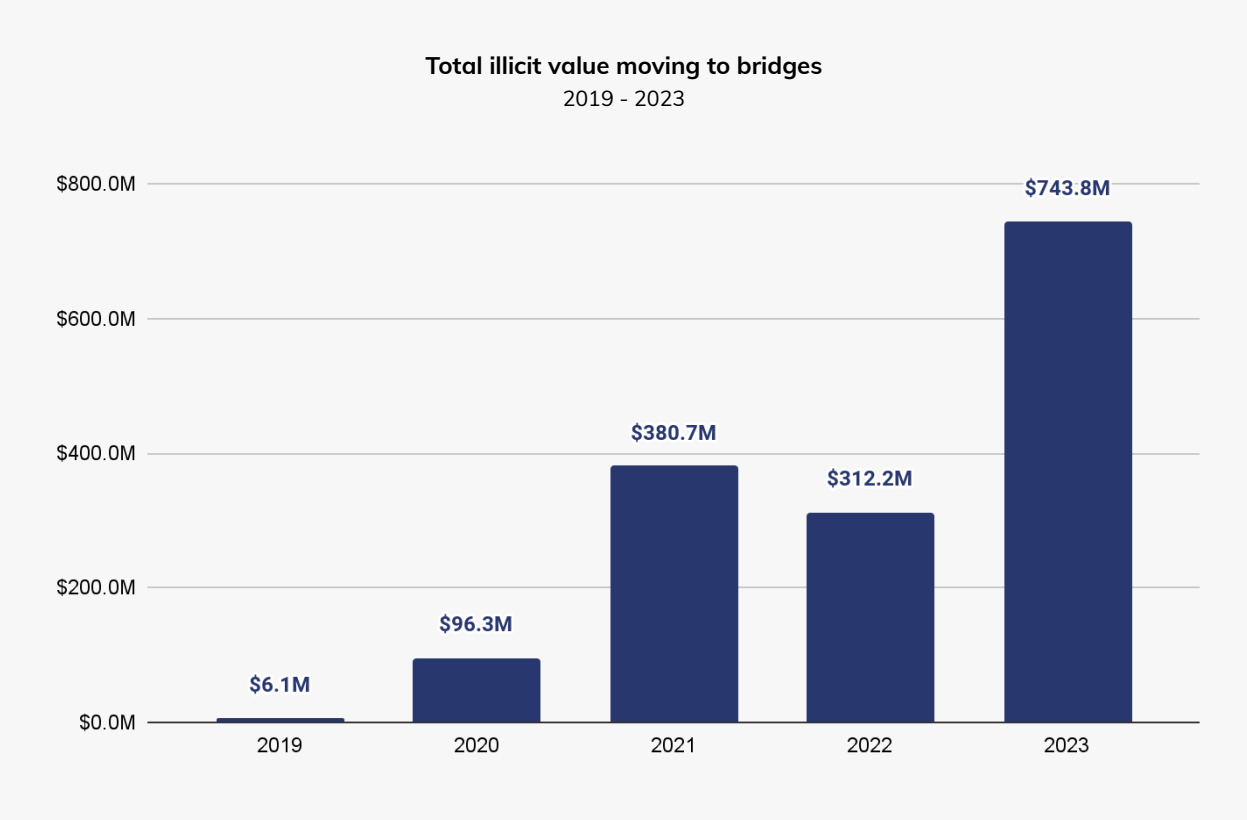


Based on Chainalysis data, roughly one third of all YoMix inflows have come from wallets associated with crypto hacks. The growth of YoMix and its embrace by Lazarus Group is a prime example of sophisticated actors' ability to adapt and find replacement obfuscation services when previously popular ones are shut down.

Use of cross-chain bridges

Cross-chain bridges allow users to move funds from one blockchain to another. Generally, anyone can access these smart contracts, although in theory a bridge could implement a blacklist. All of this activity happens on-chain, which means that blockchain analysts can trace funds through bridges, as no centralized entity ever takes custody of the funds that move to bridges.

As discussed previously, illicit actors' use of bridge protocols for money laundering purposes grew substantially in 2023, particularly amongst crypto thieves.



Overall, bridge protocols received $743.8 million in crypto from illicit addresses in 2023, up from just $312.2 million in 2022.

North Korea-affiliated hackers have been among those to utilize bridges for money laundering the most, and we can see an example of this activity on the Reactor graph below.

In this case, funds associated with the 2022 Harmony hack moved to a popular bridge protocol in May 2023, where they were moved from the Bitcoin blockchain to the Avalanche blockchain. The funds were then swapped for a stablecoin, and then bridged again using a different protocol, this time from the Avalanche blockchain to the TRON blockchain.

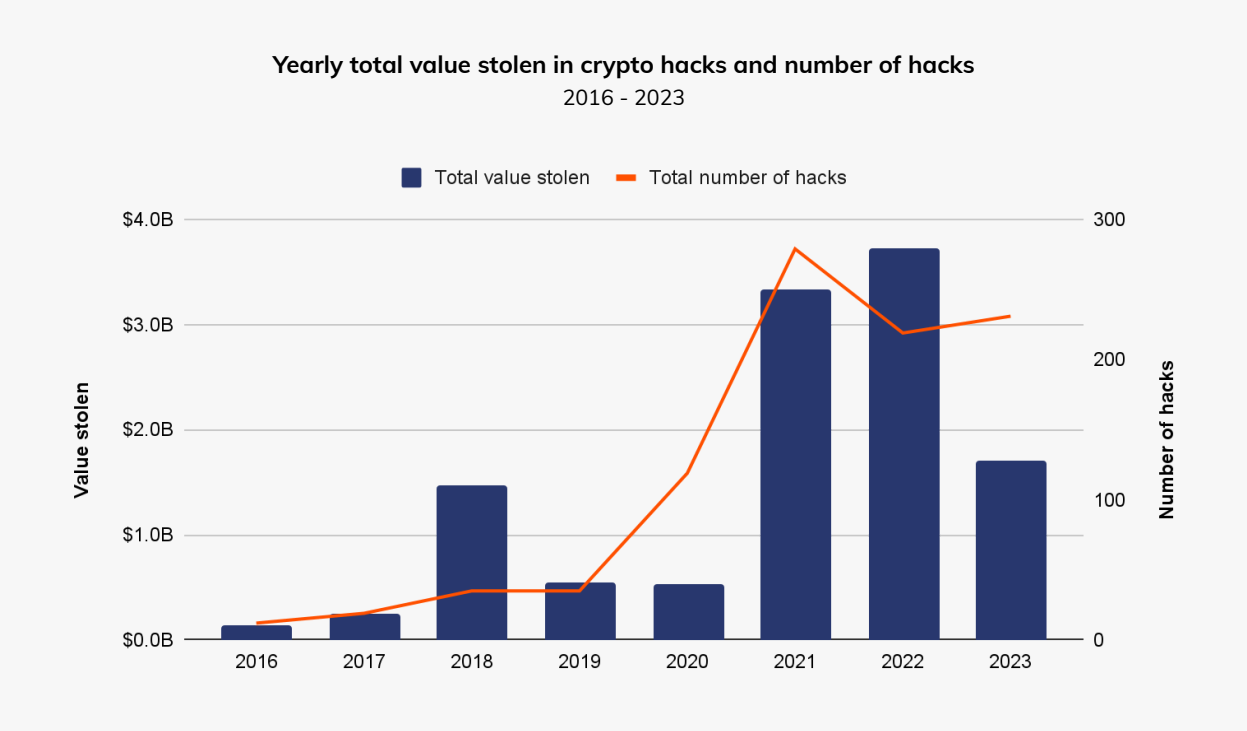
Sophisticated bad actors adapt frequently

The changes in money laundering strategy we've seen from crypto criminals like Lazarus Group serve as an important reminder that the most sophisticated illicit actors are always adapting their money laundering strategy and exploiting new kinds of crypto services. Law enforcement and compliance teams can be more effective by studying these new laundering methods and becoming familiar with the on-chain patterns associated with them.

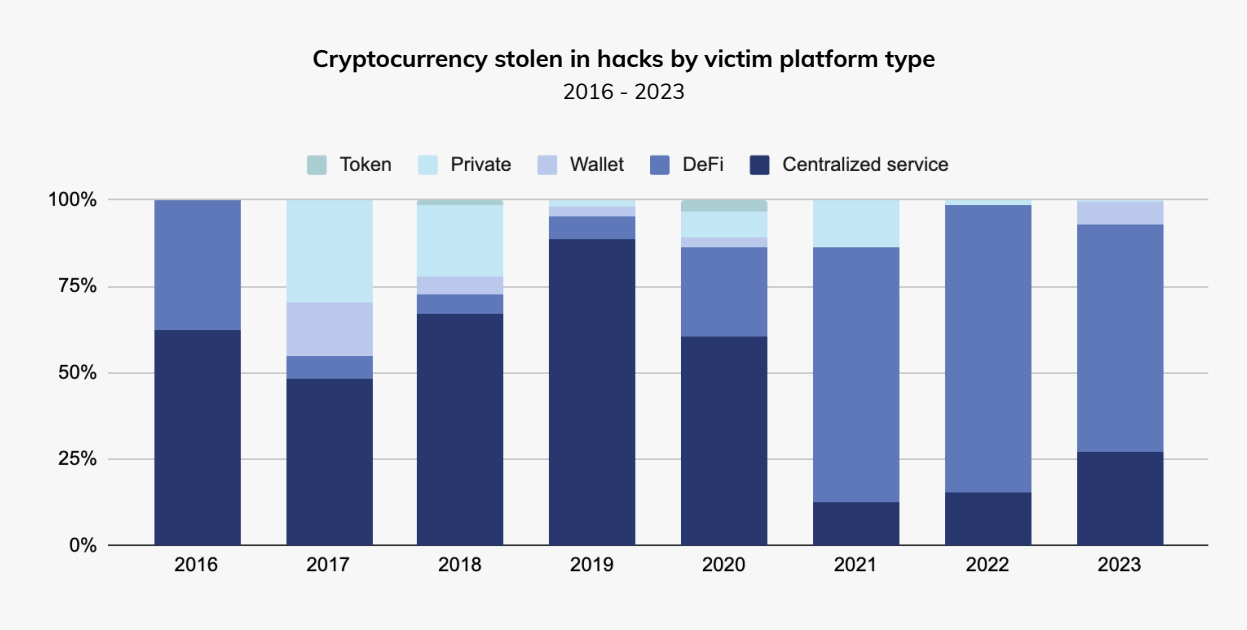
Stolen Funds

Funds Stolen from Crypto Platforms Fall More Than 50% in 2023, but Hacking Remains a Significant Threat as Number of Incidents Rises

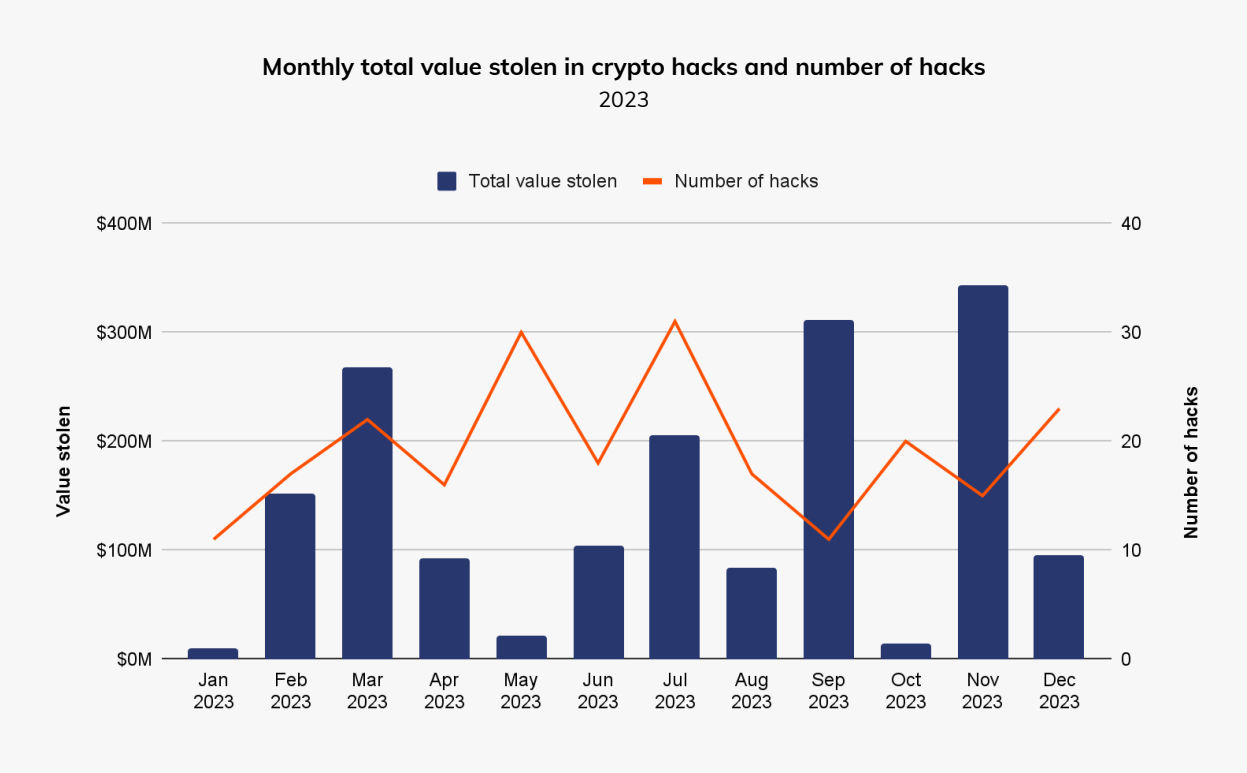
Over the last few years, cryptocurrency hacking has become a pervasive and formidable threat, leading to billions of dollars stolen from crypto platforms and exposing vulnerabilities across the ecosystem. As we revealed in last year's Crypto Crime Report, 2022 was the biggest year ever for crypto theft with $3.7 billion stolen. In 2023, however, funds stolen decreased by 54.3% to $1.7 billion, though the number of individual hacking incidents actually grew, from 219 in 2022 to 231 in 2023.



Why the huge drop in stolen funds? Mostly due to a drop in DeFi hacking. Hacks of DeFi protocols largely drove the huge increase in stolen crypto that we saw in 2021 and 2022, with cybercriminals stealing more than $3.1 billion in DeFi hacks last year. But this year, hackers stole just $1.1 billion from DeFi protocols. This amounts to a 63.7% drop in the total value stolen from DeFi platforms year-over-year. There was also a significant drop in the share of all funds stolen accounted for by DeFi protocol victims in 2023, as we see on the chart below.



We'll explore the possible reasons for the drop in DeFi hacking in greater detail later on. Despite that drop, there still were several large hacks of notable DeFi protocols throughout 2023. In March, for instance, Euler Finance, a borrowing and lending protocol on Ethereum, experienced a flash loan attack, leading to roughly $197 million in losses. July 2023 saw 33 hacks — the most of any month — which included $73.5 million stolen from Curve Finance. We can see the spikes driven by those hacks below.



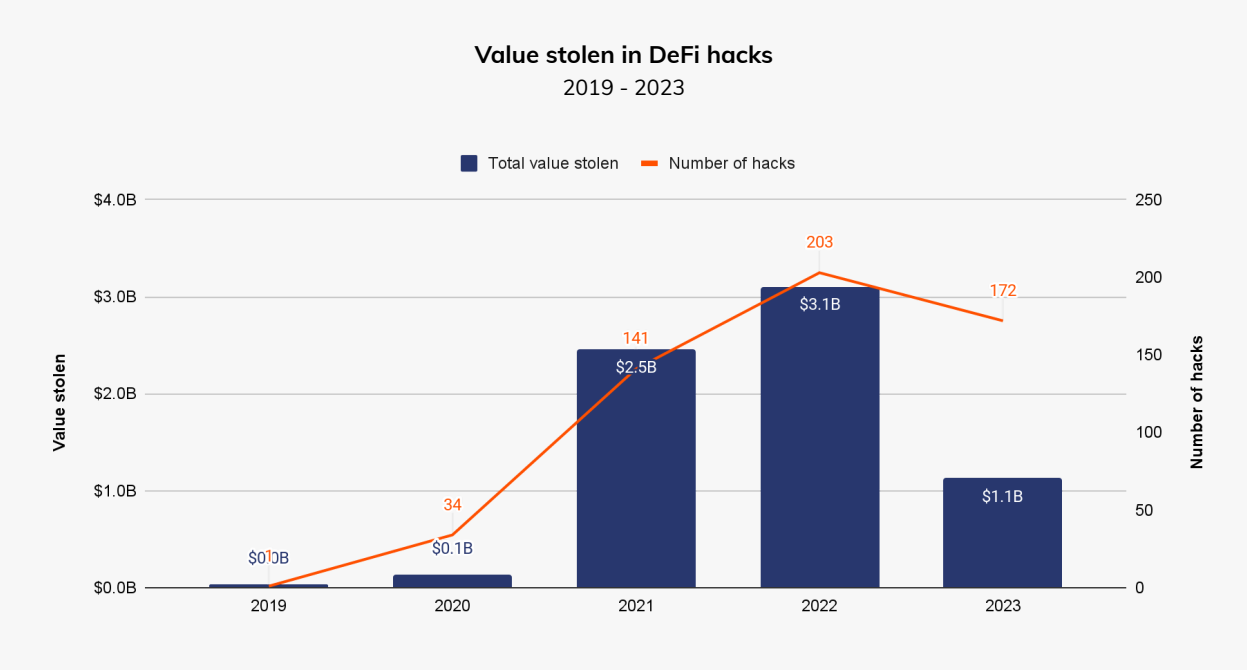
Similarly, several large exploits occurred in September and November 2023 on both DeFi and CeFi platforms: Mixin Network ($200 million), CoinEx ($43 million), Poloniex Exchange ($130 million), HTX ($113.3 million), and Kyber Network ($54.7 million).

Keep reading to learn more about crypto hacking trends in 2023, including how North Korea-affiliated cyber criminals had one of their most active years, executing more individual crypto hacks than ever before.

Attack vectors affecting DeFi are sophisticated and diverse

DeFi hacking exploded in 2021 and 2022, with attackers stealing approximately $2.5 billion and $3.1 billion, respectively, from protocols. Mar Gimenez-Aguilar, Lead Security Architect and Researcher at our partner Halborn, a security company specializing in web3 and blockchain solutions, told us more about the rise in DeFi hacking during those years. “There’s been a worrying trend in the escalation of both the frequency and severity of attacks within the DeFi ecosystem,” she explained. “In our comprehensive analysis of the top 50 DeFi hacks, we observed that EVM-based chains and Solana are among the most targeted chains, largely due to their popularity and capability to execute smart contracts.” When examining this trend last year, security experts told us that they believe many DeFi vulnerabilities stemmed from protocol operators focusing primarily on growth, and not enough on implementing and maintaining robust security systems.

However, for the first time since DeFi’s emergence as a key sector of the crypto economy, the yearly total stolen from DeFi protocols fell — and fell significantly.



The value lost in DeFi hacks declined by 63.7% year-over-year in 2023, and median loss per DeFi hack dropped by 7.4%. And, while the number of individual crypto hacks rose in 2023, the number of DeFi hacks specifically declined by 17.2%.

In order to understand this trend better, we worked with Halborn to analyze 2023 DeFi hacking activity through the lens of the specific attack vectors hackers utilized.

Classifying and analyzing attack vectors within the DeFi landscape

Attack vectors affecting DeFi are diverse and constantly evolving; it is therefore important to classify them to understand how hacks occur and how protocols might be able to reduce their likelihood in the future. According to Halborn, DeFi attack vectors can be placed into one of two categories: vectors originating on-chain and vectors originating off-chain.

On-chain attack vectors stem not from vulnerabilities inherent to blockchains themselves, but rather from vulnerabilities in the on-chain components of a DeFi protocol, such as their smart contracts. These aren't a point of concern for centralized services, as centralized services don't function as decentralized apps with publicly visible code the way DeFi protocols do. Off-chain attack vectors stem from vulnerabilities outside of the blockchain — one example could be the off-chain storage of private keys in, say, a faulty cloud storage solution — and therefore apply to both DeFi protocols and centralized services.

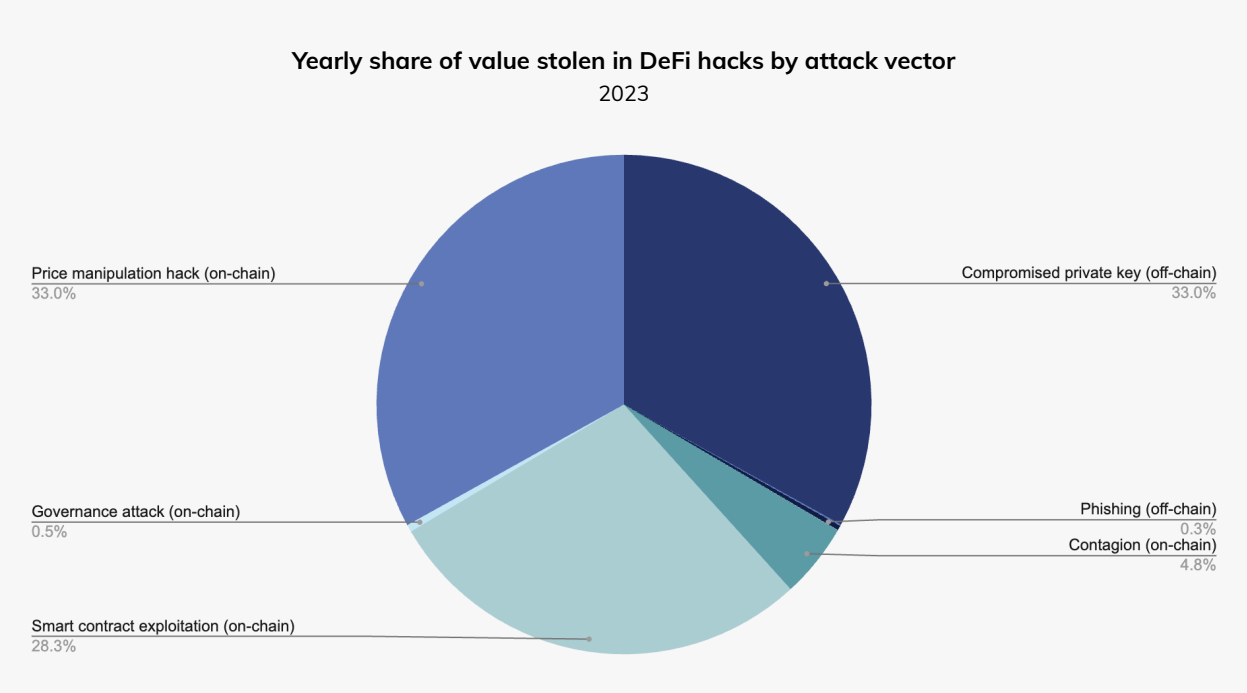
Hack attack vector sub-category	Definition	On-chain or off-chain
Protocol exploitation	When an attacker exploits vulnerabilities in a blockchain component of a protocol, such as ones pertaining to validator nodes, the protocol's virtual machine, or in the mining layer.	On-chain
Insider attack	When an attacker working inside a protocol, such as a rogue developer, uses privileged keys or other private information to directly steal funds.	Off-chain
Phishing	When an attacker tricks users into signing permissions, often done by supplanting a legitimate protocol, allowing the attacker to spend tokens on users' behalf. Phishing may also happen when an attacker tricks users into directly sending funds to malicious smart contracts.	Off-chain
Contagion	When an attacker exploits a protocol due to vulnerabilities created by a hack in another protocol. Contagion also includes hacks that are closely related to hacks in other protocols.	On-chain
Compromised server	When an attacker compromises a server that is owned by a protocol, thereby disrupting the protocol's normal workflow or gaining knowledge to further exploit the protocol in the future.	Off-chain

Wallet hack	When an attacker exploits a protocol that provides custodial/ wallet services and subsequently acquires information about the wallets' operation.	Off-chain
Price manipulation hack	When an attacker exploits a smart contract vulnerability or utilizes a flawed oracle that does not reflect accurate asset prices, facilitating the manipulation of a digital token's price.	On-chain
Smart contract exploitation	When an attacker exploits a vulnerability in a smart contract code, which typically grants direct access to various control mechanisms of a protocol and token transfers.	On-chain
Compromised private key	When an attacker acquires access to a user's private key, which can occur through a leak or a failure in off-chain software, for example.	Off-chain
Governance attacks	When an attacker manipulates a blockchain project with a decentralized governance structure by gaining enough influence or voting rights to enact a malicious proposal.	On-chain
Third-party compromised	When an attacker gains access to an off-chain third-party program that a protocol uses, which provides information that can later be used for an exploit.	Off-chain
Other	Either the attack does not fit in any of the previous categories or there is not enough information to properly classify it.	On-chain/Off-chain

Source: Halborn

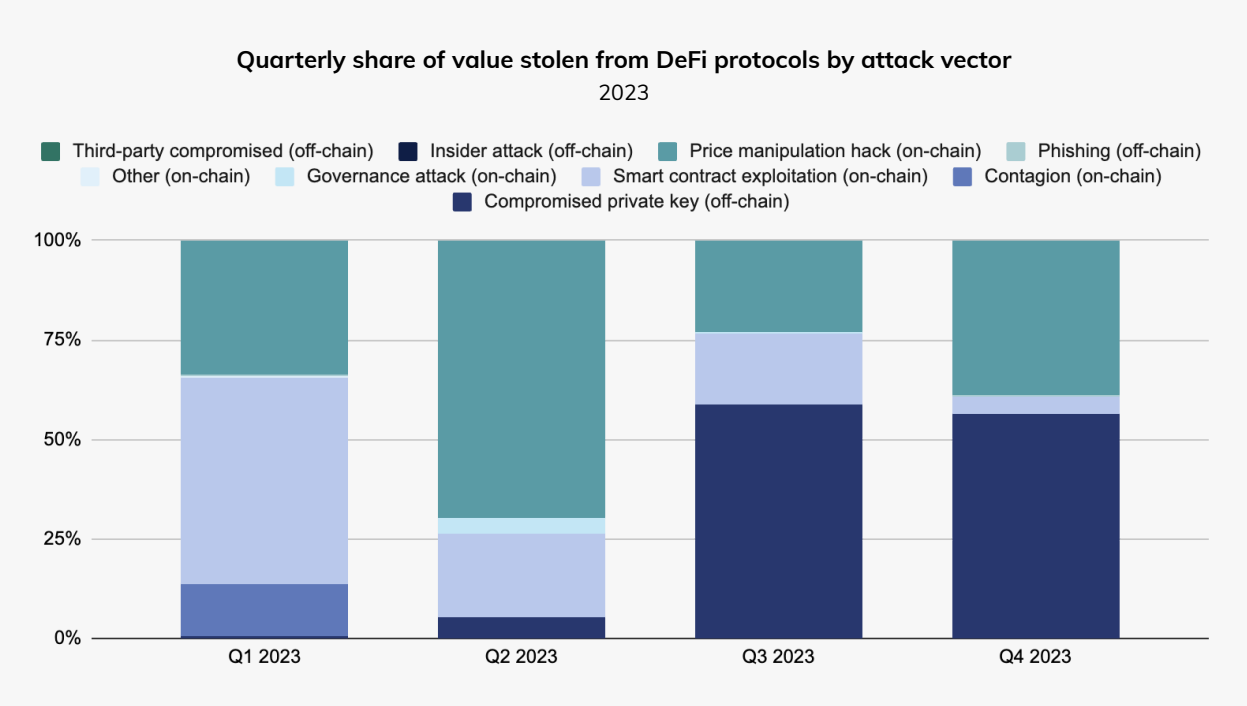
According to Gimenez-Aguilar, both on-chain and off-chain vulnerabilities present serious concerns. "Historically, the majority of DeFi hacks have stemmed from vulnerabilities in smart contract design and implementation — a large proportion of the affected contracts we examined had either not undergone any audit or had been audited inadequately," she said, explaining on-chain vulnerabilities. "Another notable trend is the increase in attacks as a result of compromised private keys, which underscores the importance of improvements in security practices outside of a given blockchain."

Indeed, the data shows that both the on-chain and off-chain vulnerabilities Gimenez-Aguilar describes — in particular the compromise of private keys, price manipulation hacks, and smart contract exploitation — drove hacking losses in 2023.



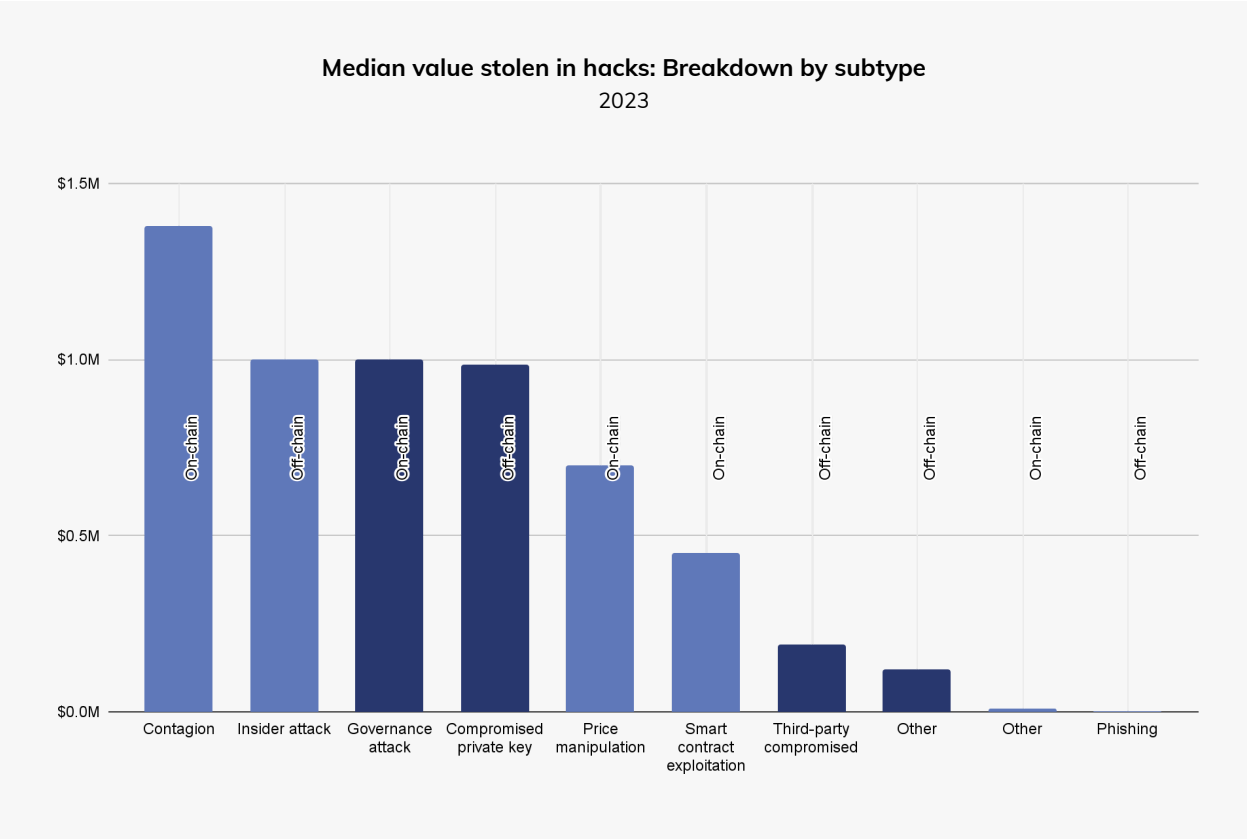
Source: Halborn

Overall, on-chain vulnerabilities drove the majority of DeFi hacking activity in 2023, but as we see on the chart below, that changed over the course of the year, with compromised private keys driving a larger share of hacks in the third and fourth quarters.



Source: Halborn

On a hack-by-hack basis, hacks stemming from contagion (on-chain) were the most destructive, with a median loss of $1.4 million. Governance attacks (on-chain), insider attacks (off-chain), and compromised private keys (off-chain) follow, with all three accounting for a median hack value of roughly $1 million.

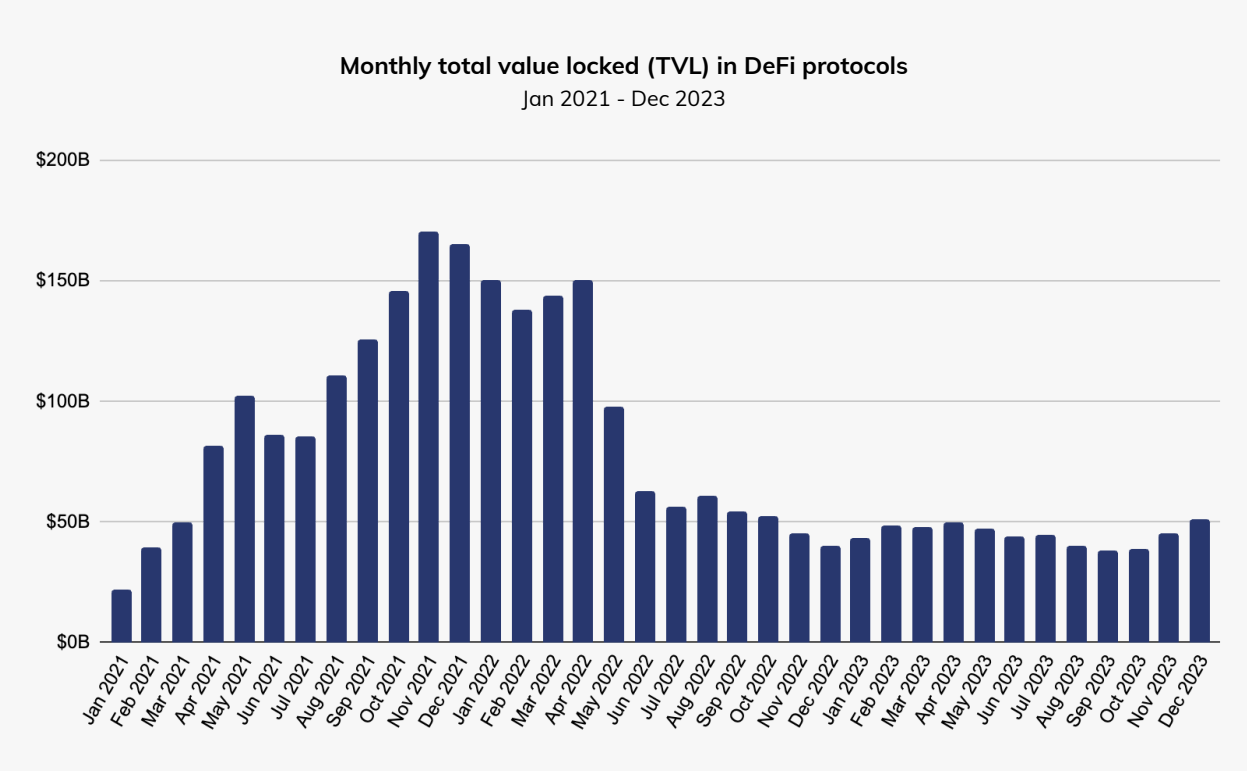


Source: Halborn

Overall though, the data provides reasons for optimism. Both the drop in raw value stolen from DeFi, and the relative decline in on-chain vulnerability-driven hacking over the course of 2023 suggests that DeFi operators may be getting better at smart contract security. “I do think that the increase of security measures in DeFi protocols is a key factor in the reduction in the quantity of hacks related to smart contracts vulnerabilities. If we compare the top 50 hacks by value lost from this year with those from previous ones (studied in Halborn’s Top 50 hacks report), there is a reduction in percentage of losses from 47.0% of the total to 18.2%. Price manipulation attacks, nevertheless, remain almost constant with around 20.0% of the total value lost. This is an indication that, when performing an audit, protocols should also take into account how they interact with the whole DeFi ecosystem,” said Gimenez-Aguilar. However, she also stressed that the growth in hacks driven by attack vectors such as compromised private keys indicates that DeFi operators must move beyond smart contract security and address off-chain vulnerabilities as well: “Doing the same comparison as before, losses related to compromised private keys increased from 22.0% to 47.8%.” As we see above, both on-chain and off-chain vulnerabilities can be highly destructive.

However, Gimenez-Aguilar also acknowledged that the drop in DeFi hacking losses may be driven in part by the overall drop in DeFi activity in 2023, which may have simply decreased the number of DeFi protocols

that made ripe targets for hackers. Total value locked (TVL), which measures the total value held or staked in DeFi protocols, was down for all of 2023, following a sharp decrease in the middle of 2022.



Source: DeFiLlama

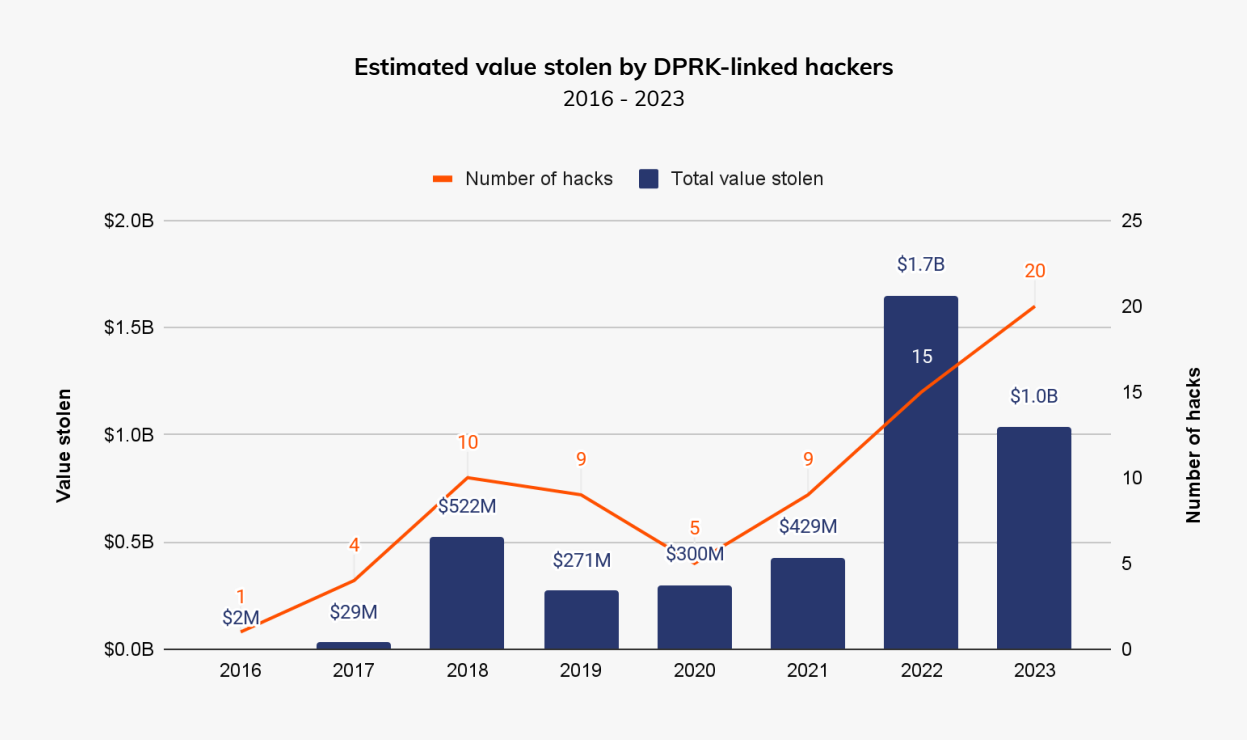
We can't say for sure whether the drop in DeFi hacking was driven primarily by better security practices or the drop in DeFi activity overall — most likely, it was a mix of the two. But, if the decrease in hacking was primarily driven by the drop in overall activity, then it would be important to watch whether DeFi hacking rises again in tandem with another DeFi bull market. Such a bull market would lead to higher TVL and therefore a larger pool of DeFi funds for hackers to target.

Regardless, there are steps DeFi operators should take to improve security. DeFi protocols vulnerable to on-chain failures can develop systems that monitor on-chain activity related to economic risks and prior platform losses. Companies such as Hypernative and Hexagate, for example, produce customized alerts to prevent and react to cyber attacks, which can help platforms better secure integrations with third parties such as bridges, and communicate with customers who might be at risk. Platforms vulnerable to off-chain failures may aim to reduce reliance on centralized products and services.

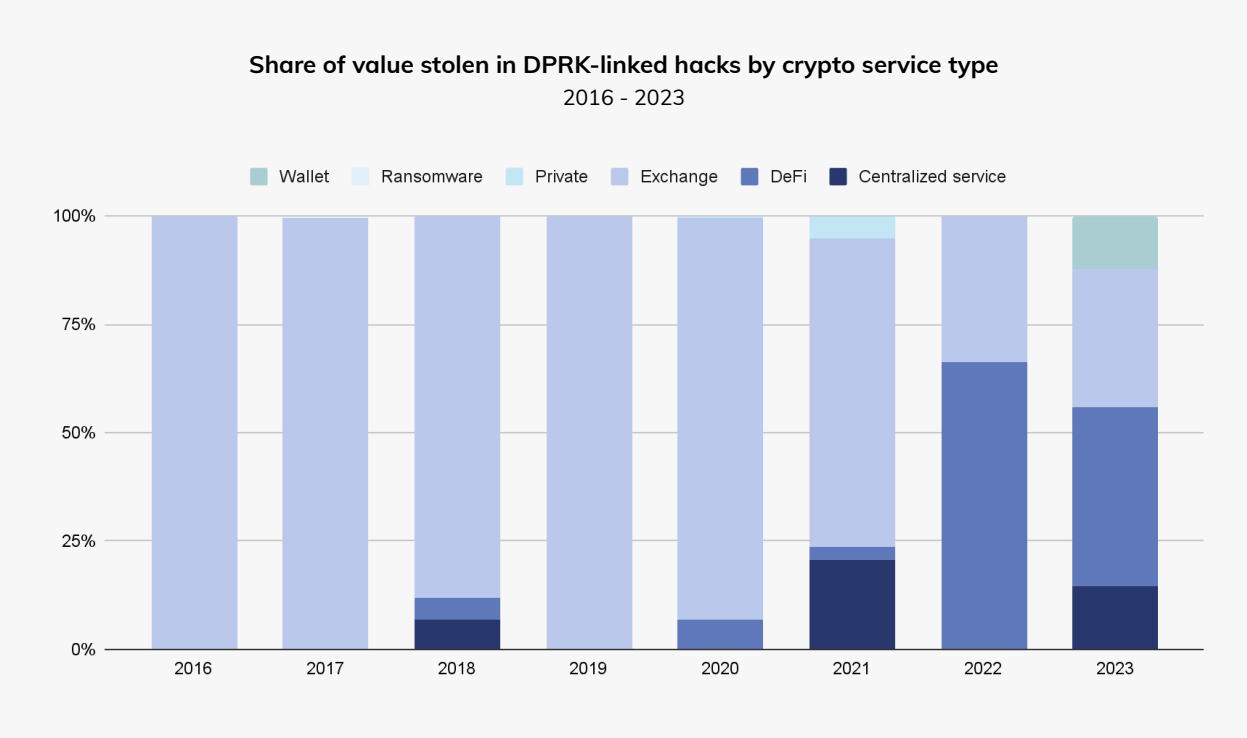
North Korea hacked more crypto platforms than ever in 2023, but stole less in total than in 2022

North Korea-linked hacks have been on the rise over the past few years, with cyber-espionage groups such as Kimsuky and Lazarus Group utilizing various malicious tactics to acquire large amounts of crypto assets.

Just last year, cryptocurrency stolen by hackers associated with North Korea reached its highest level of approximately $1.7 billion. In 2023, we estimate that the total amount stolen is slightly over $1.0 billion, but as we see below, the number of hacks rose to 20 — the highest number on record — in the context of the overall crypto bear market.



North Korea-linked hackers stole approximately $428.8 million from DeFi platforms in 2023, and also targeted centralized services ($150.0 million stolen), exchanges ($330.9 million), and wallet providers ($127.0 million).



2023 saw a notable decrease in North Korean targeting of DeFi protocols, mirroring the overall drop in DeFi hacking that we discussed above.

CASE STUDY

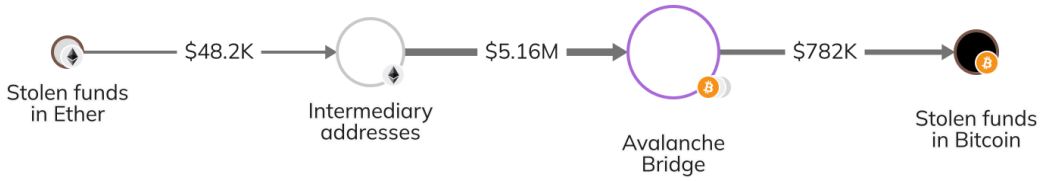
The DPRK's Atomic Wallet exploit

In June 2023, thousands of users of Atomic Wallet, a non-custodial cryptocurrency wallet service, were targeted by a hacker, leading to estimated losses of $129 million. The FBI later attributed this attack to North Korea-affiliated hacking group TraderTraitor and stated that the Atomic Wallet exploit was the first in a series of similar attacks, including the Alphapo and Coinspaid exploits later in the month. Although the specifics of how the attack occurred remain unclear, we used on-chain analysis to look at what happened to the funds after the initial attack, which we've broken down into four phases.

In the first phase, the attacker chain hopped — moving assets from one blockchain to another, typically to obfuscate the flow of ill-gotten funds — to the Bitcoin blockchain via the following three methods:

1. Sending funds to centralized exchanges. While we can't continue to trace funds on-chain following their movement to a centralized service, we know in this case that funds stolen from Atomic Wallet were converted into Bitcoin at centralized exchanges because we gathered intelligence from other trusted sources with whom we regularly collaborate.
2. Sending funds to cross-chain bridges where they could be moved to the Bitcoin blockchain.
3. Sending funds to wrapped Ether (wETH) contracts, then moving to the Bitcoin blockchain via the Avalanche Bridge.

The Chainalysis Reactor graph below illustrates the third method whereby the stolen funds (in Ether at the time) moved through several intermediary addresses before reaching the Avalanche Bridge and converting to Bitcoin.

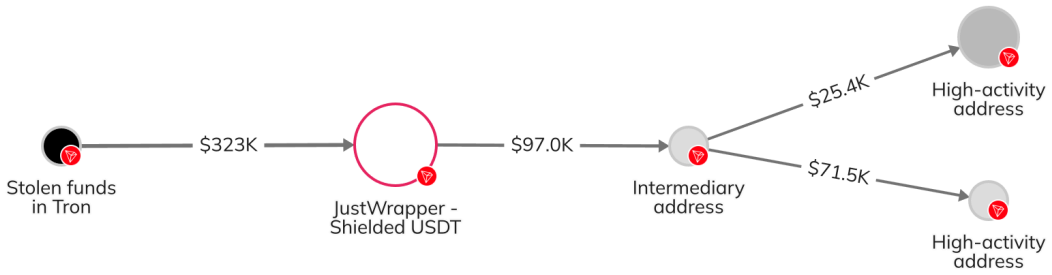


In the second phase, the attacker sent the stolen funds to the OFAC-sanctioned Sinbad, a mixing service that obscures on-chain transaction details and has been previously used by North Korean money launderers. Then, the attacker withdrew the funds from Sinbad and moved them to consolidation addresses on Bitcoin.

In the third phase, the attacker's money laundering strategy shifted to focusing almost exclusively on the Tron blockchain rather than the Bitcoin blockchain. The attacker chain hopped to the Tron blockchain via one of the following methods:

1. Sending funds to Avalanche through the Avalanche Bridge where they could be moved to the Tron blockchain.
2. Sending funds to centralized services, then moving them to the Tron blockchain.
3. Sending funds through additional mixers or privacy-enhancing services to further obfuscate the flow of funds, then moving them to the Tron blockchain.

In the fourth and final phase, the attacker deposited the funds at various services on the Tron blockchain. Some of these funds were mixed via Tron's JustWrapper Shielded Pool, whereas others were ultimately sent to high-activity Tron addresses suspected of belonging to over-the-counter traders.



Additional on-chain activity revealed that funds stolen from Atomic were consolidated with assets from other sources before moving elsewhere, which is likely related to the subsequent Alphapo and Coinspaid exploits.

The future of crypto hacking

Although the total amount stolen from crypto platforms in 2023 was down significantly from prior years, it is clear that attackers are becoming increasingly sophisticated and diverse in their exploits. The good news is, crypto platforms are becoming more sophisticated in their security and responses to attacks, too.

When crypto platforms act promptly after exploits, law enforcement agencies will be better equipped to contact exchanges where frozen funds are located to initiate seizure and contact services through which the funds flowed to gather relevant information about accounts and users. Over time, as these processes improve, it is likely that funds stolen from crypto hacks will continue to decline.

Market Manipulation

54% of ERC-20 Tokens Listed on DEXes in 2023 Display Patterns That May Be Suggestive of Pump and Dump Schemes, but Represent just 1.3% of DEX Trading Volume

For most of the research that we publish in our annual Crypto Crime Report, the data tells a clear story. For instance, funds sent to ransomware operators, darknet markets, or sanctioned entities can be measured and trends can be analyzed with Chainalysis labeling and data. But on-chain data can also be used to detect suspicious trading patterns. In these cases, the evidence on the blockchain is less definitive. Instead, on-chain data can provide a starting point for deeper investigations, usually combined with other, off-chain information. For this reason, we do not include possible market manipulation proceeds or estimates of victim losses in our count of total illicit transaction volume — there isn't enough information to determine whether the activity is criminal or not without additional context.

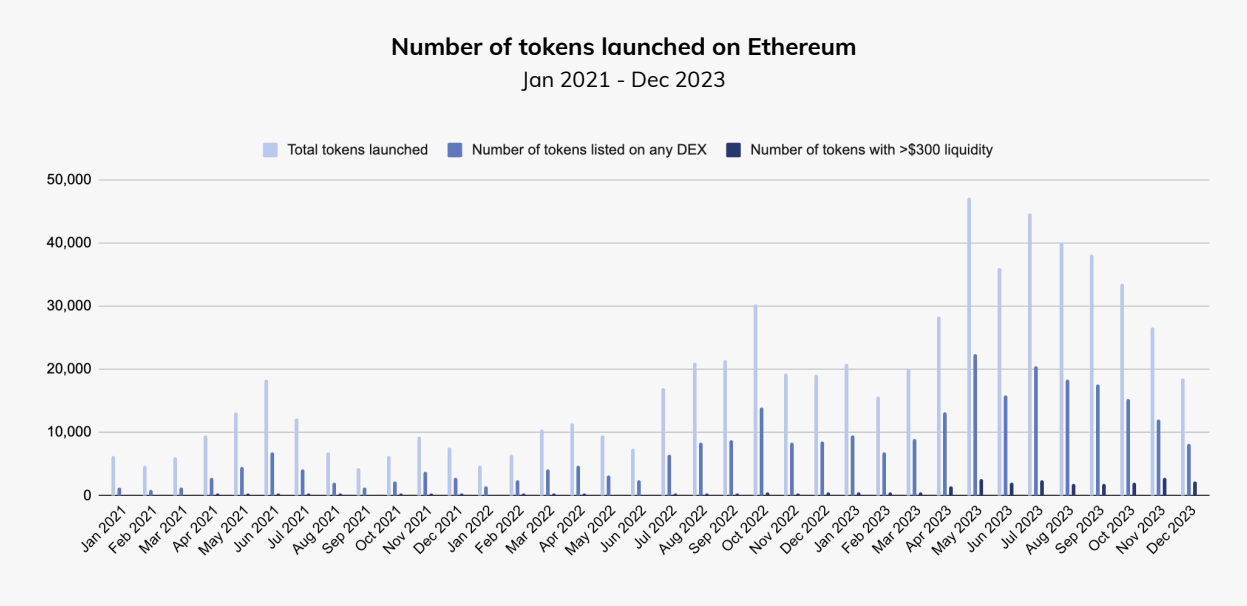
Pump and dump schemes typically involve an actor or group of actors investing in a token, heavily promoting that token to spur a price increase, and subsequently dumping their holdings at a significant profit. This often results in a heavy decline or even collapse of a token's price, impacting unsuspecting holders.

For this analysis, we designed a methodology to surface data points that identify potential areas for further investigation into possible market manipulation. We focused on DeFi, given its transparency and the availability of on-chain trading data, which is not similarly available for centralized exchanges. Specifically, we looked at the Ethereum network, which has experienced rapid growth and innovation in recent years. Thanks to the ecosystem's ERC-20 standard, or technical guidelines for Ethereum-based fungible tokens, it's never been easier to build new tokens on top of Ethereum, with all tokens able to be traded with one another and used on a variety of decentralized applications (dApps).

Below, we'll use on-chain analysis to consider what some of these patterns look like, a critical tool for market operators and government agencies alike.

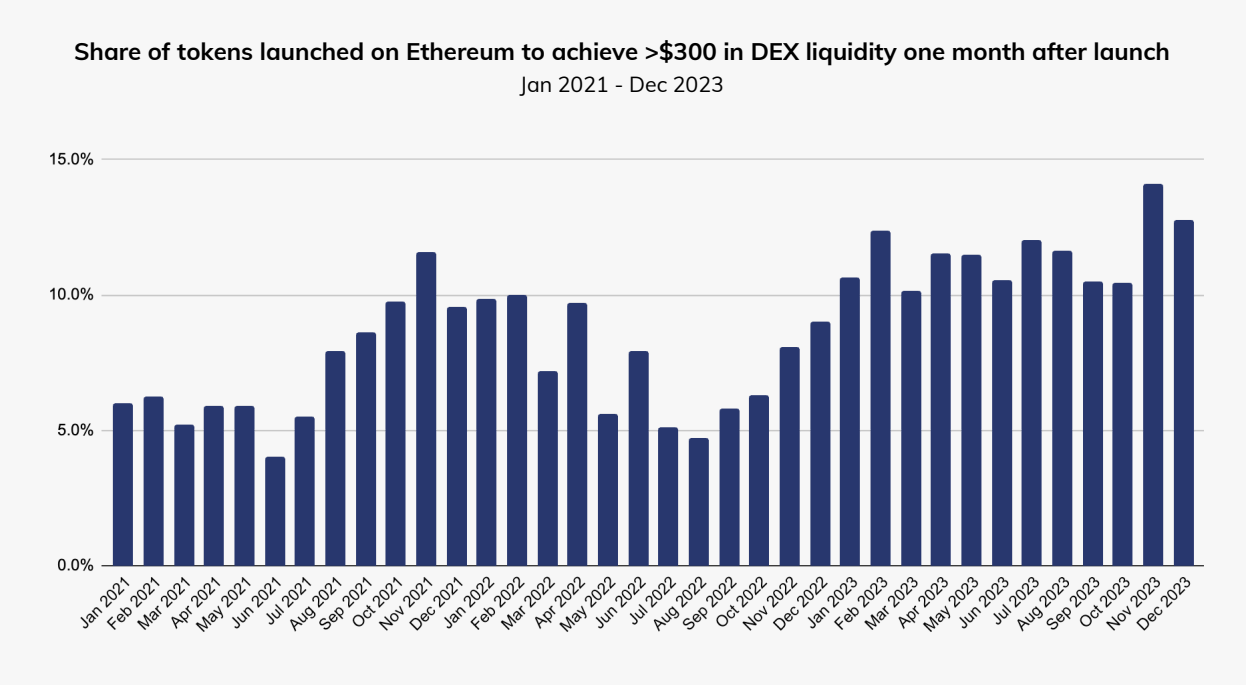
How on-chain data could be used to identify elements of possible pump and dump schemes

Between January and December 2023, just over 370,000 tokens were launched on Ethereum, approximately 168,600 of which were available to trade on at least one decentralized exchange (DEX). As we see below, the number of monthly tokens launched has been increasing since mid-2022, with recent spikes in activity nearing 50,000 per month.



This data comes from Transpose, the comprehensive source for indexed real-time blockchain data.

Not all of those tokens get significant traction, though. In any given month, less than 14.1% of all tokens launched achieve more than $300 of DEX liquidity within the subsequent month, and only 5.7% of all tokens launched in 2023 are currently above that threshold. Although this is an increase from the previous two years, low liquidity values suggest that the majority of tokens launched still cannot be easily exchanged with liquid assets such as ETH, wETH, USDC, USDT, and wBTC without having their prices significantly affected.



There are many reasons that could explain the failure to reach more liquid trading volumes. As the popularity of tokenization grows, launching new tokens into an increasingly crowded marketplace becomes more challenging.

However, some may be attempts at pump and dump schemes. Here is an example of how one type of token manipulation could occur:

1. An actor (or group of actors) either launches a new token or buys a large share of supply for an existing token — usually one with historically low volume.
2. This actor hypes up the token as an opportunity to "get rich quick," typically using social media and online chat rooms like Discord and Telegram.
3. The persistent marketing on social media and chat rooms attracts attention from users, leading to an increase in buying.
4. The actor may also engage in wash trading, which involves the simultaneous buying and selling of the same asset with the intent of falsifying its level of activity.
5. If successful, the token rises in value.
6. Once the token reaches the desired price target, the actor liquidates their position for a profit.
7. The price of the token rapidly drops due to increased selling pressure, leaving many victims "holding the bag."
8. If the actor is also the token creator, they may completely abandon the token project, taking more users' funds with them, also known as a "rug pull." However, this is not always possible depending on the governance of the project.

Many of these elements can be identified in on-chain data. We utilized Transpose to look for ERC-20 tokens that met the following three criteria, which we'll refer to as **Criteria A**:

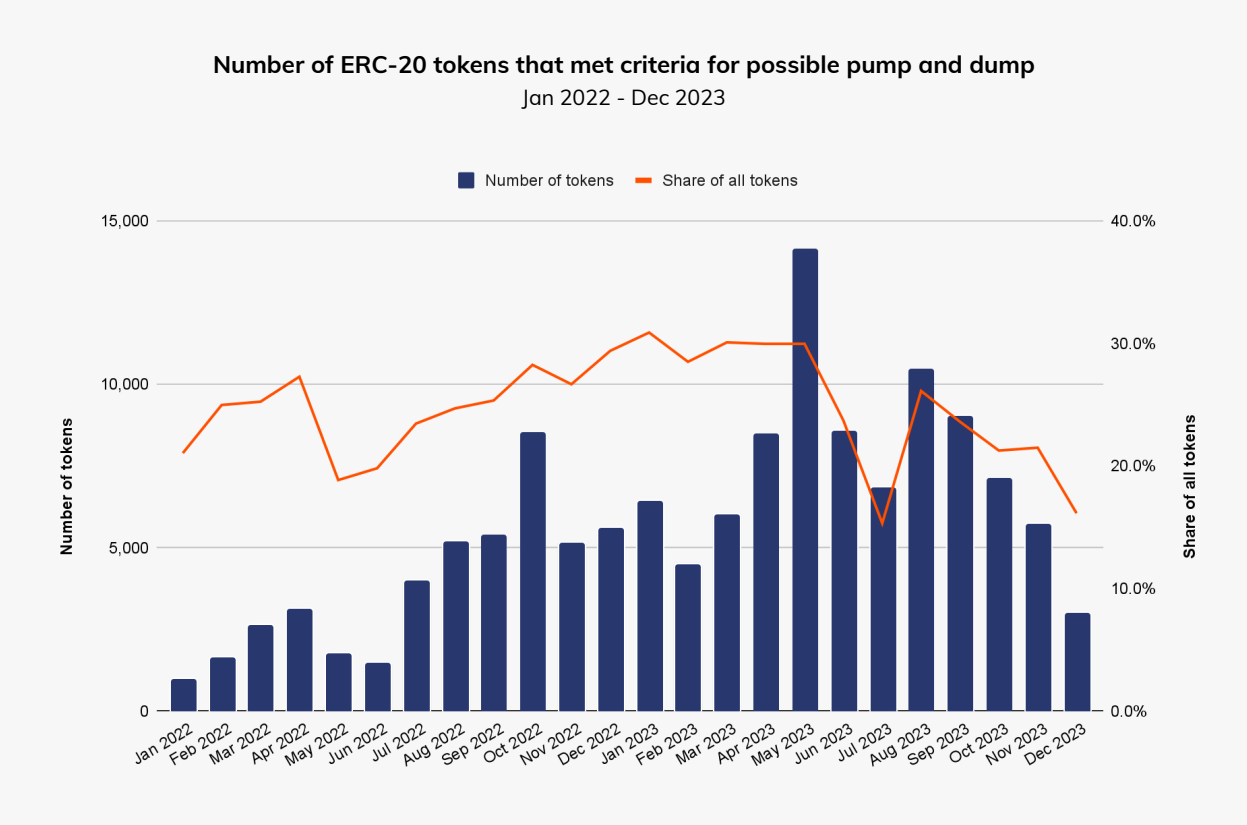
1. The token was purchased five times or more by DEX users with no on-chain connection to the token's biggest holders, indicating that it achieved some level of traction in the market.
2. A single address removed more than 70.0% of the liquidity in the token's DEX liquidity pool, indicating that the biggest holder dumped the token. In most cases, the address removed the token's liquidity within the first few weeks of launch.
3. The token currently has liquidity of $300 or less, indicating that the market for the token essentially ceased following the removal of liquidity. If the token was involved with multiple DEX pools, we combined the liquidity of each one.

We found that approximately 90,408 tokens launched in 2023 met Criteria A. This number represents 24.4% of all tokens launched on Ethereum and 53.6% of tokens that were listed on a DEX during the time period studied. However, over the course of the year, the volume of transactions made with tokens that met Criteria A accounted for only 1.3% of total trade volume on Ethereum DEXes.

	Number of tokens	Percent of all tokens launched
Total tokens launched	370,066	100.0%
Tokens listed on DEX	168,623	53.6%
Tokens currently with less than $300 in liquidity where a single address removed more than 70.0% of liquidity in a single transaction with five or more previous DEX purchases	90,408	24.4%

This methodology does not mean these tokens were the subjects of pump and dump schemes — rather, it illustrates how operators or regulators can leverage on-chain trading data to identify and prioritize patterns that may suggest illicit activity and warrant further investigation.

The monthly number of new tokens meeting Criteria A has been declining since mid-2023, although it is still higher than the number from 2022.



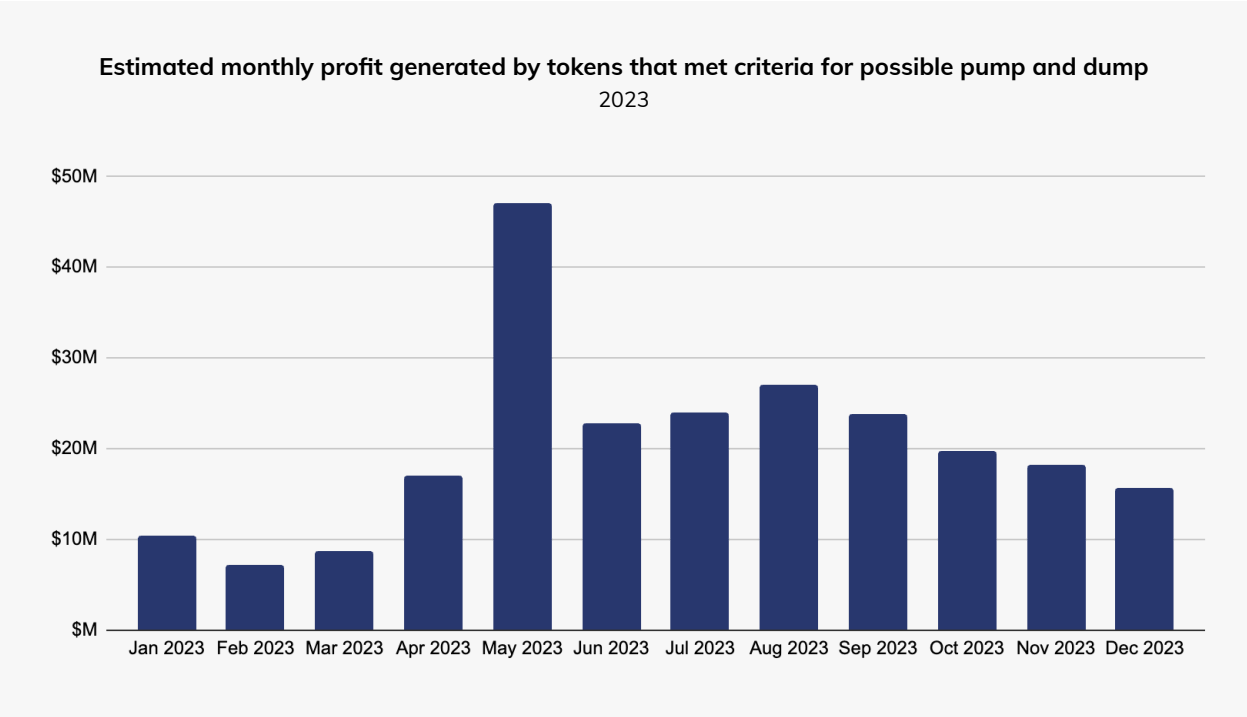
Source: Transpose

How much did actors who launched tokens meeting Criteria A profit before their tokens plummeted in value? We can calculate this using the following formula, based on how wallets associated with a token's launch interacted with its DEX liquidity pools and traded the token itself.

A = Amount withdrawn from DEX pool by possible illicit actor
B = Amount deposited into DEX pool by possible illicit actor
C = Funds spent by illicit actor to trade token, possibly via wash trading

Profit = A - B - C

Using this formula, we calculate that actors who launched tokens meeting Criteria A collectively made approximately $241.6 million in profit in 2023, not accounting for other costs to build and launch the token.



Source: Transpose

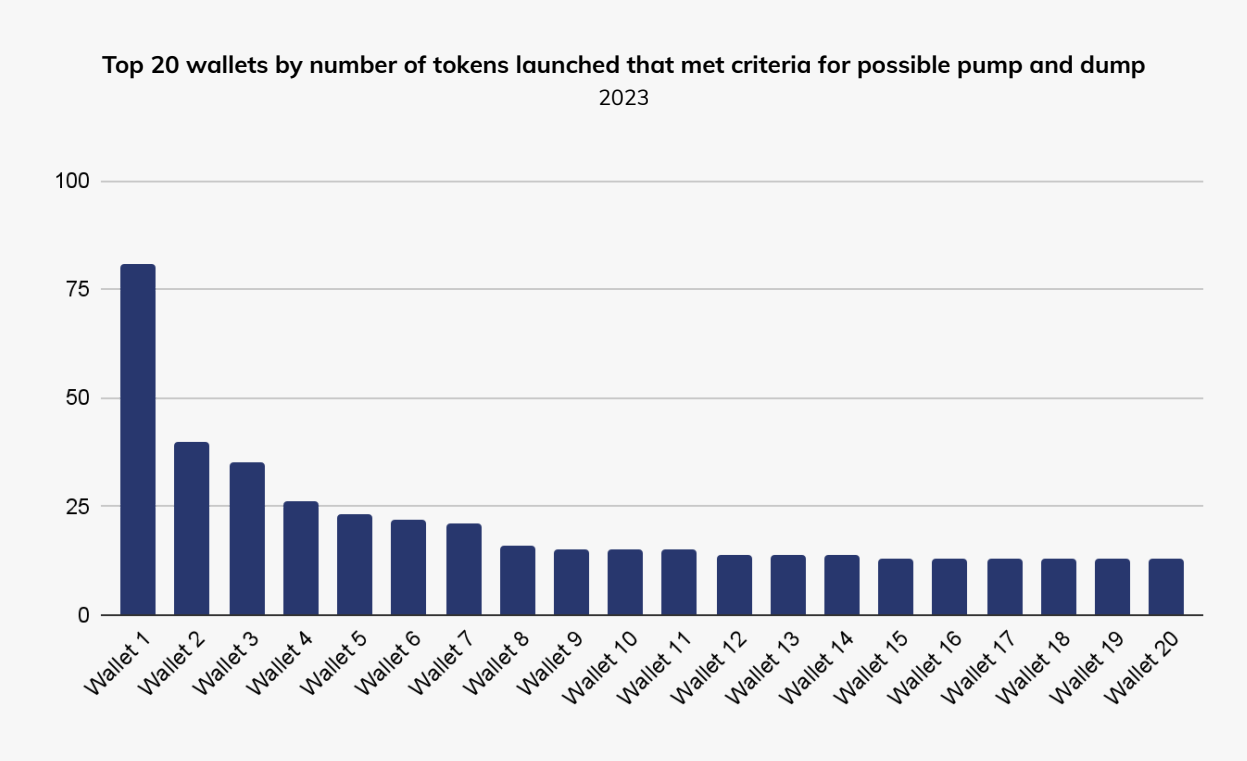
Although the total profit amassed by these actors is significant, individual tokens meeting our criteria on average produce just $2,672 each in profit and, again, account for just 1.3% of total Ethereum DEX trading volume for 2023. The data paints a picture of an ecosystem in which potentially bad actors could generate tens of thousands of potential pump and dump tokens, most of which fail to generate significant profit and don't attract meaningful trading volume.

CASE STUDY

One of 2023's most prolific token creators generated 81 different token types

Some of the actors involved also appear to launch multiple tokens that meet our criteria.

During the time period studied, we identified one address — Wallet 1 on the chart below — that appears to have been involved in the most launches of tokens meeting Criteria A. The operator of this address launched 81 different token types to generate an estimated $830,000 in profits.



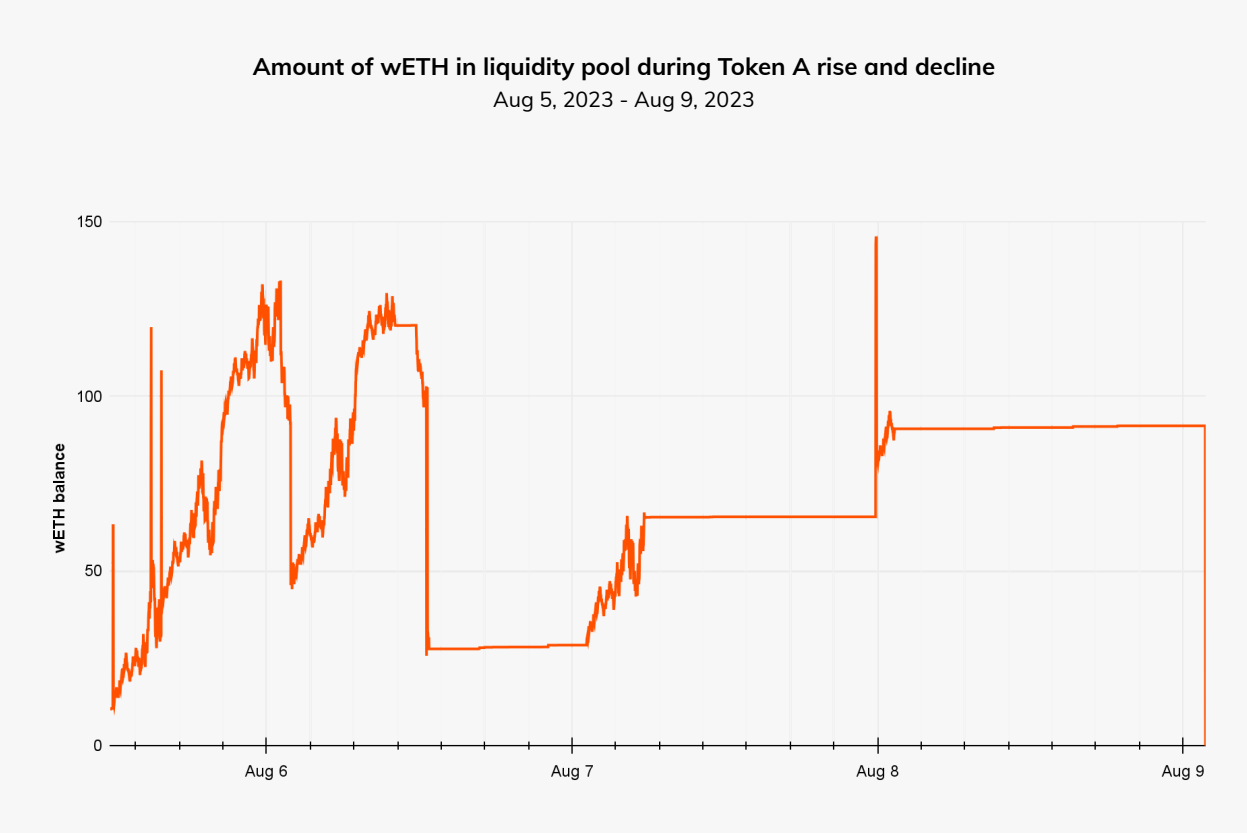
In one instance, this address earned approximately $46,000 on the launch and DEX listing of a token we'll refer to as Token A.

We can see a breakdown of how this address operator successfully executed these activities and more using Chainalysis Storyline. First, on August 5, 2023, the address operator sent wrapped Ether (wETH) and Token A to a liquidity pool. Next, the address operator appears to have wash traded using ETH and wETH, shown by the eight subsequent transactions, and removed some liquidity on August 6, likely to take partial profits.

After executing these trades, the address operator removed all wETH and Token A liquidity on August 9 by selling existing positions, and left remaining users with no liquidity to sell their own assets. Since these last removals, there have been no additional transactions in this liquidity pool, suggesting a rug pull in addition

to the suspected pump and dump scheme. Taken together, this activity suggests the actor may have employed different tactics for a relatively complex attack.

The below chart illustrates how the liquidity of the DEX pool shifted during this period, showing several sharp increases in the wETH balance on August 6. On the far right, we see that the liquidity moved back to zero once the address operator withdrew all funds on August 9. Overall, 108 other market participants using this DEX pool appear to have lost funds; they had purchased approximately $55,000 in Token A during this period.



Source: Transpose

Monitoring market patterns to maintain crypto market integrity and stability

Market manipulation, such as pump and dump schemes, are destructive to the crypto markets in the same way they are to traditional markets. However, cryptocurrency's inherent transparency provides an opportunity to build safer markets. Market operators and government agencies can deploy monitoring tools that can help identify and prioritize areas for further investigation in a way that wouldn't be possible in traditional markets.

Tools like Transpose can help monitor on-chain data for signs of unusual activity, and help surface actionable leads in conjunction with various forms of off-chain data.

CSAM

On-chain Analysis Suggests CSAM Vendors May Benefit from Privacy Coins Like Monero and Other Obfuscation Measures

CSAM (child sexual abuse material) is an understudied part of the crypto crime ecosystem. The industry is broadly aware that there are digital spaces where CSAM can be bought and sold using crypto, and there are well-publicized instances of law enforcement shutting down crypto-based CSAM marketplaces like Welcome to Video.

Not all CSAM activity involves cryptocurrency, and in many cases, users simply trade CSAM amongst themselves. But cryptocurrency-based sales of CSAM are a growing problem. Tamsin McNally, Hotline Manager at the Internet Watch Foundation (IWF) shared with us that they "find virtual currency is the dominant choice for buyers and sellers of commercial child sexual abuse content, so much so that we now have a dedicated crypto unit that works with law enforcement and the finance industry to help provide evidence for investigations." This analysis is our first attempt to produce a comprehensive, objective measure of the CSAM-cryptocurrency ecosystem.

First, we debut a methodology for measuring the scope of the crypto-based CSAM ecosystem across a number of different variables, based on on-chain activity. Overall, our data suggests that while the size of the crypto-based CSAM market has decreased in 2023, the sophistication of CSAM sellers and in turn their resilience to detection and takedowns has increased over time. In addition, we'll look at CSAM vendors' use of obfuscation measures such as mixers and privacy coins like Monero, and examine how vendors may benefit from them.

All of the CSAM data we analyze here is based on a subset of over 400 on-chain **CSAM vendor wallets** we've identified that were active between 2020 and 2023 and met a specific threshold of transaction activity. We observed over 10,000 wallets that sent funds to CSAM vendor wallets in 2023, which for the purposes of this analysis we label as **CSAM buyers**. Identifying CSAM vendors isn't easy, as most shy away from advertising even on the darknet due to the stigma associated with this particularly abhorrent form of crime — virtually all darknet markets, for example, explicitly ban the sale of this material. Our identifications of CSAM vendor wallets come from a variety of sources, including the IWF, other partners and customers, and our own investigations.

We are almost certainly not capturing all on-chain CSAM activity, but given the breadth of sources we draw from, as well as the fact that we have a big enough sample size to measure non-scale based characteristics like longevity and sophistication, we believe this analysis sheds valuable light on how on-chain CSAM marketplaces operate and have changed over time.

How crypto's CSAM problem has changed over time: A four-component measurement

We quantify most forms of cryptocurrency-based crime primarily based on the crypto value received by illicit addresses. However, this would be misleading in the case of CSAM. As a recent research report by the European Parliament explains, there's more CSAM on the internet than ever before, and it's never been cheaper to produce. Given the flood of inexpensive material, and the fact that each piece of content inherently involves abuse, we don't believe that a dollar figure can accurately measure the true damage of CSAM.

Instead, we've come up with a four-component measurement to assess the unique problem of CSAM over time based on different on-chain metrics. For any given period of time, we can assign a score for each of the four components, and in that way see how the cryptocurrency-based CSAM market changes across each component over time. Those four components are listed below.

1. Scale

Scale captures the size of the CSAM market in terms of transactions and participants.

On-chain metrics here include:

- Number of wallets sending to CSAM vendors[3]
- Number of distinct CSAM vendors active during the time period
- Number of transactions incoming to CSAM vendors
- Total value sent to CSAM vendors

2. Severity

Severity is intended to capture the extremity and volume of the content being shared on a per transaction basis. While this can't be directly seen on-chain, we can infer these characteristics based on the price of individual transactions with CSAM vendors.

On-chain metrics here include:

- Mean payment size
- Median payment size
- Number of CSAM vendors that have received payments of $70 or more in size — these represent the highest tier of payments that CSAM vendors typically charge in a single transaction for content. We'll explain the five-tier payment classification system experts use for CSAM marketplace analysis in more detail later.

[3] For the purposes of this analysis, we do not count transactions from services to CSAM vendors, which could also represent people purchasing this material. We also do not count instances where one individual may be purchasing CSAM from another who made the initial purchase from a CSAM vendor. For example, if personal wallet 1 transfers to CSAM vendor 1, and then personal wallet 2 transfers to personal wallet 1, we don't count that second transaction, which might be redistribution. Again, we are almost certainly not capturing all on-chain CSAM activity.

3. Sophistication

Sophistication refers to the level of obfuscation measures taken by CSAM providers during a given time period. Later in the report, we'll examine the relationship between sophistication and CSAM vendors' ability to stay in operation for longer.

On-chain metrics here include:

- Inflows to CSAM vendors from mixers (which we assume to be customer payments made via mixers)
- Outflows from CSAM vendors to mixers (which we assume represent efforts by CSAM vendors to launder funds)
- Outflows from CSAM vendors to instant exchange services that support privacy coins like Monero (which we assume are possible conversions into privacy coins by CSAM vendor operators for money laundering purposes)

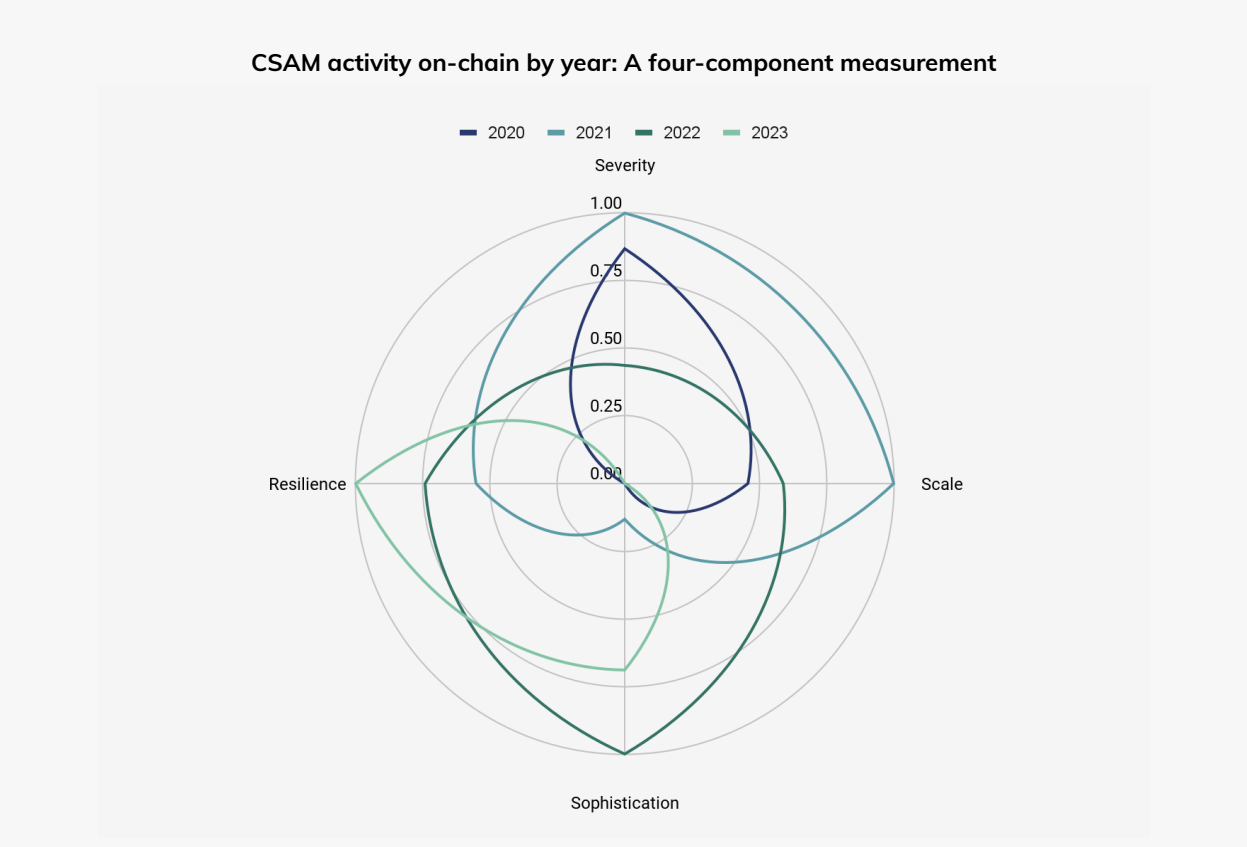
4. Resilience

Resilience refers to CSAM vendors' ability to become active and stay in business.

On-chain metrics here include:

- Average cumulative lifespan of active CSAM vendors
- Number of CSAM vendors that became inactive during the time period (this would negatively impact the resilience score)
- Number of new services that became active during the time period
- The net growth or decline of CSAM vendors, calculated by subtracting the number of services that became inactive during a given year from the number of new services that emerged in that year

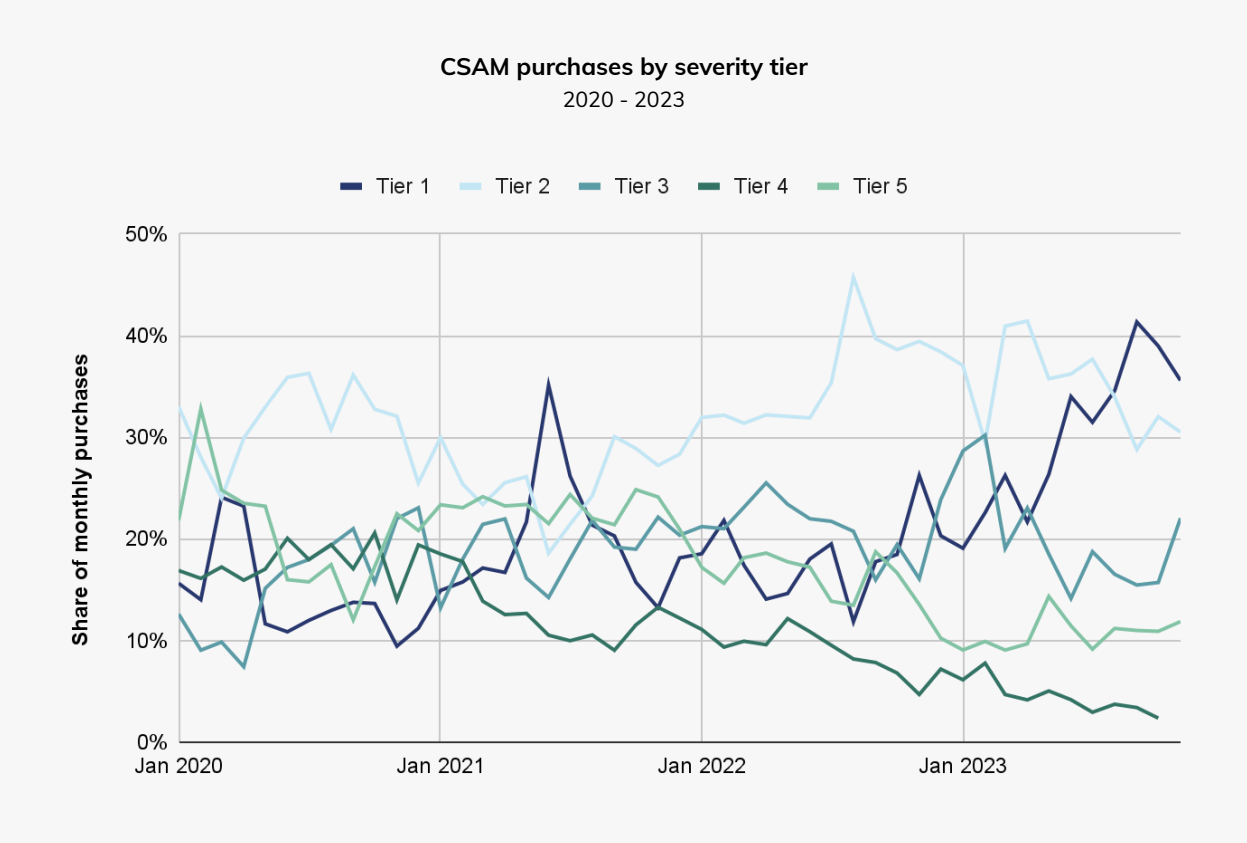
Let's look at how the crypto-based CSAM market has changed over the last four years along each of those four axes.



Overall, we see that the scale and severity of CSAM activity peaked in 2021 after relatively low activity in 2020. The fluctuations in severity become clearer when we incorporate our five-tier payment classification system. This tiered pricing system has been identified by the IWF as being used by many CSAM vendors, with higher tiers being more expensive and giving users a greater volume of content, and often more extreme content, in the context of a single purchase. The tiering system is as follows:

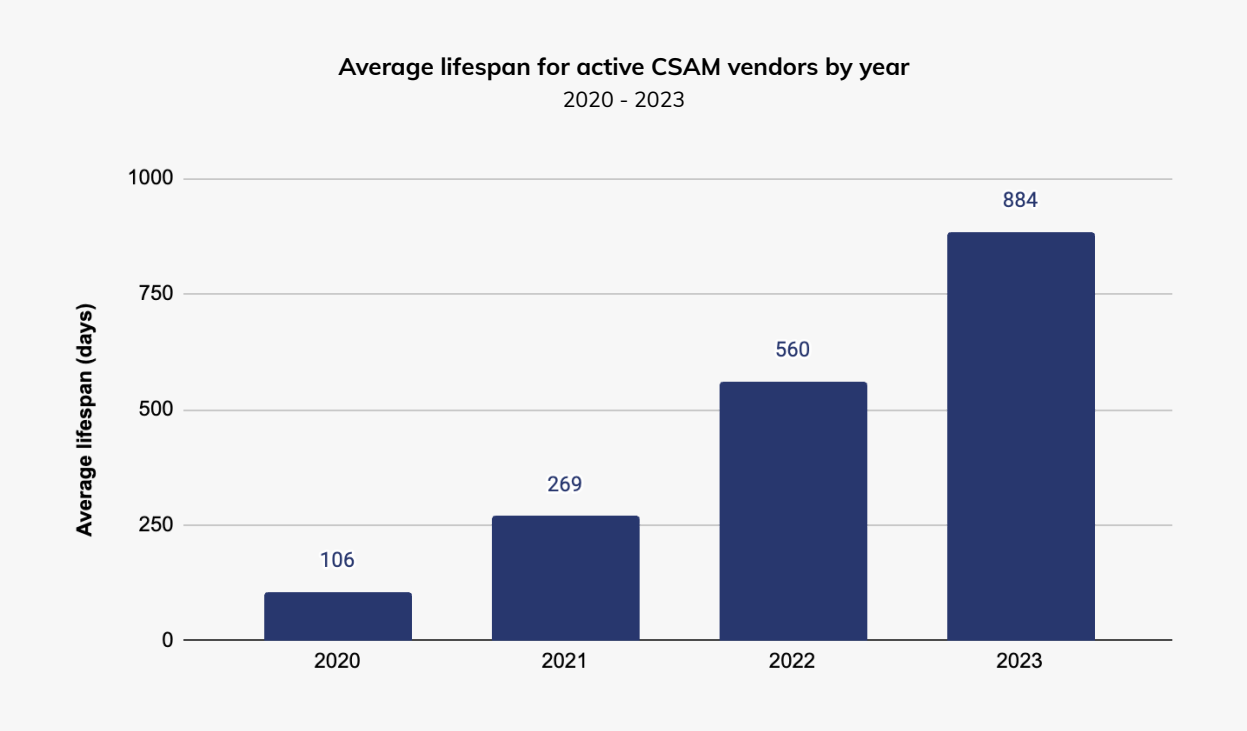
- **Tier 1:** $10 - $20
- **Tier 2:** $20 - $35
- **Tier 3:** $35 - $50
- **Tier 4:** $50 - $70
- **Tier 5:** >$70

As we can see on the chart below, purchases in Tiers 4 and 5 have decreased as a share of overall CSAM transactions over time since 2021, while the share for Tiers 1 and 2 has increased.



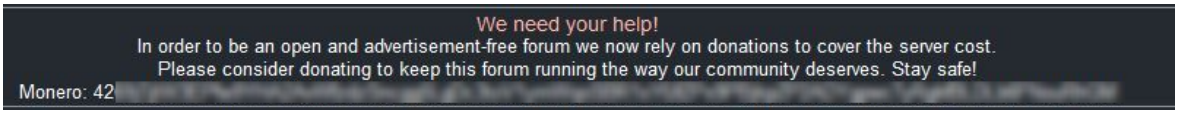
This may indicate that the CSAM being disseminated is becoming less extreme, or that less material is being provided on a per purchase basis. Of course, it could also mean that the market is being flooded with content, leading to price drops across the board regardless of the extremity of the content. For instance, researchers have noted that AI is enabling the dissemination of synthetic CSAM — a glut of such content could drive prices down.

We also see that the resilience of CSAM vendors has gone up. Look at the following chart, which shows the lifespan of all CSAM vendors we track by start date and end date.



Lifespans are trending upwards: In 2023, the lifespan of the average active CSAM vendor is 884 days, up from 560 days in 2022. However, relatively few new CSAM vendors have cropped up in 2023 — just 43, compared to 112 in 2022. Still, how is it that so many CSAM vendors are able to persist for so long, and why is resilience going up?

Of course, there are many steps CSAM vendors could be taking to obfuscate their activity that have nothing to do with cryptocurrency, such as the use of internet anonymity tools like Tor. But when it comes to crypto specifically, the data suggests CSAM vendors may be benefiting from the use of Monero. Monero is the most popular of the so-called "privacy coins," which are cryptocurrencies whose blockchains employ unique privacy enhancing features that make it more difficult to follow the flow of funds or discern their original source.



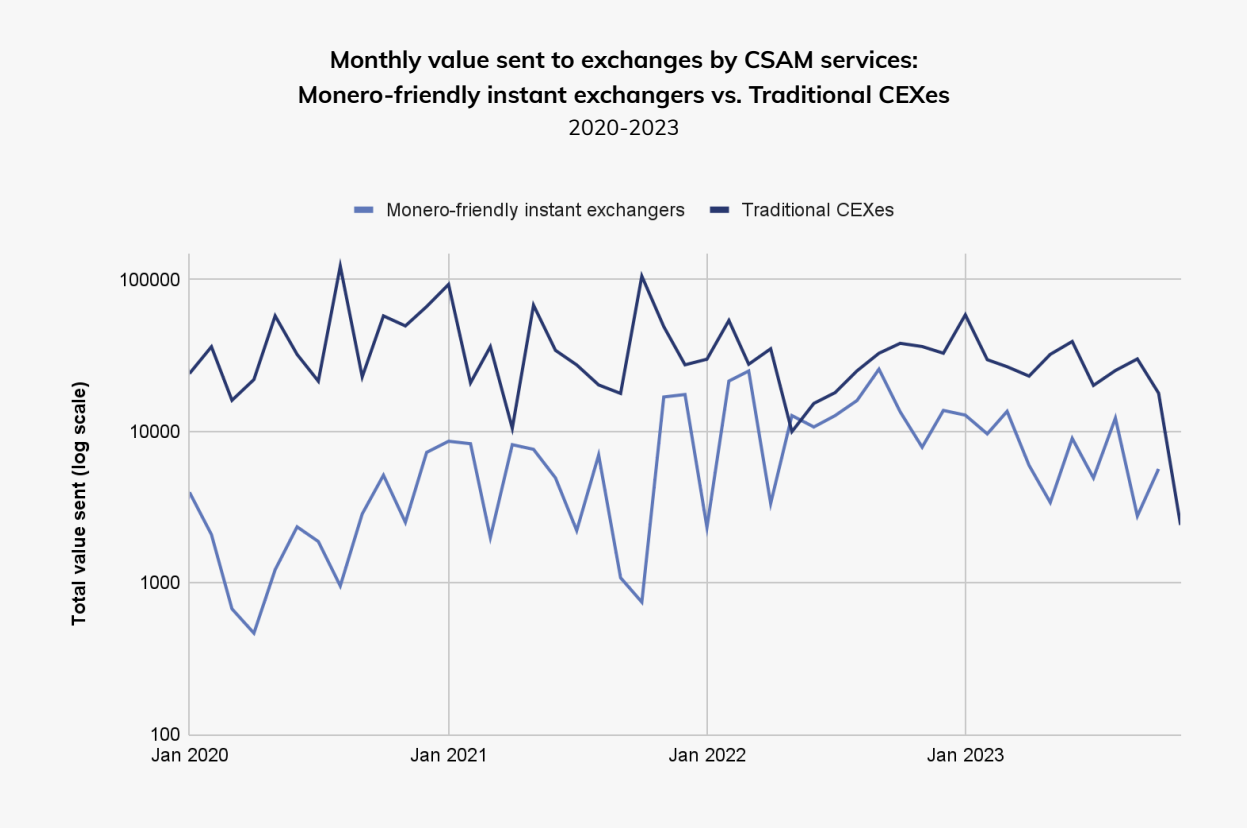
This screenshot shows a CSAM vendor soliciting Monero donations on its darknet website.

Many CSAM vendors have adopted Monero in recent years, though Bitcoin is by far the most widely used cryptocurrency for CSAM purchasing. In fact, while the screenshot above shows a vendor asking users to pay in Monero, the data suggests Monero's role is more prevalent in CSAM vendors' efforts to launder their on-chain earnings, rather than to obscure the purchases themselves. It's difficult to show Monero's role directly on-chain using standard blockchain analysis techniques, but we can look at CSAM vendors' use of

Monero-friendly instant exchangers to estimate their potential Monero use. Unlike traditional centralized exchanges (CEXes), which have largely delisted Monero, instant exchangers are non-custodial and generally don't offer crypto-to-fiat conversion — but unlike, say, a DeFi protocol, they are centrally managed by a single organization. Instant exchangers typically draw on the liquidity of multiple CEXes to give users the best possible prices, and facilitate the exchange of one crypto for another directly between users' wallets, such that the transaction is often difficult to trace on-chain. That, along with the fact that many instant exchangers don't require KYC, can make them helpful for concealing the original source of cryptocurrency.

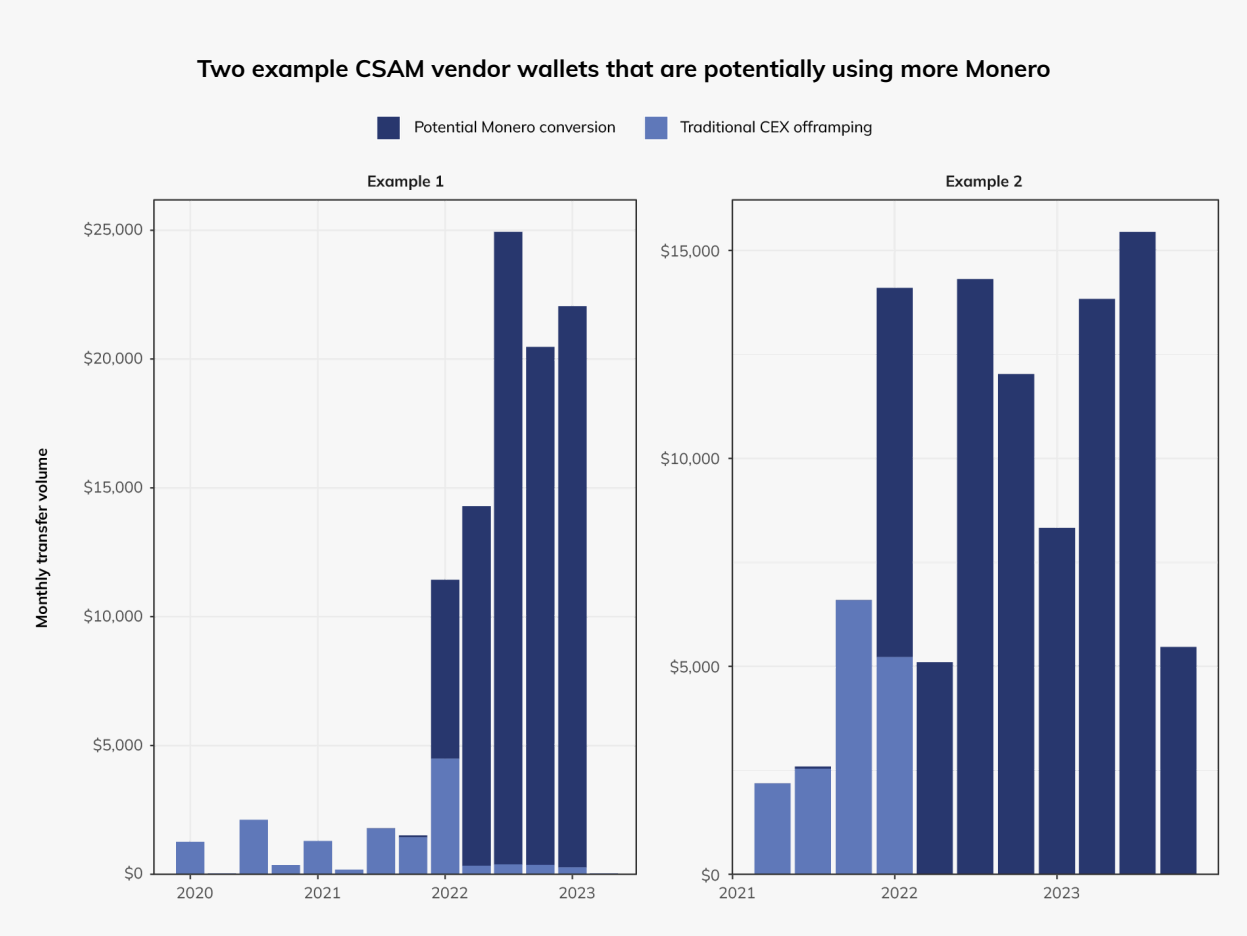
It is also possible that CSAM vendors are swapping into other cryptocurrencies, including privacy coins other than Monero. But based on vendors' specific solicitation of Monero and our own investigations, we believe Monero to be the currency of choice for laundering via instant exchangers.

Our data shows that CSAM vendors' usage of instant exchangers that allow for Monero conversion has increased significantly over the last few years.

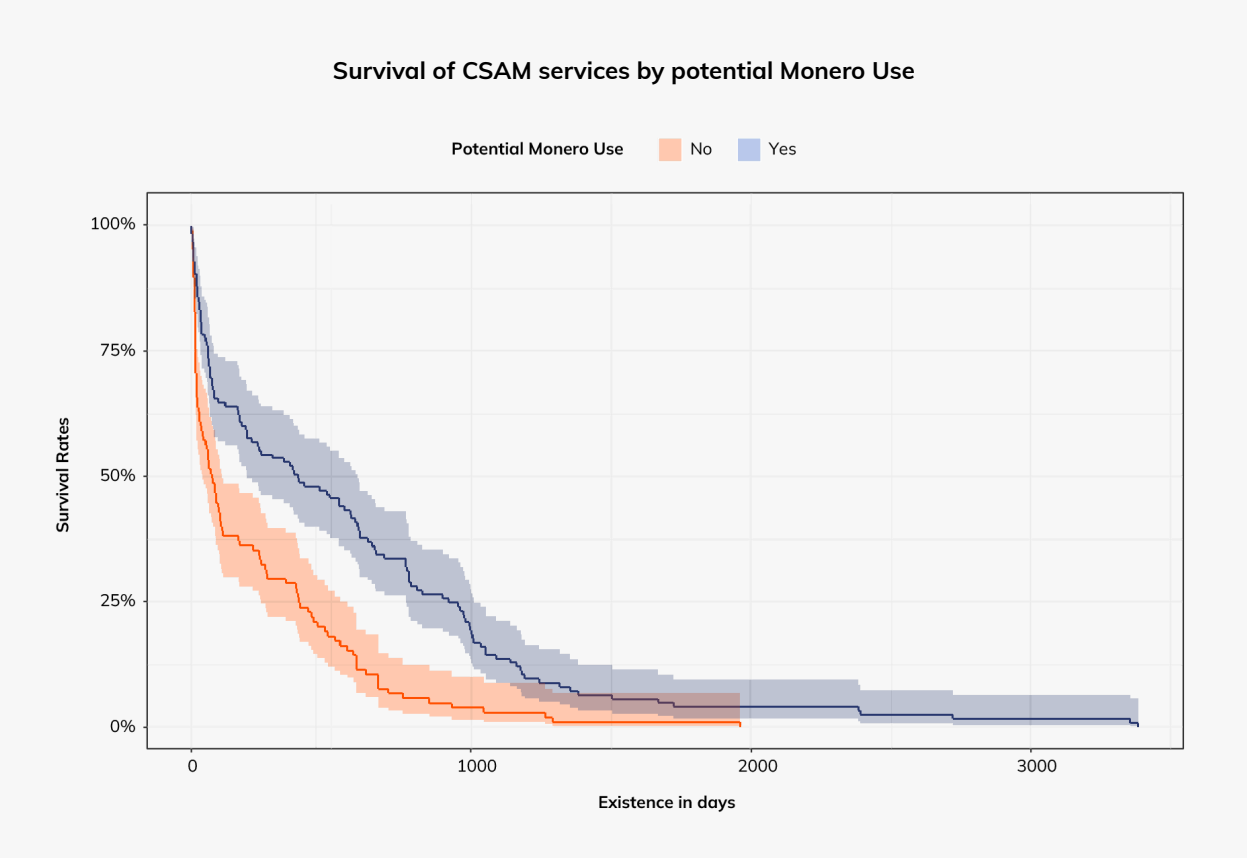


Traditional CEXes have always been the biggest recipient of funds sent by illicit services, including CSAM vendors. However, Monero-friendly instant exchangers have narrowed the gap in recent years, suggesting that CSAM vendor wallets may be increasing their usage of Monero for money laundering purposes, even though they continue to receive the bulk of customer payments in Bitcoin. Some CSAM vendors have transitioned almost entirely away from direct sending to CEXes, instead sending funds only to

Monero-friendly instant exchangers. We can see two examples of CSAM vendors that made that switch in 2022 on the chart below.



If CSAM vendors' usage of Monero-friendly instant exchangers does indeed correlate with actual usage of Monero, the data suggests that Monero may be helping those CSAM vendors survive longer. Check out the following chart, which compares the survival rates over time of a sample of CSAM vendors that send funds to Monero-friendly instant exchangers versus those that do not.



CSAM vendors that use Monero-friendly instant exchangers are much more likely to survive initially than those that don't — within 50 days of launching, the survival rate of potential Monero using CSAM vendors is roughly 77.6%, compared to just 57.0% for all others. Furthermore, at the 1,000 day mark, 19.2% of potential Monero using CSAM vendors are still active, compared to just 3.8% of all others. While the lack of KYC at many instant exchangers and inability to trace through these centralized services may also play a role, the data suggests that Monero could be a huge boon to CSAM vendors.

It's important to note that the use of an instant exchanger does not necessarily provide anonymity for users. Some instant exchangers do have KYC and other compliance processes, including transaction monitoring. We also know that many comply with law enforcement requests related to investigations, including ones involving CSAM.

Overall, 52.0% of CSAM vendor wallets active in 2023 have sent funds to Monero-friendly instant exchangers. One reason that number isn't higher could be Monero's comparative difficulty of use. Many exchanges don't support Monero for off-ramping purposes, though users could always swap back from Monero to a different cryptocurrency that's easier to convert into cash. Regardless, the data suggests that the availability of privacy coins like Monero may help CSAM vendors stay in business longer. Law enforcement may consider investment in specialized blockchain analysis services that can make tracing Monero and other assets possible, and instant exchangers that do not employ traditional compliance practices may consider building programs that contribute to a safer ecosystem.

CASE STUDY

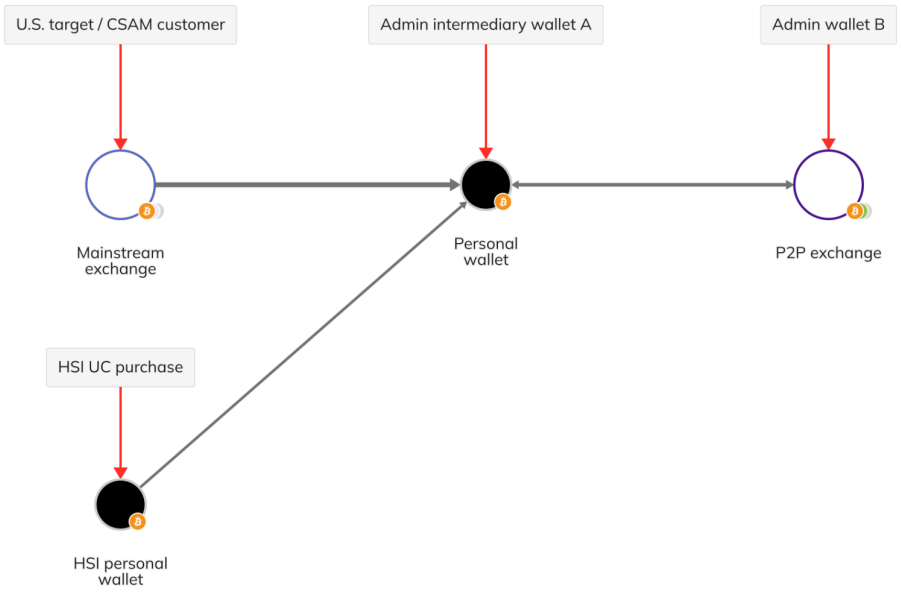
Using blockchain analysis to track down CSAM vendors and administrators

Now that we've examined how the CSAM marketplace has changed over time, and the techniques vendors may be using to evade detection, the question remains: How can law enforcement catch the people buying and selling CSAM with cryptocurrency? We've got one example courtesy of Homeland Security Investigations (HSI). Using blockchain analysis tools, HSI Special Agents, Analysts and New York Police Department (NYPD) detectives were able to identify the administrator of a large-scale darkweb CSAM service and rescue a child being victimized by one of the service's customers. The team accomplished this starting with nothing more than a web address scrawled on a piece of paper, discovered while searching the apartment of what appeared to be a lone sex offender. We'll describe how they did it below.

Following the trail from one arrest to an online network

In 2019, an NYPD detective working with HSI New York's Cyber Division arrested New York City resident Jason Seto in an undercover operation, in which Seto believed he was meeting up with a 14-year-old boy for sexual activity. Soon after, the investigators discovered something interesting while executing a search warrant at the suspect's apartment: A TOR web address written on a piece of paper next to the suspect's computer. The detective visited the darkweb website and immediately discovered a directory of CSAM forums and websites, one of which allowed users to purchase CSAM and even arrange meetups with underage victims, all paid for in Bitcoin.

Being well-versed in blockchain analysis, the detective worked alongside HSI New York's Darkweb and Cryptocurrency Task Force in pursuing next steps. Investigators sent a small test payment of Bitcoin to the address provided by the service, and communicated with the site's administrator. The detective posed as a user seeking CSAM content, and promised to send a full payment once the administrator confirmed receipt of the initial transaction. Once the administrator confirmed he'd received the Bitcoin, the detective knew the address truly belonged to the administrator, and ceased communication. From there, a task force analyst watched the address' on-chain activity using Chainalysis Reactor, and waited for the administrator to move the funds. Sure enough, the administrator eventually sent Bitcoin to a peer to peer (P2P) exchange. From there, the task force's investigation led to the identity of the individual.



Immediately, one can see why it's crucial for law enforcement professionals in all agencies and divisions — not just those focused on cybercrime — to understand the basics of cryptocurrency and blockchain analysis. "Law enforcement has to evolve and keep up with technology in order to identify cyber criminals," said HSI New York Supervisory Special Agent (SSA) Anthony V. With cryptocurrency now playing a role in many forms of crime with a financial component — including sex crimes against minors, as we see in this case study — law enforcement must know how to identify and analyze cryptocurrency addresses in order to be as effective as possible.

In this case, the darkweb administrator was identified as residing outside of the United States and investigators are working diligently to follow up on viable leads.

Blockchain analysis leads to second arrest and rescue of child

The HSI task force wasn't done yet. Thanks to the unique transparency of blockchains, investigators could do more than watch where the darkweb administrator sent funds after discovering his Bitcoin address. They could also observe incoming funds from other customers. This is an important advantage that law enforcement agents gain when investigating criminal activity being conducted with cryptocurrency rather than fiat currency. "Understanding the illicit flow of cryptocurrency allows law enforcement to unravel complex investigations," explained SSA Anthony V.

While observing the darkweb administrator's Bitcoin wallet, investigators saw another address sending Bitcoin in an amount suggesting the purchase of CSAM videos. The agents saw that the new address had been funded by a centralized cryptocurrency exchange, and began investigating further. The task force identified the CSAM buyer and discovered that he was also producing his own CSAM, abusing a 12-year-old victim to do so. Courts eventually sentenced this buyer to 55 years in prison.

How law enforcement agents can use blockchain analysis to fight CSAM

As we discussed above, law enforcement agents can fight CSAM more successfully — as well as other forms of crime — if they become familiar enough with blockchain analysis to spot crypto addresses and analyze their on-chain activity for actionable leads.

However, cryptocurrency exchanges have an important role to play as well. With the right transaction monitoring tools, exchanges can get alerted in real time if their users transact with any addresses identified as belonging to a CSAM vendor, and proactively report those transactions to the proper authorities. Exchanges can also help by collaborating with law enforcement when agents request information.

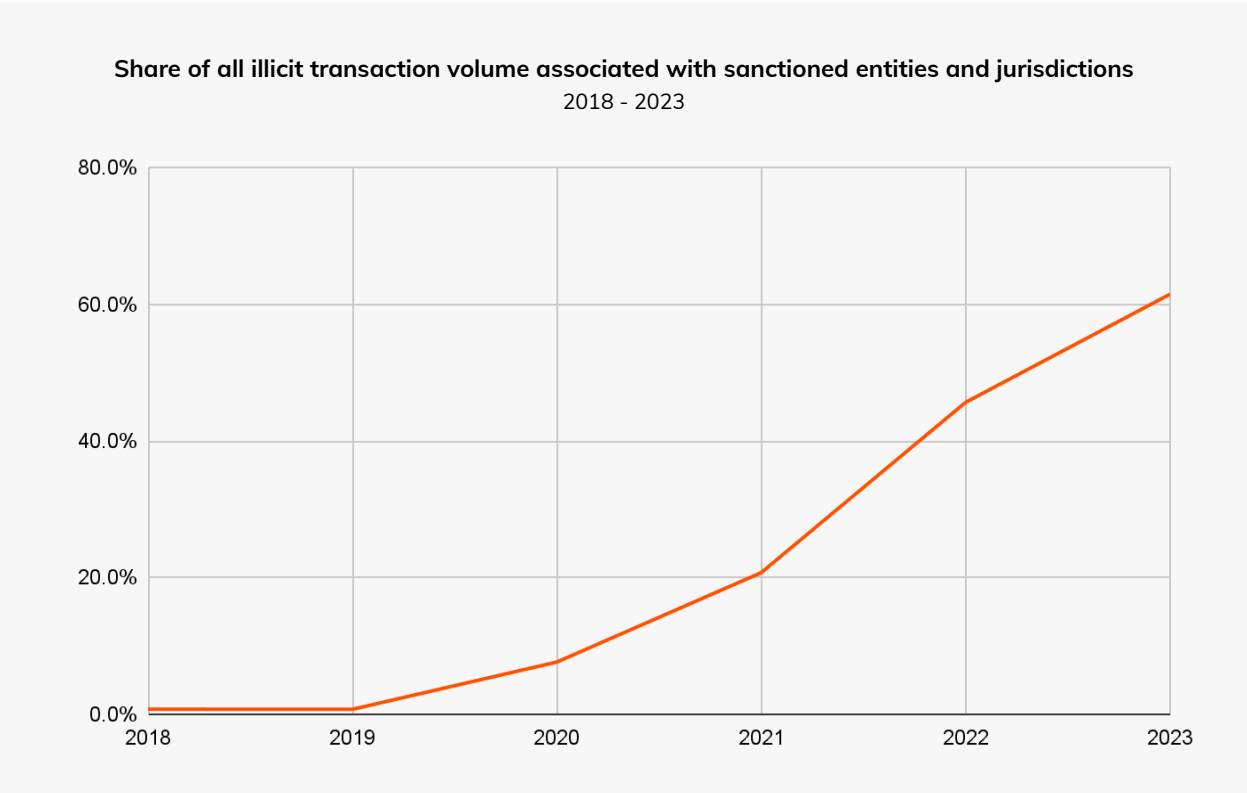
HSI encourages collaboration between the private sector and law enforcement, especially when it comes to the exploitation of the most vulnerable in our society — our children. We commend our partners at the HSI and the NYPD for their work on this case.

Sanctions

In 2023, OFAC's Crypto-linked Sanctions More than Double, Tornado Cash Inflows Slowly Climb

In 2023, the U.S. Office of Foreign Assets Control (OFAC) imposed a total of 18 sanctions on individuals or entities that included cryptocurrency addresses in their designation. Additionally, Chainalysis has identified crypto addresses belonging to other entities that OFAC designated in 2023, such as ransomware gang members associated with Trickbot. Each year, OFAC continues to expand on its crypto-related designations, including a wider variety of entities under additional sanctions programs.

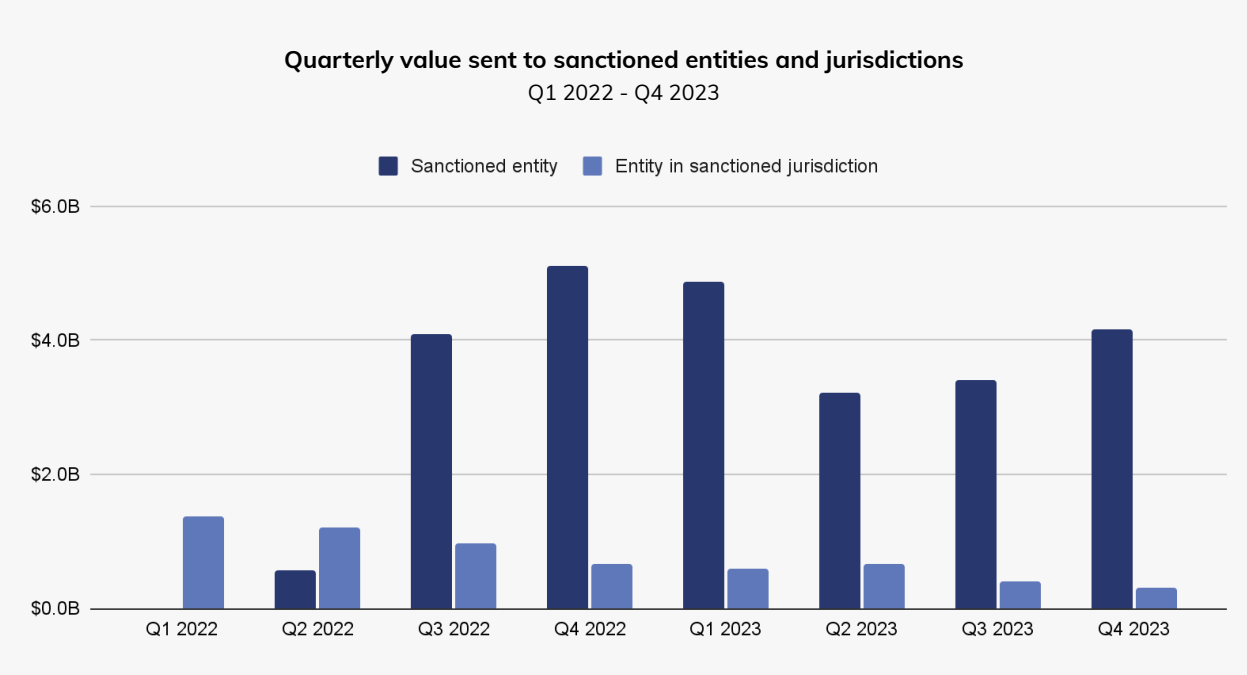
Overall, crypto inflows to sanctioned entities and jurisdictions comprised 61.5% of all illicit transaction volume last year as seen in the chart below, representing $14.9 billion in transaction volume. Notably, the targets of OFAC's crypto-linked sanctions shifted from the previous year. While OFAC designated major services like Garantex, Hydra, and mixers Tornado Cash and Blender.io in 2022, its sanctions mostly targeted groups and individual actors in 2023, with the exception of fraud shop Genesis Market and crypto mixer Sinbad.io.



As we see on the chart, sanctions-related transaction volume is making up a larger and larger share of all illicit transaction volume over the last few years, in part due to the number of entities being sanctioned, but also due to the difficulty of enforcing sanctions against entities in regions that don't comply with OFAC's designations or against decentralized operations. In addition to the increased number of crypto sanctions, OFAC has also designated larger services over time. As mentioned, this includes some entities that cannot concurrently be shut down by law enforcement — like the notorious decentralized mixer Tornado Cash that was sanctioned in 2022 — and therefore continues to transact after being sanctioned, though at much smaller volumes. Garantex, a Russia-based crypto exchange sanctioned in 2022, also continues to receive crypto as it is in a region that doesn't comply with OFAC's sanctions. In this section of the crime report, we'll provide an overview of sanctions trends, share who was sanctioned and why, examine Tornado Cash's post-designation crypto activities, and discuss the origin points of crypto inflows to Iran.

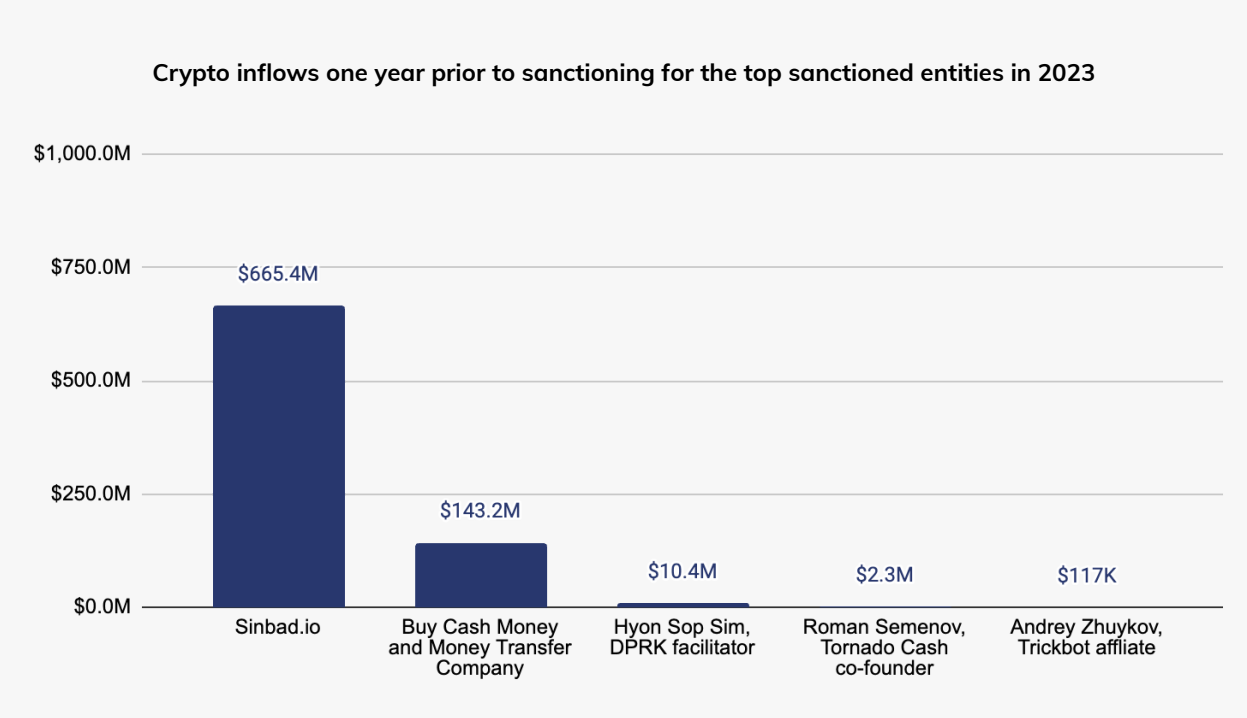
Sanctions activity and trends in 2023

Since 2022, total crypto transaction value associated with sanctioned entities has remained high, as seen in the chart below. Two services are mostly responsible for this elevated volume: Garantex — sanctioned on April 5, 2022 for its affiliation with illicit actors including ransomware as a service (RaaS) groups — and Tornado Cash, sanctioned on August 8, 2022, for its role in laundering crypto stolen by the North Korean-linked hacking organization Lazarus Group. As for crypto sent to sanctioned jurisdictions, that has trended downward from the bull market peaks of 2021.



When examining the top five entities sanctioned in 2023 by volume and their crypto inflows in the year leading up to their designations, we see below that they collectively received $821.4 million in crypto during that time. Sinbad.io — a Bitcoin mixer which OFAC sanctioned and law enforcement shut down in November of 2023 — was used by North Korea-affiliated hacking outfit Lazarus Group for crypto

laundering, and took the lion's share of those inflows with $665.4 million in crypto received. As mentioned earlier, 2023 mostly saw sanctions against smaller targets and individuals, rather than major services.



Drug-related sanctions with a crypto nexus in 2023

As the U.S. fentanyl crisis persists, drug-related sanctions appeared to be a priority in 2023. OFAC imposed nine fentanyl-related sanctions including crypto addresses as identifiers in their designations, across four different sanctioning events. On April 17, OFAC designated individuals and entities in China and Latin America for their role in fentanyl manufacturing and trafficking. On September 26, it sanctioned individuals involved in illegal fentanyl, cocaine, and methamphetamine trafficking into the United States on behalf of Mexico's Sinaloa Cartel. And on October 3, it sanctioned China-based individuals and companies involved in the manufacturing and distribution of fentanyl, other drugs, and associated precursor chemicals. It's also worth noting that, in 2023, OFAC updated a designation to add a crypto address for China-based chemical company Hebei Atun, which was sanctioned in 2021 for its involvement in fentanyl precursor chemical sales.

North Korea-related sanctions with a crypto nexus in 2023

Last year, across three different sanctioning events, OFAC designated five individuals/entities tied to its North Korea Sanctions Regulations program that included crypto addresses in their designations. The first event occurred on April 24, against China-based individuals facilitating crypto money laundering activities used to fund North Korean weapons of mass destruction and missile programs. The second event, on May 23, was a joint action by OFAC and South Korea's Ministry of Foreign Affairs (MOFA), against entities and individuals associated with illicit North Korean revenue generation schemes. The third on November 29 was a sanction against crypto mixer Sinbad.io for its use by Lazarus Group — a North Korea-affiliated cybercriminal syndicate — to launder millions of dollars in stolen crypto. And while no crypto addresses

were included in its designation, on November 30 OFAC and Japan's Ministry of Foreign Affairs jointly sanctioned North Korean hacking group Kimsuky for its cyber espionage activity and support of North Korea's nuclear weapons program. This came after South Korea's Ministry of Foreign Affairs sanctioned Kimsuky in June of that year, where cryptocurrency addresses were included in the designation.

Crypto-linked entities sanctioned in 2023: Who they are and what they do

Below is a breakdown of individuals and entities with ties to cryptocurrency that were sanctioned by OFAC in 2023, along with the reason they were sanctioned.

Name	Reason for sanction
North Korea hacking group Kimsuky	Cyber espionage
Crypto mixer Sinbad.io	Crypto money laundering
Russian national Ekaterina Zhdanova	Crypto money laundering
Gaza-based MSB Buy Cash	Terrorism financing
China-based illicit drug producers	Fentanyl manufacturing and distribution
Sinaloa cartel affiliates	Drug trafficking & crypto money laundering
Trickbot affiliates	Ransomware
Roman Semenov, Tornado Cash co-founder	Money laundering
ISIS and Al-Qaeda operatives	Terrorism
North Korea hackers	Hacking and money laundering
Dubai-based financial services firm, its CEO John Desmond Hanafin, and affiliates	Russian sanctions evasion
Russian national Mikhail Matveev	Ransomware
China-based individuals facilitating DPRK	Crypto money laundering
Chinese chemical businesses and Latin American drug cartel associates	Fentanyl production and purchase
Fraud shop Genesis Market	Stolen PII
Russia-based cybercrime gang Trickbot	Malware
Igor Vladimirovich Zimenkov and affliates	Russian arms dealing

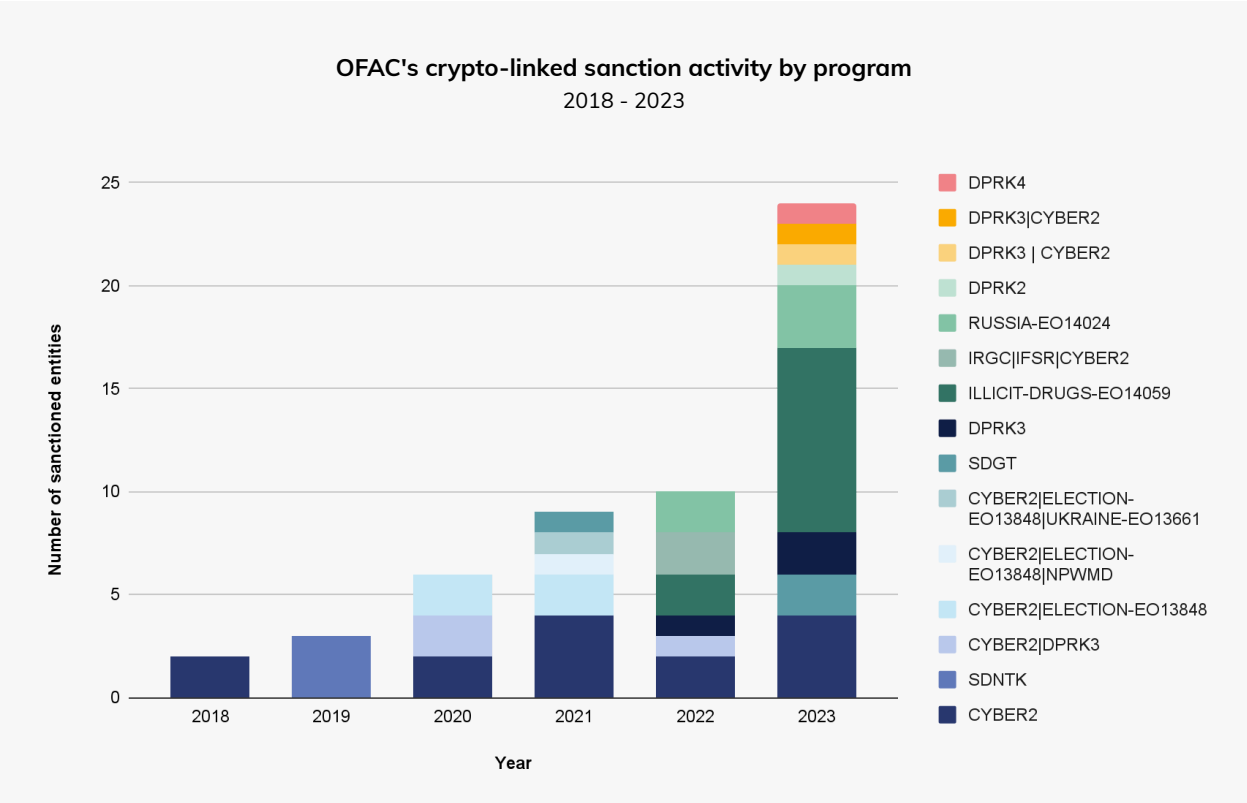
OFAC's crypto-linked sanctions by program

Since OFAC began including crypto addresses in its designations six years ago, it's worth examining the variety of sanctions programs on which it based these actions. Year to year, we can observe compositional changes in the types of sanctions OFAC has imposed according to these programs. Before we look at those trends, here are the programs where crypto has been included and any corresponding Executive Orders (EOs).

OFAC program name	Description
CYBER2	Malicious cyber threat actors, EO 13694 and EO 13757
DPRK2	Activity related to the Democratic People's Republic of Korea (DPRK), EO 13687
DPRK3	Activity related to DPRK, EO 13722
DPRK4	Activity related to DPRK, EO 13810
ELECTION-EO13848	Foreign actors interfering with US elections, EO 13848
IRGC/IFSR	Iranian actors/Iranian Financial Sanctions Regulations
ILLICIT-DRUGS	Foreign persons involved in global illicit drug trade, EO 14059
NPWMD	Weapons of mass destruction proliferators
RUSSIA-EO14024	Specified harmful activities of the Russian government, EO 14024
SDGT	Global terrorism
SDNTK	Foreign narcotics kingpin
UKRAINE-EO13661	Persons contributing to the situation in Ukraine, EO 13661

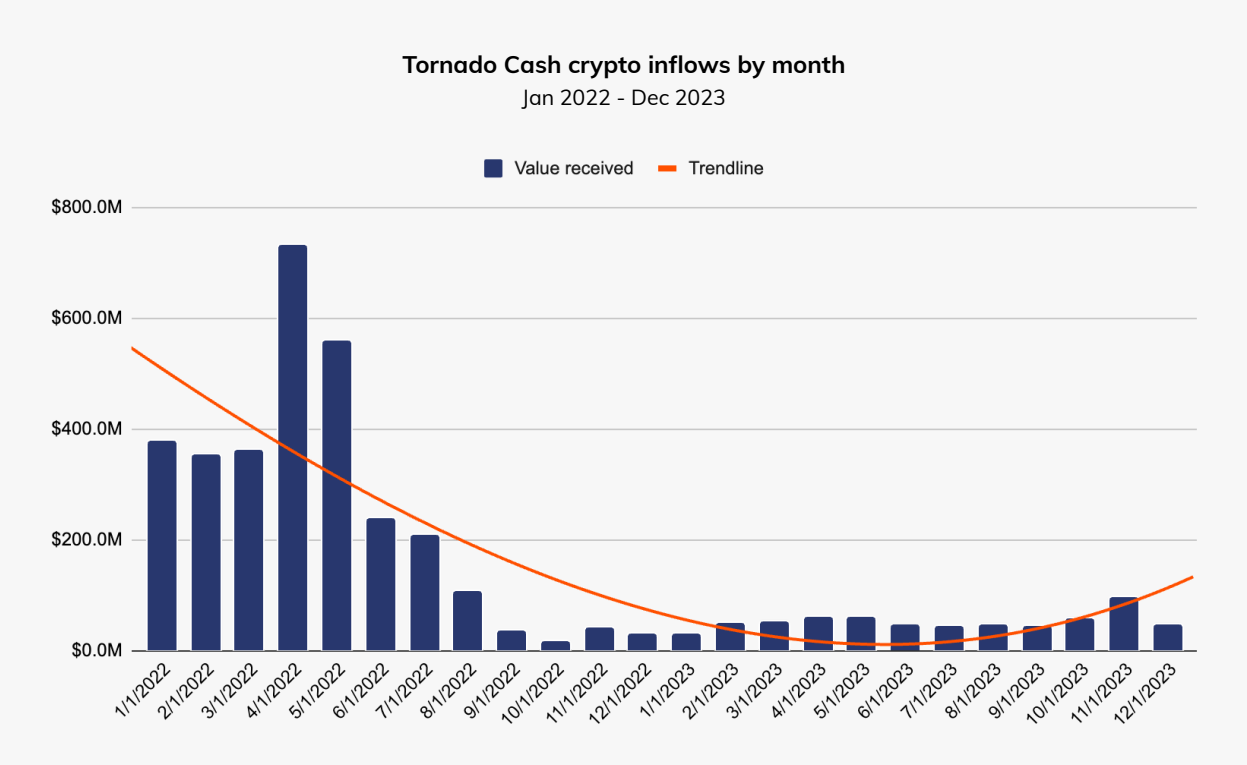
When looking at the history of OFAC's crypto-linked sanctions, we see an expansion in the programs it's employed since the first designation in 2018, starting with single programs in the first and second years, and branching out to several more in the years following. This highlights just how many sanctions programs have a cryptocurrency connection, underscoring the pervasive use of crypto by bad actors, and the steps the industry has taken to react to that.

In the chart below, we see that crypto-linked sanctions tied to OFAC's illicit drugs program increased substantially in 2023, with four times as many designations as 2022. Crypto-related sanctions against North Korea (DPRK2-4) also rose, as did designations against cybercriminals (CYBER2).



Tornado Cash inflows slowly rebound post-sanctioning

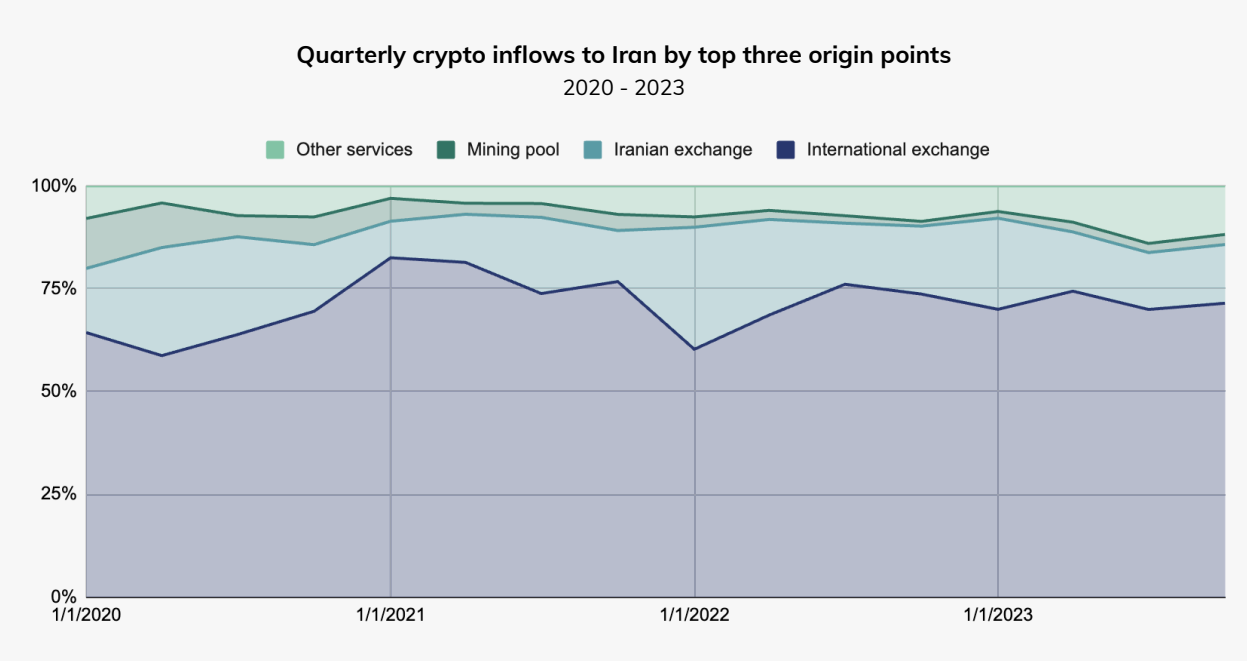
In August of 2022, Ethereum mixer Tornado Cash was sanctioned for its role in laundering over $455 million worth of cryptocurrency stolen by Lazarus Group. Despite this action and OFAC's delisting and redesignation of Tornado Cash that November, due to the decentralized nature of its operations, Tornado Cash could not physically be shut down. While on-chain data indicates that, relative to the pre-sanctions monthly average, the mixer's monthly inflows dropped by as much as 93% immediately following OFAC's designation, Tornado Cash inflows have since risen from that low by 28 percentage points, and the mixer has received a total of $822.0 million in crypto since the designation.



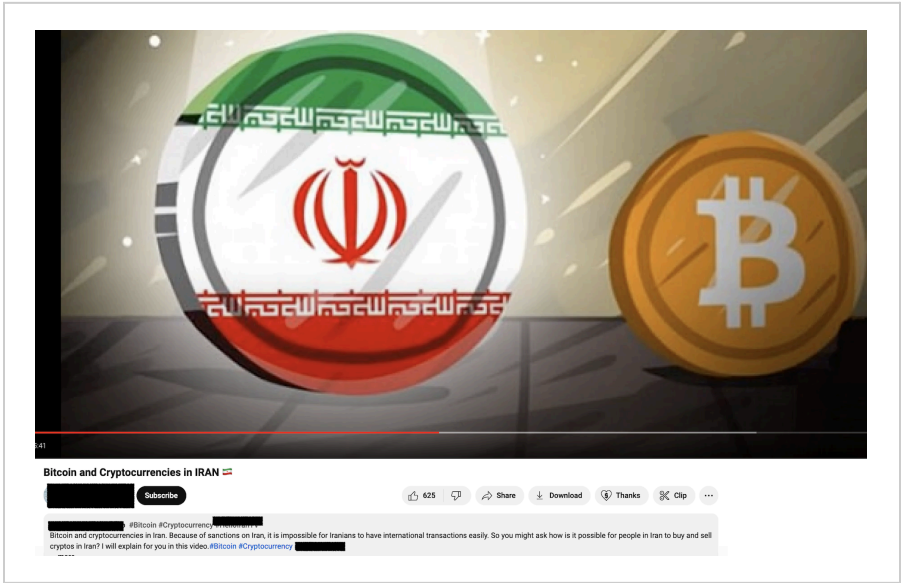
However, it's important to note that when looking at the comparable period prior to OFAC's designation, Tornado Cash processed over $7.6 billion in crypto, indicating that the sanctioning event has since reduced crypto sent to the mixer by 89.2%. It's still worth watching Tornado Cash as its continued activity in the last year highlights the challenge of enforcing sanctions on decentralized entities, while also demonstrating the efficacy of sanctions and reinforcing the need for regulation in the DeFi ecosystem.

Sources of crypto inflows to Iranian exchanges in 2023

Iran continues to be a major cryptocurrency adopter, with dozens of exchanges in the country processing billions of dollars in transactions, which begs the question: How is Iran using crypto? And how is it potentially using it to evade international sanctions? The following chart shows crypto inflows to Iran by source between 2020 and 2023.



In 2023, 73.3% inflows to Iranian exchanges came from international mainstream exchanges and could indicate that Iranian services are heavily used to facilitate transfer of value in and out of the country. With the broad-reaching international sanctions against Iran, crypto could be a mechanism used to evade detection. This is further evidenced by how-to videos regularly posted on social media platforms that explicitly detail ways for Iranian entities to skirt sanctions by using crypto. For example, one video description states, "Because of sanctions on Iran, it is impossible for Iranians to have international transactions easily. So you might ask how is it possible for people in Iran to buy and sell cryptos in Iran? I will explain for you in this video."



Screenshot of a video that claims to instruct Iranians on how to evade sanctions using crypto

Interestingly, the second largest counterpart to Iranian crypto exchanges is other Iranian crypto exchanges, at 17.1% of the total volume. This may indicate Iranians are also using crypto exchanges for either in-country transactions or to send funds amongst friends and relatives. Given the extreme volatility of the Iranian Rial, it's possible that Iranians are seeking other mechanisms to transfer value, which may account for Iran's relatively high ranking in the Chainalysis Global Crypto Adoption Index at 28th in the world.

The third largest counterpart to Iranian crypto services is mining pools, with 3.16% of the total volume across all assets and 29.1% of Bitcoin flows. Iran legalized cryptocurrency mining in 2019 and it's also the eighth largest oil producer in the world, with 4% of global oil production. Given the extensive sanctions against Iran and its access to affordable energy, experts have warned that Iran could use crypto mining as a revenue generation tool to mitigate the impact of global sanctions.

Considering this data, in the absence of access to traditional financial systems, Iranian exchange users may be leveraging licit services like the international mainstream exchange ecosystem to transfer and store value.

Recapping crypto-related sanctions in 2023

Crypto inflows to sanctioned entities and jurisdictions took the largest share of illicit inflows in 2023. This could be happening partly because entities in heavily sanctioned jurisdictions lack access to traditional financial systems and are attempting to use crypto to evade sanctions. It could also be because of the aforementioned challenges associated with enforcing sanctions against entities like Tornado Cash or Garantex. And though Tornado Cash couldn't be completely stopped after its designation, it's evident that OFAC's sanctions have substantially diminished the mixer's inflows. When looking at the increasing number of crypto-linked sanctions programs, it's apparent that as crypto adoption by illicit actors continues to grow, sanctioning bodies like OFAC are continually evolving their methods to identify these actors and disrupt their activities.

Terrorism Financing

Assessing Terrorism Financing On-chain is Crucial and Complex

The use of cryptocurrency by terrorist organizations represents a small share of illicit transactions in the cryptocurrency ecosystem, but it is an ever-present concern. At the same time, the inherent transparency and traceability of blockchain technology makes crypto a less favorable vehicle for terrorism financing.

The gravity of any funds contributing to terrorism, regardless of the amount, requires the utmost attention from the public and private sectors. The challenge of validating terror related activities in both fiat and cryptocurrency complicates efforts to draw clear estimates on overall volumes. Misinterpretation of crypto transaction data may result in unnecessary de-risking on the one hand, or non-compliance and increased risk of facilitating terrorism financing on the other. Furthermore, analyzing the flow of funds in this nuanced ecosystem without proper context can lead to inaccurate conclusions about the true scale of terrorism financing.

The situation is further complicated when considering the necessity of humanitarian aid in many jurisdictions that also present terrorism financing risk, primarily those in ongoing states of war. There's an ethical dilemma in potentially blocking legitimate humanitarian aid in efforts to curb terror financing. Blanket labeling of transactions as terrorist activities by private entities who lack the authority to make such designations can have far-reaching implications. A multifaceted approach incorporating not only intelligence, but also regulatory and ethical considerations with a commitment to factual accuracy and thorough verification is essential.

How terrorist organizations have used cryptocurrency

In this analysis of on-chain terrorism financing, we will focus on two primary mechanisms: complex organizational-level financial facilitation and small crowdfunding campaigns.

First, we look at groups like Hezbollah, known for their complex networks in traditional finance and their efforts to extend these operations with cryptocurrency. We review on-chain activity associated with Hezbollah, including their reliance on service providers and engagement with mainstream exchanges. Then, we examine a second, less sustainable method: crowdfunding, where terrorist organizations have only achieved limited success.

Exploring the financial networks of complex terrorist organizations

In June 2023, Israel's National Bureau for Counter Terror Financing (NBCTF) announced the first ever seizure of cryptocurrency linked to Hezbollah and Iran's Quds Force. This seizure, totaling about $1.7 million, targeted financial facilitator Tawfiq Muhammad Said Al-Law and the crypto wallet network he utilized to facilitate his activity. Al-Law is a Syria-based hawala operator who was involved in running Hezbollah's cryptocurrency infrastructure along with sanctioned senior Hezbollah members.

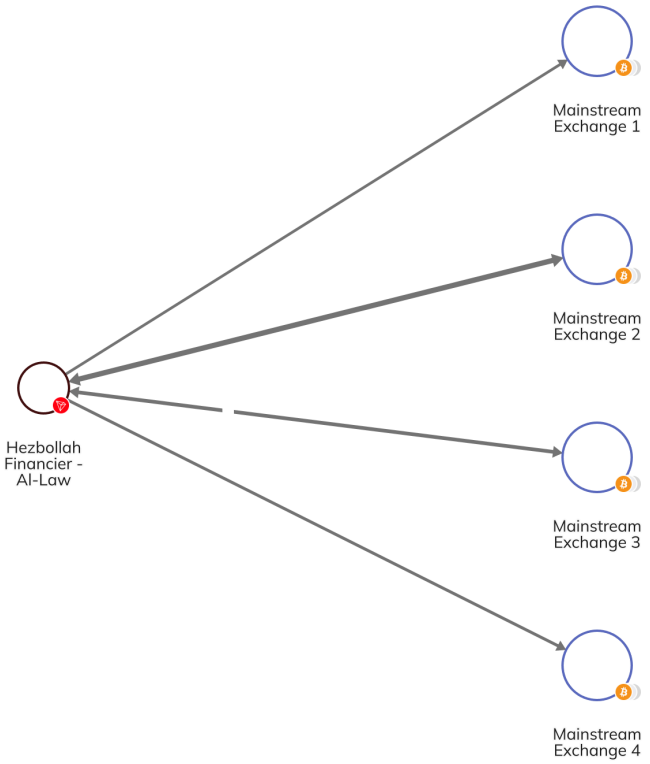
The NBCTF seizure provides a unique look at Hezbollah's cryptocurrency financing infrastructure, which uses a mix of service providers and mainstream exchanges, not unlike their traditional financial exploits. For groups like Hezbollah, service providers like money services businesses (MSBs) frequently emerge as key facilitators, processing financial transactions that exceed the scale of typical individual dealings but fall well below the activity of most cryptocurrency exchanges. These intermediaries vary widely in their operations, with some functioning similarly to over-the-counter (OTC) brokers, handling a significant volume of transactions. Others, like hawalas, operate on a smaller street-level scale.

The involvement of service providers that may facilitate illicit transactions introduces a significant obstacle. Calculating terrorism financing totals based on the flow of funds through these intermediary service providers significantly increases the risk of overestimating terrorism-related activities, as these services generally also process unrelated transactions carried out by everyday users with no illicit intent. A service that attracts illicit activity due to lax compliance practices would present a significantly different risk profile from one whose operators are actively facilitating on behalf of terrorist organizations or state sponsors of terror, like Iran. Although there are no confirmed on-chain instances of the latter case, that is not to say it cannot happen — it simply means they have not utilized known Iranian services to potentially facilitate this activity. Therefore, government agencies with access to off-chain intelligence are more likely to detect these activities, and can leverage blockchain analysis tools to further investigate these financial flows.

Complex organizations like Hezbollah have historically leveraged facilitators like Al-Law, who are not necessarily on sanctions lists or did not have clear open affiliation with Hezbollah, which makes it difficult for financial institutions and virtual asset service providers (VASPs) to effectively flag risks in both traditional finance and cryptocurrency. Their deliberate attempts to evade detection and sanctions mean that mainstream and regional service providers may inadvertently become exposed to these illicit networks.

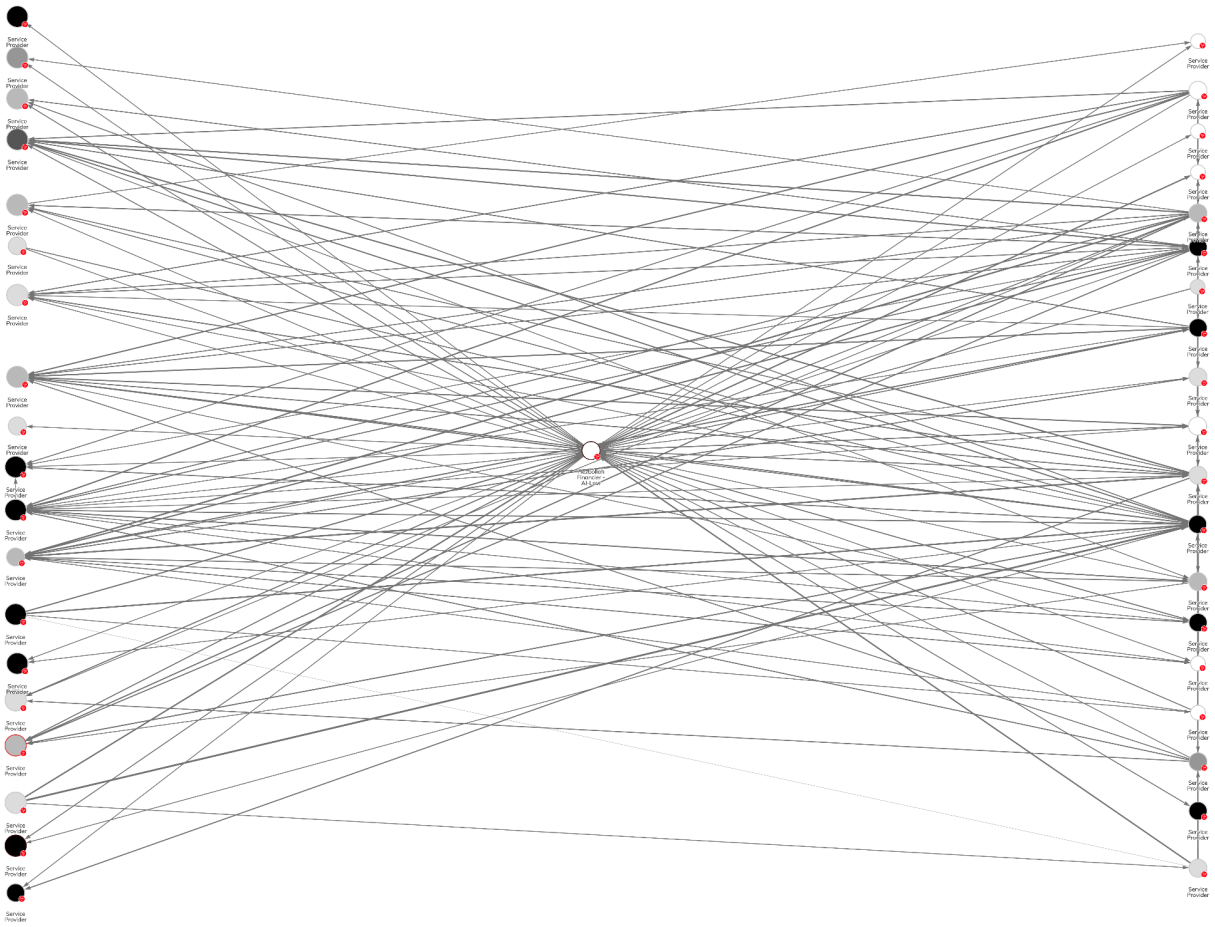
Al-Law used a network of legitimate mainstream exchanges, as well as other service providers, to facilitate the movement of his funds. Out of 904 total transfers made by the known Al-Law wallet in just under one year, 145 involved mainstream exchanges.

We can see some of this activity on-chain in the Chainalysis Reactor graph below.



Al-Law also employed an extensive network of wallets beyond mainstream exchanges for cryptocurrency transactions. These wallets collectively received funds ranging from millions to over $1 billion in cryptocurrency, involving hundreds to tens of thousands of transfers separate from those with Al-Law. This suggests the potential involvement of service providers. Whether these service providers are aware or not, their involvement in terrorist financing activities can contribute to a complex web used by terrorist organizations to deliberately conceal the source, destination, and purpose of the transactions.

The Chainalysis Reactor graph below highlights Al-Law's usage of a complex network of potential service providers:



Financially astute terrorist organizations may attempt to leverage more intricate networks to evade detection. This includes the use of OTCs, hawalas, smaller informal exchanges, and even mainstream services. The transparent nature of public blockchains, combined with blockchain analysis tools, can provide unparalleled insights into the on-chain activity of major terrorism networks. When terrorists use cryptocurrency, transactions are traceable across public ledgers, making it possible to follow the flow of funds with a level of detail not typically available with traditional financial avenues. Investigators can decipher and map the intricate financial maneuvers of these organizations, identifying tactics of crypto movement and management.

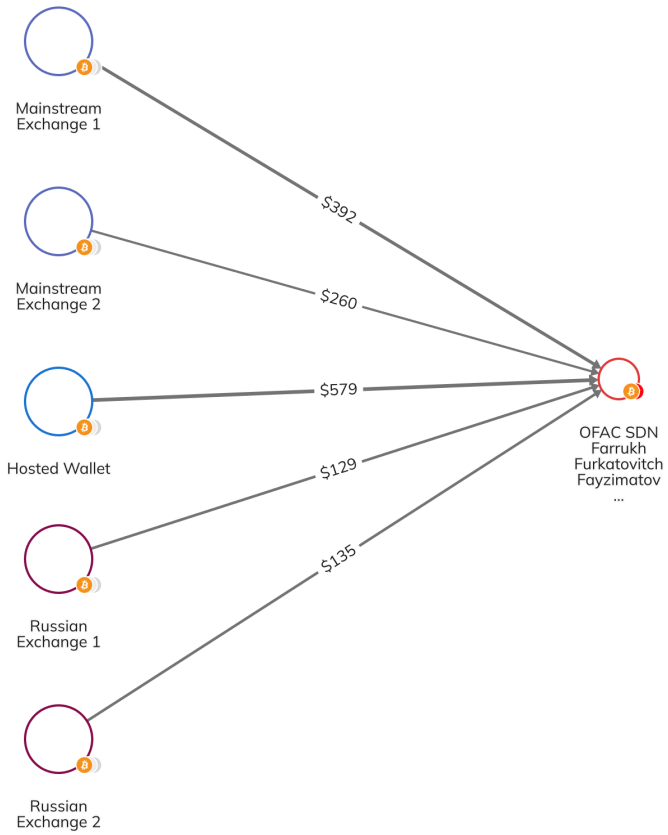
How small-scale crowdfunding campaigns subsidize terror activity

Public donation campaigns are less sophisticated than the elaborate financial networks of some terrorist groups. These campaigns are typically run under the guise of charities or crowdfunding, which have generally proven to be less effective over time. The public nature of these efforts, paired with the

transparency and immutability of the blockchain, make social media campaigns for known terrorist organizations a challenging fundraising method. Last year, Al-Qassam Brigades (AQB), the military wing of Hamas, announced their decision to stop accepting crypto donations, due to the risk of prosecution for potential donors.

Despite these obstacles, terrorist organizations continue to turn to social media to solicit donations. Consider the case of Farrukh Furkatovitch Fayzimatov, a Tajik national and Syria-based fundraiser and recruiter for Hay'at Tahrir Al-Sham (HTS) — a designated terrorist organization. The Office of Foreign Assets Control (OFAC) sanctioned Fayzimatov in 2021 for using social media to disperse propaganda and solicit donations on behalf of HTS, which included a specific bitcoin address in this designation. Nevertheless, Fayzimatov continues to create new crypto addresses in various currencies since his designation, amassing over $12,000 from various counterparts. These funds include small contributions from mainstream exchanges, hosted wallets, and even Russian exchanges without Know Your Customer (KYC) processes.

We can see some of this activity on the Chainalysis Reactor graph below.

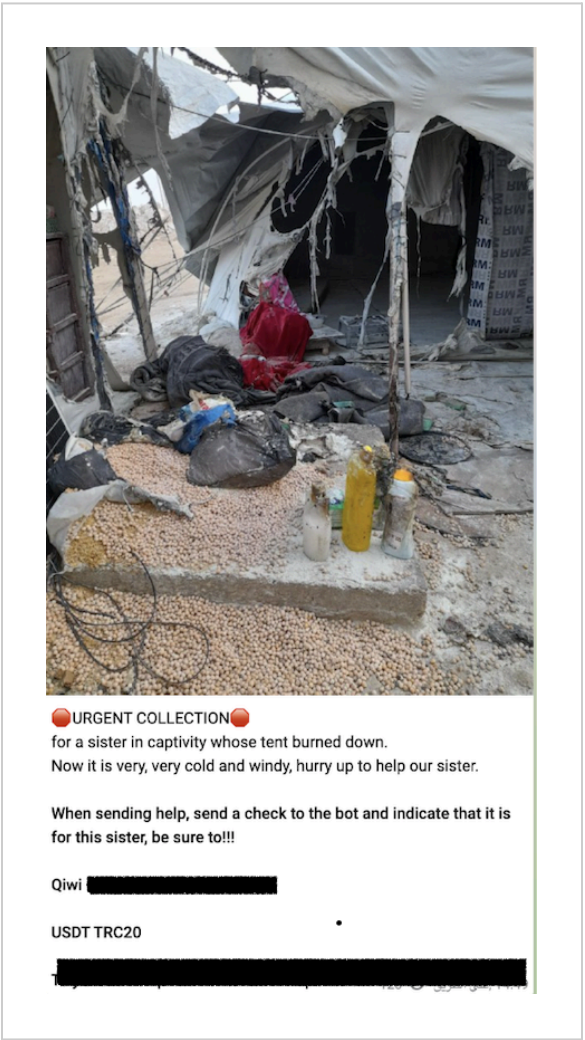


The case of Fayzimatov is more clear-cut due to his official sanctions designation, but distinguishing between terror financing and legitimate humanitarian efforts is often challenging, particularly in war-torn regions. To help address this, OFAC issued an advisory clarifying the provision of permissible humanitarian

support to Syria in August of 2023. A risk remains, however, that terrorist organizations might exploit the nuance of general licenses to raise funds under the veil of legitimate charity.

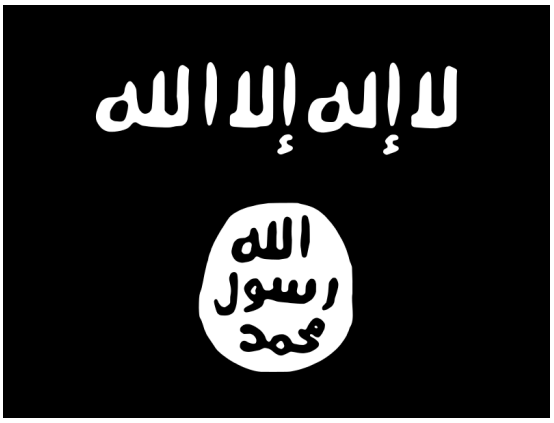
Chainalysis has observed efforts by militant and pro-ISIS social media accounts to raise funds, including via cryptocurrency. These fundraising campaigns frequently purport to be gathering humanitarian aid, often focusing on the well-known al-Hol and al-Roj detainment camps. They emphasize the plight of imprisoned women and children, leveraging narratives of neglect, abuse, and poor conditions in these camps to gain legitimacy and bolster fundraising. Cases such as these, in which legitimate humanitarian concerns mesh with extreme ideology and lack of accountability as to the ultimate destination of all funds raised, present significant analytic and ethical quandaries.

Some of the al-Hol and al-Roj fundraising channels are fairly circumspect regarding their ideology, focusing entirely on daily life in the camps and humanitarian needs. Below is a machine translation of an example fundraising post:



A fundraising channel focusing on humanitarian aid

However, other donation channels are more explicit regarding their ideology and show higher levels of operational security, including fundraising campaigns in which prospective donors must contact the channel administrator directly. The below post from a separate donation channel shows concerning imagery (left), with text evoking the ISIS flag (right):



!Do not be careless about the status of your sisters
MashaAllah a sister, May Allah reward her well, has made a donation to her imprisoned sisters in debt, but the amount has not !been completed
If everyone who can afford it can send 10$, we will reach the .amount of promissory note
Wallahi do not neglect even a good deed , we do not know what !deed will lead us to paradise

!О Уммати 🚫

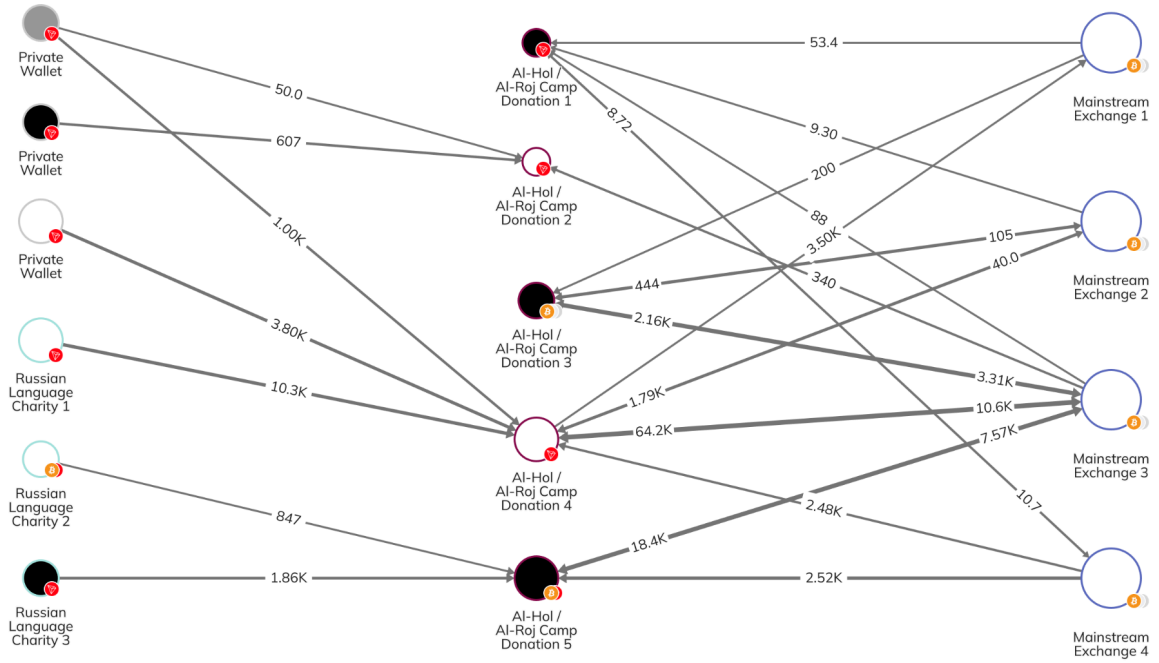
!Не будь беспечной в отношении положения своих сестер
Машааллах, сестра, да вознаградит ее Аллах, сделала пожертвование для своих сестер асират, у которых есть долги, !но сумма не полная
Если каждый, кто может себе это позволить, сможет .отправить 10 $, мы получим сумму в два раза больше
Валлахи, не пренебрегайте даже одним добрым делом, мы не !знаем, какое действие приведет нас в рай

اتصل للمساعدة: [redacted]

Contact for donation: [redacted]

This donation channel shows more signs of possible links to extremist ideology

As seen in the Chainalysis Reactor graph below, al-Hol and al-Roj camp crypto donation campaigns are becoming more commonplace, receiving funds from a variety of sources including mainstream exchanges, Russian language charities, and other private wallets.



Distinguishing between legitimate humanitarian aid and terrorist financing becomes more challenging for the private sector, especially when considering the analysis to make a decision of whether to block funds and de-risk, or to allow the transfer, based solely on details from social media donation campaigns. These social media accounts often have minimal identifying information about the operator or ultimate use of all funds raised.

The challenge lies in distinguishing legitimate humanitarian aid, such as fundraising for disasters like the Syria/Turkey earthquakes last year, and fundraising that might inadvertently support terrorism-related activities. Monitoring these broad donation networks to ensure funds are used appropriately is difficult, underscoring the risk of mistakenly labeling all such contributions as terrorism related, which could hinder much-needed humanitarian aid. In response, OFAC issued another compliance advisory in November of 2023 to provide guidance around the provision of aid to the Palestinian people, similar to the one issued for Syria. This issue has gained urgency as the conflict between Israel and Hamas intensifies, balancing dire humanitarian needs against the risks of terror financing.

The difficulties of identifying and combating complex terrorism financing networks on-chain are both intricate and high-stakes. How does one define the line between legitimate financial transactions and those that are tied to terrorism? Who holds the authority to draw this crucial line, and how do we account for the nuances that often blur it?

Collaboration between the private and public sectors to combat terrorism financing

Contrary to common belief, cryptocurrency is not a widely used or effective tool for terrorism funding due to its transparency, traceability, and immutability. Nonetheless, even small amounts of funds sent to terrorists can have devastating consequences.

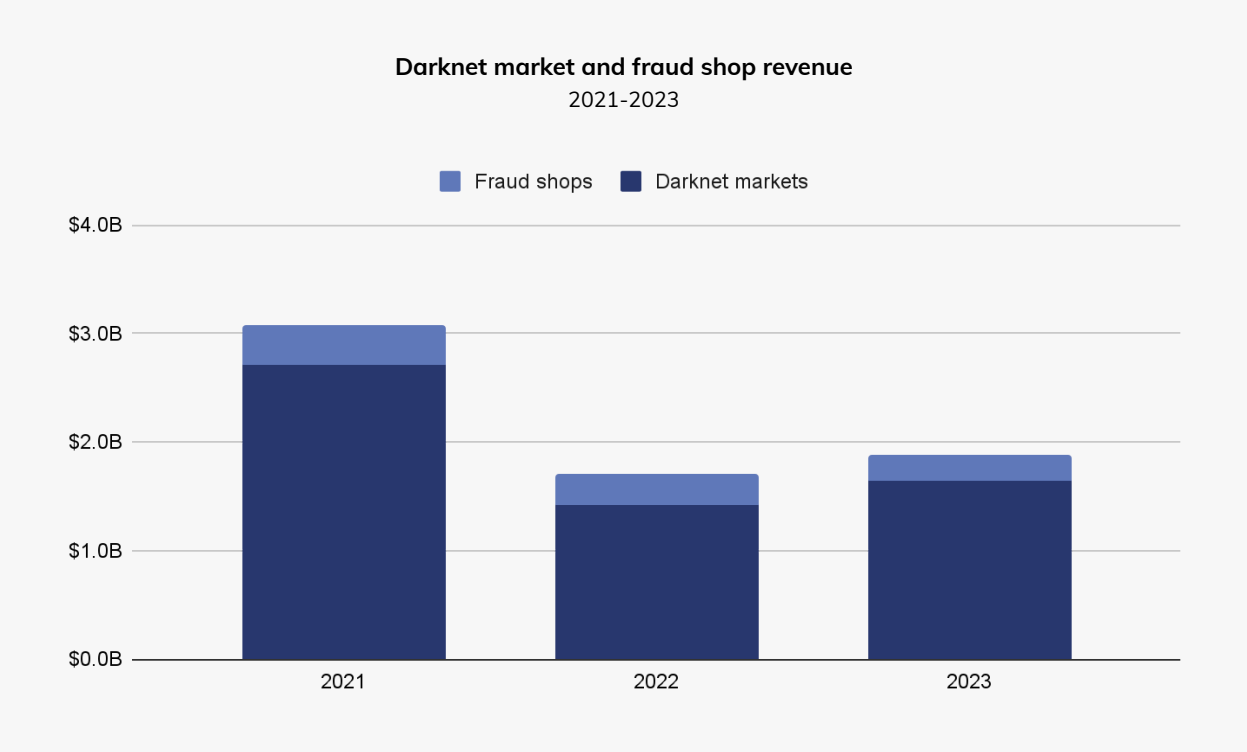
Public-private partnerships play a fundamental role in identifying, analyzing, and validating potential terrorist financing risks. Absent this collaboration, private sector firms struggle to make informed, risk-based decisions, which could result in either mistakenly blocking legitimate funds or inadvertently allowing funds to reach the hands of terrorists. Bridging this gap requires cooperation between public and private sectors, with financial institutions, exchanges, and blockchain analytics companies contributing to lead generation and insight sharing. Additionally, the public sector's communication around campaigns with potential terrorist financing risks is critical. Such cooperation ensures that the financial ecosystem does not inadvertently support terrorism, while also facilitating the flow of legitimate, critical humanitarian aid to its intended recipients.

These efforts have already resulted in the seizure of funds from groups like Hamas and Hezbollah, demonstrating that it is possible to deconstruct and disrupt financial infrastructure supporting terrorism. However, identifying terrorism financing on the blockchain is a complex, high-stakes task that requires a nuanced approach, clear delineation, and ongoing collaboration between the public and private sectors.

Darknet Markets

Darknet Market Revenues rise as Markets Develop Role Specialization

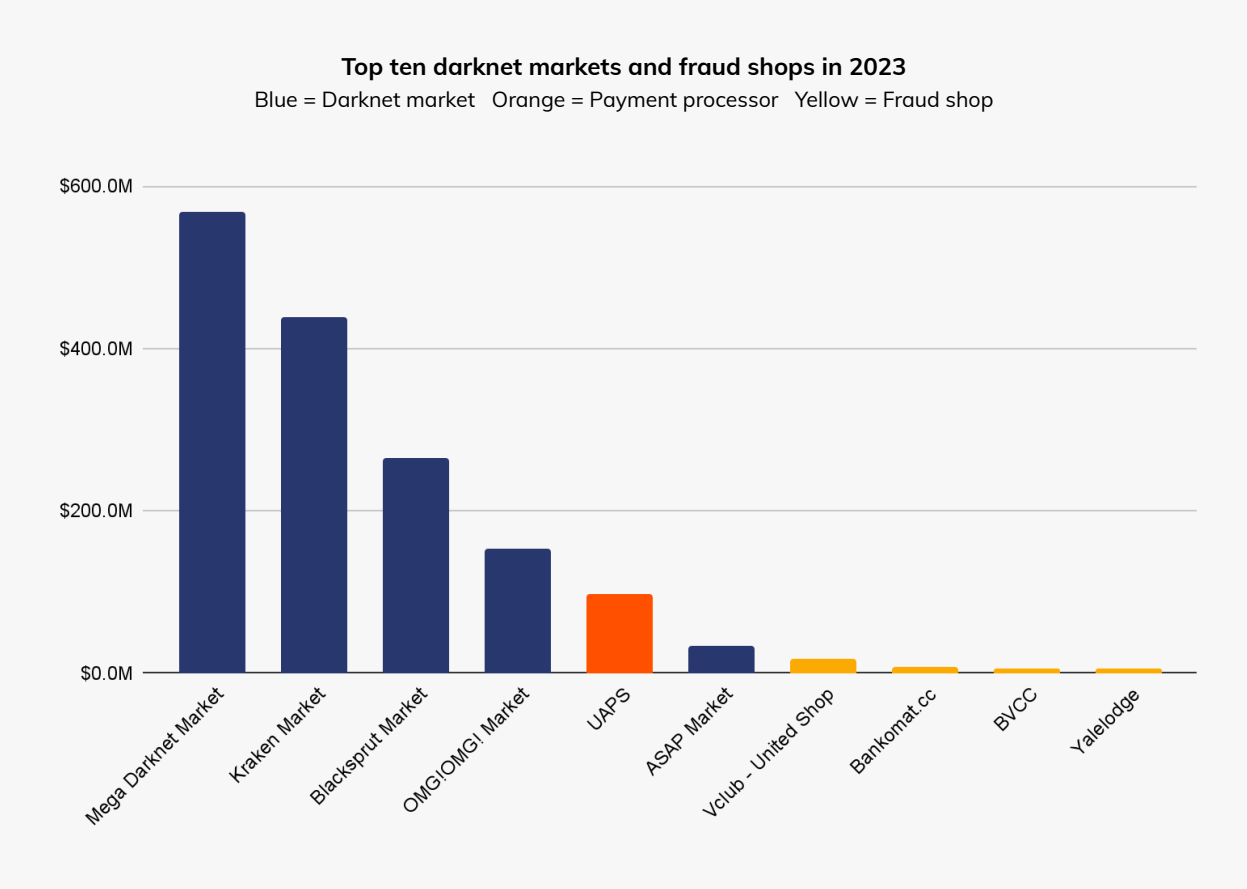
As discussed at the outset of our report, darknet markets were one of two categories of crypto crime that saw revenues rise in 2023. In total, darknet markets and fraud shops received $1.7 billion last year, a rebound from 2022 — the year that saw the sizable Hydra Marketplace close. The ensuing war for darknet market dominance that began in 2022 continued into 2023, but no other market has since matched Hydra's financial success. We'll discuss theories as to why, and other darknet market trends here.



The chart above shows that, while values haven't risen back to 2021 levels, darknet market revenue has slightly rebounded since Hydra's closure in 2022.

The continuing battle for darknet market dominance

In terms of individual market success, Mega Darknet Market led the pack with over half a billion in crypto inflows, and Kraken Market (not to be confused with the popular cryptocurrency exchange Kraken) in particular gained prominence among Russian darknet markets, as shown on the following chart. Blacksprut and OMG!OMG!, markets that jockeyed for position in the wake of Hydra's closure, are still top players in the darknet market ecosystem.



In recent years, some darknet markets and fraud shops have been integrating crypto payment processors on their websites via APIs, possibly as a way to improve operational efficiency and increase security. Essentially, these payment processors provide a white label service for darknet markets and fraud shops, and a seamless checkout experience for those services' customers. UAPS, shown in the chart above, is one such example of a payment processor that many fraud shops, including the OFAC-designated Genesis Market, used in 2023. The value received by UAPS in this chart includes payments sent to multiple fraud shops using the service as a payment processor.

Another newer trend: Darknet markets that employed brazen marketing tactics in 2022 appeared to gain a competitive edge in 2023. Take Kraken Market for instance, which opened in 2022 and bills itself as Hydra's successor. As a way to tease its impending launch, in the fall of 2022, Kraken Market employed an immersive 3D billboard in Moscow containing an animated kraken.

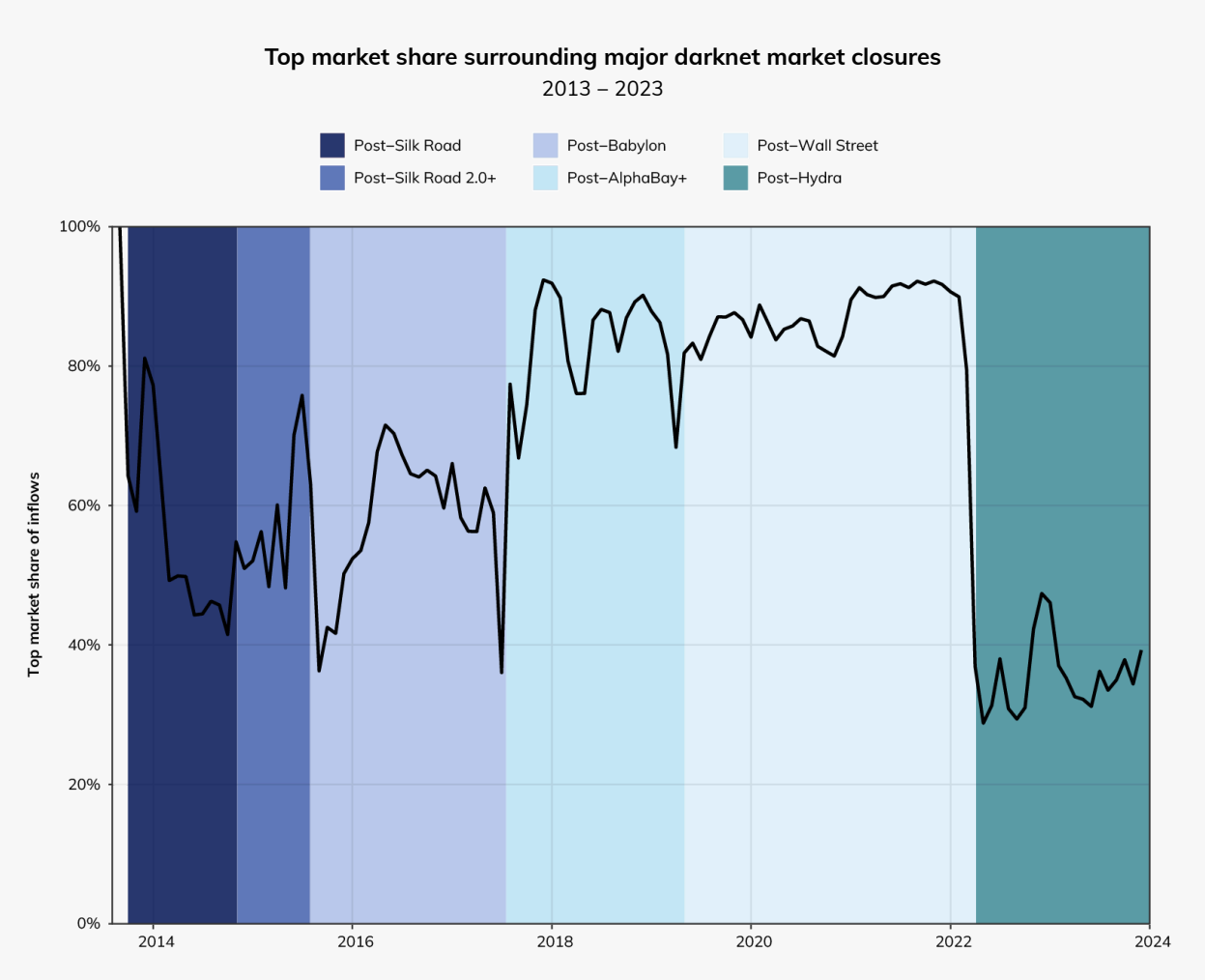
Kraken Market's immersive 3D billboard in Moscow. Source: Lenta.ru

And, perhaps the most aggressive marketing stunt the darknet market ecosystem has seen yet, in December of that year, Kraken Market wrapped a bus in an advertisement that included a QR code for the market's website. The bus blocked two traffic lanes on a road near Russia's Ministry of Foreign Affairs before security forces removed it an hour later.

On a smaller scale, Mega Darknet Market placed a few ads with QR codes in public places like Moscow subway trains. While tactics like these may have helped boost revenue for both markets, again, they have yet to match Hydra's sizable financial success.

Darknet market services show fragmentation in 2023

Throughout the history of the darknet market ecosystem, at different turns one marketplace has typically played the dominant role. The last several years' examples include Silk Road, AlphaBay, Wall Street Market, and Hydra, most recently. Historically, as law enforcement closed each dominant marketplace, a new leader emerged. We can see this pattern on the following chart, which shows the level of market share controlled by the dominant market of each epoch. The recovery pattern is fairly consistent until the Hydra Marketplace closure, after which no dominant darknet market emerged.



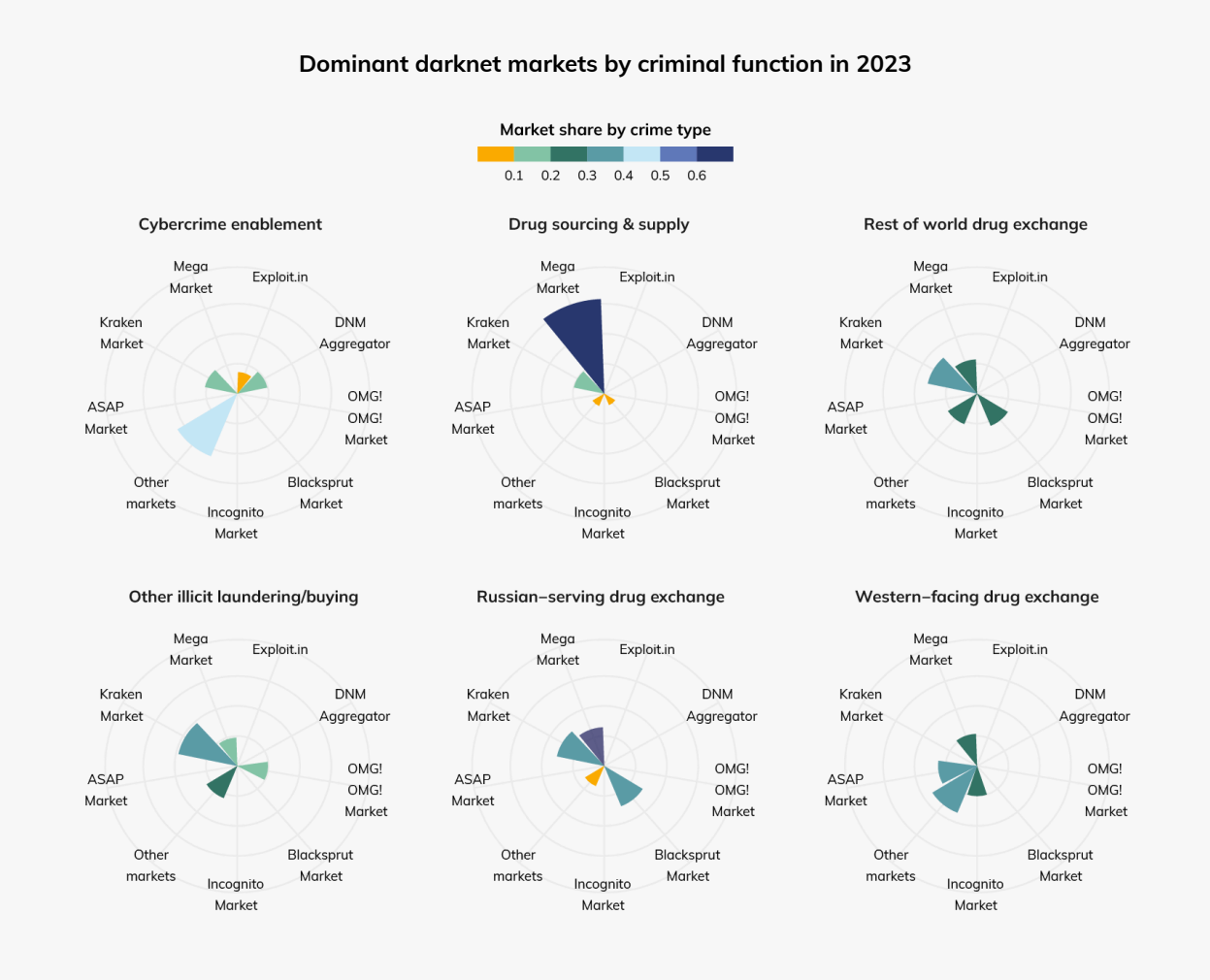
Darknet market role specialization provides one possible explanation as to why the ecosystem has yet to see a dominant player.

Darknet markets differentiate themselves by unique service offering

Historically, darknet markets have been heavily associated with illicit drug trade, a reputation that Silk Road played a significant role in creating. However, over the years some markets have evolved beyond this capacity to develop a robust catalog of illicit services like money laundering, fiat offramping, and products that enable cybercriminal activities like ransomware and malware attacks. One such sophisticated darknet market, Hydra, offered all that and more.

By contrast, it appears today's darknet markets largely serve specific niches and have individually organized themselves into unique criminal functions, which we determined when examining the origin points for darknet market inflows last year. As such, the chart below illustrates darknet market share by crime type based on the following categories:

- **Cybercriminal enablement.** Darknet market services related to ransomware, malware, stolen funds, and other types of cybercrime. Enablement could include root kits, access to personally identifiable information (PII), and potentially, offramping for stolen funds.
- **Drug sourcing and supply.** Online pharmacies or darknet markets that sell drugs to vendors on other darknet markets.
- **Other illicit laundering/buying.** Transfers made to darknet markets for the purpose of obfuscating on-chain activity or purchasing illegal products.
- **Rest of world drug exchange.** Drug purchases made on darknet markets serving a global customer base, as opposed to primarily a Western or Russian customer base.
- **Russian-serving drug exchange.** Drug purchases made on darknet markets by customers based in Russia.
- **Western-facing drug exchange.** Drug purchases made on darknet markets by customers generally based in the United States and Western Europe.



The categorization in the chart above is based on origin points. Cybercrime enablement represents flows from ransomware, stolen funds, malware, or fraud shops to darknet markets.

Drug-related revenue comes from sources like exchanges. Western drug flows in particular come from US-domiciled exchanges and trace flows from those to darknet markets. The entity “DNM Aggregator” that appears within each category refers to a service we’ve identified as being in control of multiple, disparate darknet markets.

When it comes to cybercriminal enablement, markets like Kraken Market, the DNM Aggregator, and Exploit.in are go-to services, providing bad actors with tools to carry out ransomware attacks, hacks, and more. Kraken Market also captured the largest share of transfers potentially sent for the purpose of obfuscating funds, as well as buying illegal products. In addition to that activity, markets like these host vendors that advertise their own cashout or swapping services, resulting in tens of millions of dollars in laundered funds.

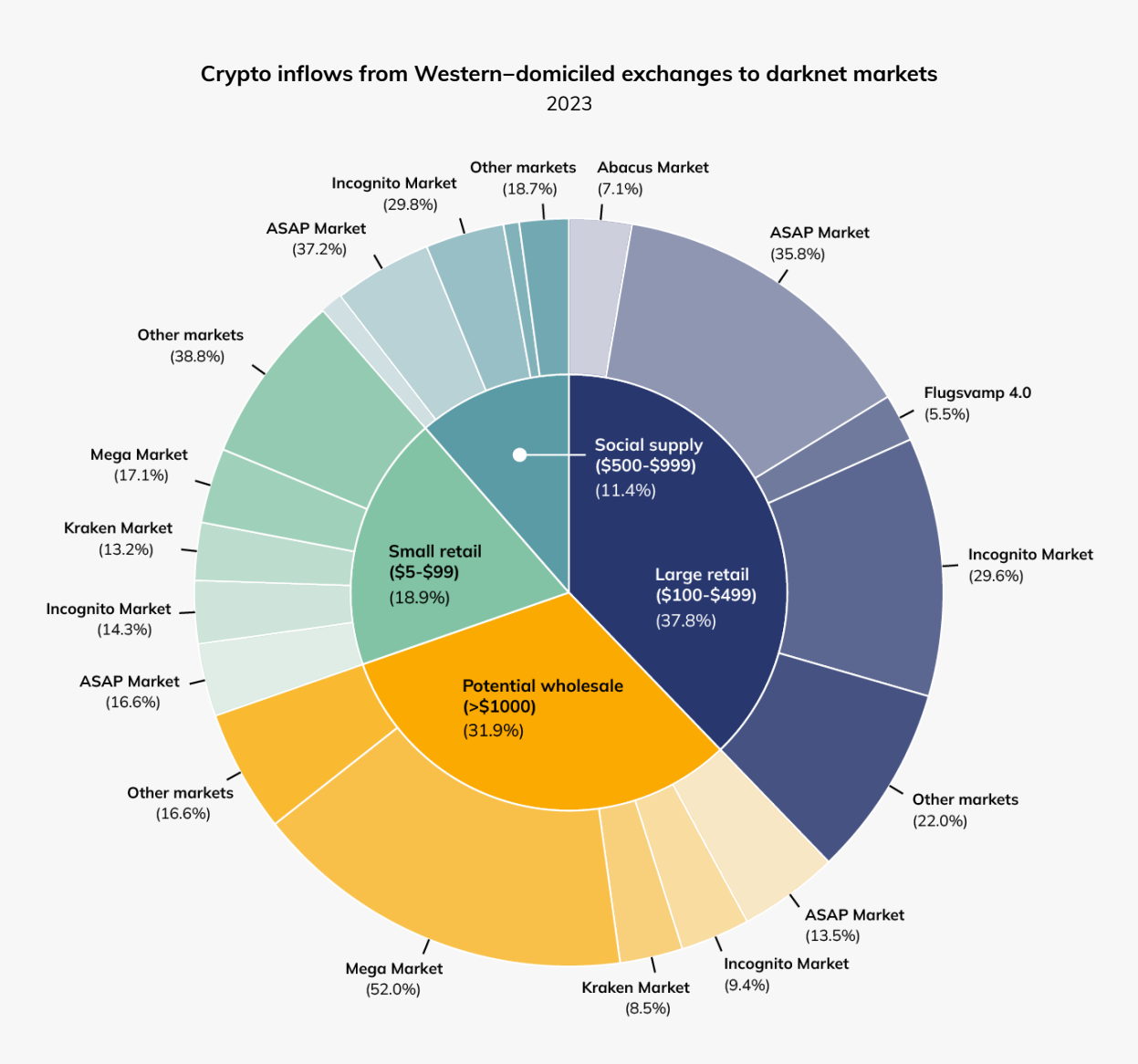
Mega Darknet Market is the dominant drug supply source for drug vendors on other darknet sites, holding a 63.4% share of that market. When looking at darknet drug markets serving Russia-based customers, Kraken Market captured 30.9% of market share, with Blacksprut and Mega Darknet markets closely following. As for drug markets serving Western customers, ASAP Market held a 25.0% share, followed by Mega and Incognito.

Darknet market revenue based on drug-purchasing behaviors

When looking at 2023 drug-purchasing habits for customers from exchanges primarily serving users in North America and Western Europe, the data indicate that just two markets played dominant roles across drug purchase types, while most captured smaller, fragmented shares of total revenue received.

Here are category definitions for the chart below. Keep in mind that these categories are based solely on purchase sizes, which we use to make assumptions about their likely purpose.

- **Small retail.** Purchases of less than $100, likely made for personal consumption.
- **Large retail.** Purchases between $100 and $500, likely made for personal consumption.
- **Social supply.** Purchases between $500 and $1,000, which indicate customers may be sharing drugs with other third parties in social settings.
- **Potential wholesale.** Purchases over $1,000, more likely to be made by drug sellers and distributors.



The chart above shows that ASAP and Mega Darknet markets led the large retail and wholesale segments respectively. Looking closer at ASAP Market inflows, it won some share of revenue across all drug purchase types, receiving 37.1% of social supply, 35.7% of large retail, 16.5% of small retail, and 13.5% of wholesale purchases.

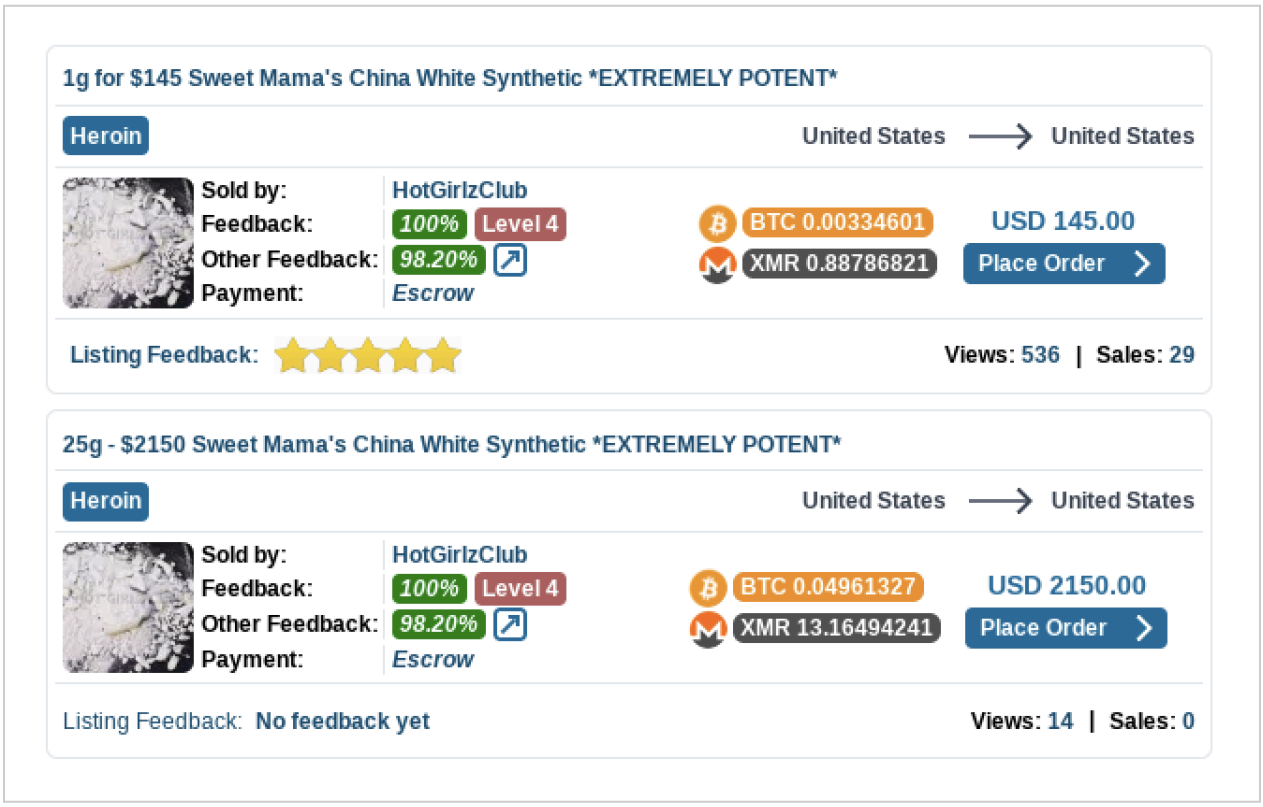
Though Mega Darknet Market typically serves a Russian customer base, the drug revenue shown in the chart above likely came from customers based in Europe. Mega clearly dominated the realm of wholesale drug purchases, capturing 51.9% of that segment.

Fentanyl sales in darknet markets

Despite most darknet markets banning the sale of fentanyl in their terms of service, nearly all mainstream Western-facing markets have vendors that sell fentanyl-laced products. While it received a relatively small

share of large retail purchases as shown in the previous chart, Abacus Market is one such example. Though many customers are concentrated in Australia, Abacus has vendors and customers around the world, including the United States.

Customer reviews found on the Abacus site indicate that some of its American vendors sell drug products laced with fentanyl. Additionally, vendors found on Abacus and many top Western-facing markets sell an analog of fentanyl called a-Methylfentanyl — colloquially known as "China White." According to the Universal Journal of Clinical Medicine, drug researchers believe that this analog is the product of contamination during important parts of the fentanyl synthesis process, and is sold for its powerful effects, which can be up to 300 times more potent than morphine. It has appeared in overdose deaths in recent years.



U.S.-based drug vendors on Abacus Market advertising a synthetic opioid called China White, which its customers can purchase using Bitcoin or Monero.

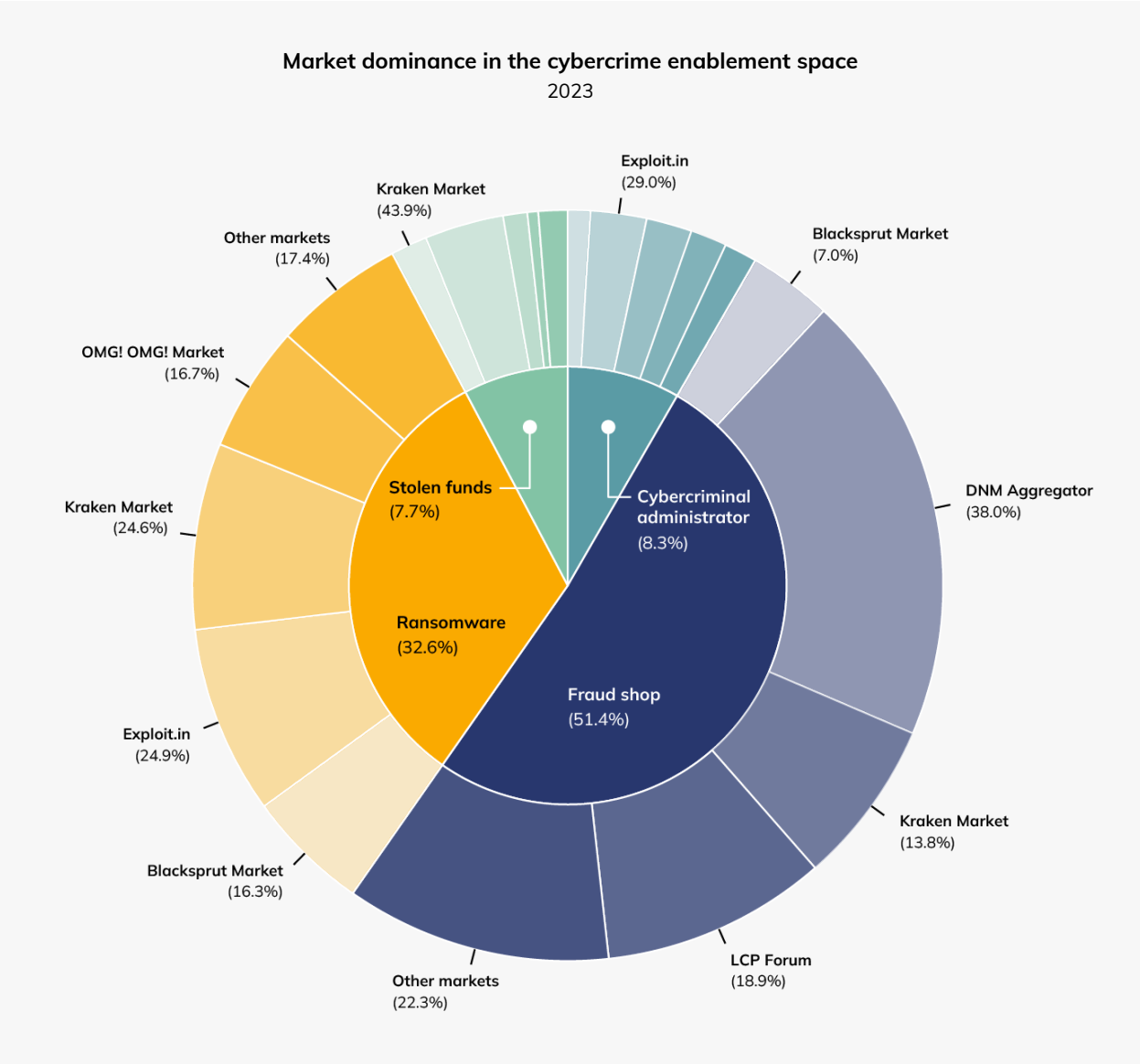
Another darknet market known for facilitating fentanyl sales to the United States was Canada-based AlphaBay. A once-sizable illicit enterprise that began in 2014, AlphaBay was closed by authorities in 2017 and then reopened in 2021. The last version of the market operated until February of 2023, and a month after that closure, a former AlphaBay vendor pled guilty to distributing fentanyl that caused fatal overdoses in Oregon.

Fentanyl and fentanyl-laced drugs also arrive in the United States through Latin America based cartels. U.S. customers predominantly purchase drugs from these groups that are known to have used crypto to

source fentanyl precursor chemicals from labs based in China. The cartels then use those chemicals to manufacture fentanyl that is later sold in the U.S.

Crime forums and markets specializing in cybercrime enablement

Much like with drug sales, a similar pattern of task differentiation emerged among darknet markets providing cybercriminal services. In the chart below, we see that the DNM Aggregator emerged as the clear leader among fraud shops enabling cybercrime, and Exploit.in and Kraken Market almost equally sold tools used to facilitate ransomware attacks. Kraken Market also received the largest share of stolen funds. As for cybercriminal administration, the category includes inflows from ransomware affiliate wallets. This includes purchases such as malicious software and supporting services which cybercriminals sometimes make using escrow services on crime forums.



Dutch National Police share depth and sophistication of Genesis Market identity theft operation

Fraud shops are vendors that typically operate on the dark web and facilitate the sale of stolen data and personally identifiable information (PII), which cybercriminals abuse in illicit activities like scamming, identity theft, and ransomware. One fraud shop that provided services like these, Genesis Market, saw its end last April after a coordinated, international law enforcement effort called Operation Cookie Monster closed it down, and OFAC sanctioned it.

Though it's common for fraud shops to operate on the dark web, Genesis Market was accessible on the clearnet via Google search, and simply required an invitation code to create an account. This ease of access attracted a new breed of criminals not typically associated with cybercrime. To them and others, Genesis sold forms of stolen PII like credentials for email and social media accounts, as well bank accounts and crypto service accounts, and in its lifetime received tens of millions of dollars in crypto, mostly Bitcoin.

For a fraud shop, Genesis Market demonstrated an unusual level of sophistication by offering Impersonation-as-a-Service (IMPaaS), meaning robust "online fingerprints" of victims rather than just their credentials for individual services; Genesis' IMPaaS packages included access to victims' browser cookies, which allowed cybercriminals to circumvent two-factor authentication (2FA) and wreak havoc with victims' accounts.

We spoke with Ruben van Well, Chief Inspector of Team Cybercrime Rotterdam from the Dutch National Police, to learn about their involvement in the Genesis Market case, and how the Genesis operation worked.

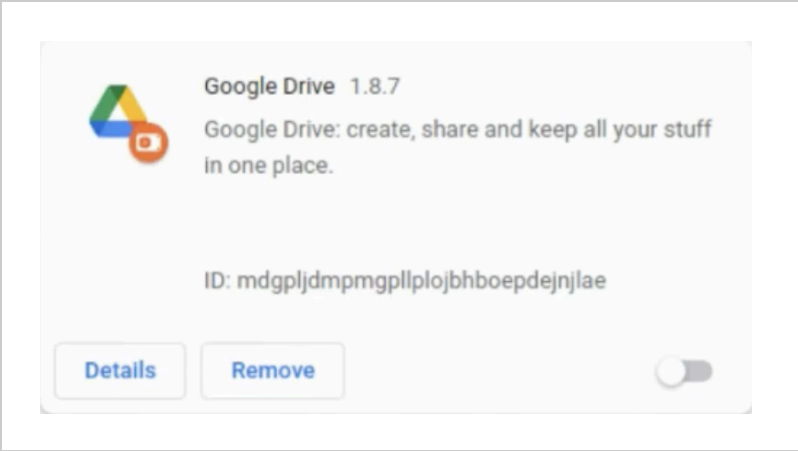
How Genesis Market stole the identity of over 2 million victims worldwide

In 2019, the FBI started its investigation into Genesis Market and enlisted other government agencies and law enforcement organizations across the world, working towards the market's closure on April 4, 2023. As part of the investigation, the Dutch National Police took the lead on cybercrime prevention, and Van Well shared his insight on the sophistication of the fraud shop's operation.

In order to gain control of victims' computers, the malware Genesis Market employed used a legacy Bitcoin address to determine the command-and-control (C2) server, from which cybercriminals initiated remote access to infected devices.

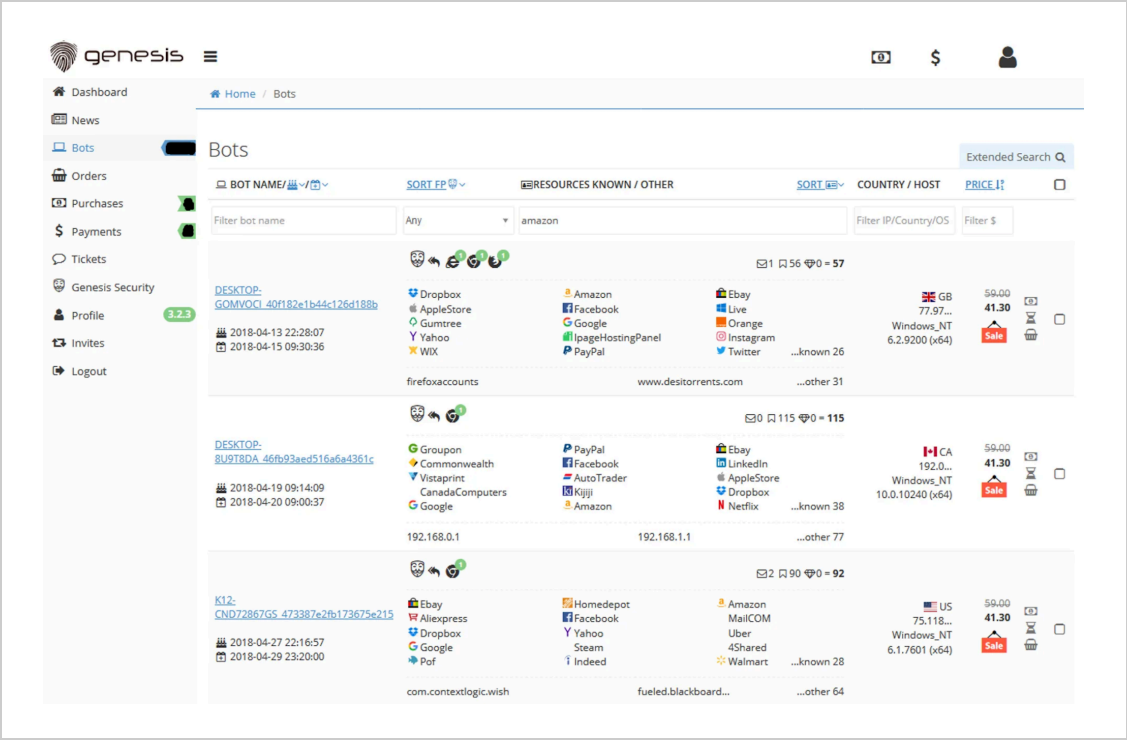
The legacy Bitcoin address pivotal to the malware side of the Genesis operation

The information-stealing malware package that Genesis Market used to exploit victims included a hidden Chromium-based browser plugin, made to look like a Google Drive plug-in, which captured credentials stored in victims' browsers.



Hidden browser which captured credentials stored in victims' browsers

As it retrieved data from malware-infected computers, Genesis sold victims' online footprints — which it called "bots" — on its market. Each bot represented a compromised computer or device and the credentials associated with its owner. While it operated, Genesis Market sold 1.6 million bots. On the fraud shop's website, cybercriminals could comb through hundreds of thousands of bots on its robust user interface (UI), filtering results by criteria like country or searching for credentials tied to a particular domain name. The UI showed how many logins and what accounts each bot contained; the more logins provided, the more expensive the bot, especially when it included bank or crypto account credentials. The UI also showed when the victim's device was infected by the malware and when it was last updated, and Genesis provided customers with a wiki on how to abuse victims' credentials.



A page on the former Genesis Market showing bots (i.e., victims' profiles) for sale. Source: ZDNet

One of its most insidious innovations — the Genesium browser — was a browser plugin that Genesis built for its customers to use. Any time the information-stealing malware detected changes to a victim's passwords or a new account, it would update the Genesium browser with the latest credentials. In addition to stealing logins, the malware scraped browser cookies, granting cybercriminals control over session cookies which helped them mimic victims' computers. Since many website cookies persist for 30 days, criminals were often able to evade 2FA processes.

"This made Genesis Market extremely dangerous because they had their hands on a lot of credentials but they could also impersonate the victim online," says Van Well. "We saw bank accounts and crypto wallets being cleared, as well as identity being misused to open new accounts. We saw goods being bought from online shops, and a variety of cybercrime, which was all related to Genesis Market."

In one particularly devastating case, a man lost his entire $80,000 pension. Using his credentials, cybercriminals committed a variety of online fraud activity over the course of six months. Given the tooling's ability to capture new password updates, the perpetrators could easily maintain control over his accounts, and they opened bank accounts in his name and had his physical mail sent to an address where they could receive it.

How the Dutch National Police helped Genesis Market victims

In addition to investigating individual incidents of crime against Dutch citizens, the Dutch National Police worked with public and private sector partners to investigate the infection chain — the path of distribution and installation — for the information-stealing malware that enabled Genesis Market to steal victims'

identities. The results of that investigation were published in a report called Technical analysis of the Genesis Market. Van Well explained that his organization doesn't typically share so much detailed technical information around investigations, but it felt imperative to provide these details to law enforcement and tech companies around the world to help them fight future cybercrimes. Though Genesis Market domains and servers were seized and antivirus programs have been updated, cybercriminals have already rebuilt illicit services like these.

To help Genesis Market victims and prevent future crimes, the Dutch Police created a Check your hack tool that lets victims see if their credentials were sold or for sale on Genesis Market. The tool is still available today, and interested parties simply need to enter their email address to place an inquiry. If the address is in one of the cybercrime datasets, the person will receive an email that includes personalized instructions on how to clean up their computer and make it safe again. In the first 24 hours of launching Check your hack, two million people took advantage of the service. So far, five million people have used the tool, and over 13,000 victims have been notified that their computer was infected, and received instructions to help them make their device safe again.

As far as financial recourse for victims, some banks and insurance companies have provided payouts and will include those funds as damages in lawsuits against Genesis Market cybercriminals. As for Genesis Market cybercriminals located in the Netherlands, three have already been convicted and received prison sentences considered severe for that jurisdiction. The first received 24 months and the second, four years. The third convicted cybercriminal — the biggest Dutch user and the number 10 user worldwide — received a four-year sentence.

Fraud shops use payment processor to boost efficiency

In 2023, Chainalysis discovered that some popular fraud shops rely on payment processors as a way to reduce their own costs, add efficiency to their operations, and perhaps add a layer of security to transactions. Genesis Market extensively used a payment processor called UAPS, so much that the processor's average inflows fell by 25.7% after Genesis closed last April. Regardless, UAPS remains a key provider of payment infrastructure to top fraud shops.

Darknet market revenues rose slightly, but have yet to regain Hydra Marketplace highs

While the darknet market ecosystem showed signs of recovery in 2023, it has yet to return to the revenues it experienced before the Hydra Marketplace closure in 2022, given the financial success of that operation. It's noteworthy that, despite some unusual marketing efforts, no other darknet market has since assumed Hydra's mantle of being the one-stop-shop for illicit products and services. Though the sanctioning and closure of fraud shop Genesis Market occurred last year, there were no other sanction events for the darknet market ecosystem, or major market takedowns. We'll continue monitoring darknet market trends in 2024, and are curious to see what new tactics markets and fraud shops may employ to find more customers.

Scams

Scam Revenue Down But Approval Phishing and Romance Scams Stand Out as Threats

Based on Chainalysis data and designations, scams were once again one of the biggest drivers of cryptocurrency-based crime, with associated wallets bringing in at least $4.6 billion in revenue in 2023. While that represents a year-over-year decline compared to 2022, readers should keep in mind that this is a lower-bound estimate based on value sent to addresses currently identified as scams. Chainalysis will almost certainly catch more such addresses in the future, and add their historical activity to our analysis, which will increase the numbers you see here. For example, when we published our report last year, we identified $5.9 billion in scamming revenue for 2022. That estimate has now increased to $6.5 billion.

As scammers in this category become more sophisticated and varied in their tactics, it also becomes more and more difficult to identify addresses associated with crypto scams. The bad actors behind romance scams (also frequently known as "pig butchering" scams), for instance, often communicate addresses to victims in one-to-one communication channels like text, and unless victims report their losses to the authorities — far from a guarantee — it can be difficult for blockchain analysts to identify those addresses as scam-related, especially as compared to the enormous crypto ponzi schemes we've seen in years past, which go out of their way to advertise themselves to the masses. These complications likely cause more undercounting of scam activity, especially in the past two years as romance scams have become more prevalent.

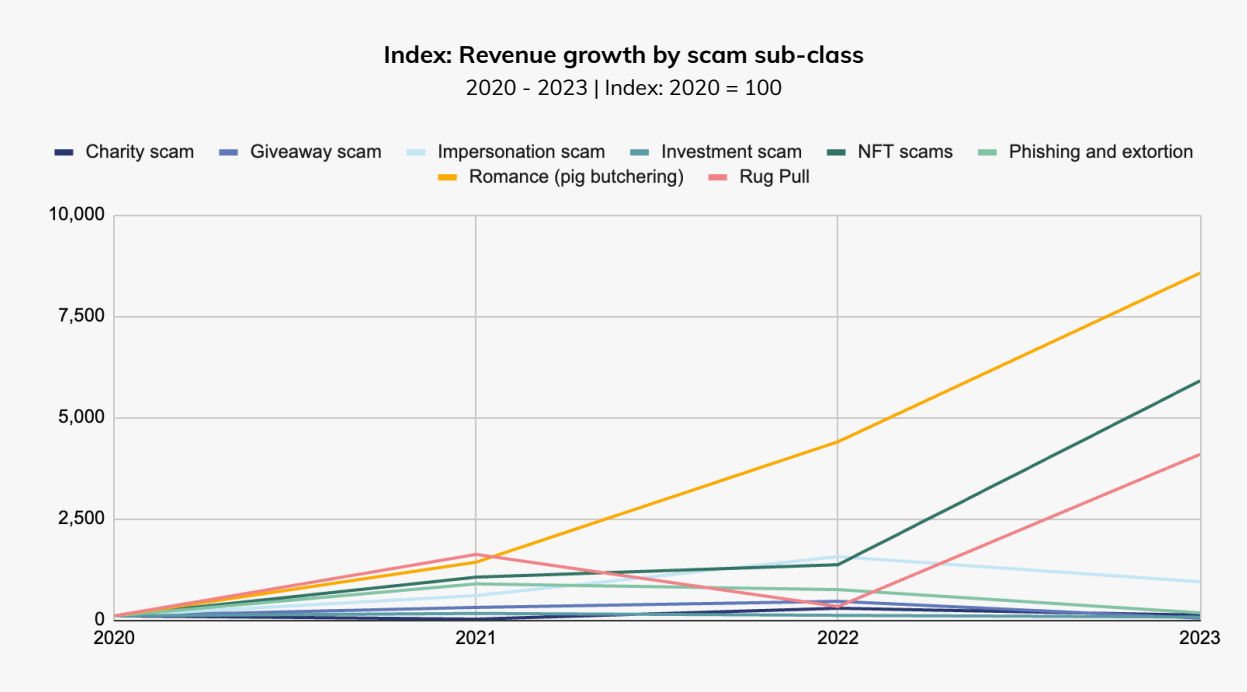
As we'll also explore, approval phishing scams, which have become more prominent in 2023, function differently on-chain from most other scam types we examine, in ways that can make them difficult to measure at scale. For that reason, most of our approval phishing scam research will focus on specific approval phishing scammers whose on-chain operations we have thoroughly identified and therefore may not capture all on-chain approval phishing activity.

Nevertheless, the scamming activity we've identified as of today cuts across all categories and enables us to identify key trends in crypto scamming broadly. It's also worth noting that many people are likely being scammed by bad actors who claim to be promoting a cryptocurrency investment opportunity, but receive funds from victims in fiat — those numbers wouldn't be reflected in our data at all.

Comparing scams by category

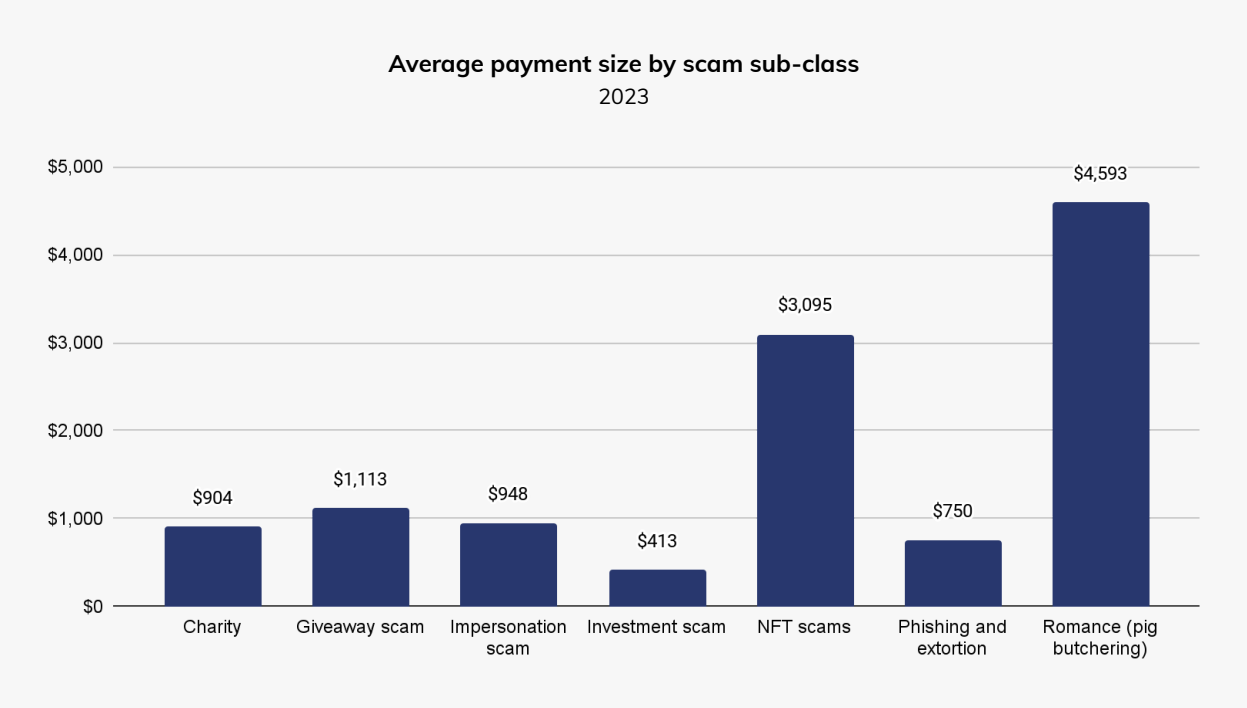
Chainalysis labels on-chain entities as scams based on methodologies and research findings which point to the presence of certain patterns and criteria. As a unifying theme, we consider all scam activity to involve a target failing to receive what they understood they were being promised by the perpetrator, or otherwise being misled by the perpetrator as to an expected outcome.

Despite the aggregate decline in total value sent to scams, revenues for different categories of crypto scams don't rise and fall together. Some categories of scams have risen significantly in revenue taken from victims.



Romance scams in particular grew significantly in 2023, more than doubling revenue year-over-year. In fact, our data suggests that romance scam activity has grown by 85x since 2020. This is especially

concerning when we factor in that romance scams have the worst impact on victims of all scam types, based on average payment size.



Keep in mind too that many victims likely make multiple payments to an individual scam address, so the actual losses per victim can be much higher than these averages.

It's also worth noting that some scams could theoretically fit into multiple categories. Many romance scams, for instance, have an online footprint that's virtually indistinguishable from the typical investment scam, with websites and social media posts promising improbably high returns. We primarily categorize these scams as romance scams based on information from victims, customers or partners, and other sources indicating that the scammers are utilizing the tactics typical of a romance scam, meaning that they're contacting individuals and attempting to build relationships in order to con them. As such, readers should keep in mind that some scams we categorize as generic investment scams are likely also engaging in romance scam tactics.

Targeted approval phishing scams see explosive growth over last two years, with at least $374 million suspected stolen in 2023

Approval phishing is a scamming tactic that has existed for many years. But whereas approval phishing scammers have historically targeted wide swaths of crypto users through the proliferation of fake crypto apps, romance scammers (also known as pig butchering scammers) appear to have adopted this technique to great effect in recent years.

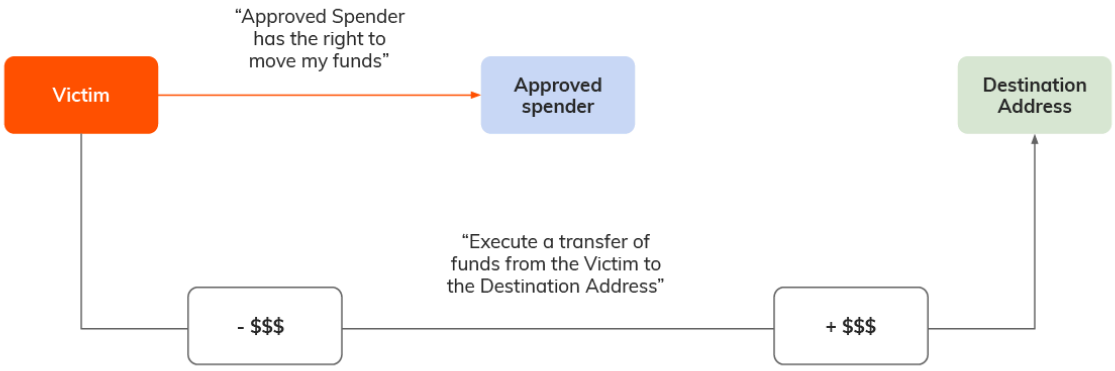
Approval phishing differs from other crypto scams in a small but important way. Typically, scammers trick victims into sending them cryptocurrency, usually through a phony investment opportunity or by impersonating somebody else. But in an approval phishing scam, the scammer tricks the user into signing a malicious blockchain transaction that gives the scammer's address approval to spend specific tokens inside the victim's wallet, allowing the scammer to then drain the victim's address of those tokens at will. Some victims have lost tens of millions to these scams.

It's important to note that in general, approval phishers send the victim's funds to a separate wallet from the one granted approval to make transactions on the victim's behalf. The on-chain pattern typically proceeds as follows:

- **Victim address** signs transaction approving second address to spend its funds
- Second address, which we'll refer to as **approved spender address**, executes transaction to move funds to a new **destination address**

In general, if transactions unfold in this manner, and the approved spender address is the initiator of the draining transaction, rather than the victim address as we'd expect in a non-malicious transaction, it's likely an instance of approval phishing. However, further investigation would be necessary to know for sure.

Anatomy of an approval phishing scam

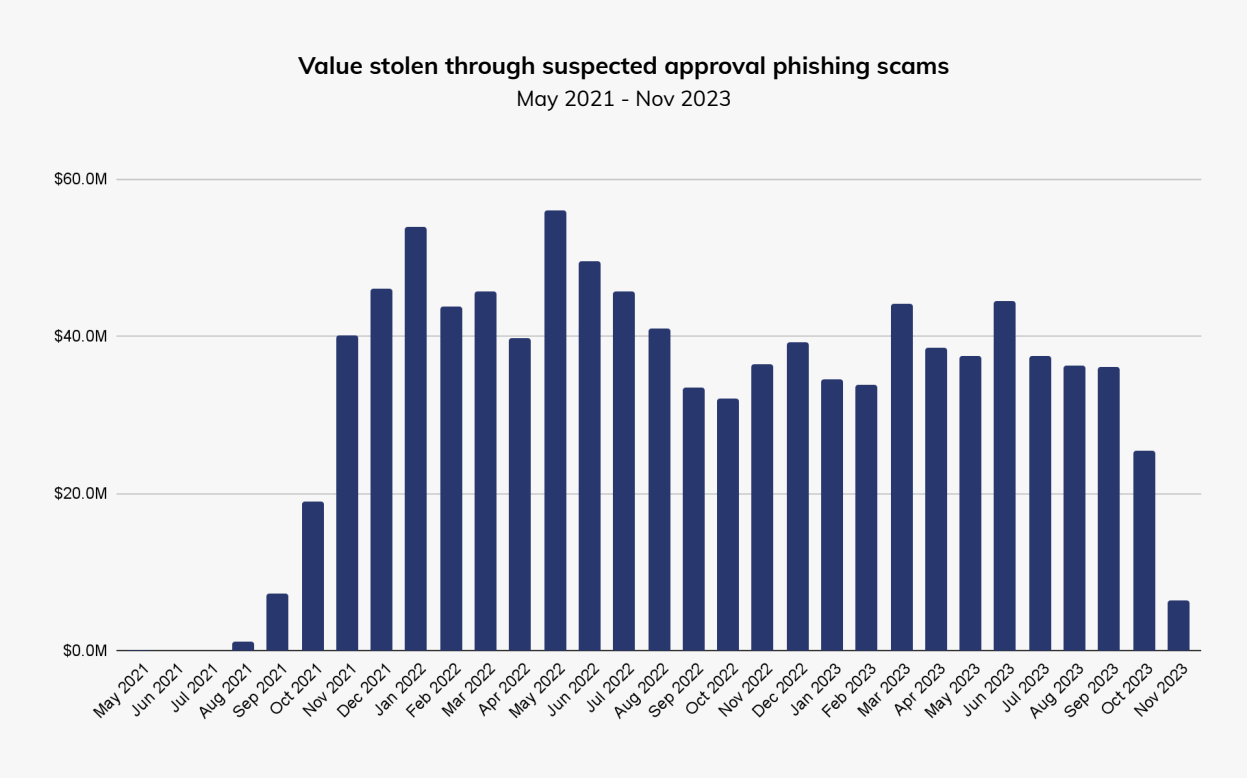


Many decentralized apps (dApps) on smart contract-enabled blockchains, like Ethereum, require users to sign approval transactions giving the dApps' smart contracts permission to move funds held by the user's address. Approvals granted to secure dApps are generally safe because properly designed smart contracts can only use that approval when directed to do so by the user, or when such approval is required in the normal functioning of the dApp. In those cases, we would generally expect the dApp user's address to be the one initiating the transaction to spend the funds. But, approval phishers can take advantage of the fact that many crypto users are used to signing approval transactions — the trick is in what permissions are given, and the trustworthiness of the party receiving that permission. For instance, one approval phishing scam saw bad actors promote a bogus story of a Uniswap approval phishing scam, and set up a fake Etherscan page where users could check their transaction approvals by connecting their wallets and

signing an approval transaction to see if they'd fallen victim — that last transaction was the core of the actual approval phishing scam.

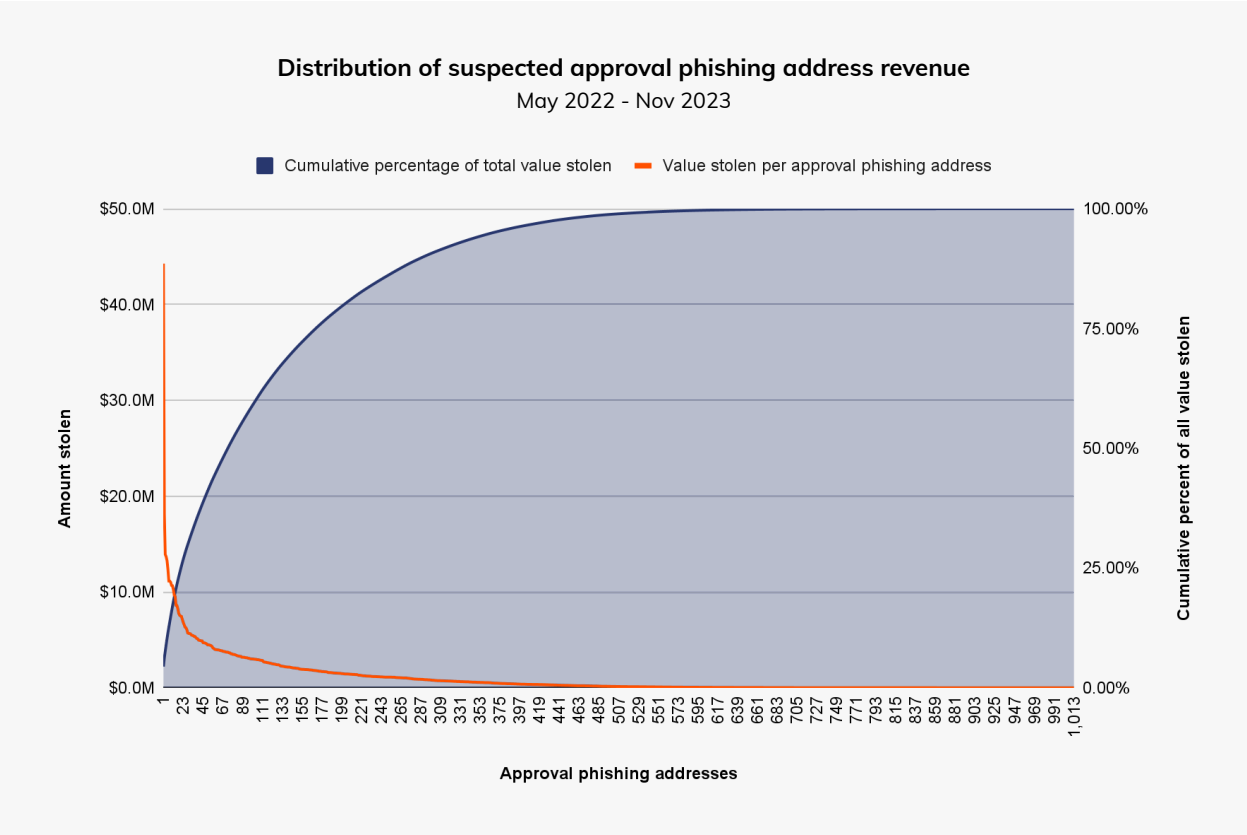
However, research suggests that approval phishers are now more and more targeting specific victims, building relationships with them and using tactics associated with romance scams to convince victims to sign approval transactions. Metamask lead product manager Taylor Monahan (aka @tayvano_) has tracked romance scam-style approval phishing on a custom Dune Analytics dashboard.

We identified a set of 1,013 addresses involved in what appears to be targeted approval phishing by starting with a smaller list of approval phishing addresses whose owners are known to be using romance scam tactics. We then identified other addresses connected to those in the initial list that had executed similar transactions, effectively allowing us to build out a more complete network of interconnected approval phishers' on-chain activity. We estimate that victims of the addresses we started with, plus those we identified based on their distinct pattern of activity, have lost approximately $1.0 billion to approval phishing scams since the start of our dataset in May 2021. While it's important to note that this $1.0 billion total is an estimate based on on-chain patterns, and that some of it could represent laundering of funds already controlled by the scammers, this figure is likely just the tip of a much larger iceberg. Romance scams are notoriously underreported, and our analysis began from a limited set of reported instances.



The suspected approval phishing scammers we're tracking saw their revenue peak in May 2022. Overall, 2022 saw victims lose an estimated $516.8 million to approval phishing, versus just $374.6 million in 2023 through November. Like many forms of cryptocurrency-based crime, the vast majority of approval phishing theft is driven by a few highly successful actors. We can see this on the distribution graph below, which

shows the approval phishing revenue of our 1,013 addresses during the time period studied, and the cumulative share of all value stolen through approval phishing by the addresses in our sample in descending order.



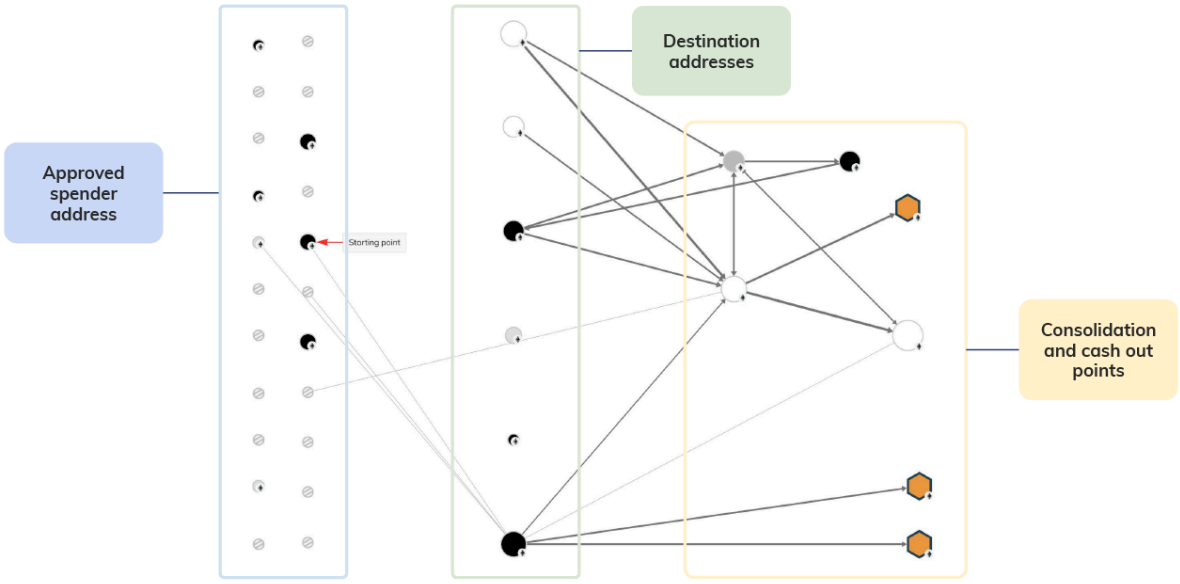
The most successful approval phishing address likely stole $44.3 million from thousands of victim addresses, representing 4.4% of the total estimated stolen during the time period studied. The ten largest approval phishing addresses combined account for 15.9% of all value stolen during the time period studied, while the 73 biggest account for half of all value stolen.

We believe that the industry can address the approval phishing scam problem in a variety of ways, from user education to employing pattern recognition tactics similar to those we used to compile this data. Generally speaking, the relevant addresses and wallets in approval phishing scams are:

- **Approved spender wallets** victims are tricked into designating as approved to spend funds in their wallet
- **Destination addresses** to which victim funds are drained
- **Consolidation addresses** where funds drained from many victims are gathered

Funds are typically moved from consolidation addresses to cash out points — primarily centralized exchanges — as we see on the graph below.

Recognizing the patterns of approval phishing



Based on the patterns identified above, exchange compliance teams could monitor the blockchain for suspected approval phishing consolidation wallets with heavy exposure to destination addresses. They could then see in real time when those wallets move funds to their platform, and then could take steps such as automatically freezing the funds or reporting to law enforcement. More broadly, the industry can work to educate users not to sign approval transactions unless they're absolutely sure they trust the person or company on the other side, or understand the level of access they're granting.

Inside the KK Park: Myanmar's most notorious pig butchering compound

We spoke with Eric Heintz, Global Analyst at the Global Fusion Center of the International Justice Mission. There, Heintz and his team assist IJM's field offices in their work to help human trafficking victims of pig butchering gangs. As part of this effort, they also track the gangs themselves, monitoring their recruiting activity on social media, mapping out their compounds through satellite imagery, and communicating with victims.

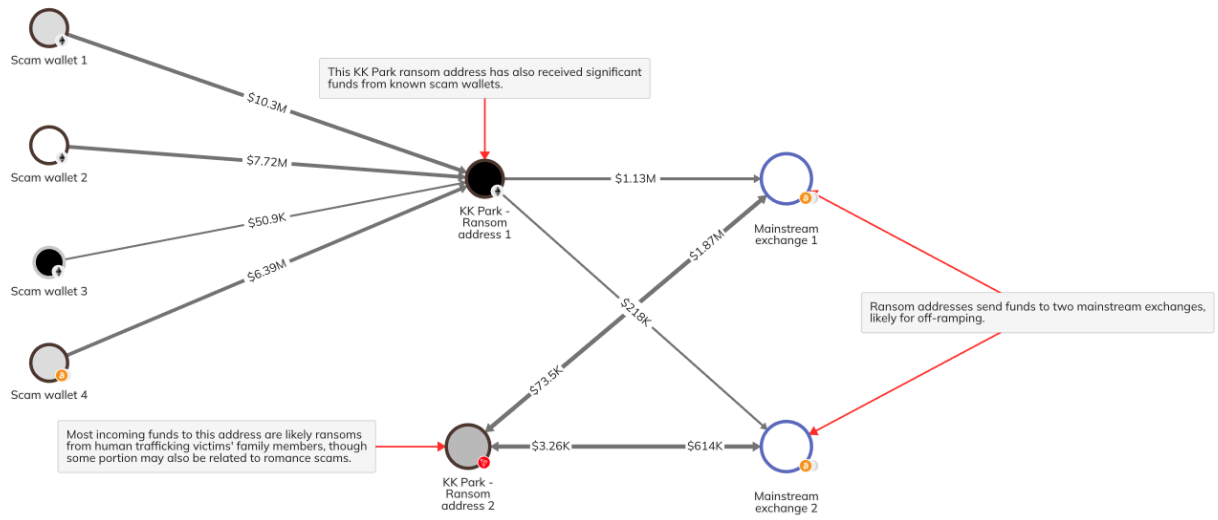
"The conditions these people face are horrible," he told us. "They're forced to work 12 or more hours per day, and if they don't meet quotas on contacting potential scam victims, the gangs beat them, torture them, and even withhold food."

Heintz also told us a bit more about the compounds themselves. Typically, one company owns the land and the buildings, and then rents them out to other companies who carry out the actual romance scams. According to Heintz, the owners of the compounds often also provide "security" for their tenants, meaning guards who will prevent human trafficking victims from escaping.

How do the companies within these compounds use cryptocurrency? Of course, we know that they take crypto payments from scam victims. But Heintz also told us that pig butchering gangs will often tell the families of trafficked workers to pay them ransoms in exchange for their family member's freedom — those payments also often happen in cryptocurrency. Heintz sent us ransom payment addresses provided to him by trafficking victims and their families, associated with a pig butchering gang at KK Park, one of the most notable compounds in Southeast Asia. "Some scam operations may be mixing proceeds from scams with ransom payments from victim families," said Heintz. Indeed, the addresses he provided show on-chain connections to addresses associated with romance scams, in addition to activity likely related to ransom payments.

Satellite image of KK Park ©2023 Maxar Technologies

First, some context on KK Park before we dive into on-chain analysis. KK Park is one of the biggest, most notorious romance scam compounds in operation today. Located in the aforementioned Myanmarese town of Myawaddy, KK Park is reported to hold over 2,000 trafficked romance scam workers. The two ransom addresses provided to us by Heintz are, according to him, associated with a Chinese romance front company for a pig butchering gang that operates out of KK Park. The following Chainalysis Reactor graph shows some of the addresses' on-chain activity.



From just the two ransom addresses provided to us by Heintz, we're able to gain insight into millions of dollars' worth of activity associated with this prolific pig butchering gang. First, we see that while the addresses were provided to victims' families as a means of ransom payment, both have also received significant funds from a number of known scam addresses. Ransom address 1, for instance, has received roughly $24.2 million in crypto from the four scam-associated wallets to its left. Both ransom addresses send and receive significant amounts to and from mainstream exchanges — some of those incoming transactions are likely ransoms.

Our on-chain analysis shows how tightly interwoven pig butchering gangs' ransom-taking operations are with their primary business of conducting romance scams. The brutal conditions trafficking victims face on the compounds also lend additional urgency to solving the problem of romance scamming — not only are consumers being bilked out of hundreds of millions of dollars each year, but the gangs behind those scams are also perpetuating a humanitarian crisis. The good news is the cryptocurrency ecosystem is taking action: In November, the stablecoin issuer Tether and the cryptocurrency exchange OKX announced that they collaborated with the United States Department of Justice in an investigation that led to Tether freezing approximately $225 million in USDT tokens linked to an international human trafficking syndicate in Southeast Asia responsible for romance scams, helped in part by Chainalysis solutions. Additionally, a South Korea-led Interpol operation in late 2023 saw authorities arrest 3,500 cybercriminals associated with online scamming and seize $300 million in funds, $100 million of which was made up of digital assets. We encourage all cryptocurrency businesses to search for any possible exposure they may have to this activity, and report as much information as they can to law enforcement.

Chainalysis

Building trust in blockchains

About Chainalysis

Chainalysis is the blockchain data platform. We provide data, software, services, and research to government agencies, exchanges, financial institutions, and insurance and cybersecurity companies in over 70 countries. Our data powers investigation, compliance, and market intelligence software that has been used to solve some of the world's most high-profile criminal cases and grow consumer access to cryptocurrency safely. Backed by Accel, Addition, Benchmark, Coatue, GIC, Paradigm, Ribbit, and other leading firms in venture capital, Chainalysis builds trust in blockchains to promote more financial freedom with less risk. For more information, visit www.chainalysis.com.

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