

SILK ROAD – ANONYMOUS DEEP WEB MARKETPLACE

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NOTE

Since this paper has been written Silk Road founder and admin Dread Pirate Roberts has been revealed to be San Franciscan Ross Ulbricht, the site has been shut down twice and the current iteration Silk Road 3.0 is running similarly to the version discussed in this paper, the original Silk Road 1.0. Millions in Bitcoins have been confiscated by the FBI and dozens of admins and sellers have been arrested. All of these recent events will have caused changes to the site's infrastructure and user culture that are not discussed in the following paper.

ABSTRACT

The Silk Road is an anonymous marketplace for contraband that can only be accessed through the Deep Web and functions through implementation careful security measures including the use of Bitcoins as its only currency. Buyers and sellers create trust the site by rating one another and the site supports a trusting environment with an escrow system to hedge transactions. Users can also interact in a separate forum where Silk Road culture can be seen. Though the site has received mixed reactions from the media these articles have caused the site to grow. Many governments have targeted the Silk Road and attacks have been made against it. Throughout, the marketplace has continued to expand and increase its security measures, making it the most popular online market for drugs.

THE DEEP WEB

Commercial anonymity has been revolutionized by the web. In years past to make a transaction there had to be face-to-face contact between the customer and the seller, while modern consumers can purchase almost anything online without any human interaction.

For most transactions the Internet simplifies the process, but with purchases that could embarrass the buyer or even put them in jail, online anonymity has transformed the process remarkably.

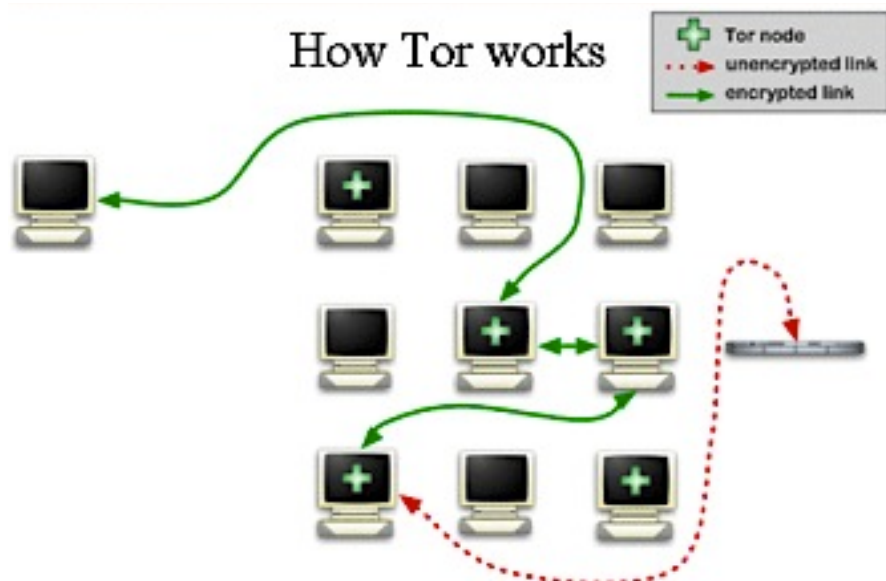
To make an illicit transaction ten years ago the consumer would have to know a guy who knows a guy who knows a dealer who knows a supplier. The initial contact relays the order to his connection and so on through the chain to a supplier. If one node was busted the whole network could be exposed.

Finding trustworthy contacts who have the needed connections to purchase contraband is very difficult without ubiquitous Internet use. There are no references or listings in the phone book so without Google search word of mouth is the obvious, if inefficient and unsafe, way to share information.

Online networks can be dissected similar to physical networks. To make a transaction the buyer's computer must send a packets through a network of routers to fetch information from the website. Law enforcement can trace this path from the computer to the router nodes to the website and back.

This is why Tor was invented. Tor – or the Onion Router – takes requests for webpages and passes them on to other onion routers until one of them fetches the page, passing it through the layers of routers back to the computer that requested it.

The difference between normal computing and Tor is encryption: all traffic on Tor routers is virtually untraceable



and part of the unsearchable part of the Internet called the Deep Web. This is the part of the web that cannot be indexed by standard search engines like the Surface Web.

Tor can bypass a high school's proxy list or the Great Firewall of China, making it perfect for all kinds of embarrassing or illegal online activity. The Farmer's Market, one of the first online drug markets to operate in the Deep Web, was taken down by operation "Adam Bomb" and its eight admins were arrested because its security was not robust enough to protect it.

The DEA acknowledged the Silk Road and began an investigation in 2011. When asked this year if he was worried Dread Pirate Roberts (the Silk Road's admin and founder) said, "No. I have confidence in our security measures."

SITE ARCHITECTURE

The Silk Road uses a basic ecommerce web design with different product categories, pictures of top items, and account information shown in the user's national currency or in Bitcoins, the crypto-currency used on the site.

The screenshot shows the Silk Road anonymous market website. At the top left is the logo featuring a green camel and rider, with the text "Silk Road anonymous market". To the right of the logo, the user's account status is displayed: "messages 0 | orders 0 | account ₿0.00". Below this is a search bar with the text "Search" and a "Go" button. A "Shop by Category" dropdown menu is open, listing various categories and their item counts: Drugs (11,178), Cannabis (2,586), Dissociatives (232), Ecstasy (1,140), Opioids (685), Other (405), Precursors (98), Prescription (2,669), Psychedelics (1,223), Stimulants (1,560), Apparel (336), Art (112), Biotic materials (2), Books (529), Collectibles (13), Computer equipment (75), Custom Orders (78), Digital goods (471), Drug paraphernalia (361), and Electronics (109). The main content area displays a grid of product listings. Each listing includes an image, a title, a description, and a price in Bitcoin (₿). The products shown are: 50g Moroccan Hexagram/Jodenster Hash (₿1.32), {FLAX} testosterone 1% gel 100ml pump (₿0.84), GHB Powder 25g (₿0.38), 50 mg 2c-b - buy four get one free! (₿0.16), Tramadol (Ultram) 50 mg x 50 (₿0.36), and 75ml Rick Simpson Oil Ointment (₿0.70). At the bottom left, a status bar indicates "Transferring data from silkroadvb5piz3r.onion...".

Traffic statistics *

Total population	100,000
Active population	20,000
Male:female ratio	4:1
New users /day	100
Page views /day	100,000

Sales statistics *

Estimated sales	\$22,000,000
Estimated profit	\$2,000,000
Profit/Sales	9.1%

Operator commission schedule

First \$50	10%
\$51 - 150	8.5%
\$151 - 300	6%
\$301 - 500	3%
\$501 - 1000	2%
Over \$1000	1.5%

User feedback ratings

5/5	96.5%
4/5	1.3%
3/5	0.8%
2/5	0.3%
1/5	1.1%

Top 5 shipping origins

USA	43.83%
Undeclared	16.29%
UK	10.15%
Netherlands	6.52%
Canada	5.89%

Top 5 shipping destinations

Worldwide	49.67%
USA	35.15%
EU	6.19%
Canada	6.05%
UK	3.66%

*Approximate

Registered users can access their inbox, orders, shopping cart and account using the top navigation bar. Similarly sellers can access these options as well as their listings. Account balances can be shown in dollars or in Bitcoins, the currency used on the site.

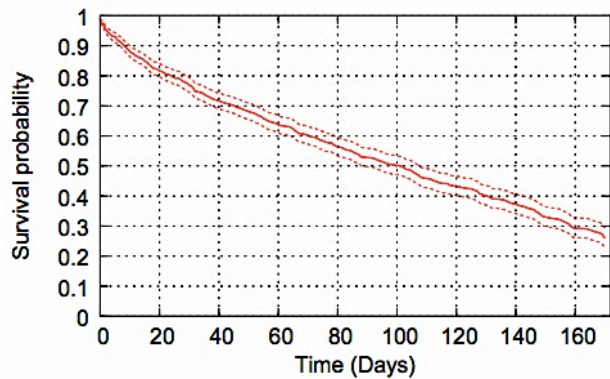
A small news button shows recent posts by libertarian founder Dread Pirate Roberts and a small icon of the character he named himself after with a hyperlink to his statement. This includes the Silk Road's purpose, rules, and advice on how to utilize the site to its fullest. One of his most appropriate comments is that "the old saying, 'with freedom comes responsibility' could not be more true here."

SELLERS

Because of the inherent anonymity of the Silk Road, it is difficult to aggregate information on the users of the site. Based on the shipping origins, it can be estimated that about 40% of sellers are in the United States, assuming that there are no appreciable differences between the American and world-wide seller behaviors.

Seller accounts are auctioned to Silk Road users to deter fake or dishonest sellers. This also discourages sellers to create more than one seller account though, surprisingly, does not create sizeable switching costs as seen in the chart below.

The Silk Road wiki includes a comprehensive seller's guide with rules, advice, and how-to's for sellers. The process is highly customizable: sellers can choose whether to link their listings to USD or to BTC, if the whole population can see the listing, and



Probability a seller will continue publicly selling on the site. About half the sellers leave within 100 days and one-fifth leave within 3 weeks. Christin, 2012

using USD instead of BTC to price goods, sellers will always get the amount of money they have set as a price, no matter the Bitcoin rate that day and hour.

Hedging with the escrow system assures sellers that if the rate fluctuates after an order is placed but before the payment is made that they will receive the USD amount that the order is worth. As the seller's guide explains, if order worth 10 BTC is \$100 but the BTC rate halves while the order is being filled, the seller will receive 20 BTC from the escrow system.

Popular sellers who become overloaded like user TedDanzig SR, the most popular maker of fake identification on the anonymous marketplace, can go in to stealth mode. Sellers were being overloaded by the mass of orders, especially from new users who often had to ask many questions. Stealth mode for an entire user or for a listing allows the page to be accessed directly via its URL to filter out browsing users. It was designed as a temporary measure.

The architecture behind seller accounts is all about safety. The crypto, Bitcoins, and Tor ensure anonymity while the link to USD and escrow system ensure that the sellers will not lose money when Bitcoins fluctuate. At the end of the seller's guide he states:

“Regardless of your motivations, you are a revolutionary. Your actions are bringing satisfaction to those that have been oppressed for far too long. Take pride in what you do and stand tall.”

whether to hedge the exchange in the Silk Road's escrow system.

If a seller uses dollars to price their items and hedges the transactions with escrow, they protect themselves from fluctuations in the Bitcoin rate.

The Bitcoin rate can have sizable fluctuations over a few hours so sellers need to safeguard their prices both during the time a product is listed and the time between the transaction and its delivery. By

BUYERS

Most of the Silk Road wiki buyer's guide is focused on purchasing items reliably and anonymously. The admins assume that Silk Road buyers are less tech savvy than sellers, congratulating them in the first section for successfully finding the site through Tor. The next sections outline basic tasks essential to the purchasing process such as getting Bitcoins, using the shopping cart, making payments, and receiving packages.

Other parts assure buyers that their anonymity and money will be safe through use of the escrow system, good shipping practices, and what information sellers can see about them.

The buying process begins with the acquisition of Bitcoins. Almost no BTC trading websites allow users to pay with credit, debit, or Paypal. Instead, users must make international wire transfers or direct deposits to intermediaries, which will credit the account for a fee. For some new Bitcoin users it can take weeks to actually make the purchase because of the high barriers to entry caused by difficult – though extremely private – ways to buy Bitcoins. Mining Bitcoins successfully is not a simple task and is usually taken on for financial gain, rather than the consumption of Deep Net goods, therefore it is uncommon amongst Silk Road users.

Bitcoins are just the beginning of the Silk Road's architecture for buyers. There are suggestions on how to choose a receiving address for a Silk Road "wallet" which will hold the Bitcoins within the site, what happens with that wallet, how to encrypt the wallet's address when you send it to a vendor, who sees their purchasing statistics, and even a tumbler. The buyer's guide assures users:

"Just when you thought the Silk Road couldn't be more secure, we went one step further. The tumbler sends all payments through a complex, semi-random series of dummy transactions, each with a new, one-use receiving address, making it nearly impossible to link your payment with any coins leaving the site."

Category	# Items	Pcnt
Weed	3338	13.7%
Drugs	2194	9.0%
Prescription	1784	7.3%
Benzos	1193	4.9%
Books	955	3.9%
Cannabis	877	3.6%
Hash	820	3.4%
Cocaine	630	2.6%
Pills	473	1.9%
Blotter (LSD)	440	1.8%
Money	405	1.7%
MDMA (ecstasy)	393	1.6%
Erotica	385	1.6%
Steroids	376	1.5%
Seeds	374	1.5%
Heroin	370	1.5%
DMT	343	1.4%
Opioids	342	1.4%
Stimulants	291	1.2%
Digital goods	260	1.1%

If weed, cannabis, and hash are combined they total 5,035 or 20.7% of all listings. Christin, 2012

These aren't average drug-buyers. Silk Road users are secretive, sometimes paranoid, and are usually looking for a safe, high quality product that cannot be found in their physical area. The hoops they must jump through are numerous but the safety afforded is remarkable.

ANONYMITY

The Silk Road is run on anonymity. Without it, neither buyers nor sellers would be safe making online transactions, killing the entire project.

Users are attached to handles within the site to develop reputations, but these accounts are designed never to link that handle to the person or people behind it, unlike on sites like 4chan where even the posts cannot be linked back to a user or sites like Facebook where the profile-to-person connection creates its value.

A growing trend in the information age is to share personally identifying information on the web through social network sites like Facebook and, through the terms of service, allow authorities to access it; privacy, online or off, is being traded for "security." NPR held a conversation on April 22nd about whether cameras, like those used widely in the Boston bombing search were a good security measure or an invasion of privacy. One of the main points experts made was that even the existence of cameras on the streets or in stores decreases the illegal activity that occurs there.

While many called in to say authorities should have to get a warrant to access the information, other spoke of how the cameras were a fine tradeoff. "If you're minding your own business and aren't doing anything wrong, then there's nothing to worry about," one listener commented.

Silk Road users are not of this mind. In the forums users speak of how they would rather buy products freely, but laws prohibit their possession or consumption. Rather than sacrifice their freedom to buy what they want, users give up some security: there is always the possibility of consequences. Better than any other marketplace, the Silk Road attempts to provide both freedom and security through its extreme anonymity.

Pages of information are devoted to assuring its users that there are no digital cameras on the site; no one will know who the user is unless he or she is not vigilant. Tor, Bitcoins, the tumbler, and PGP/GPG encryption allow users to make huge contraband transactions without government agency intervention or discovery.

Anonymity is a double-edged sword though. Child pornographers, thieves, and terrorists utilize the same technology that protects the Silk Road. Even on the market, users cannot be held accountable for their actions outside of the site, even if they cheat, disrupt the community, or violate the guidelines. Though anonymity increases information security, it decreases the security that transactions will be made honestly.

FEEDBACK

Similar to eBay, the Silk Road uses a reputation system based on customer feedback. At the top of each seller's profile is a box with reputation-generating information as seen below for seller TedDanzigSR. Though 99.2% of the feedback was positive (3-5 stars) he is only barely in the top quintile of sellers, indicating that some sellers have extremely high feedback.

TedDanzigSR

[send a message](#)

has been a vendor for **8 months**
was last seen: **today**
ranked in the **top 19%** of sellers with **99.2%** positive feedback from **more than 300** transactions
has **172 fans** - *become a fan*

[report this vendor](#)

Each seller profile also includes all of the feedback the seller has ever received from most recent to least recent. One recent post for user TedDanzigSR reads "Once again, excellent vendor... I'm heading out to grab a pack of Heineken, thanks to Ted." This information is provided to combat the double-edged security sword; if the users cannot face consequences outside the site for misbehavior, their customers can create consequences within the site.

Admins monitor the "report this vendor" messages and, if a seller is not following through on deliveries, their account can be revoked. Similarly users can report vendors violating the guidelines to sell products like child pornography, weapons, or "anything whose purpose is to harm or defraud."

Though well adapted, the system cannot completely protect users from bad sellers. Though the Silk Road forbids sellers to post reviews in their own feedback section and implements architecture that requires users complete a transaction with a seller before giving feedback, sellers can still create fraudulent buyer accounts, laundering money in cycles between the accounts to write feedback. The disincentive is the high transaction commission.

To limit the impact of low feedback scores, vendors like TedDanzigSR blacklist customers who rate them with less than 5/5, preventing them from buying and rating again.

Some of these are the same methods that giants like eBay and Amazon employ, but without the ability of legal ramifications. The Silk Road functions successfully without the help of out-of-site consequences though – the community self regulates itself to a relatively safe standard.

HOW SELLER FEEDBACK IS CALCULATED

Only once a vendor has a significant number of ratings do they have a rank posted. Buyer's feedback carries different weights in computing the seller's reputation based on three factors listed below listed in order of importance.

1. How active the buyer determined by the standard deviation +1 of the log number of vendors reviewed by the buyer if above average or the $1/(SD - 1)$ if below average
2. The age of the rating determined by raising 1.02337 to the age in days and inverting it
3. The price of the transaction determined by the formula $0.2\log(0.02*($price)+1)+1$

Multiply the three weights to find the total weight, then compute the average and SD for the seller ranking.

TRANSACTIONS

Buyers and sellers use the limited information they can find on each other – feedback on sellers and purchasing statistics on buyers – to determine if there is enough trust in the financial relationship to make a transaction. An ecommerce study by Cheskin Research and Sapient found that:

“Consumers see the world of the Web as one of chaos, offering both possibilities and threats. Only after they believe they have secured control over their own personal data within the system, are they willing to begin to try out e-commerce... Independent of trust issues, strong fulfillment and navigation are key.”

Each part of the transaction process gives users tools to assess trustworthiness of the other party and security that, if the transaction goes bad, the Silk Road has “backup plan” infrastructure to protect both the buyer and the seller.

The process is defined explicitly by the website once a buyer places an order. The seller can cancel the order at any time, refunding the buyer, or the buyer can cancel within four days to receive a full refund if the order is not “in transit.” Once the seller ships the product, regardless of the outcome, the buyer can leave feedback. The seller can still cancel the order with full refund to the buyer, even at this point. The buyer can now finalize the order, releasing payment to the seller, though the Silk Road suggests that finalization happen after the product arrives and is assessed.

The ability to cancel orders is important because it gives users secured control over the transaction the same way anonymity features give them control over their personal data – both critical to ecommerce.

A BIT ON BITCOINS

All Bitcoin transactions have to go through blockchain, the shared public transaction log that confirms all transfers between encrypted Bitcoin digital wallets that utilize PGP keys. Transactions through blockchain cannot be altered or traced once they have been made.

When 1 BTC was approximately 8 USD, \$3.82 million dollars worth of Bitcoins were found in a wallet under the name Pirateat40. It was, at the time, one of the largest sums of digital currency in any given account. The user who stumbled over the wallet claimed he had found the infamous Dread Pirate Roberts of the Silk Road that the DEA had made a “high profile” case.

As soon as the whistle was blown, all of the money disappeared without a trace, probably dispersed to many smaller wallets. If it was the Dread Pirate Roberts and he kept that sum in BTC, his wallets would now be worth \$100 million dollars, even though the Bitcoin market crashed this month, April 2013. If he had cashed out at the peak, the total amount could be double that.



March - April 2013 (Bitcoin market crash showing price line and volume bars)

If the buyer is unsatisfied, the order can be sent to the Resolution Center where: 1. The buyer and seller agree on a refund amount, 2. The admin decides a refund amount, or 3. The buyer does nothing, causing the transaction to finalize (releasing payment) after 17 days.

THE SILK ROAD FORUM

Separate from the actual anonymous marketplace, the Silk Road has a forum for users to discuss topics relevant of the site, request new products, or receive technical support. Discussion boards are created and maintained by the admins, but anyone can create a profile to post whether they have used the marketplace or not.

The discussion boards are divided in to three sections:

1. Discussion

- Silk Road discussion
- Security
- Shipping
- Drug safety
- Philosophy, economics and law
- Off topic
- Newbie discussion

2. Market

- Product requests
- Product offers
- Rumor mill

3. Support

- Customer support
- Technical support
- Bug reports
- Feature requests

The Discussion section is most popular, the top board is the Rumor Mill where users can discuss vendors and products. The topics are usually titled as the “official reviews” of a Silk Road seller, though there are also a lot of boards for products, especially those sold by multiple vendors such as breeds of cannabis and certain hallucinogens.

General Forum Statistics

Total members	63,235
Total posts	872,222
Avg posts /day	1550
Total topics	57,445
Avg topics /day	2070
Total page views	62,643,930
Most online	290
Avg online /day	106

Top 10 Boards

Rumor Mill	250,375
Newbie discussion	159,259
Off topic	100,252
Product offers	92,392
Silk Road discussion	73843
Security	54,960
Drug safety	38,831
Product requests	34,689
Shipping	28,811
Technical support	10,836

Top 5 Topics (by replies)

“PLACE SPAM HERE GET 50”	30,443
“h3r0 n Vendors”	17,385
SR Cocain Vendors & Reviews”	8,739
“The Avengers LSD Vendors”	7,990
“Official discussion thread of current LSD vendors”	7.675

Forum History (by page views)

Jan 2013	3,864,279
Sept 2012	4,178,417
May 2012	2,824,417
Jan 2012	1,512,396
Sept 2011	693,261
June 2011	236,417

From Silk Road Forum statistics

Active posts in the Rumor Mill often have hundreds of replies and, on top boards such as “The Avengers LSD Vendors Review – SEE THE OP” (LSD Avengers Spokesperson is the OP) have hundreds of thousands of views.

Some users, like the LSD Avengers Spokesperson or the Dread Pirate Roberts use their Silk Road handles on the forum while others create new handles so not to connect their posts to their business transactions. There is no way to connect a Forum account to a Silk Road account other than to state what the name of the other account is, so it’s very easy to create multiple positive reviews for ones own product or to post negative reviews about competitors. This is why the Silk Road advises users to trust in-site feedback more as a user must actually make a transaction to post feedback.

The disconnect between the sites also makes it difficult to determine what percentage of marketplace users are also on the Forum. With almost 872,222 posts and 63,235 members growing by 90,000 page views and 97 new registrations per day, the Forum is incredibly active. Though the Silk Road does not publish statistics on its users and only a few guests are present at any time in the Forum, it can be assumed that most Forum users are or have been marketplace users.

FORUM POSTS

The Forum consists mainly of topics and the posts within them, but there are other ways to interact including private messages, polls, and karma. Polls are denoted by a small icon next to the post and allow users to choose multiple-choice style from the answers given. One poll asked users to choose their age but was mostly unproductive; four out of eleven user chose the “rather not say” category.

Karma in the Forum is not used the way Reddit karma works. While in forum sites like Reddit, karma is used to determine page rank and can be accumulated by users, the Forum only utilizes the second: users can “applaud” or “smite” each other. Though almost all feedback in the marketplace was positive and it is much more common in other web forums to give good karma than bad, many users choose to smite each other in the Forum. “Hero member” Anonymous Addict posts almost every day about coke, Bitcoins, and Linux but had +138/-103 karma. Even Dread Pirate Roberts has smites (+421/-18).




It seems that users are highly controversial on the Forum, often disagreeing with each other about both on and off topic issues. Many users are Libertarians like Dread Pirate Roberts, while others are simply looking for high-quality, safe contraband. Karma-style reputation is usually used to discourage misbehavior in forums, but on a site that's purpose is misbehavior, karma can be used to demote opinion rather than as moderation. This is made possible by the detachment of karma from any other function on the Forum – users often do not care about their karma because it has no tangible effect on their use.

FORUM USERS

User profiles on the forum show whether the user is a vendor, the number of posts and average posts per day, a short bio, their karma, age, location, registration date, local time, and when the user was online last.

A brief of this information, seen on the last page for Dread Pirate Roberts, appears next to each post the user makes. It includes a more visual representation of a user's reputation than their actual profile which shows the quantitative data used to reach that level. Dread Pirate Roberts is a "Hero Member," the highest of the five user levels.

Dread Pirate Roberts Administrator  <input type="checkbox"/> Offline [Add To Buddy List] Send PM Show Posts	Posts: 570 (0.842 per day)
	Personal Text: as you wish...
	Karma: +426/-18
	Age: N/A
<hr/>	
	Date Registered: June 18, 2011, 12:07 am
	Local Time: April 25, 2013, 01:49 pm
	Last Active: Today at 01:07 pm
<hr/>	

Newbies get one gold block, Jr. Members two, continuing for Full Members, Sr. Members, and Hero Members with Administrators showing red blocks instead of gold. This instantly gives readers a visual representation of how active another user is and the type of user they are on the forum, allowing them to decide if that user's post is trustworthy or not based on their experience, rather than their karma which just shows popularity. Vendors often link to their Silk Road page in the signature of their posts, allowing readers to go directly from the Forum to their wares.

The Forum provides a place for users to create a community, not just buy or sell drugs. This is a part of the Silk Road that revolves around helping one another as well as making a profit.

A popular post in the Newbie Discussion allows users who have never used PGP encryption to test it out by encrypting a message with the OP's public key and sending it in a private message. The OP will respond with a message encrypted with his private key that the user must then unencrypt to read.

A lot of newbies in the marketplace get "bitten" by experienced sellers for not knowing how to use Bitcoins, the Silk Road, or PGP encryption for their private messages because the vendors are there to make a profit, not teach newbies. The Forum is a place to learn and find solidarity in the fact that everyone there is part of a community that most governments would love to kill.

The Forum has been around since the beginnings of the marketplace as a tightly connected companion site. Activity on it quintupled the first year the Silk Road was operational and it is on track to double this year, mirroring the rapid growth of the Silk Road since the 2011 Gawker article that made it famous.

MEDIA ATTENTION

Only four months after the site was launched, Adrian Chen a writer for *Gawker* published an article titled "The Underground Website Where You Can Buy Any Drug Imaginable." The site had less than 400 listings at the time compared to over 10 thousand listings today. The products haven't changed much over time; almost all of the listings were for drugs though there were three other categories: lab supplies, digital goods, and services.

"It's Amazon – If Amazon sold mind-altering chemicals"

Adrian Chen, *Gawker* 2011

The original article included information on the products, sellers, Bitcoins, Tor, interspersed with brief almost instructional bits on how to get to the Silk Road and make a transaction. After the article's release users flocked to the Silk Road. In the summer of 2011, a thousand users joined the Forum every month.

While other articles have increased the site's populations, many users attribute its success to the *Gawker* article; in the Deep Net sites can go for years without attracting much

attention because they cannot be searched in the Surface Net or found through browsing. Once the Silk Road was out there, word of mouth, other articles, and communities like Reddit spread the word.

There have been articles written on the site by *Wired*, the *Guardian*, Australia's *Canberra Times*, *NBC New York*, *GQ*, and *Forbes*. Many publish multiple articles, keeping their readers



updated on the staggering success of the website. *Forbes* in particular has published four pieces and often mentions the site in articles about the Bitcoin market.

Some articles, like the NBC expose, focus on the attempts to shut such “brazen” law breaking down while others, like *GQ*, tell a the story of the Silk Road and its niche market. *Forbes* and *Bitcoin Magazine* are more interested in the economics behind

the Silk Road, often referencing the six-month academic study by Carnegie Mellon professor, Nicolas Christin.

Christin used an automated crawling mechanism to retrieve data from all item, user, and category pages. He ran the crawler every day from February 3, 2012 to July 24, 2012. It was Christin who discovered that the Silk Road facilitates £1.2 million in transactions monthly, a statistic that has been quoted in almost every article written since the first working draft of the paper was published.

Media opinions are heated but for the Silk Road “there’s no such thing as bad publicity.” Even articles that support the arrest of all users can attract new customers - after all, most of these articles are about how hard it is to catch the perpetrators.

LEGAL ACTION

While bringing the Silk Road in to the public eye, *Gawker* also made US Senator Charles Schumer aware of the marketplace. The Senator took the Silk Road to the attention of the DEA and Department of Justice to get the site shut down in 2011.

At a news conference Sen. Schumer made a statement about the Silk Road:

"Literally, it allows buyers and users to sell illegal drugs online, including heroin, cocaine, and meth, and users do so by hiding their identities through a program that makes them virtually untraceable.

"It's a certifiable one-stop shop for illegal drugs that represents the most brazen attempt to peddle drugs online that we have ever seen. It's more brazen than anything else by light-years."

The Department of Justice's operation "Adam Bomb" had already taken down a similar site, the Farmer's Market. Marc Willems was arrested in Lelystad, The Netherlands, the same day co-founder Michael Evron was arrested in Columbia. In the next 24 hours there were six more arrests by DEA agents in the US. They were accused of running a "dark web online narcotics marketplace" that, unfortunately for them, hadn't been careful enough with email and payment details.

Brian M Grey, the acting special agent in charge of Operation Adam Bomb issued a warning to sites like the Silk Road:

"Today's action should send a clear message to organizations that are using technology to conduct criminal activity, that the DEA and our law-enforcement partners will track them down and bring them to justice."

The DEA hasn't had a lot of success at tracking Silk Road users down or bringing them to justice yet, though the site is definitely on their radar. One year after the Farmer's Market arrests, the DEA told a news station that it was investigating. DEA spokesperson Rusty Payne told *The Verge*:

"Typically we are not really giving out investigative updates about what we're doing but it's safe to say we are heavily involved in looking in to that."

The UK's Serious Organized Crime Agency is doing the same, though neither have had the success of Australia.

Though other governments have made arrests associated with the Silk Road, Australia is the first country to convict one. Australian Customs and Border Protection officers examined mail intended for Paul Leslie Howard, discovering 46.9 grams of MDMA and 14.5 grams of cocaine. When federal police raided his home in July 2012 they found \$2300 in cash, 35 stun guns disguised as cell phones, and a money counter. On Howard's phone were text messages like "promote the LSD I got more in. I sold 200 cubes last week." He bought and sold through the Silk Road, as well as dealing locally.

Howard was drawn to the site by the Eileen Ormsby's blog *All Things Vice: your guide to the seedier side*. Since the arrest the Silk Road has told users not to follow theirs or Ormsby's Twitter feed with their real names.

COMPLICATIONS

Though convictions are not one of them, the Silk Road has problems that could drive users away from the marketplace in droves, most notably the Bitcoin crash and DOS attacks.

For the last four months the Bitcoin rate has been growing exponentially; 1 BTC was worth less than 20 USD in January, doubled by March, and reached 100 USD/BTC by April 1st. On April 10th, the Bitcoin rate crashed from \$266 to \$105 then back to \$160 in six hours, though on some sites



Bitcoins dropped closer to \$50 and took days to recover. Some of the popular sites even shut down trading during this period, causing panic among those invested heavily in Bitcoins who watched their millions halve in hours.

Five days after the crash *Forbes* asked Dread Pirate Roberts what the impact was on the Silk Road:

“Bitcoin’s foundation, its algorithms and network, don’t change with the exchange rate. It is just as important to the functioning of Silk Road at \$1 as it is at \$1,000. A rapidly changing price does have some effect, but it’s not as big as you might think.”

Some sellers, like the Bitcoin exchanges, took their listings down to keep users from paying with a currency that was, at the time, worthless. Dread Pirate Roberts knows his customers well though: transactions picked back up as soon as the Bitcoin rate stabilized.

Unfortunately, only two weeks after the crash, the Silk Road was hit with a DOS attack that crippled the site for days.

Dread Pirate Roberts kept the community updated via the Forum on the attack, which he guessed came from a single attacker not associated with any government entity. Because the site is run on Tor, it is impossible to see where the Silk Road's servers are just as it is impossible to see where an attack is coming from.

The Silk Roads administrators and a few volunteers from the community worked non-stop to get the site back up and, after 36 hours, transactions could be processed as normal.

In an update to Silk Road users, Dread Pirate Roberts said that this was the "most sophisticated attack we've seen." He thanked his team and surprisingly the attacker for forcing them to rethink their infrastructure and finished by stating, "Our security system is substantially more robust and hardened for having gone through this."

Though the DOS frustrated users, responses post-attack are overwhelmingly positive. Users are proud of their administrators for handling the issue efficiently, keeping them posted, and beefing up security. Though a few complain about the inconvenience, most users understand the logistics and are happy with the action taken.

THE FUTURE OF THE SILK ROAD

The Silk Road has grown exponentially since it opened two years ago despite the many ups and downs. Though its currency crashed, a DOS shut it down, governments have targeted it, and the media has both condemned and admired it, users support it whole-heartedly. They come together in a forum where solidarity in their illegality can be found. They buy and sell goods that often cannot be found on the Surface Net or often on the Deep Net. They built a reputation system that keeps transactions safe and fair for both parties. There have been arrests as well as a successful conviction, but most remain completely, anonymously safe.

Though there have been technical difficulties, the Silk Road business model is a success; most startups – legal or otherwise – cannot boast \$2 million in revenue their second year. That kind of success is usually reserved for elite Silicon Valley tech wizards.

The site fills a niche market that most users didn't know they even needed, in the way of many ecommerce success stories. Turnover for new users may be high, but once a user has made a few purchases they are hooked. Drugs are naturally addicting and the site makes a sizeable profit from addicts who have to get drugs to fulfill their needs. Instead of going to the street, these people can now order online anonymously and safely. The process of buying online is itself addicting.

The loyal customer base also returns for the solidarity found within the Silk Road Forum. Society condemns vendors as drug dealers and customers as criminals, seeking harsh legal consequences for both parties. Dread Pirate Roberts, an outspoken libertarian, leads a mini-movement within the site of users that advocate for the decriminalization of drugs and other contraband. Others find communities around specific products that would be difficult to establish in their communities because of small populations or the necessity of anonymity.

Because these users are incredibly loyal, because the Silk Road is growing despite major setbacks, because the market has monopolized online illegal sales, and because the site architecture has withstood police and federal investigations from multiple countries, this community has proven itself durable. It has faced adversity, overcoming each obstacle.

This is not to say that there is no future obstacle could end the Silk Road. It is almost inevitable that it be taken down by one government or another (there is no such thing as a perfect crime). But that day is predictably a long way off, perhaps so long off that most of the listings posted on the marketplace will be legalized and actually sold on Amazon.

For the foreseeable future, users will continue to flock to the market, causing the Silk Road to continue monopolizing the ecommerce black market. At least until a legal body has the power to stop it.

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