PRODAFT

PROACTIVE DEFENSE AGAINST FUTURE THREATS

# LockBit RaaS
# In-Depth Analysis

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**What's new?**

The PRODAFT Threat Intelligence (PTI) Team has published this report to provide in-depth knowledge about the threat actors who operate LockBit ransomware. The PTI Team has managed to extract decryption tools for most of the victims who were affected by the LockBit. All affiliates of the ransomware group, including the developer, were also identified during the investigation of the PTI Team. This report answers questions such as : How do they select their targets? How many targets did they breach? How does the network operate? Who are the affiliates?

**Why does it matter?**

Ransomware is a growing problem and most of the research in this area is focused on analyzing malware samples and their encryption techniques. There are a limited number of sources which cover the working dynamics of the threat actors. Statistics related to the ransomware groups are formed by reported cases and approximations. This report contains the most accurate metrics and provides a full visibility of a well-known ransomware group structure.

**What should be done?**

If no one pays any ransom then the ransomware business will surely end. However, this is not an easy decision when C-levels are under constant pressure of losing reputation and money. The report will help the reader to understand more about the threat actors and their operations. Several countermeasures will be provided along with the vulnerabilities used in ransomware cases. **#DontPanicDontPay**

# 1 Introduction

Ransomware is a type of malicious software which encrypts the victim's data and demands a ransom payment. In addition to making the data inaccessible, most of the attackers threaten to publish the victim's data unless the ransom is paid until a certain time (*"Double Extortion"*). Ransomware is mostly used as a money making scheme by cyber criminals, however it may also be used in different scenarios to coerce the user into any action by using leverage. While ransomware has been in use for decades, it has gained much popularity among cyber criminals in recent years due to the level of experience it requires to conduct such attacks and the easiness of using anonymous payment methods. It is expected that losses from ransomware attacks are likely to exceed $20 billion by 2021 [1].

Ransomware can be separated into two groups based on their modus operandi, namely FAR (Fully Automated Ransomware) and SAR (Semi-Automated Ransomware). In FAR cases, ransomware generally infects the system via phishing emails or malicious web pages which contain the malicious payload. The malware contains the code to spread deeper into the network, identify files, carry out the encryption, and leave a note to the victim, explaining how to make the payment for the recovery. Threat actors using FAR mostly focus on distribution channels and spreading methods of the malware and tend to stay away from making direct contact with the victim. Although the execution of the FAR attacks is more straightforward, the success rate is much lower for high-value organizations as they have different protection tools such as AVs, access controls, and EDRs in place. Victims of FAR attacks also more cautious about paying the ransom as there is a tendency among people to distrust automated systems. The behavior model is similar to a customer asking for a representative before purchasing to clarify doubts. It is hysterical to see people still want to negotiate and discuss the payment with a human being, knowing that they are criminals.

On the other hand, SAR attacks involve manual interaction of cyber criminals with the victims' servers. In order to access the network of the target organization attackers often use 0-day or N-day exploits. We also observe that some of the attackers buy RDP or VPN credentials directly from other hackers and underground markets. Upon successful entry, attackers use common pentest tools for lateral movement in the network, escalate their privileges, and carry out encryption step via set of encryption tools and/or ransomware. In rare occasions, some of the encrypted data can be recovered due to operational mistakes [4].

Modern cyber crime businesses use hierarchical work flow to monetize their operations. X (Ransomware, Malware, Dropper, ...) as a Service models became popular among criminals as different skill-set required in conducting such advanced attacks. In this report, we will explain how RaaS models work in general and also present in-depth knowledge from the attackers side. We believe that our findings will help other researchers to understand working dynamics of similar ransomware groups.

In this report we will analyze a widely known ransomware called "LockBit" and provide a deep understanding of how criminals breach and monetize their operations. We will not focus on sample analysis as there are many resources covering the technical analysis part of the malware execution. Instead, this will be the first report which presents all possible

behind-the-scenes information of a large ransomware group.

> Please note that this report has two versions. The *"Private Release"* is provided to law enforcement agencies, applicable CERTS / CSIRTS, and members of our U.S.T.A. Threat Intel Platform (with appropriate annotations and reductions). Likewise, the *"Public Release"* is publicly disseminated for the purpose of advancing global fight against high-end threat actors and APTs.

# 2 Executive Summary

## 2.1 Overview

LockBit is a relatively new ransomware which became quite popular in the past few months. Formerly known as "ABCD" ransomware, it has since grown into a unique threat within the scope of these extortion tools [3]. Our PTI Team started analyzing LockBit group around 20.03.2021 based on an emergency request from one of our clients. The investigation completed by successfully retrieving the decryption keys and restoring the files of our client. Moreover, we helped dozens of other victims to retrieve their decryption keys, thus prevented an estimated 8 million dollars of loss. This report presents interesting facts about the ransomware business by accurately showcasing rates, commissions, infection techniques, and criminal organization's structure.

## 2.2 LockBit Ransomware

LockBit ransomware is a malicious program that prevents users from accessing their computers unless the requested ransom payment is given to the attackers. LockBit can automatically scan a network for useful targets, spread the infection, and encrypt all computers that are available. This ransomware is used in very unique attacks against companies and other organizations.

According to the statistics shared by the [2], The LockBit ransomware attacks has increased drastically in the Q4 of 2020. Following table shows that LockBit ransomware is at the third place among other ransomware families with 7.5% of the market share.

## Most Common Ransomware Variants in Q1 2021

| Rank | Ransomware Type | Market Share % | Change in Ranking from Q4 2020 |
|---|---|---|---|
| 1 | Sodinokibi | 14.2% | - |
| 2 | Conti V2 | 10.2% | +4 |
| 3 | Lockbit | 7.5% | +6 |
| 4 | Clop | 7.1% | New in Top Variants |
| 5 | Egregor | 5.3% | -3 |
| 6 | Avaddon | 4.4% | +3 |
| 7 | Ryuk | 4.0% | -4 |
| 8 | Darkside | 3.5% | New in Top Variants |
| 9 | Suncrypt | 3.1% | -1 |
| 9 | Netwalker | 3.1% | -5 |
| 10 | Phobos | 2.7% | -1 |

*Top 10: Market Share of the Ransomware attacks*

**Figure 1. COVEWARE Most Common Ransomware Variants in Q1 2021**

For ransomware creators, RaaS is a new business model. The ransomware developers, similar to software as a service (SaaS), sell or lease their ransomware variants to affiliates, who then use them to carry out attacks. This business model often includes a platform in the form of a management panel. Customers of LockBit service(affiliate threat actors) uses this management panel to create new ransomware samples, manage victims and get statistics about their attacks. According to the PTI Team investigation LockBit threat actors are also using methods called extortion and victim shaming to force victims to pay the ransom money.

> **Analyst Note :** The concept of "victim shaming" can be explained as, a pressure tactic often used by ransomware groups to push victim organizations into full filling the ransom demand. This tactics may include threatening to release stolen confidential data of the victims or e-mailing the business partners of the victims about the ransomware attack.

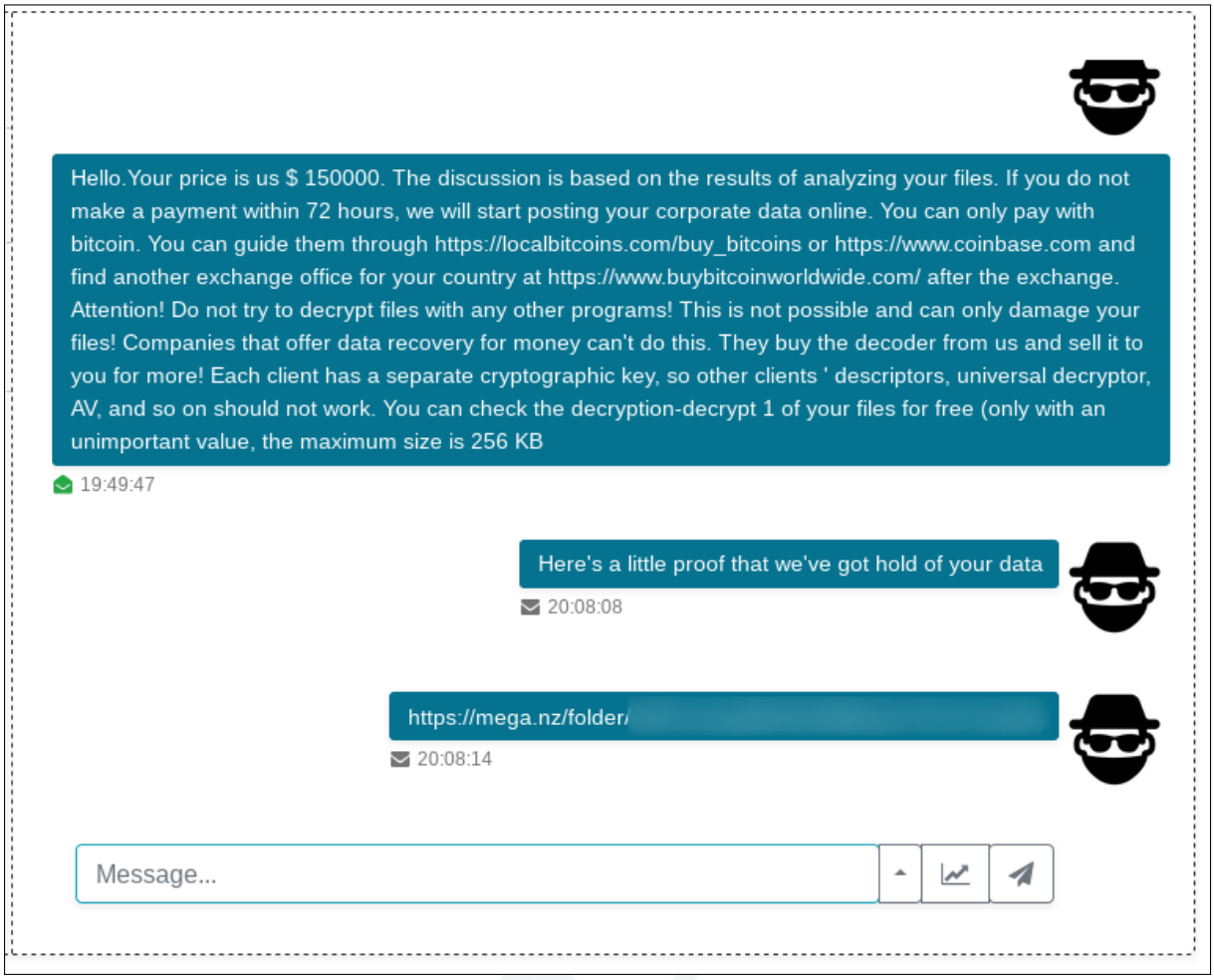



Figure 2. **LockBit threat actors using extortion**

## 2.3 RaaS Business Structure

RaaS owners employ multiple affiliates who are responsible for breaching into victims and encrypt their files. These affiliates are selected mostly from forums, among highly-skilled hackers with penetration testing background. Another way of becoming an affiliate is to have an established trade network to obtain access information from other criminals. In both cases, RaaS owners require references from other criminals before hiring any affiliate. Reputation of the criminals become essential in such cases. Most of the affiliates earn between 10%-30% commission from each ransom payment. RaaS owners also often provides virtual machines, exploits, and tools for their affiliates to support their attacks. Each affiliate has an access to a panel where they can monitor their victims and communicate with them. An affiliate panel usually has the following capabilities :

- Creating/Building a ransomware executable
- Providing a Decryptor program upon payment
- Providing a payment gateway (cryptocoins) for the victims
- Calculating the commission rates of the affiliates

- Monitoring victims and statistics
- Providing a chat functionality to talk with the victims

Affiliates try to maximize their profit by forcing victims to pay using different psychological tactics (See Section 4.2). Moreover, affiliates are expected to be in a constant effort to breach into new targets. Whenever an affiliate becomes inactive for a long period of time, RaaS owners remove the account of that affiliate which will also effect their reputation.

# 3 Technical Analysis

This section contains technical analysis of the LockBit ransomware as a service (R.A.A.S.) platform including the management panel, ransomware sample, decryptor software and the step by step analysis of a LockBit attack kill chain. This section also contains intelligence about the threat actors(developers and affiliates) using LockBit service and their TTP analysis.

## 3.1 The LockBit Attack Kill Chain

Following steps will briefly explain the overall LockBit attack kill chain, every piece of techniques, tactics, and procedures given in the following steps are based on the LockBit service affiliates at the time of the PTI Team investigation. The attack vectors and every kind of actor specific behaviour can be different in every LockBit attack, since LockBit is a R.a.a.S platform.

### 3.1.1 Target Selection

Ransomware operators use multiple methods for selecting their next potential target. LockBit affiliates use mass vulnerability scanning, phishing, and credential stuffing[8] as main sources for finding new victims. According to our investigation, the most frequent method used by the LockBit group is to buy already compromised servers & RDP accesses from underground shops. These kind of credentials can be purchased as low as $5, thus makes it very lucrative for affiliates considering the demanded ransom amount. During the LockBit investigation, the PTI Team was also able to identify couple of the attack vectors used for mass vulnerability scanning by the LockBit affiliates. According to the chat logs between the LockBit affiliates and multiple victims, the Fortinet VPN exploit [6] was one of the most used method to gain access to the target company networks.

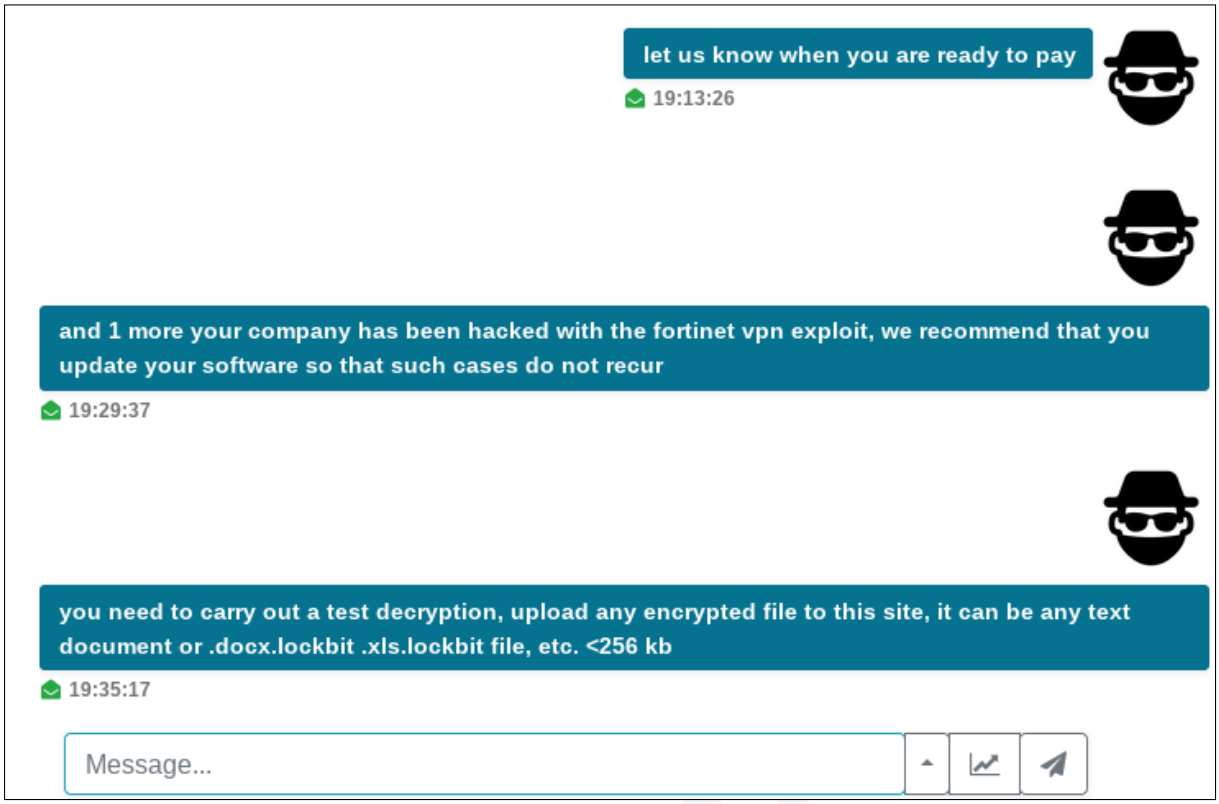



Figure 3. **LockBit affiliate explaining the used attack vector**

The PTI Team was also able to contact multiple LockBit victim companies. Based on the forensic analysis made on the victim companies, the PTI Team came to the conclusion that LockBit affiliates also uses generic Phishing campaigns and credential stuffing attacks for gaining access to the target company servers.

### 3.1.2 Preparation

After gaining access to the target company servers, LockBit affiliates usually starts the enumeration process. According to our forensic investigations on multiple LockBit victims, the PTI Team observed that before launching the LockBit ransomware, attackers tries to identify mission critical systems such as domain controllers, backup servers or NAS devices. Once the necessary enumeration is done by the attackers, the data exfiltration phase begins. The LockBit attackers evaluate the data inside the breached system and decide whether it is important for the target company. The critical data gets exfiltrated by the attackers and uploaded to free file upload services such as MEGA. Uploaded data are used for extortion while negotiating with the victims.

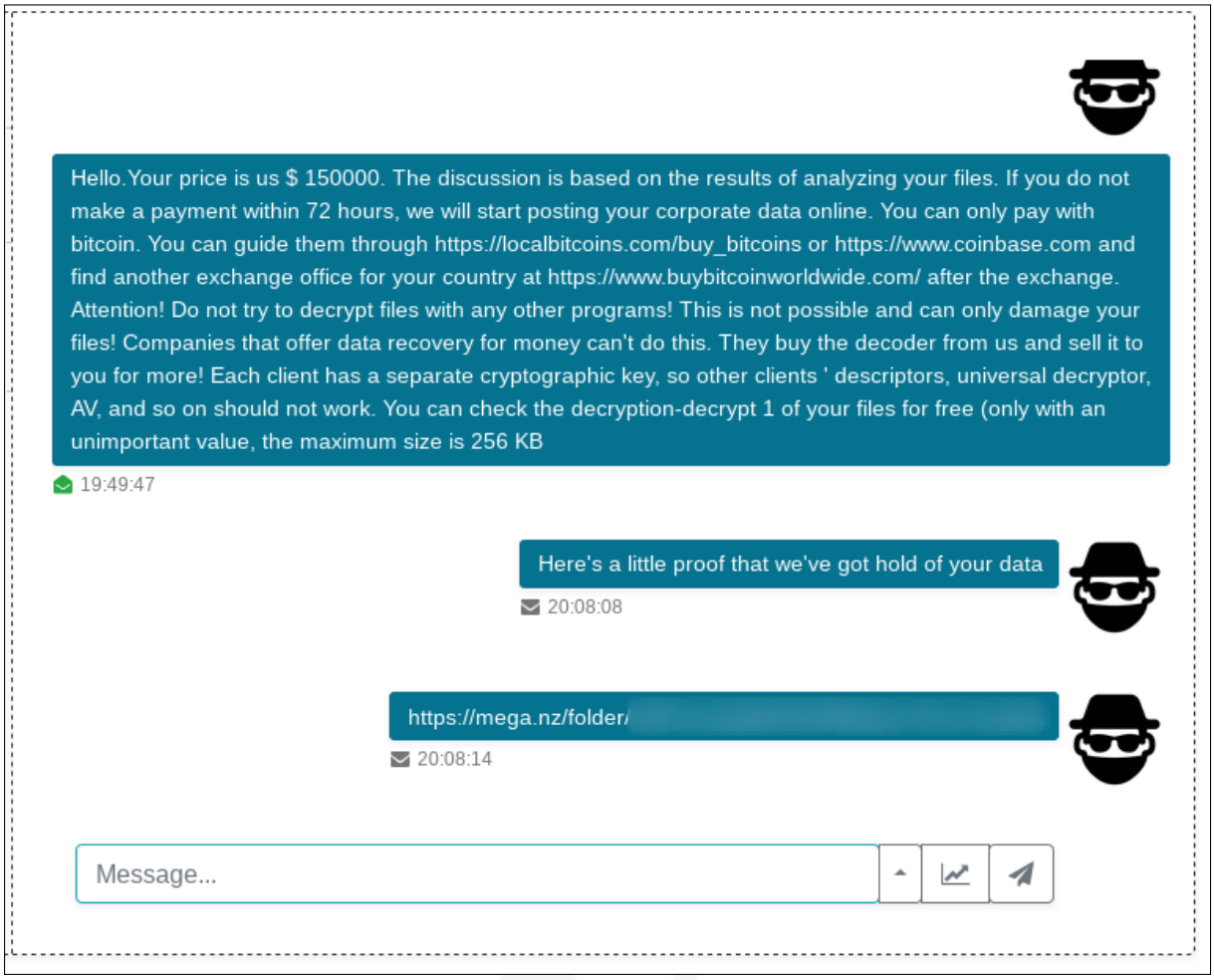



Figure 4. **Exfiltrated data used for extortion**

After the data exfiltration phase, a unique LockBit ransomware sample is generated from the build page of LockBit management panel. The build page of LockBit management panel is shown in the following image.

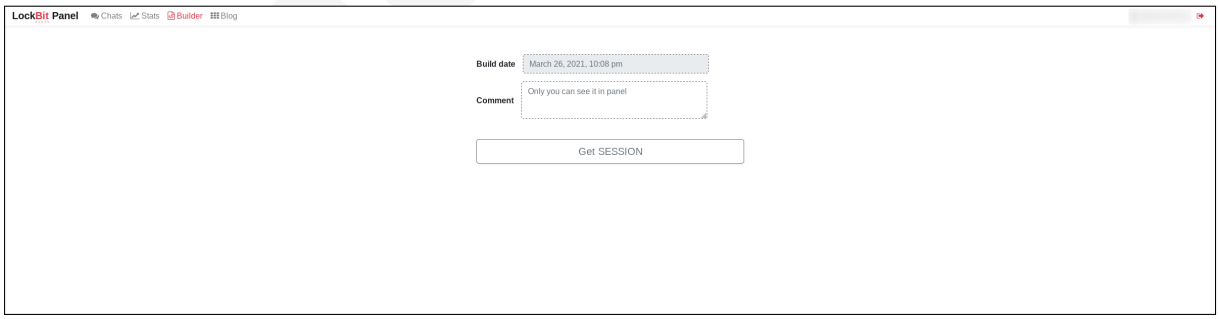



Figure 5. **LockBit management panel builder page**

Affiliates are able to build unique ransomware samples with entering a explanatory comment. The build comments are used for identifying the victims and their systems, usually LockBit

affiliates enter the target company name as comment. Because once the victim company starts a dialog with their unique session key, the chat session is tagged with the corresponding build comment on the LockBit management panel database.

### 3.1.3 Deployment and Execution

In this step the LockBit ransomware generated by the affiliates are executed manually inside the target company systems. Once the LockBit ransomware executed in a system, it will immediately begin the reconnaissance phase, in this phase of the ransomware attack, LockBit sample will try to enumerate all the accessible directories and network shares inside the target system.

After the enumeration LockBit ransomware encrypts each file with a random AES key. Randomly generated AES key is encrypted with the static public key inside the LockBit sample, finally encrypted AES key is inserted into a specific offset inside the file. This way every file inside the target system is encrypted with a different key. And each file can only be opened by the randomly generated RSA private key during the build of the unique sample on the management panel.

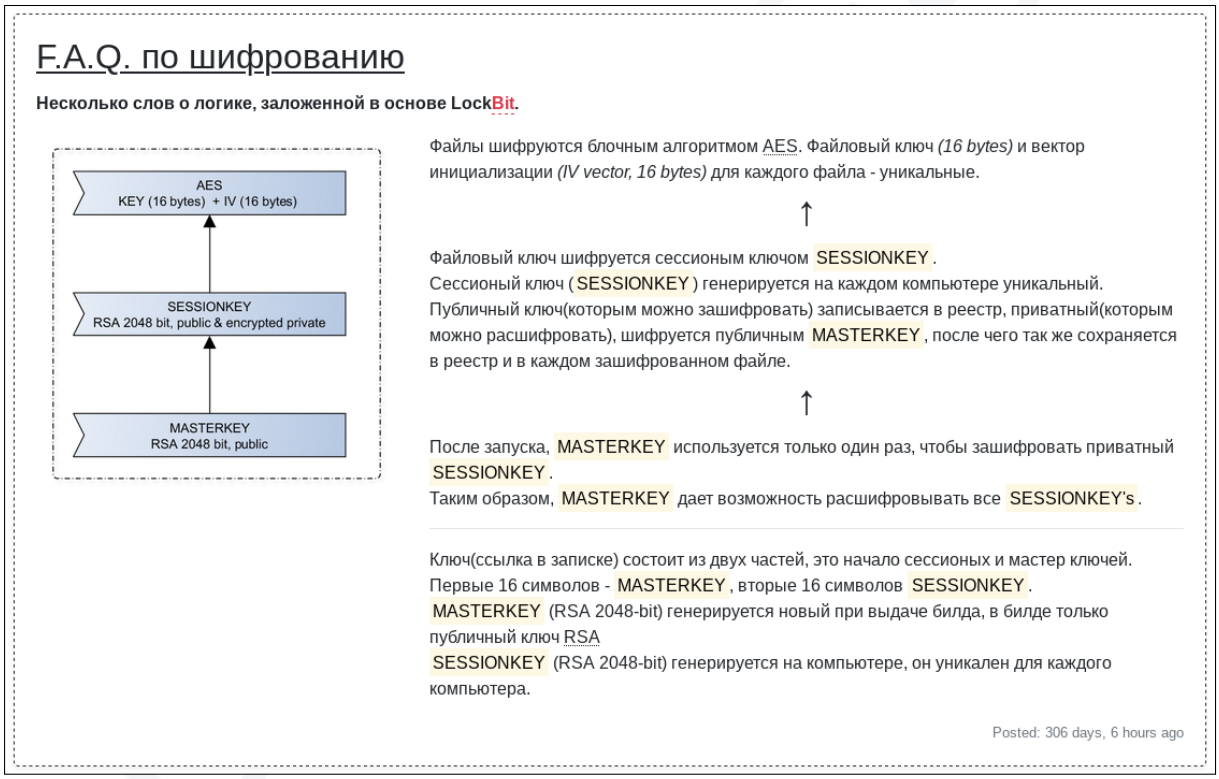



Figure 6. **LockBit ransomware working logic**

### 3.1.4 Demand and Negotiation

At the end of the ransomware execution phase, all important files of the victim are encrypted, backups are deleted and the system wallpaper is changed with the following image.


Figure 7. **Victim desktop after LockBit attack**

As described in the wallpaper image, LockBit ransomware creates "Restore-My-Files.txt" and "LockBit-note.hta" files on the target system desktop. The HTA file is executed automatically upon creation. The "LockBit-note.hta" file is a well designed HTML page explaining the situation and ways to contact the LockBit attackers for purchasing a decryptor software.

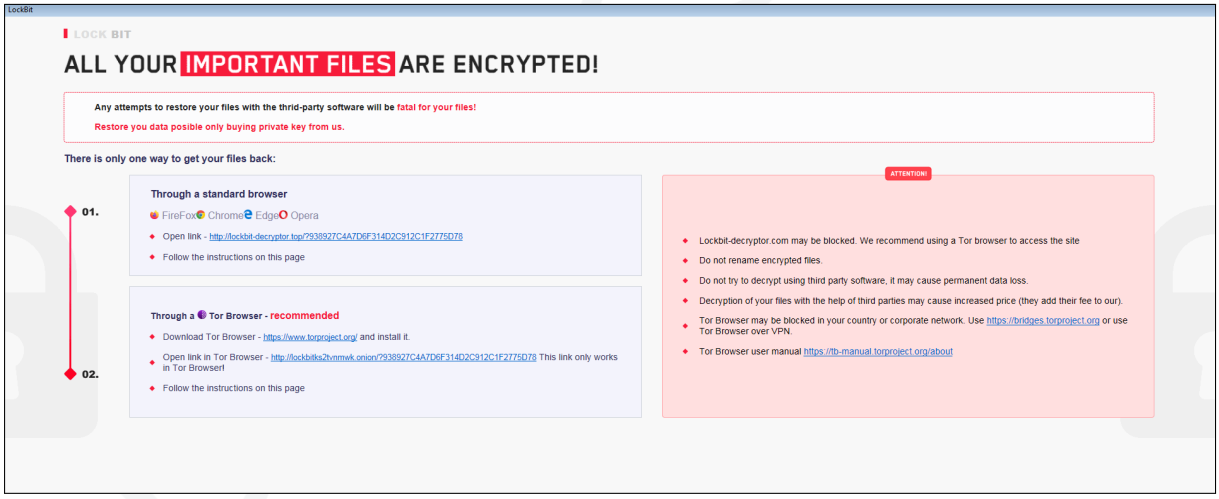



Figure 8. **LockBit ransom note inside the victim system**

According to the ransom note, the **http://lockbit-decryptor.top/** and **http://lockbitks2tvnmwk.onion/** websites contains further instructions for purchasing a decryptor software. The ransom note also contains instructions about installing TOR browser in order to access the LockBit's ONION web page. During the time of the PTI Team investigation lockbit-decryptor.top domain was no longer active. The links inside the ransom

note contains a get parameter value formed by victims master and session keys. Once the victims visit the LockBit website with the given unique link, they are greeted with the following page.

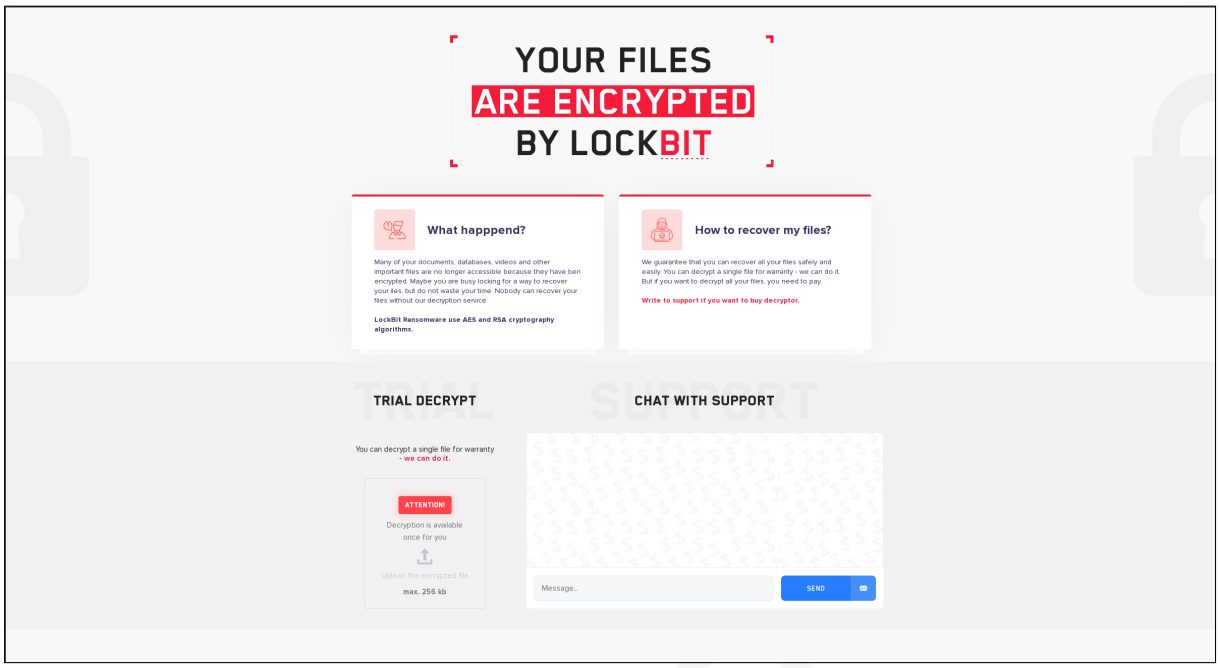



Figure 9. **LockBit victims landing page**

LockBit contact page contains "CHAT WITH SUPPORT" and "TRIAL DECRYPT" sections, victims are expected to get in contact with the LockBit attacker using the chat window regarding the purchase of the decryptor software. Once a victim sends a message over their unique contact URL, new victim tab with the corresponding build comment shows up on the LockBit management panel dashboard. The "TRIAL DECRYPT" section inside the victim dashboard, allows the victims to decrypt a single file with a size smaller than 256KB. This particular file must originate from the system with the corresponding ID(unique contact URL). The LockBit panel automatically checks whether if the given file actually belongs to the corresponding victim ID and then serves the decrypted file to the victim. This feature ensures the victims that LockBit attackers are able to decrypt their files successfully and with an automated fashion.

## 3.2 Management Panel

During the investigation, the PTI Team was able to detect and gain access to some parts of the LockBit R.a.a.S. infrastructure. The LockBit infrastructure consists of a management panel hosted as a TOR hidden service website with the address **http://lockbitaptku3l2q.onion/**. The management panel is mainly used for managing victims, affiliate accounts, generating new ransomware builds and serving the decryptor software if the demanded ransom is payed.

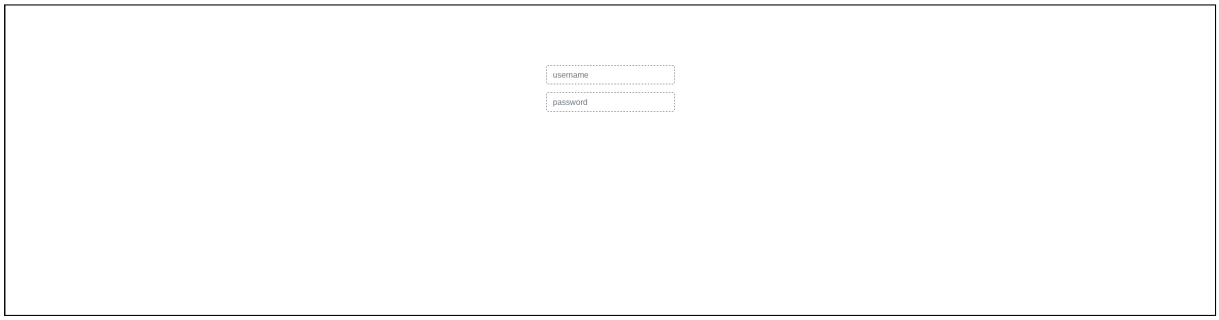



Figure 10. **LockBit management panel login page**

As described in the previous step, main dashboard of the LockBit management panel contains the chat window. As can be seen in the following image, the LockBit affiliates often starts the conversation with a prepared text that explains the situation briefly and informs the victims about the current decryptor price, payment deadline, payment method(BTC), and instructions about how to obtain bitcoin for payment.

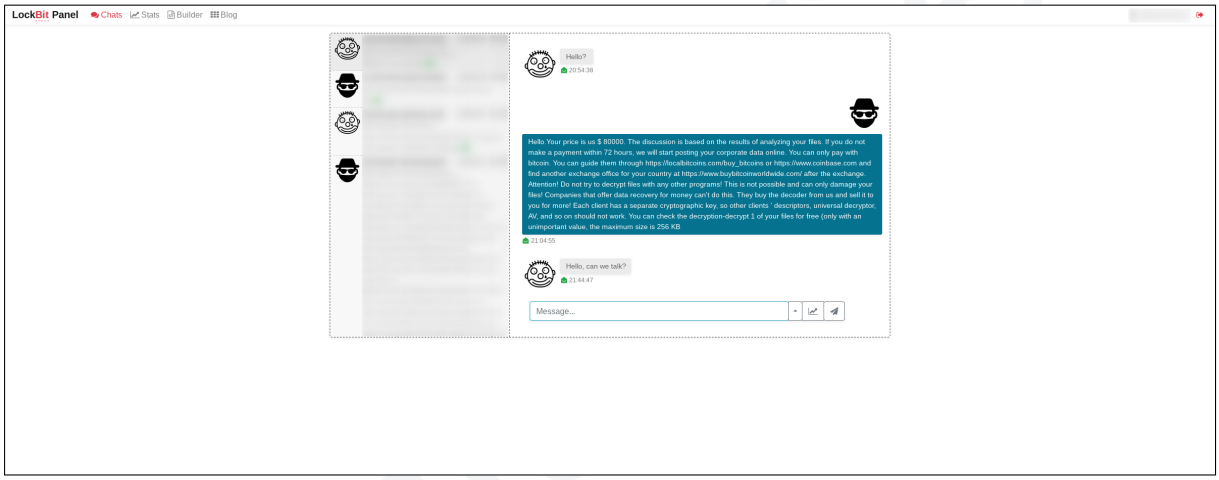



Figure 11. **LockBit management panel chat page**

Affiliates also explains the "TRIAL DECRYPT" mechanism to the victims because the trial decrypt step is mandatory for purchasing the decryptor software. Each victim must upload a file for trial decrypt in order to get the decryptor software. This mechanism prevents third party intervention to the process and ensures that the negotiator actually has access to the victim files. On the chat window there is a victim details button that displays the victim master and session keys, fist and last visit dates, total views, build date and build comments. Following image contains the mentioned victim details window.


**Figure 12. LockBit management panel victim details**

The LockBit affiliates can also view their current victim statistic on the management panel statistics page. Page contains a view chart, recently visited victims, and recently uploaded test files. The affiliates are able download the decrypted victim test files from this page.

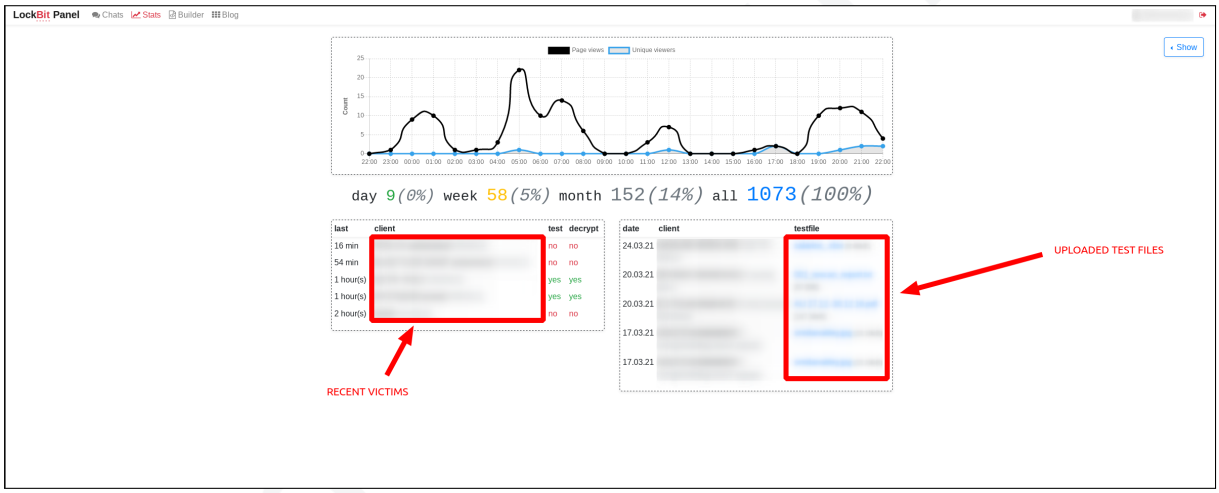



**Figure 13. LockBit management panel statistics page**

Finally, inside the affiliate management dashboard chat window there is a "Decrypt" button for automatically generating the decryptor for that particular LockBit victim. In order to successfully generate the decryptor, victims need to upload a encrypted file for trial decrypt. Once the decryptor generated for that particular victim, the chat session gets removed from the LockBit affiliate's dashboard and conversation ends.

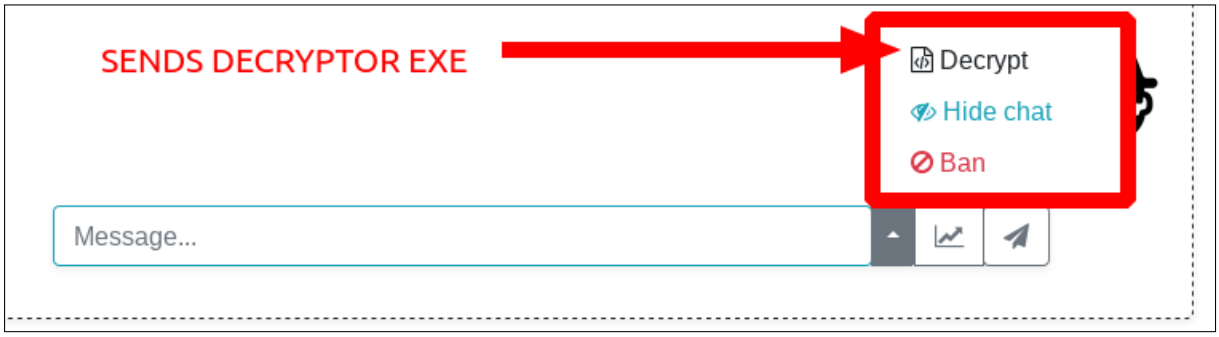



Figure 14. **LockBit management panel victim decrypt button**

Another role of the LockBit management panel is managing the affiliate accounts. When the admin user logs into the management panel, user is greeted with extra "Users", "BlogPost", "PhpMyAdmin" pages for adding new affiliate accounts, publishing new blog post entries and accessing the PhpMyAdmin panel.

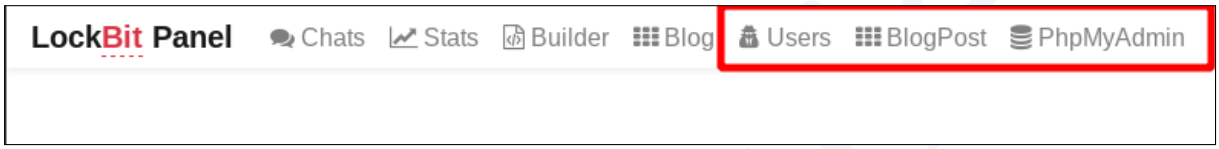



Figure 15. **LockBit admin user panel menu**

The admin user is also able to view every affiliate chat session inside the main dashboard of the management panel. The statistics page also includes all victim page views of every affiliate account when logged in with the admin user.

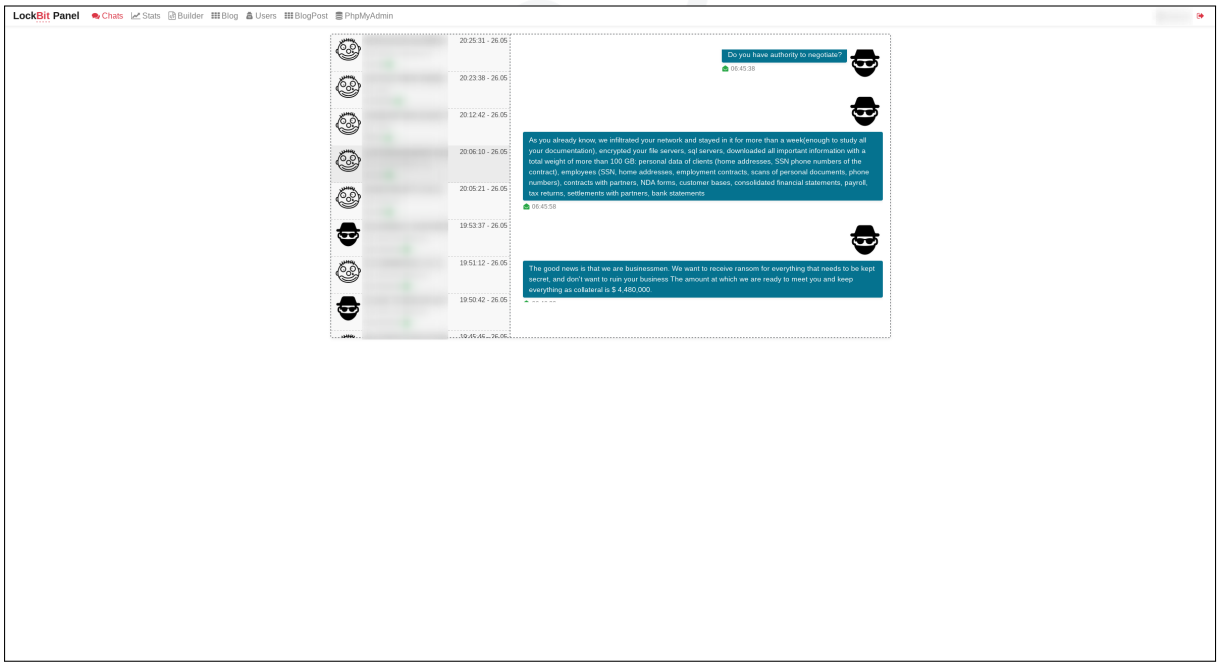


Figure 16. **LockBit admin user dashboard**

The admin user is also able to access the PhpMyAdmin panel for removing affiliate users and manually extracting decryption keys of the victims. The PhpMyAdmin panel is found to be located at address **http://lockbitaptku3l2q.onion/bfdnffektc/**.

## 3.3 LockBit Decryptor

Once the decrypt button is pressed for a victim on the management panel, a unique decryptor EXE file is generated for that particular victim's ID(master an session keys). If the victim used the trial decrypt attempt, generated decryptor software link will be displayed at the bottom of the victims chat page. From this point victims can download the decryptor EXE file and run inside their encrypted systems for decrypting their files.

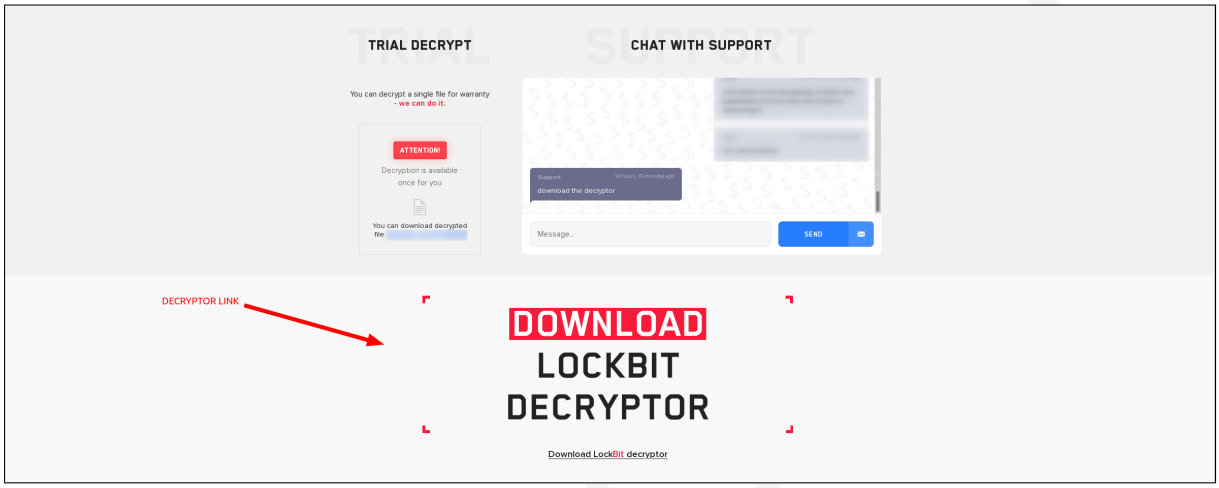
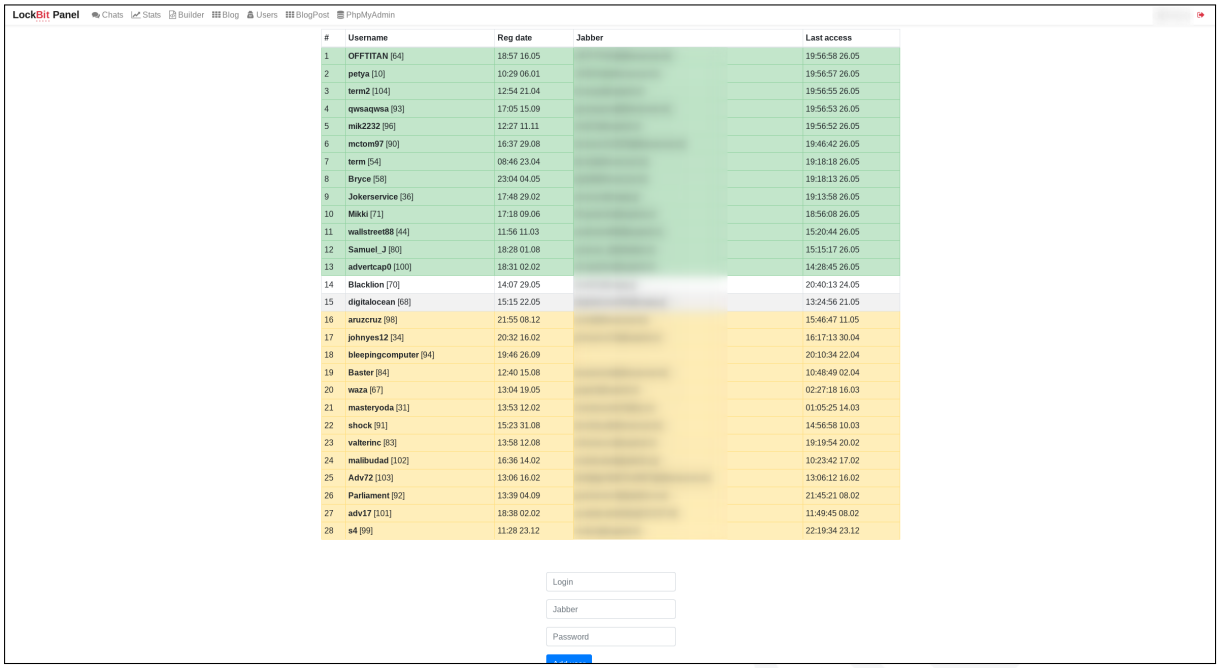



Figure 17. **Enabled LockBit decryptor link inside the victim chat dashboard**

According to the PTI Team analysis, decryptor software successfully decrypts the locked files inside the victim's system without performing any malicious activity.

## 3.4 De-Anonymization

The PTI Team also focused on revealing the identity of the LockBit affiliates, retailers, and developers. The management panel analysis revealed many information about the LockBit affiliates. As described at the 3.2 section, the admin user is able to view and manage affiliate accounts on the system. As can be seen in the following image every affiliate account is created with a Jabber contact address.




| # | Username | Reg date | Jabber | Last access |
|---|---|---|---|---|
| 1 | OFFTITAN [64] | 18:57 16.05 | | 19:56:58 26.05 |
| 2 | petya [10] | 10:29 06.01 | | 19:56:57 26.05 |
| 3 | term2 [104] | 12:54 21.04 | | 19:56:55 26.05 |
| 4 | qwsaqwsa [93] | 17:05 15.09 | | 19:56:53 26.05 |
| 5 | mik2232 [96] | 12:27 11.11 | | 19:56:52 26.05 |
| 6 | mctom97 [90] | 16:37 29.08 | | 19:46:42 26.05 |
| 7 | term [54] | 08:46 23.04 | | 19:18:18 26.05 |
| 8 | Bryce [58] | 23:04 04.05 | | 19:18:13 26.05 |
| 9 | Jokerservice [36] | 17:48 29.02 | | 19:13:58 26.05 |
| 10 | Mikki [71] | 17:18 09.06 | | 18:56:08 26.05 |
| 11 | wallstreet88 [44] | 11:56 11.03 | | 15:20:44 26.05 |
| 12 | Samuel_J [80] | 18:28 01.08 | | 15:15:17 26.05 |
| 13 | advertcap0 [100] | 18:31 02.02 | | 14:28:45 26.05 |
| 14 | Blacklion [70] | 14:07 29.05 | | 20:40:13 24.05 |
| 15 | digitalocean [68] | 15:15 22.05 | | 13:24:56 21.05 |
| 16 | aruzcruz [98] | 21:55 08.12 | | 15:46:47 11.05 |
| 17 | johnyes12 [34] | 20:32 16.02 | | 16:17:13 30.04 |
| 18 | bleepingcomputer [94] | 19:46 26.09 | | 20:10:34 22.04 |
| 19 | Baster [84] | 12:40 15.08 | | 10:48:49 02.04 |
| 20 | waza [67] | 13:04 19.05 | | 02:27:18 16.03 |
| 21 | masteryoda [31] | 13:53 12.02 | | 01:05:25 14.03 |
| 22 | shock [91] | 15:23 31.08 | | 14:56:58 10.03 |
| 23 | valterinc [83] | 13:58 12.08 | | 19:19:54 20.02 |
| 24 | malibudad [102] | 16:36 14.02 | | 10:23:42 17.02 |
| 25 | Adv72 [103] | 13:06 16.02 | | 13:06:12 16.02 |
| 26 | Parliament [92] | 13:39 04.09 | | 21:45:21 08.02 |
| 27 | adv17 [101] | 18:38 02.02 | | 11:49:45 08.02 |
| 28 | s4 [99] | 11:28 23.12 | | 22:19:34 23.12 |

**Figure 18. Users page of the LockBit admin panel**

Table 1 contains the usernames, number of victims, register and last access dates for every LockBit affiliate.

| Username | Victims | Register Date | Last Access Date |
|---|---|---|---|
| OFFTITAN | 64 | 18:57 16.05 | 19:56:58 26.05 |
| petya | 10 | 10:29 06.01 | 19:56:57 26.05 |
| term2 | 104 | 12:54 21.04 | 19:56:55 26.05 |
| qwsaqwsa | 93 | 17:05 15.09 | 19:56:53 26.05 |
| mik2232 | 96 | 12:27 11.11 | 19:56:52 26.05 |
| mctom97 | 90 | 16:37 29.08 | 19:46:42 26.05 |
| term | 54 | 08:46 23.04 | 19:18:18 26.05 |
| Bryce | 58 | 23:04 04.05 | 19:18:13 26.05 |
| Jokerservice | 36 | 17:48 29.02 | 19:13:58 26.05 |
| Mikki | 71 | 17:18 09.06 | 18:56:08 26.05 |
| wallstreet88 | 44 | 11:56 11.03 | 15:20:44 26.05 |
| Samuel_J | 80 | 18:28 01.08 | 15:15:17 26.05 |
| advertcap0 | 100 | 18:31 02.02 | 14:28:45 26.05 |
| Blacklion | 70 | 14:07 29.05 | 20:40:13 24.05 |
| digitalocean | 68 | 15:15 22.05 | 13:24:56 21.05 |
| aruzcruz | 98 | 21:55 08.12 | 15:46:47 11.05 |
| johnyes12 | 34 | 20:32 16.02 | 16:17:13 30.04 |
| bleepingcomputer | 94 | 19:46 26.09 | 20:10:34 22.04 |
| Baster | 84 | 12:40 15.08 | 10:48:49 02.04 |
| waza | 67 | 13:04 19.05 | 02:27:18 16.03 |
| masteryoda | 31 | 13:53 12.02 | 01:05:25 14.03 |
| shock | 91 | 15:23 31.08 | 14:56:58 10.03 |
| valterinc | 83 | 13:58 12.08 | 19:19:54 20.02 |
| malibudad | 102 | 16:36 14.02 | 10:23:42 17.02 |
| Adv72 | 103 | 13:06 16.02 | 13:06:12 16.02 |
| Parliament | 92 | 13:39 04.09 | 21:45:21 08.02 |
| adv17 | 101 | 18:38 02.02 | 11:49:45 08.02 |
| s4 | 99 | 11:28 23.12 | 22:19:34 23.12 |

**Table 1.** LockBit Full List of Affiliate Information

The reconnaissance on the Jabber addresses and aliases of the affiliates revealed that two of the threat actors might also be working for Babuk [5] and REvil [9] ransomware groups. The detailed information about the connection between two threat actors and other ransomware groups is redacted due to ongoing investigation.
The analysis on the victim chat logs revealed several other BTC wallet addresses shared additionally with some of the victims. The PTI Team is still conducting taint analysis on the wallet addresses for detecting shared spending or laundering attempts.

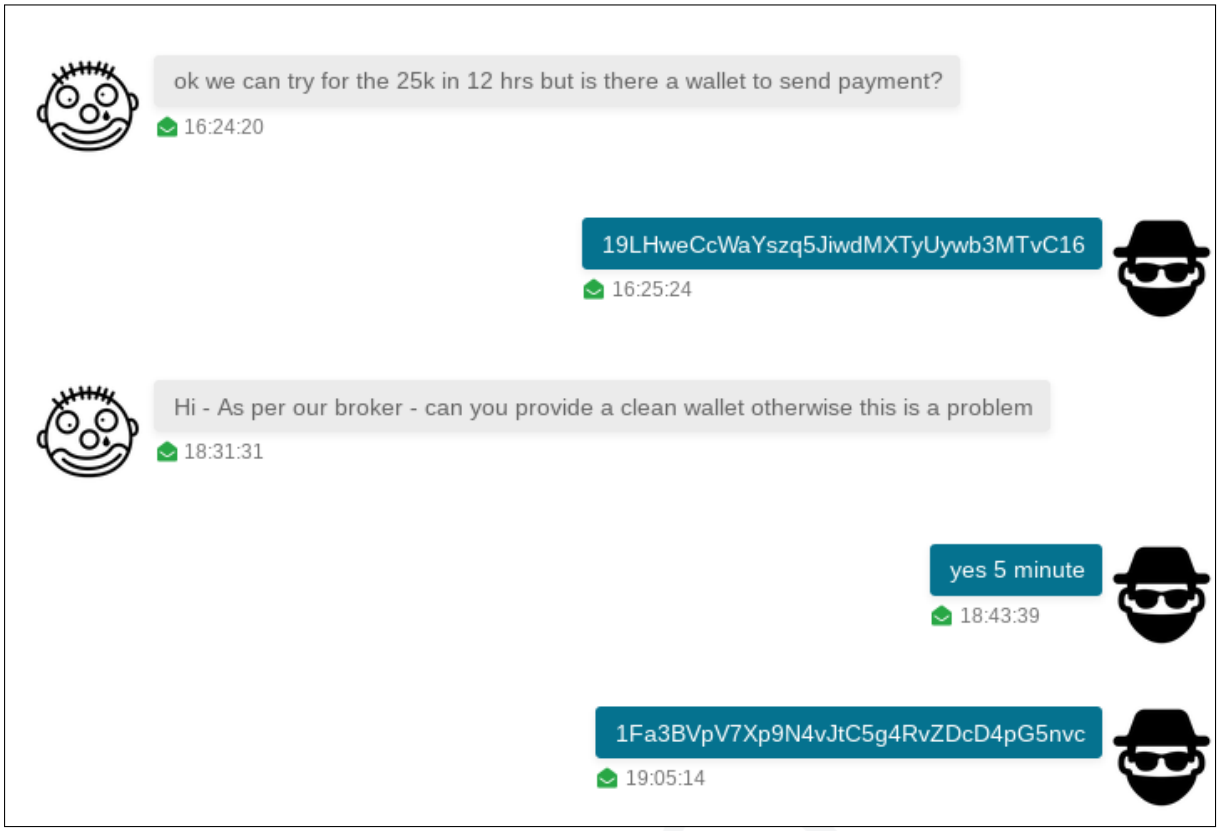



**Figure 19. LockBit threat actor giving out alternative wallet addresses**

The PTI team was able to capture **45.135.187.132** IP address on Monday, 22 March 2021 21:30:03 UTC which is the IP address of one of the LockBit developers. Based on our observation, the IP is another proxy layer (probably a VPN) used before accessing to the TOR network. We were also able to identify the OS details of the hidden server during our investigation. The hidden service host is found to be a Ubuntu server with host name "Fibonacci".

```
Linux Fibonacci 4.15.0-99-generic #100-Ubuntu SMP Wed Apr 22 23:32:56 UTC+3 2020
x86_64
/>
```

**Console 1.** OS Details of the LockBit onion server

The captured IP address with the corresponding timestamp are shared with the local law enforcement authorities for further legal action.

# 4 Statistics and Observations

According to the victim details obtained from each of the affiliate accounts on LockBit management panel, the PTI Team discovered that the LockBit R.a.a.S platform has successfully infected more than thousands of devices around the world. Almost all of the victims are enterprise corporations. The average ransom amount is calculated to be roughly $85,000.

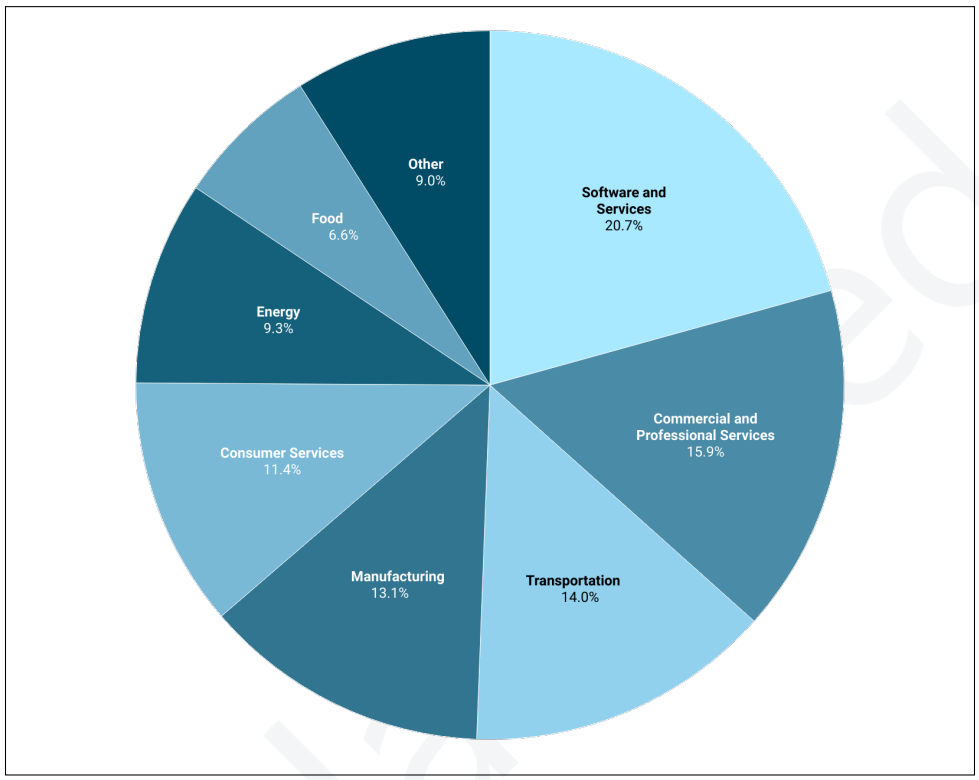



Figure 20. **Sector distribution of victims**

Victim sector distribution does not show a significant value for the investigation as criminal groups buy accesses and scan vulnerable hosts almost in a random fashion. We can see that more than 20% of the victims were operating in the software and services sector. Commercial and professional services as well as the transportation sector also highly targeted by the LockBit group. However, it should be noted that the value of the ransom is determined by the affiliate after various checks using online services. This value does not solely depend on the sector of the victim.

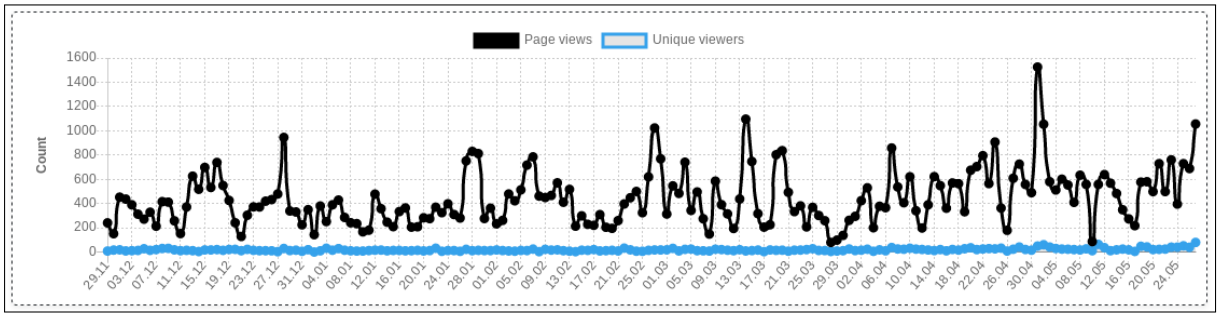



Figure 21. **Victim page view statistics**

Page view statistics show us the ransomware victims are . We can clearly see that the activity peaked around the beginning of May 2021. The indicator also shows that on 11th of May, there were no page views. This might be caused from a fault, system upgrade, or a possible DDOS attack. Several other ransomware groups were also presented in global articles around these times, which might be another indicator of a possible server upgrade/transfer. The server became after the 12th of May, and the activity increased for the following week. As the TOR hidden server reroutes the traffic to 127.0.0.1, the unique IP count is shown as 0 on most of the dates. Several deviations present local page hits (mainly from the developer side).

## 4.1 Known Recruiter Profiles

Ransomware groups hire several people from deepweb/darknet forums to attract new affiliates into their network. These recruiters generally create topics in well-known forums and discussion boards. In order to become an affiliate, one must have high-skills, motivation, and good references who can verify the candidate. In the following examples, we present several Call for application posts written by the LockBit recruiters.

On average, affiliates gain between 10%-30% commission from each ransom payment.

## 4.2 Psychological analysis

> "Do you accept the terms of the contract ?"

It bears all the hallmarks of the final sentence of a success business conversation – however it is preceded by :

> "ALL YOUR DATA IS ENCRYPTED.To recover the data, you need a decryptor. The cost of the decryptor is 1000 US dollars. Payment is accepted only in bitcoins. after payment, you will receive a decryptor and instructions on how to counteract hacking. Your data will be restored within 15-30 minutes. Do you accept the terms of the contract ?"

The sense of panic is spreading. Perhaps your whole business is thrown down a black hole, and since you want to save your business and the data it has generated in terms of business intelligence, you engage with the individuals – correction – the organised group whose business idea happens to be a criminal one. They prey on the notion that your livelihood is

under threat and you expect to save it. Victim shaming is a powerful tool of persuasion.

Looking at Fig 9, one can not note the sense of business as usual atmosphere that is conveyed. There "What-" and "How-" box – which adequately describe what happened and how you can solve it. And as any proper vendor they offer a sample of their product – the victim is given an opportunity to "TRIAL DECRYPT" one of the ransomed files. Similar to regular businesses they offer "CHAT WITH SUPPORT", should you have any questions ...

We managed to acquire chat logs between the two parties i.e. the victims of extortion and the perpetrators. And it most cases the start with the message above or a similar one, and follow certain pattern : from duress and threats, and prof of data and payment instructions to (almost) friendly advice.

Once the initial sense of helplessness settles, the victims reach out through the platform – the chat forum – provided by the extortionists. What follows is rather a normal conversation between two parties engaged in negotiations :

Negotiations :

> "name the amount you are willing to pay"

> ""If you offer the amount and it suits us, we will make a deal"

Duress and threats :

> "If you do not make a payment within 72 hours, we will start posting..."

> "I will accept your offer if you pay within 12 hours!Hurry up!"

> "24 hours for payment, then the amount will increase to $30,000"

and :

> "Attention! Do not try to decrypt files with any other programs! This is not possible and can only damage your files!"

> "Don't mess with us"

To further their business case the perpetrators offer proof :

> "Here's a little proof that we've got hold of your data"

followed by a link.

Payment instructions :

> "You can only pay with bitcoin. You can guide them through..."

followed by specific instructions and bitcoin wallet information.

And once the victim has provided the wallet to the perpetrators they start to stall before they engage in ransom jacking, from the simple

"wait" to

"the key production time is from 12 to 24 hours"

They also try to come across as if they are doing you a favour, similar to a regular business transaction i.e. you purchased an insurance :

> "After the payment, we will tell you the vulnerability and you will close it. A second attack will be excluded"

Generally the conversations are follow a pattern with almost like standardised answers as seen above, however one cannot refrain from thinking that they maybe Star Wars fans : *"Look for options, time you have"*.

Crime as a service (CaaS) is in this case manifested as ransomware as a service (R.A.A.S) – a service provided by computer experts who happen to be part of criminal networks, making them in fact criminals. It is beyond the scope of this report to further describe the underworld of organised crime, however this is a highly organised and well-developed undertaking.

The chat logs indicate a pattern, comparable to a regular telemarketing call, where the individual perpetrators have the freedom to offer discounts and manage deadlines while still being in control. Considering the nature of the organisational chart of organised crime, it cannot be disregarded that – as a management tool – the use of force, implicitly or explicitly is always a option. As for the victims, they all have their account of what happened and the reason for accepting to pay the ransom. Regardless of the circumstances and the justification for agreeing – paying ransom continues to fuel the industry.

> "We appreciate your patience and understanding"

## 5 Money Flow

During our analysis, we investigated some of the wallet addresses and investigated the money flow throughout the blockchain. We observed that the crime group frequently uses CoinJoin mixing techniques(Wasabi wallet) and several money-laundering services to obfuscate their transactions. In addition to that, closer inspection of the transactions shows some of the money has been converted into different crypto-currencies(Monero, Zcash) using prevalent exchangers like Changenow, Simpleswap, etc. These results provide further support for the idea that KYC/AML procedures are inadequate to stop the ransom payments due to the nature of the operation. Some of the wallet addresses and received amounts are listed in Table 2.

| Wallet ID | Received Amount |
|---|---|
| 1PtfhwkUSGVTG6Mh6hYXx1c2sJXw2ZhpeM | 5.79744443 BTC |
| 13fd2yY6YZCfxBThW56b2qB64GoDAdZ5kX | 0.55172631 BTC |
| 141H8ggje2xpkxaU5omBM2NKmVRaXRrDUP | 0.17925505 BTC |
| 14gDLtXDbeEoABDNdBWfo8gwzAEgrFVSi3 | 0.52314268 BTC |
| 1AtNrniXD3VNsHFJVa9VCrkYyojttq7XfS | 0.48942500 BTC |
| 1ECam5rHSnvDdayDTJhyhgu9vmsZA7RPVk | 0.52958356 BTC |
| 1GDyofmVdpDQorFSJCMALcJpGKEMZGfEvh | 1.25979324 BTC |
| 1HPz7rny3KbjEUURHKHivwDrNWAAsGVvPH | 3.64764636 BTC |
| 1JRy9iccU7WapSzdoCDLxFZ8VKViPrvjPA | 0.18086716 BTC |
| 1LQnQBGq62xsqpm7e3f5PgSTfVaPopHMYY | 3.03000000 BTC |
| 1PCAxk4jqA7fnLdcrQj2o9swa95DejVpv6 | 1.16662661 BTC |
| bc1qq9p72p304ct8fgel6a02qpp5wyd0q8fm2lggzt | 2.53950000 BTC |
| bc1qrqfa59znk9g6u5u52ryzhpqyvn8nu4rp6rgc5z | 0.12000000 BTC |
| bc1qvgpu75msnccdyx744dkz2q8adkdy6eccg0svp2 | 0.30491839 BTC |

**Table 2.** Some of the wallet addresses used during extortions

We used an external crypto-asset monitoring platform in order to have a clear view of the crypto transactions. However, most of the destination addresses were obscured using mixers. However, in rare instances, we could not identify any advanced medium for obfuscation. We leave this part for the authorities to conduct a thorough investigation.

## 6 Conclusion

There is a growing body of research that recognizes the methodologies of ransomware attacks. Besides, the recent Colonial Pipeline attack showed how these attacks could be dangerous in the physical world, apart from the cyber domain. In this report, we presented the inner workings of one of the most well-known ransomware group and helped many victims to recover their data. However, rapid acceptance of crypto currencies and shifting to remote work will significantly increase the ransomware attacks in the near future. In order to disrupt the operation of cybercriminals and tackling complex challenges, public and private bodies need to work collaboratively. We believe that our research will shed light on the inner structures of the cybercriminals and help others to identify the LockBit operatives' external connections (like ReVil) as a part of a broader investigation. As we also presented in our research that some of the affiliates do not bother to decrypt the victim's files even if they were paid in full. Cybercriminals should not be trusted. We advise all potential victims not to pay any ransom and report the incident to the authorities immediately. We also advise to follow other ransomware prevention initiatives such as "The No More Ransom Project" [7] to get an updated information about the recent cases and decryption opportunities.

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The public version of the report will be shared from our github page `https://www.github.com/prodaft`. The readers can find new samples, IOCs, and new versions of this report from our github page as we will constantly update our page based on new findings.

## Historique

| Version | Date | Auteur(s) | Modifications |
|---|---|---|---|
| 1.0 | 23.05.2021 | PTI Team | Initial TLP:RED DRAFT release |
| 1.1 | 18.06.2021 | PTI Team | Initial TLP:WHITE release |
| 1.2 | 18.06.2021 | PTI Team | Typo fixed, affiliate list updated. |



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