

**By Aleksandar Milenkoski, Collin Farr, and Joey Chen, in collaboration with  
QGroup**

providers in the Middle East.

- We assess it is likely that WIP26 is espionage-related.
- WIP26 relies heavily on public Cloud infrastructure in an attempt to evade detection by making malicious traffic look legitimate.
- WIP26 involves the use of backdoors, dubbed CMD365 and CMDEmber, which abuse Microsoft 365 Mail and Google Firebase services for C2 purposes.
- WIP26 also involves the use of Microsoft Azure and Dropbox instances as data exfiltration and malware hosting sites.

## Overview

In collaboration with [QGroup GmbH](#), SentinelLabs is monitoring a threat activity we track as WIP26. The threat actor behind WIP26 has been targeting telecommunication providers in the Middle East. WIP26 is characterized by the abuse of public Cloud infrastructure – Microsoft 365 Mail, Microsoft Azure, Google Firebase, and Dropbox – for malware delivery, data exfiltration, and C2 purposes.

The WIP26 activity is initiated by precision targeting of employees through WhatsApp messages that contain Dropbox links to a malware loader. Tricking employees into downloading and executing the loader ultimately leads to the deployment of backdoors that leverage Microsoft 365 Mail and Google Firebase instances as C2 servers. We refer to these backdoors as CMD365 and CMDEmber, respectively. The main functionality of CMD365 and CMDEmber is to execute attacker-provided system commands using the Windows command interpreter.

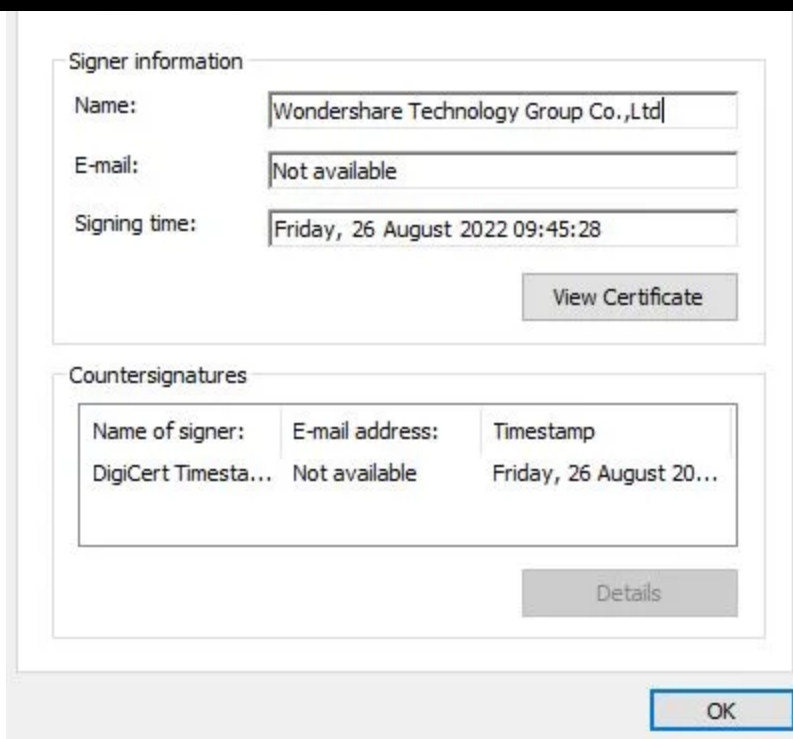
for defenders. The CMD365 and CMDEmber samples we observed masquerade as utility software, such as a PDF editor or browser, and as software that conducts update operations. The masquerading attempt involves the use of filenames, application icons, and digital signatures that indicate existing software vendors.

This report provides details on the WIP26 threat activity and further context around the use of CMD365 and CMDEmber.

## Intrusion Vector and Activities

The initial intrusion vector succeeded through sending targeted WhatsApp messages to employees. The messages contained Dropbox links to archive files that supposedly contain only documents on poverty issues in the Middle East. The archives stored such documents, but also a malware loader ( **PDFelement.exe** ) masquerading as the **PDFelement** application.

The **PDFelement.exe** malware loader has an invalid digital signature that indicates the vendor of the PDFelement application – Wondershare.



The digital signature of *PDFelement.exe*

The loader deploys the CMD365 backdoor, a .NET executable named **Update.exe**, and creates a scheduled task named **MicrosoftUpdatesA** that executes CMD365 at system startup for persistence.

```
PS C:\Users\user> $task = Get-ScheduledTask | where TaskName -eq "MicrosoftUpdatesA"
PS C:\Users\user> $task.actions
```

```
Id           :
Arguments    :
Execute      : C:\Users\Public\Documents\Update.exe
WorkingDirectory :
PSComputerName :
```

The *MicrosoftUpdatesA* scheduled task

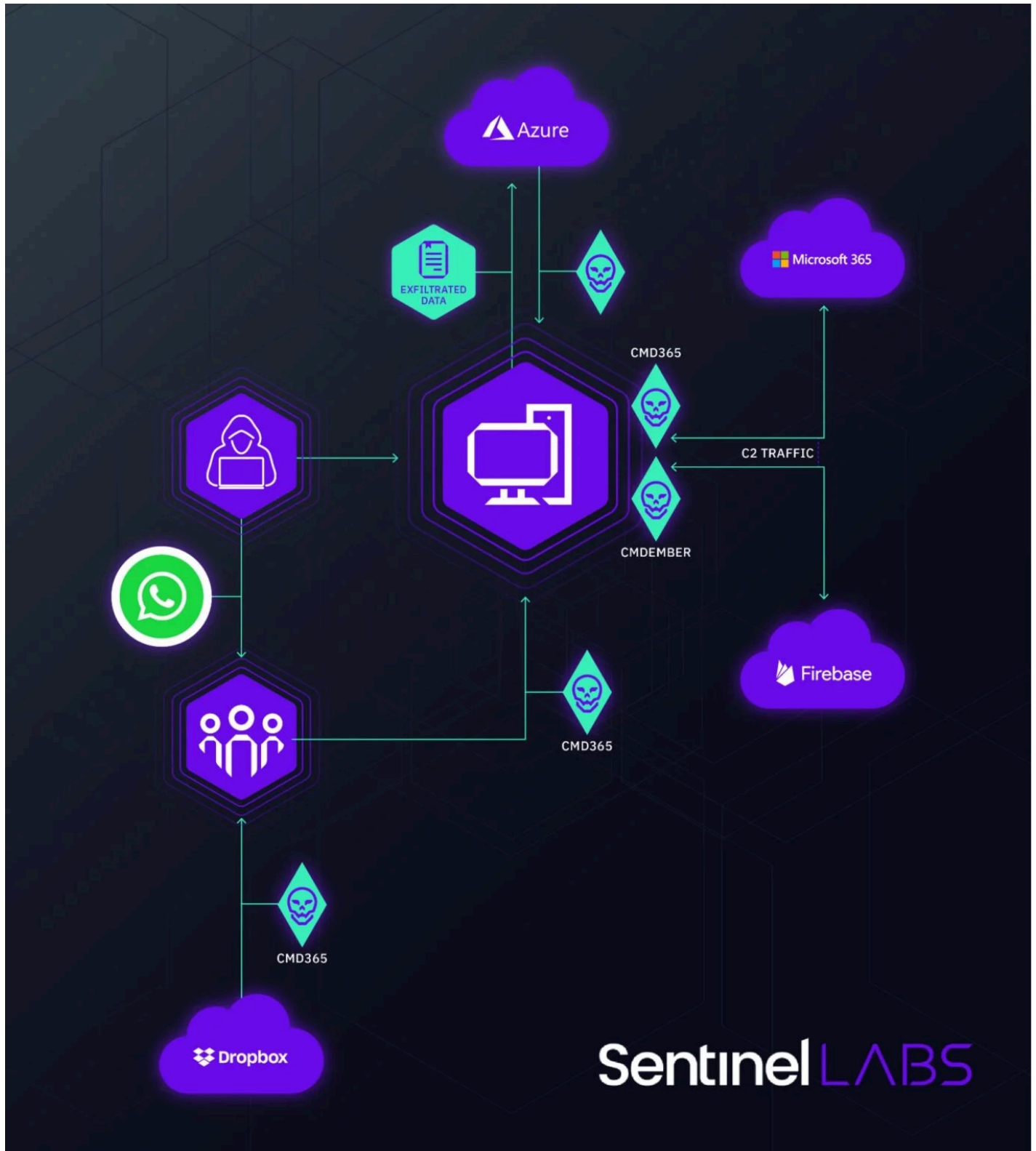
activities, such as reconnaissance, privilege escalation, staging of additional malware, and data exfiltration.

Among the malware deployed on compromised machines, we observed another CMD365 sample in addition to the `Update.exe` – `EdgeUpdater.exe`. Further, we observed CMDEmber samples, which use Google Firebase [Realtime Database](#) instances as C2 servers – `.NET` executables named `Update.exe` and `Launcher.exe`.

The exfiltrated data included users' private browser data and reconnaissance information on particular high-value hosts in the victim's network. This is a typical precursor to the subsequent targeting of these hosts. The data exfiltration was orchestrated through the execution of PowerShell commands to transport key data to Microsoft Azure instances. The threat actor behind WIP26 used the Windows Azure website `socialmsdnmicrosoft.azurewebsites[.]net` as a malware hosting site and `akam.azurewebsites[.]net` as a data exfiltration site.

In addition to exfiltration, the threat actor utilized the open source tool [Chisel](#) masquerading as the [Media Player Classic](#) application with an invalid certificate signed as "Rare Ideas LLC". This was used to create a TCP tunnel over HTTP from the IP address `193.29.56[.]122`, an IP that has previously been associated with Cobalt Strike activity. This was the first and only direct access attempt that was not from Microsoft 365 Mail or Google Firebase instances.

The figure below gives an overview of the Cloud infrastructure the threat actor behind WIP26 used for initial infection and as C2 servers, and exfiltration and



CMD365 interacts using the Microsoft [Graph API](#) with a Microsoft 365 Mail inbox that has the role of a C2 server. An open-source implementation of Graph API usage for C2 communication is the [Azure Outlook C2](#) tool.

The CMD365 sample `Update.exe` is a `.NET` application that masquerades as the legitimate [Postman](#) application, signed with an invalid signature.

The digital signature of *Update.exe*

The core feature of CMD365 is to execute attacker-provided system commands as standard input to an instance of the Windows command interpreter.

CMD365 executes a command

CMD365 issues an HTTP `POST` request to `login.microsoftonline[.]com` to authenticate itself to a Microsoft 365 Mail inbox using valid credentials that are hardcoded in the malware. The malware then receives an OAuth Bearer access token that it uses in the further interaction with Microsoft 365.

CMD365 authenticates at Microsoft 365 Mail

CMD365 then creates an inbox folder with a name that is unique for each infected machine. The name is a combination of the physical address of the main active network interface on the machine, the machine's computer name, and the name of

CMD365 builds a machine-specific inbox folder name

CMD365 creates an inbox folder

CMD365 polls the inbox folder for C2 commands by querying for emails whose subjects start with the keyword **Input**. These emails contain C2 input intended for processing by CMD365 on infected machines.

CMD365 polls for C2 commands

The C2 server and CMD365 exchange encrypted and Base64-encoded data. For data encryption and decryption, the malware uses the AES key **Xc4u7x!A%D\*G-KaPdSr56tp2s5v8y/B?** (in string format) and an empty initialization vector (IV).

CMD365 encrypts data

## CMDEmber: Abuse Of Google Firebase

CMDEmber interacts with a Google Firebase Realtime Database instance that has the role of a C2 server. The CMDEmber sample **Launcher.exe** is a **.NET** application that masquerades as the **Opera** browser and has an invalid signature that indicates the Opera Norway software vendor. CMDEmber uses the **open-source** Firebase library by Step Up Labs for communicating with the Google Firebase instances.

The digital signature of *Launcher.exe*



When executed, CMDEMBER connects to the Firebase instance `https://gma11-52fb5-default-rtdb.asia-southeast1.firebaseio[.]app/` or `https://go0gle-service-default-rtdb.firebaseio[.]com`, and then exfiltrates information about the infected machine. The exfiltrated data includes some of the information that the CMDEMBER collects – the computer name, the bitness, name, and ID of the CMDEMBER process, the name of the user in whose context CMDEMBER executes, and the IPv4 and physical addresses of all operational network interfaces on the infected machine.

CMDEMBER uses the MD5 hash of the Triple DES key

`Mgirdhgi256HIKnuefsdf!dfgsdfkjsrht` (in string format) to encrypt and decrypt the Base64 data exchanged with the C2.

CMDEMBER sends and receives data from the C2 server by issuing HTTP `POST` and `GET` requests, respectively. The URL paths of these requests contain a unique identifier of each infected machine, which is a combination of the ID and bitness of the CMDEMBER process, and the physical addresses of the operational network interfaces at the victim machine.

## CMDEMBER exfiltrates machine information

After exfiltrating information about the infected machine, CMDEMBER polls the Firebase instance for C2 commands by issuing HTTP `GET` requests that include the identifier of the infected machine.

Firebase C2 server stores exchanged data with all infected machines in a JSON-formatted file such that the nodes are the unique identifiers of the machines:

- The `who` field indicates the communication direction. The value `server` marks data sent from the C2 server to an infected machine, whereas the value `client` marks data sent in the opposite direction.
- The field `data` stores the actual data: attacker-provided commands, command outputs, or the information that CMDEMBER exfiltrates from infected machines.

Exfiltrated machine information (obfuscated form)

Command sent to an infected machine (deobfuscated form)

Command output from the infected machine (deobfuscated form)

## Attribution Analysis

We assess it is likely this activity is espionage-related. We track this activity as WIP26 – the Work-In-Progress (WIPxx) designation is used for unattributed activity clusters.

The initial intrusion vector we observed involved precision targeting: The threat actor sent WhatsApp messages to targets with download links to backdoor malware. Further, the targeting of telecommunication providers in the Middle East suggests the motive behind this activity is espionage-related. Communication

actor targeted users' private information and specific networked hosts of high value.

The threat actor behind WIP26 activity appears to have made some OPSEC errors. For example, the JSON file where the Google Firebase C2 server stores data exchanged with machines infected by CMDEMBER is publicly accessible at the time of writing, providing further insights into the WIP26 activity.

The use of public Cloud infrastructure by APT groups is not unheard of. These threat actors continue to innovate in order to stay stealthy. This includes leveraging public Cloud infrastructure for C2 purposes to blend in and make the detection of C2 traffic harder for defenders.

For example, the North Korean APT 37 (InkySquid) has [used](#) the Microsoft Graph API for C2 operations. Further, similar to CMD365, the [SIESTAGRAPH](#) backdoor, used in the [REF2924](#) intrusion set targeting the Foreign Affairs Office of an ASEAN member, leverages the Microsoft Graph API to access Microsoft 365 Mail for C2 communication. Also, the DoNot threat group, which is known for targeting Kashmiri non-profit organizations and Pakistani government officials, has [abused](#) Google Firebase Cloud Messaging to stage malware. Finally, threat activity tied to APT28 (Fancy Bear) has [leveraged](#) Microsoft OneDrive services for C2 purposes.

## Conclusions

The WIP26 activity is a relevant example of threat actors continuously innovating their TTPs in an attempt to stay stealthy and circumvent defenses. The use of public Cloud infrastructure for malware hosting, data exfiltration, and C2 purposes aims at

tactic in the continuous effort to identify threat groups engaged in targeting critical industries.

SentinelLabs continues to track the WIP26 threat cluster to provide further insight into its evolution, future activity, and attribution.

### Indicators of Compromise

Type	Value	Note
SHA-1	B8313A185528F7D4F62853A44B64C29621627AE7	The PDFelement.exe malware loader
SHA-1	8B95902B2C444BCDCCB8A481159612777F82BAD1	CMD365 sample (Update.exe)
SHA-1	3E10A3A2BE17DCF8E79E658F7443F6C3C51F8803	CMD365 sample (EdgeUpdater.exe)
SHA-1	A7BD58C86CF6E7436CECE692DA8F78CEB7BA56A0	CMDEmber sample (Launcher.exe)
SHA-1	6B5F7659CE48FF48F6F276DC532CD458BF15164C	CMDEmber sample (Update.exe)
Domain	<a href="https://gmall-52fb5-default-rtdb.asia-southeast1.firebaseio.com/">https://gmall-52fb5-default-rtdb.asia-southeast1.firebaseio.com/</a>	Google Firebase instance used for C2 purposes

URL	<a href="https://graph.microsoft[.]com/beta/users/3517e816-6719-4b16-9b40-63cc779da77c/mailFolders">https://graph.microsoft[.]com/beta/users/3517e816-6719-4b16-9b40-63cc779da77c/mailFolders</a>	Microsoft 365 Mail location used for C2 purposes
URL	<a href="https://www.dropbox[.]com/s/6a8u8wlpvv73fe4/">https://www.dropbox[.]com/s/6a8u8wlpvv73fe4/</a>	Dropbox malware hosting site
URL	<a href="https://www.dropbox[.]com/s/hbc5yz8z116zbi9/">https://www.dropbox[.]com/s/hbc5yz8z116zbi9/</a>	Dropbox malware hosting site
URL	<a href="https://socialmsdnmicrosoft.azurewebsites[.]net/AAA/">https://socialmsdnmicrosoft.azurewebsites[.]net/AAA/</a>	Microsoft Azure malware hosting site
URL	<a href="https://socialmsdnmicrosoft.azurewebsites[.]net/ABB/">https://socialmsdnmicrosoft.azurewebsites[.]net/ABB/</a>	Microsoft Azure malware hosting site
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URL	<a href="https://socialmsdnmicrosoft.azurewebsites[.]net/AMA/">https://socialmsdnmicrosoft.azurewebsites[.]net/AMA/</a>	Microsoft Azure malware hosting site
URL	<a href="https://socialmsdnmicrosoft.azurewebsites[.]net/AS/">https://socialmsdnmicrosoft.azurewebsites[.]net/AS/</a>	Microsoft Azure malware hosting site
URL	<a href="https://akam.azurewebsites[.]net/api/File/Upload">https://akam.azurewebsites[.]net/api/File/Upload</a>	Microsoft Azure data exfiltration site
IP address	193.29.56[.]122	Chisel C2 server

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### ALEKSANDAR MILENKOSKI

Aleksandar Milenkoski is a Senior Threat Researcher at SentinelLabs. With expertise in malware research and focus on targeted attacks, he brings a blend of practical and deep insights to the forefront of cyber threat intelligence.

Aleksandar has a PhD in system security and is the author of numerous reports on cyberespionage and high-impact cybercriminal operations, conference talks, and peer-reviewed research papers. From 2011 to 2014, he was a European Commission Marie Skłodowska-Curie Research Fellow. His research has won awards from SPEC, the Bavarian Foundation for Science, and the University of Würzburg.



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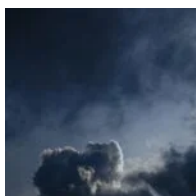
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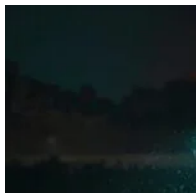
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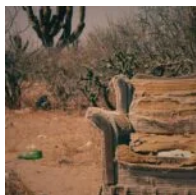
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