

WhatsApp & privacy

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Summary

In this thesis I look at the smartphone application WhatsApp and try to figure out whether or not users should be concerned about their privacy when using WhatsApp. Specifically I look at what information WhatsApp uses and whether or not it is possible to obtain information about other users. WhatsApp reads the contact list from the phone and shares it with the server, however users grant WhatsApp permission to do so upon installing Whatsapp. Trying to obtain information about a third party using WhatsApp does not reveal their name. It is however possible to reveal their WhatsApp profile picture (assuming they have one) given their phone number.

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1 Introduction

WhatsApp is a smartphone application that allows users to send messages to other WhatsApp users, often used as a replacement for SMS messaging. WhatsApp has recently been in the news concerning the privacy of its users. Although some measures were taken some problems may still remain. This thesis tries to find out what problems still exist. This thesis will try to answer the following questions:

- What information does WhatsApp use?
- What information is shared between the WhatsApp client and WhatsApp server?
- What information can be gained about a third party using WhatsApp?
- What information can be seen by intercepting network traffic?

2 Related work

WhatsApp has been in the media¹ regarding privacy because WhatsApp was reading contact information of users not using WhatsApp. The CPB has found ² WhatsApp violating privacy. According to the CPB, WhatsApp is keeping a record not only of phone number of users that use WhatsApp but also of users that do not use WhatsApp. Also it tells how WhatsApp sends its messages unencrypted. This allows for easy sniffing of messages send. (At the present time WhatsApp has updated its security and now does encrypt its network traffic.) Also the CPB seemed to be able to crack the automatically generated passwords by faking the mac address on Android phones and IMEI number on other devices. Another research ³ looked at several smartphone applications, including Whatsapp. Its concern was that contacts were added other than those added manually to WhatsApp and that there was no warning to users that the contact information was shared with the WhatsApp server.

¹<http://nos.nl/artikel/467275-whatsapp-blijft-privacy-schenden.html>, January 28th 2013

²College bescherming persoonsgegevens,CPB(2013). *Onderzoek naar de verwerking van persoonsgegevens in het kader van de mobiele applicatie WhatsApp door WhatsApp Inc.*

³Sheppard, M, *Smartphone Apps, Permissions and Privacy.*

3 Background

WhatsApp is a popular application for smart phones. It allows users to send messages to other users in a similar fashion as SMS (Short message service) messages. On top of that it allows user to make groups which they can use to send messages to the whole group. It also allows users to set their own profile picture.

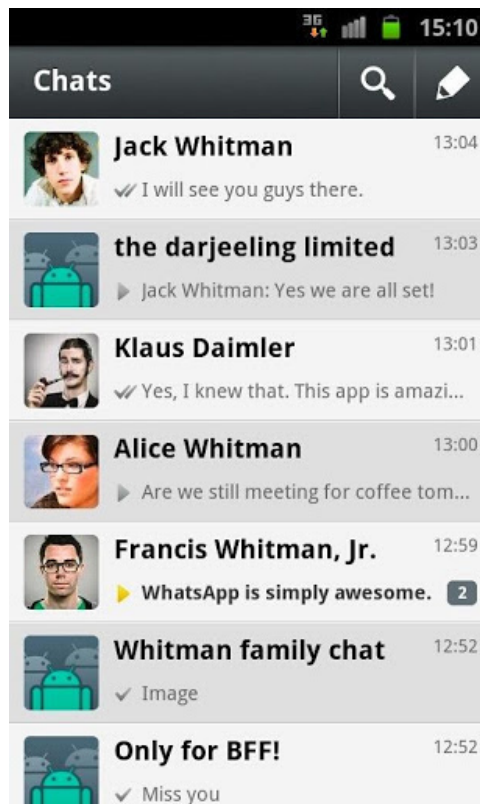


Figure 1: Example of a list of ongoing conversations



Figure 2: Example of a group chat

WhatsApp accounts are based on a person's cellphone number and will automatically generate a list of contacts. WhatsApp generates this list by checking your regular contact list on your phone for contacts that also happen to use the WhatsApp client. WhatsApp accounts are identified by their phone number. When a new contact is added to the regular contact list on the phone, WhatsApp will also add this contact to the WhatsApp contact list, assuming the contact also uses Whatsapp. Users need an invitation to gain access to a group (to allow group chat). However, when a contact is added to the WhatsApp contact list no confirmation from that contact is needed. For this thesis I will be using a phone running the Android operating system. Like other Android applications, WhatsApp makes use of Google services like the Google contact list. This may mean that WhatsApp on Android might have some minor differences compared to WhatsApp running on other operating systems.

3.1 WhatsApp capabilities

WhatsApp allows a user to:

- Set their status message, a simple short message visible to everyone. For example one could set their status message to be “Busy”,
- Send a message to a contact,
- Create a new group,
- Add a user to a group.

The WhatsApp client remembers:

- A contact list containing names, profile pictures and status messages,
- past conversations (unless deleted by user),
- group conversations,
- Your status message,
- Your name.

The WhatsApp server contains the same information as the client as will be explained in chapter 4.

4 Analysis of WhatsApp

In this chapter I will answer the questions asked in chapter 1 and describe the methods used to answer these questions. I will first examine the permission given to the application to get an idea of what WhatsApp is capable of. Then I will explain what information I gained by external observation. Last I will explain my efforts at trying to analyze the network traffic.

4.1 WhatsApp permissions

WhatsApp is given several permissions when installed. Quoting the Google Play store⁴ WhatsApp is granted the following permissions when installed

- ”Your accounts”

⁴<https://play.google.com/store/apps/details?id=com.whatsapp>

- "use accounts on the device"
 - "Allows the app to request authentication tokens."
- "add or remove accounts"
 - "Allows the app to perform operations like adding and removing accounts, and deleting their password."
- "create accounts and set passwords"
 - "Allows the app to use the account authenticator capabilities of the AccountManager, including creating accounts and getting and setting their passwords."
- "Your location"
 - "approximate location (network-based)"
 - "Allows the app to get your precise location using the Global Positioning System (GPS) or network location sources such as cell towers and Wi-Fi. These location services must be turned on and available to your device for the app to use them. Apps may use this to determine where you are, and may consume additional battery power."
 - "precise location (GPS and network-based)"
 - "Allows the app to get your precise location using the Global Positioning System (GPS) or network location sources such as cell towers and Wi-Fi. These location services must be turned on and available to your device for the app to use them. Apps may use this to determine where you are, and may consume additional battery power."
- "Your messages"
 - "receive text messages (SMS)"
 - "Allows the app to receive and process SMS messages. This means the app could monitor or delete messages sent to your device without showing them to you."
 - "Send SMS messages"
 - "Allows the app to send SMS messages. This may result in unexpected charges. Malicious apps may cost you money by sending messages without your confirmation."

- "Network communication"
 - "full network access"
 - " Allows the app to create network sockets and use custom network protocols. The browser and other applications provide means to send data to the internet, so this permission is not required to send data to the internet."
- "Your personal information"
 - "read your own contact card"
 - " Allows the app to read personal profile information stored on your device, such as your name and contact information. This means the app can identify you and may send your profile information to others."
- "Phone calls"
 - "read phone status and identity"
 - "Allows the app to access the phone features of the device. This permission allows the app to determine the phone number and device IDs, whether a call is active, and the remote number connected by a call."
 - "directly call phone numbers"
 - "Allows the app to call phone numbers without your intervention. This may result in unexpected charges or calls. Note that this doesn't allow the app to call emergency numbers. Malicious apps may cost you money by making calls without your confirmation."
- "Storage"
 - "modify or delete the contents of your USB storage"
 - "Allows the app to write to the USB storage."
- "System tools"
 - "install shortcuts"
 - "Allows an app to add shortcuts without user intervention."

- "uninstall shortcuts"
 - "Allows the app to remove shortcuts without user intervention."
- "Your applications information"
 - "retrieve running apps"
 - "Allows the app to retrieve information about currently and recently running tasks. This may allow the app to discover information about which applications are used on the device."
- "Microphone"
 - "record audio"
 - "record audio"
- "Your social information"
 - "read your contacts"
 - "Allows the app to read data about your contacts stored on your device, including the frequency with which you've called, emailed, or communicated in other ways with specific individuals. This permission allows apps to save your contact data, and malicious apps may share contact data without your knowledge."
 - "modify your contacts"
 - "Allows the app to modify the data about your contacts stored on your device, including the frequency with which you've called, emailed, or communicated in other ways with specific contacts. This permission allows apps to delete contact data."

These permissions give some insight into the capabilities of WhatsApp. The permissions regarding your accounts are used to create a new WhatsApp account. The permissions regarding your locations seem excessive as they are not used at the moment. The permissions regarding sending and reading SMS messages are used for a one-time confirmation of the phone number by WhatsApp when creating a new WhatsApp account. The permissions regarding your contact list are needed because WhatsApp automatically reads your contact list. The permissions regarding phone calls is also excessive as WhatsApp does not make phone calls. The permissions for storing information are simply because WhatsApp keeps a local record of your WhatsApp

information. The permissions to (un)install shortcuts is simply to make a shortcut to WhatsApp upon installation. The ability to retrieve running applications seems unnecessary, but might be used to prevent multiple instances of WhatsApp running at the same time. The permission to record audio using your microphone seems odd as WhatsApp only send text messages. The permission to read your contact allows WhatsApp to automatically update its contact list. The permission to modify your contacts seems excessive.

4.2 What information does WhatsApp use?

As explained in chapter 3.1, the WhatsApp client remembers:

- A contact list containing names, profile pictures and status messages,
- Past conversations,
- Group conversations,
- Your status message,
- Your name.

4.3 What information is shared between the WhatsApp client and WhatsApp server?

4.3.1 What information does the client hold

To find out what information the client holds I simply opened the WhatsApp client without being connected to the internet. The WhatsApp client remembers:

- A contact list containing names, profile pictures and status messages,
- Past conversations,
- Group conversations,
- Your status message,
- Your name.

All information can be viewed offline.

4.3.2 What information does the server hold

I wanted to know what information is held by the server and not by the client. To do this I simply deleted the information present on the phone and reconnected to the server. After login in again I discovered the server contains the following:

- A contact list containing names, profile pictures and status messages,
- Past conversations,
- Group conversations,
- Your status message,
- Your name.

All information contained in the WhatsApp client is also contained in the WhatsApp server.

4.4 What information can be gained about a third party using WhatsApp ?

When first using WhatsApp, the WhatsApp client had already filled in a few contacts automatically by reading my Gmail contact list. As soon as a phone number is added to a contact in the Gmail contact list, it is also automatically added to the WhatsApp contact list. Only the phone number is needed and no conformation is needed from the contact added. Therefore it may be possible to gain additional information about a person when only a phone number is known by adding them to your WhatsApp contact list.

4.4.1 Finding out information about other users using only a phone number

This section explains my efforts to try and extract information from the WhatsApp server using only a phone number. To find out what Information I could find out about another user, I used two accounts. In this experiment I only had access to one phone, but reset it when using different accounts.

These two accounts, called Alice and Bob each had the following.

- A freshly reset phone
- A unique WhatsApp account

- A unique Gmail account
- A unique Username
- A unique Profile picture

Also neither account had knowledge about each other prior to the experiment.

I then used the account of Bob to see what information I could get from Alice using only a phone number.

I wanted to know the following;

- Is it possible to add a contact when knowing only a phone number.
- Can I find a persons real name by adding them on WhatsApp
- Can I find a persons profile picture by adding them on WhatsApp

To do this, I added a new contact to Bob's Gmail contact list. This contact had the real phone number of Alice. However this contact was added under a different name than Alice and had a different profile picture.

After adding the contact to Bob's Gmail contact list;

- A new contact was added to Bob's WhatsApp contact list using Alice's phone number,
- The new contact had the different name entered in Bob's Gmail contact list, not Alice's real name from her Gmail account or WhatsApp account,
- The new contact had the WhatsApp profile picture of Alice.

This experiment demonstrated:

- You cannot use WhatsApp to find the name belonging to a phone number using this method,
- You can find a profile picture of a WhatsApp user using only their phone number (given that they have set a profile picture).

4.5 Tools

This section introduces the tools used in section 4.6 to examine the inner workings of Whatsapp.

4.5.1 tPacketCapture

tPacketCapture⁵ is an application freely available for Android mobile phones. While running tPacketCapture allows the user to capture internet traffic sent to and from the phone similar to tcpdump and saves this to pcap files. See also figure 3. It also allows these files to be sent through email so they can be inspected on a regular computer. Although tPacketCapture does not allow you to view these pcap files, these files can easily be viewed using external tools such as Wireshark.

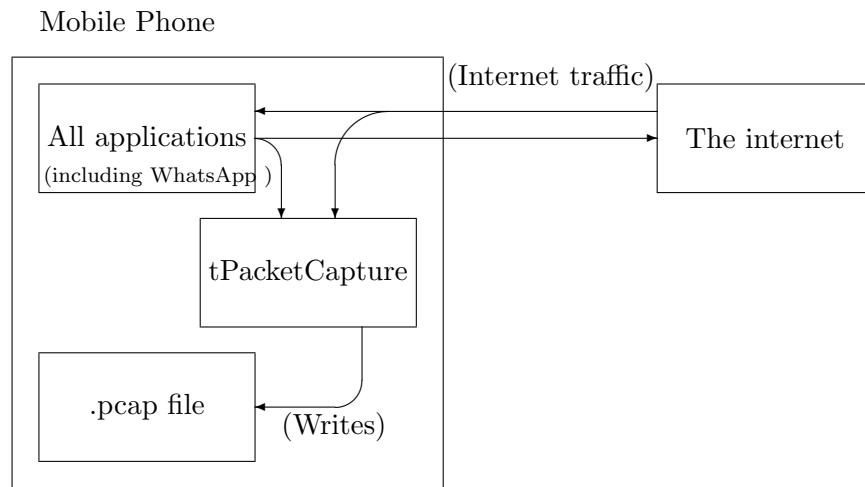
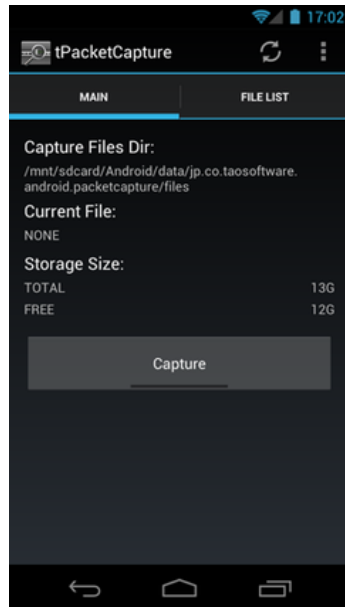


Figure 3: Usage of tPacketCapture

⁵http://play.google.com/store/apps/details?id=jp.co.taosoftware.Android_packetcapture



4.5.2 Wireshark

Wireshark⁶ is an application freely available for most desktop operating systems. Wireshark allows user to monitor network traffic as well as saving recorded network traffic as pcap files and reading saved pcap files to inspect them. See also figure 4. The main difference between Wireshark and tPacketcapture is that tPacketcapture runs on a phone and Wireshark runs at a regular desktop computer. Wireshark has the same features as tPacketcapture but in addition has the ability to read and display pcap files and show a captured packages live.

⁶<http://www.wireshark.org/>

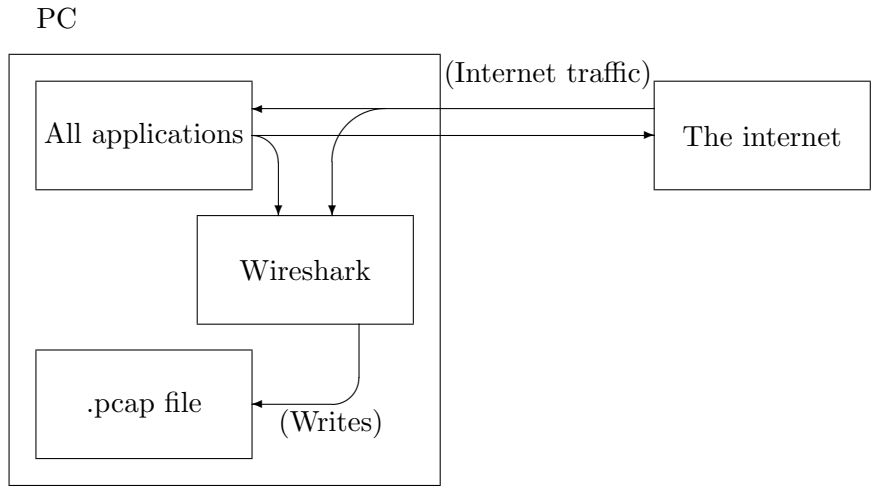
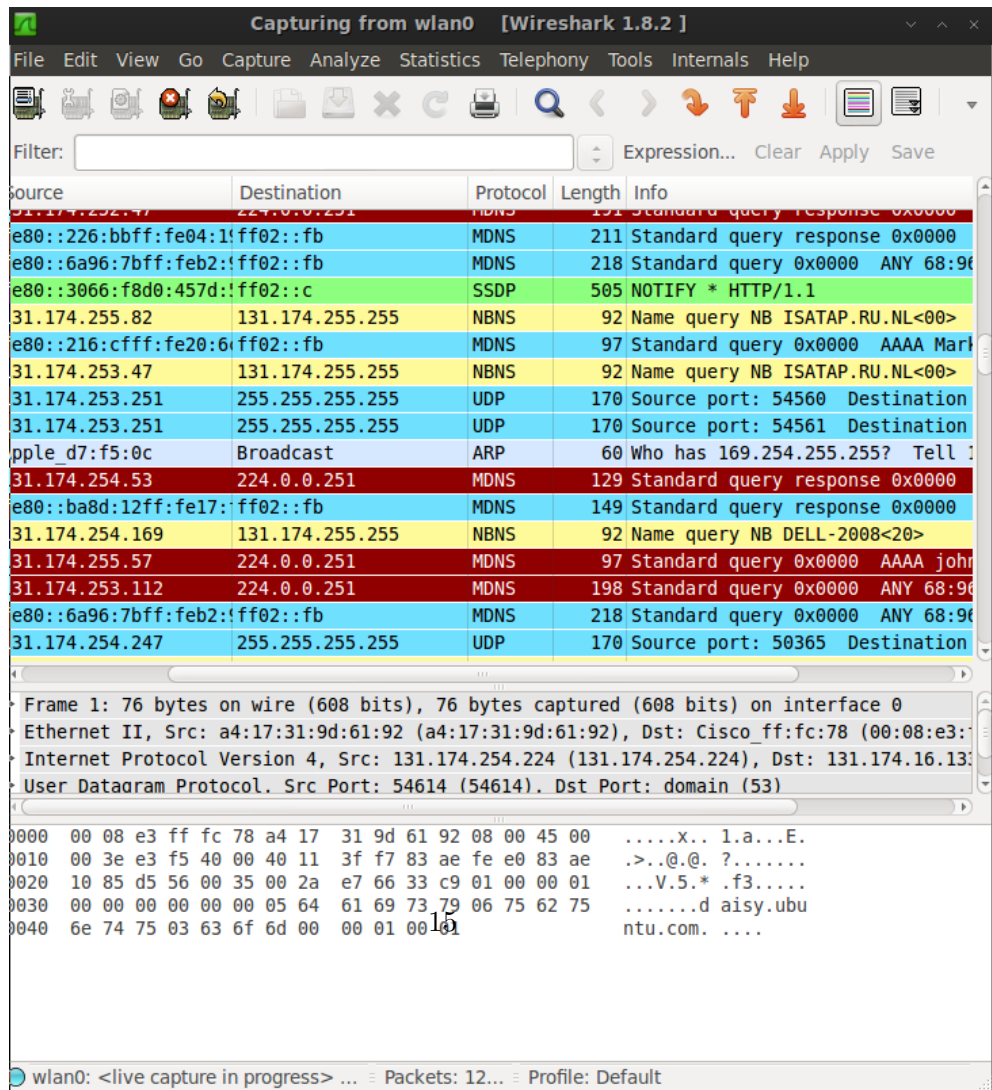


Figure 4: Online usage of Wireshark



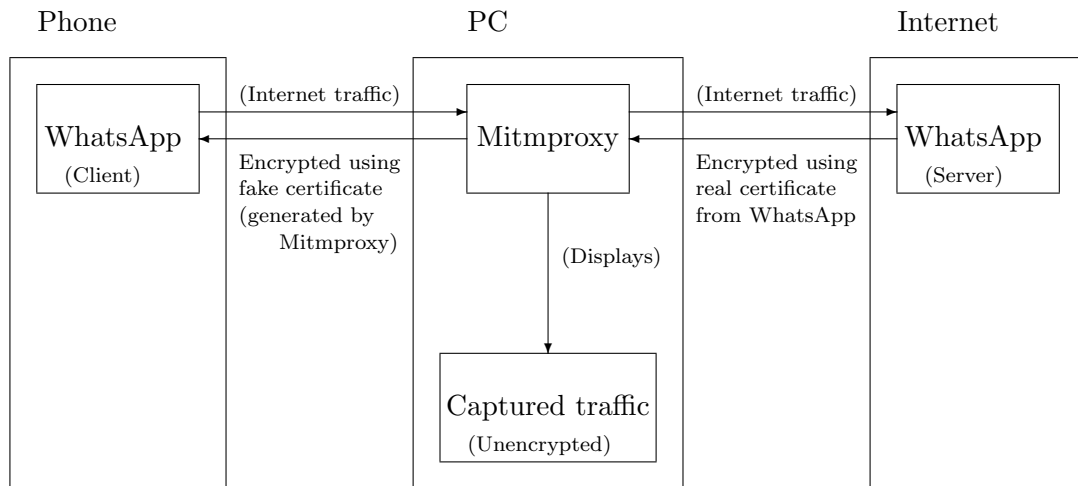


Figure 5: Mitmproxy usage

4.5.3 Mitmproxy

Mitmproxy is an application freely available for OSX, Linux and OpenBSD⁷. Mitmproxy is an TLS-capable man-in-the-middle proxy. When using Mitmproxy as an proxy trying to use TLS, the client will receive a fake certificate allowing Mitmproxy to decrypt the messages sent after which it send the message encrypted with the real key to the server. As such it is possible to analyze packages sent using encryption. Mitmproxy also has the ability to change packets on the fly.

⁷<http://mitmproxy.org/>


```
GET https://github.com/
→ 200 text/html 5.52kB
GET https://a248.e.akamai.net/assets.github.com/stylesheets/bundles/github2-24f59e3ded1f2a
1c7ef9ee730882bd8d550cfb8.css
→ 200 text/css 28.27kB
GET https://a248.e.akamai.net/assets.github.com/images/modules/header/logov7@4x-hover.png?1
324325424
→ 200 image/png 6.01kB
GET https://a248.e.akamai.net/assets.github.com/javascripts/bundles/jquery-b2ca07cb3c906cec
cfd58811b430b8bc25245926.js
→ 200 application/x-javascript 32.59kB
GET https://a248.e.akamai.net/assets.github.com/stylesheets/bundles/github-cb564c47c51a14
af1ae265d7ebab59c4e78b92cb.css
→ 200 text/css 37.09kB
GET https://a248.e.akamai.net/assets.github.com/images/modules/home/logos/facebook.png?1324
526958
→ 200 image/png 5.55kB
>> GET https://github.com/twitter
```

4.5.4 Apktool

Apktool⁸ is an application for reverse engineering Android applications. By using Apktool it is possible to convert an Android application into a Java jar file. This jar file can then be decompiled using a Java decompiler to modify its source code.

4.5.5 JAD

JAD (Java Decompiler) is a tool that tries to decompile compiled Java class files to Java source files. Unfortunately JAD has not been updated recently and is not capable of decompiling certain features introduced in Java 5, making recompiling impossible in some cases.⁹

4.5.6 JD

JD, another Java Decompiler is a newer tool that boast it is capable of decompiling Java 5 bytecode. While it does a better job at decompiling bytecode there are still certain bytecode that the decompiler cannot decompile.¹⁰

⁸<http://code.google.com/p/android-apktool/>

⁹<http://www.varaneckas.com/jad/>

¹⁰<http://Java.decompiler.free.fr/>

4.6 What information can be seen by intercepting network traffic?

To figure out what information is being sent by WhatsApp I have tried to see what information can be seen by intercepting network traffic.

4.6.1 Using tPacketcapture

I started capturing network traffic send to and from my phone by using tPacketcapture. This application captures all network traffic and can save it to a Pcap file. tPacketcapture does not allow you to view the captured traffic, however other applications can open the Pcap file to allow you to view the network traffic.

Using Wireshark I was able to see the network traffic. I first filtered out all packets that were not either send from or to the WhatsApp server based on the ip-address. After filtering out unrelated traffic, it became obvious that the WhatsApp client and server make use of TLS to encrypt the network traffic. This made reading the network traffic in its current form impossible. Wireshark shows what each packet is supposed to represent. Wireshark showed packets setting up a TLS connection and a key exchange. Using Wireshark it was easy to find the public key from the WhatsApp server. WhatsApp currently uses the following public key (represented as a hexadecimal number):

```
30 82 01 08 02 82 01 01 00 de 9d d7 ea 57 18 49 a1 5b eb d7 5f 48 86 ea
be dd ff e4 ef 67 1c f4 65 68 b3 57 71 a0 5e 77 bb ed 9b 49 e9 70 80 3d 56
18 63 08 6f da f2 cc d0 3f 7f 02 54 22 54 10 d8 b2 81 d4 c0 75 3d 4b 7f c7
77 c3 3e 78 ab 1a 03 b5 20 6b 2f 6a 2b b1 c5 88 7e c4 bb 1e b0 c1 d8 45 27
6f aa 37 58 f7 87 26 d7 d8 2d f6 a9 17 b7 1f 72 36 4e a6 17 3f 65 98 92 db
2a 6e 5d a2 fe 88 e0 0b de 7f e5 8d 15 e1 eb cb 3a d5 e2 12 a2 13 2d d8 8e
af 5f 12 3d a0 08 05 08 b6 5c a5 65 38 04 45 99 1e a3 60 60 74 c5 41 a5 72
62 1b 62 c5 1f 6f 5f 1a 42 be 02 51 65 a8 ae 23 18 6a fc 78 03 a9 4d 7f 80 c3
fa ab 5a fc a1 40 a4 ca 19 16 fe b2 c8 ef 5e 73 0d ee 77 bd 9a f6 79 98 bc b1
07 67 a2 15 0d dd a0 58 c6 44 7b 0a 3e 62 28 5f ba 41 07 53 58 cf 11 7e 38
74 c5 f8 ff b5 69 90 8f 84 74 ea 97 1b af 02 01 03.
```

See also Appendix A for the full certificate.

4.6.2 Using Mitmproxy

After realizing that I was not able to see the network traffic unencrypted, I tried using Mitmproxy. Mitmproxy is a proxy application, that when used by an application using TLS, gives out a fake certificate. Because

of this it is possible to see the network traffic unencrypted. When using a regular application that uses TLS, for instance a web browser visiting a https website, you can view the network traffic unencrypted. However this does not work using WhatsApp, because WhatsApp does not accept the fake certificate generated by Mitmproxy. Because of this, WhatsApp refuses to send any network traffic when using Mitmproxy. Therefore it is not possible to view the unencrypted network traffic.

4.6.3 Decompiling WhatsApp

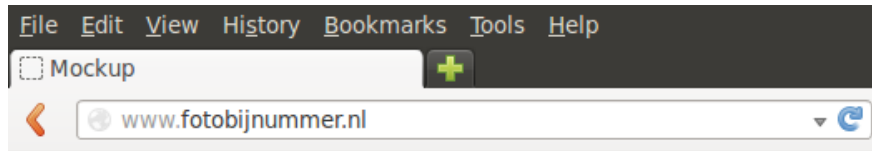
By using a patched version of WhatsApp it might be possible to get WhatsApp to accept the fake certificate provided by Mitmproxy. Searching for the public key in the WhatsApp binary yielded no results, so the WhatsApp key is not hard coded or at the very least obfuscated. Because of this I could not simply change the WhatsApp key to a fake key in the WhatsApp binary. To try and get WhatsApp to accept a different this, I first used Apktool to decompile the Android application to a jar file. I then used Java decompilers to read the source code. Using JAD I was able to read a large part of the source code. However JAD is outdated and can not decompile features added in newer version of Java, leaving certain parts unreadable. Using JD, another Java decompiler, I was able to read far more of the source code. In the decompiled source code I found several classes that were used for the TLS connections. These classes were `com/whatsapp/vt.class` and `com/whatsapp/wt.class`. However due to time constraints, I have not been able to successfully modify them to accept fake certificates.

5 Conclusions and reflection

WhatsApp uses the information from your Gmail contact list to add contacts to the WhatsApp contact list. WhatsApp will use this information to see if one of your contact in your Gmail contact list also has an WhatsApp account and, if so, will add them to your WhatsApp account.

All information contained in the WhatsApp client application is also contained in the WhatsApp server.

My research showed that trying to obtain information about a third party using WhatsApp does not reveal their name. WhatsApp will use the same name for contacts in the WhatsApp contact list as are used in the Gmail contact list. My research however has shown that WhatsApp can be used to view the WhatsApp profile picture of a third party, assuming they have one. It would be possible to create an automated tool that would return a profile



Zoek de profielfoto bij een nummer

Telefoonnummer:

Profielfoto gevonden



Figure 6: Mock up of how a lookup might look

picture given a phone number. Using this it would be possible to make an automated lookup of a profile picture given a phone number. Figure 6 gives a mock up of what it could look like.

Trying to view the network traffic by intercepting it does not work because the network traffic is encrypted. Trying to circumvent the encryption by providing a fake certificate does not work as WhatsApp checks the certificate.

5.1 Future work

Currently I have yet to succeed in circumventing the encryption of the network traffic of WhatsApp. It might be possible to circumvent this encryption using a fake certificate, however WhatsApp does not seem to accept a fake certificate. Patching the WhatsApp application to accept a fake certificate may make it possible to use a fake certificate.

6 References

College bescherming persoonsgegevens, CPB(2013), *Onderzoek naar de verwerking van persoonsgegevens in het kader van de mobiele applicatie What-*

sApp door WhatsApp Inc.

Sheppard M., *Smartphone Apps, Permissions and Privacy*

7 Glossary

- App: Short for application
- WhatsApp client: The WhatsApp application running on the phone
- Server: The WhatsApp Server that all messages are sent to
- Contact list: The WhatsApp contact list contained in the WhatsApp client and server
- Packet: A network packet
- Google Account: Account used by Google and Android to do things (Read e-mail, install apps etc.)
- Gmail Account: same as Google account
- Pcap file: A format in which packet captures can be written
- Tcpdump: A command line program that can capture packets
- WhatsApp account: The account registered at WhatsApp by phone number.

Appendices

A Capture showing the WhatsApp public key

The following is part of network traffic capture by tPacketCapture. The stream is represented both in hexadecimal and as printable ASCII characters (Unprintable characters are represented as .) This is the complete WhatsApp certificate. The public key starts at offset 0b79 and end at offset 0c84 and is marked in red.

Offset	Stream as hexadecimal	Stream as text
0000	16 03 01 0e 57 0b 00 0e 53 00 0e 50 00 05 61 30	....W...S..P..a0
0010	82 05 5d 30 82 04 45 a0 03 02 01 02 02 07 2b 71	..]0..E.....+q
0020	0e 3e 26 5b a2 30 0d 06 09 2a 86 48 86 f7 0d 01	.¿&[.0...*.H....
0030	01 05 05 00 30 81 ca 31 0b 30 09 06 03 55 04 06	....0..1.0...U..
0040	13 02 55 53 31 10 30 0e 06 03 55 04 08 13 07 41	..US1.0...U....A
0050	72 69 7a 6f 6e 61 31 13 30 11 06 03 55 04 07 13	rizona1.0...U...
0060	0a 53 63 6f 74 74 73 64 61 6c 65 31 1a 30 18 06	..Scottsdale1.0..
0070	03 55 04 0a 13 11 47 6f 44 61 64 64 79 2e 63 6f	..U....GoDaddy.co
0080	6d 2c 20 49 6e 63 2e 31 33 30 31 06 03 55 04 0b	m, Inc.1301..U..
0090	13 2a 68 74 74 70 3a 2f 2f 63 65 72 74 69 66 69	.*http://certifi
00a0	63 61 74 65 73 2e 67 6f 64 61 64 64 79 2e 63 6f	cates.godaddy.co
00b0	6d 2f 72 65 70 6f 73 69 74 6f 72 79 31 30 30 2e	m/repository100.
00c0	06 03 55 04 03 13 27 47 6f 20 44 61 64 64 79 20	..U...`Go Daddy
00d0	53 65 63 75 72 65 20 43 65 72 74 69 66 69 63 61	Secure Certifica
00e0	74 69 6f 6e 20 41 75 74 68 6f 72 69 74 79 31 11	tion Authority1.
00f0	30 0f 06 03 55 04 05 13 08 30 37 39 36 39 32 38	0...U....0796928
0100	37 30 1e 17 0d 31 32 31 32 31 34 30 36 32 31 34	70...12121406214
0110	34 5a 17 0d 31 35 31 32 33 31 31 30 31 31 30 32	4Z..151231101102
0120	5a 30 55 31 17 30 15 06 03 55 04 0a 0c 0e 2a 2e	Z0U1.0...U....*.
0130	77 68 61 74 73 61 70 70 2e 6e 65 74 31 21 30 1f	whatsapp.net!0.
0140	06 03 55 04 0b 13 18 44 6f 6d 61 69 6e 20 43 6f	..U....Domain Co
0150	6e 74 72 6f 6c 20 56 61 6c 69 64 61 74 65 64 31	ntrol Validated1
0160	17 30 15 06 03 55 04 03 0c 0e 2a 2e 77 68 61 74	.0...U....*.what
0170	73 61 70 70 2e 6e 65 74 30 82 01 22 30 0d 06 09	sapp.net0."0...
0180	2a 86 48 86 f7 0d 01 01 01 05 00 03 82 01 0f 00	*.H.....
0190	30 82 01 0a 02 82 01 01 00 da 60 40 12 9f 6d 3c	0.....`@..mj
01a0	9a cb 3d e5 88 b5 cd 4e d1 78 8a 49 f3 24 81 eb	..=...N.x.I.\$..
01b0	3d f0 e2 9b 30 52 14 96 37 0c d7 4c 26 fb ef 6d	=...0R..7..L&..m
01c0	b4 17 c5 f6 d4 01 d8 a0 3e 46 89 28 66 67 87 c5	.....¿F.(fg..
01d0	b9 e5 8f 9f 41 b6 95 a3 91 27 77 3d 9e d4 ba ff	....A....`w=....
01e0	76 bc ac ec e4 14 5e 24 96 0a 19 3b cb a2 3e d2	v.....^\$...;..¿.
01f0	84 ec 29 a6 64 bd 0d de c0 01 ca 97 f4 fe 5b 82	..).d.....[.
0200	c9 83 c2 aa c6 eb 1e a0 f1 67 1b 8d a1 10 4e fa	.....g....N.
0210	00 8a 74 6a f6 4b c8 f8 bb 9e 43 ad e4 d3 37 b0	..tj.K....C...7.
0220	cd f0 e0 13 bc 83 ef c7 f0 8d c6 d7 ee bf 6a 6c	.....j1
0230	86 c9 69 8f 94 c1 67 37 3b fc e9 15 b4 f5 ce a5	..i...g7;.....
0240	58 41 76 b5 2a fa 50 9e 48 4c 81 73 f9 b9 53 dd	XAv.*.P.HL.s..S.
0250	09 47 e9 b1 d7 7c 25 df 02 e4 0e fe 49 7c f3 5b	.G...—%.....I—.[

Offset	Stream as hexadecimal	Stream as text
0260	e6 51 64 75 cd 23 56 63 fc 5d 5e 9e bc 5b 17 14	.Qdu.#Vc.]s.[..
0270	22 af 91 ef 08 8b 15 0f 68 cc e1 47 c5 ce e8 cd	".....h..G....
0280	f1 10 6e f9 45 a2 35 0f b7 34 77 50 51 d5 78 f4	..n.E.5..4wPQ.x.
0290	97 05 0f fa 4c b4 67 37 97 02 03 01 00 01 a3 82	....L.g7.....
02a0	01 ba 30 82 01 b6 30 0f 06 03 55 1d 13 01 01 ff	..0...0...U.....
02b0	04 05 30 03 01 01 00 30 1d 06 03 55 1d 25 04 16	..0...0...U.%..
02c0	30 14 06 08 2b 06 01 05 05 07 03 01 06 08 2b 06	0...+.....+.
02d0	01 05 05 07 03 02 30 0e 06 03 55 1d 0f 01 01 ff	.....0...U.....
02e0	04 04 03 02 05 a0 30 33 06 03 55 1d 1f 04 2c 30	.....03..U....,0
02f0	2a 30 28 a0 26 a0 24 86 22 68 74 74 70 3a 2f 2f	*0(&.\$."http://
0300	63 72 6c 2e 67 6f 64 61 64 64 79 2e 63 6f 6d 2f	crl.godaddy.com/
0310	67 64 73 31 2d 38 31 2e 63 72 6c 30 53 06 03 55	gds1-81.crl0S..U
0320	1d 20 04 4c 30 4a 30 48 06 0b 60 86 48 01 86 fd	. .L0J0H..'H...
0330	6d 01 07 17 01 30 39 30 37 06 08 2b 06 01 05 05	m...0907..+....
0340	07 02 01 16 2b 68 74 74 70 3a 2f 2f 63 65 72 74	....+http://cert
0350	69 66 69 63 61 74 65 73 2e 67 6f 64 61 64 64 79	ificates.godaddy
0360	2e 63 6f 6d 2f 72 65 70 6f 73 69 74 6f 72 79 2f	.com/repository/
0370	30 81 80 06 08 2b 06 01 05 05 07 01 01 04 74 30	0...+.....t0
0380	72 30 24 06 08 2b 06 01 05 05 07 30 01 86 18 68	r0\$.+.....0...h
0390	74 74 70 3a 2f 2f 6f 63 73 70 2e 67 6f 64 61 64	ttp://ocsp.godad
03a0	64 79 2e 63 6f 6d 2f 30 4a 06 08 2b 06 01 05 05	dy.com/0J..+....
03b0	07 30 02 86 3e 68 74 74 70 3a 2f 2f 63 65 72 74	.0..;http://cert
03c0	69 66 69 63 61 74 65 73 2e 67 6f 64 61 64 64 79	ificates.godaddy
03d0	2e 63 6f 6d 2f 72 65 70 6f 73 69 74 6f 72 79 2f	.com/repository/
03e0	67 64 5f 69 6e 74 65 72 6d 65 64 69 61 74 65 2e	gd.intermediate.
03f0	63 72 74 30 1f 06 03 55 1d 23 04 18 30 16 80 14	crt0...U.#..0...
0400	fd ac 61 32 93 6c 45 d6 e2 ee 85 5f 9a ba e7 76	..a2.lE.....v
0410	99 68 cc e7 30 27 06 03 55 1d 11 04 20 30 1e 82	.h..0'.U... 0..
0420	0e 2a 2e 77 68 61 74 73 61 70 70 2e 6e 65 74 82	.*.whatsapp.net.
0430	0c 77 68 61 74 73 61 70 70 2e 6e 65 74 30 1d 06	.whatsapp.net0..
0440	03 55 1d 0e 04 16 04 14 36 29 ad 66 b0 68 c0 59	.U.....6).f.h.Y
0450	c6 04 73 92 ed 4a 91 c8 5a 27 24 ab 30 0d 06 09	..s..J..Z'\$0...
0460	2a 86 48 86 f7 0d 01 01 05 05 00 03 82 01 01 00	*.H.....
0470	be 94 ab a2 40 15 18 dc 73 e5 2f c8 f3 f0 f2 56	.....s./....V
0480	b1 28 09 04 09 c6 4d 81 49 7f 7d d0 05 4e a9 28	.(...M.I.}.N.(
0490	9e 16 12 9e 3d fe fd 16 0b e2 10 81 64 58 6a ff	....=.....dXj.
04a0	9d 9d a3 70 c0 5c 9a e3 32 5e 30 16 36 03 1a a4	...p.:20^6...
04b0	91 d8 b6 bd 04 0f c5 a4 23 2b d5 d7 11 37 52 d1	.....#+...7R.

Offset	Stream as hexadecimal	Stream as text
04c0	fd 64 e9 cc 1d 6a d6 97 eb 5c 25 6d 37 c8 8d 7c	.d...j...%m7..—
04d0	66 64 bf 28 15 ac a0 32 f6 d4 5e 09 1a a5 9c 83	fd.(...2..^....
04e0	27 a2 00 46 ef 99 36 0d 3f 11 ca a8 23 ee c9 0a	'..F..6.?...#...
04f0	a0 85 74 d0 c9 7f 69 1b 38 af e5 7e dc e9 71 ac	..t...i.8.. ..q.
0500	fe 7f e6 b5 f6 5e c1 86 ef 63 0f 05 d1 99 df 7a	.....^..c.....z
0510	12 d8 ff 6a fb ee 15 41 1b ad fc ad fe 42 60 26	...j...A.....B'&
0520	33 cb 50 88 62 b2 1a 3f 6a fe 75 43 5c a5 04 c9	3.P.b..?j.uC:.
0530	7b 7b cf a7 76 32 52 c5 10 dd fb 5e cc ec 03 0a	{ {.v2R.....^...
0540	ae b9 83 1d e7 73 b3 4c 5c 06 3d a6 f9 fb cd ca	.....s.L\.,=.....
0550	73 68 1b 39 b5 a0 53 02 75 85 2a 3b 99 e0 64 da	sh.9..S.u.*;.d.
0560	26 63 f0 d0 11 15 16 e6 04 be bf df 21 4f 59 38	&c.....!OY8
0570	00 04 e2 30 82 04 de 30 82 03 c6 a0 03 02 01 02	...0...0.....
0580	02 02 03 01 30 0d 06 09 2a 86 48 86 f7 0d 01 01	....0...*.H.....
0590	05 05 00 30 63 31 0b 30 09 06 03 55 04 06 13 02	...0c1.0...U....
05a0	55 53 31 21 30 1f 06 03 55 04 0a 13 18 54 68 65	US1!0...U....The
05b0	20 47 6f 20 44 61 64 64 79 20 47 72 6f 75 70 2c	Go Daddy Group,
05c0	20 49 6e 63 2e 31 31 30 2f 06 03 55 04 0b 13 28	Inc.110/..U...(
05d0	47 6f 20 44 61 64 64 79 20 43 6c 61 73 73 20 32	Go Daddy Class 2
05e0	20 43 65 72 74 69 66 69 63 61 74 69 6f 6e 20 41	Certification A
05f0	75 74 68 6f 72 69 74 79 30 1e 17 0d 30 36 31 31	uthority0...0611
0600	31 36 30 31 35 34 33 37 5a 17 0d 32 36 31 31 31	16015437Z..26111
0610	36 30 31 35 34 33 37 5a 30 81 ca 31 0b 30 09 06	6015437Z0..1.0..
0620	03 55 04 06 13 02 55 53 31 10 30 0e 06 03 55 04	.U....US1.0...U.
0630	08 13 07 41 72 69 7a 6f 6e 61 31 13 30 11 06 03	...Arizona1.0...
0640	55 04 07 13 0a 53 63 6f 74 74 73 64 61 6c 65 31	U....Scottsdale1
0650	1a 30 18 06 03 55 04 0a 13 11 47 6f 44 61 64 64	.0...U....GoDadd
0660	79 2e 63 6f 6d 2c 20 49 6e 63 2e 31 33 30 31 06	y.com, Inc.1301.
0670	03 55 04 0b 13 2a 68 74 74 70 3a 2f 2f 63 65 72	.U...*http://cer
0680	74 69 66 69 63 61 74 65 73 2e 67 6f 64 61 64 64	tificates.godadd
0690	79 2e 63 6f 6d 2f 72 65 70 6f 73 69 74 6f 72 79	y.com/repository
06a0	31 30 30 2e 06 03 55 04 03 13 27 47 6f 20 44 61	100...U...'Go Da
06b0	64 64 79 20 53 65 63 75 72 65 20 43 65 72 74 69	daddy Secure Certi
06c0	66 69 63 61 74 69 6f 6e 20 41 75 74 68 6f 72 69	fication Authori
06d0	74 79 31 11 30 0f 06 03 55 04 05 13 08 30 37 39	ty1.0...U....079
06e0	36 39 32 38 37 30 82 01 22 30 0d 06 09 2a 86 48	692870..”0...*.H
06f0	86 f7 0d 01 01 01 05 00 03 82 01 0f 00 30 82 01	.....0..
0700	0a 02 82 01 01 00 c4 2d d5 15 8c 9c 26 4c ec 32	.....-.....&L.2
0710	35 eb 5f b8 59 01 5a a6 61 81 59 3b 70 63 ab e3	5...Y.Z.a.Y;pc..

Offset	Stream as hexadecimal	Stream as text
0720	dc 3d c7 2a b8 c9 33 d3 79 e4 3a ed 3c 30 23 84	.=*..3.y.:;0#.
0730	8e b3 30 14 b6 b2 87 c3 3d 95 54 04 9e df 99 dd	..0.....=.T.....
0740	0b 25 1e 21 de 65 29 7e 35 a8 a9 54 eb f6 f7 32	%.!e) 5..T...2
0750	39 d4 26 55 95 ad ef fb fe 58 86 d7 9e f4 00 8d	9.&U.....X.....
0760	8c 2a 0c bd 42 04 ce a7 3f 04 f6 ee 80 f2 aa ef	.*..B...?.....
0770	52 a1 69 66 da be 1a ad 5d da 2c 66 ea 1a 6b bb	R.if...],f.k.
0780	e5 1a 51 4a 00 2f 48 c7 98 75 d8 b9 29 c8 ee f8	..QJ./H..u..)...
0790	66 6d 0a 9c b3 f3 fc 78 7c a2 f8 a3 f2 b5 c3 f3	fm.....x—.....
07a0	b9 7a 91 c1 a7 e6 25 2e 9c a8 ed 12 65 6e 6a f6	.z....%.....enj.
07b0	12 44 53 70 30 95 c3 9c 2b 58 2b 3d 08 74 4a f2	.DSp0...+X+=.tJ.
07c0	be 51 b0 bf 87 d0 4c 27 58 6b b5 35 c5 9d af 17	.Q....L'Xk.5....
07d0	31 f8 0b 8f ee ad 81 36 05 89 08 98 cf 3a af 25	1.....6.....:%
07e0	87 c0 49 ea a7 fd 67 f7 45 8e 97 cc 14 39 e2 36	..I...g.E....9.6
07f0	85 b5 7e 1a 37 fd 16 f6 71 11 9a 74 30 16 fe 13	..7...q..t0...
0800	94 a3 3f 84 0d 4f 02 03 01 00 01 a3 82 01 32 30	..?..O.....20
0810	82 01 2e 30 1d 06 03 55 1d 0e 04 16 04 14 fd ac	...0...U.....
0820	61 32 93 6c 45 d6 e2 ee 85 5f 9a ba e7 76 99 68	a2.1E.....v.h
0830	cc e7 30 1f 06 03 55 1d 23 04 18 30 16 80 14 d2	..0...U.#..0...
0840	c4 b0 d2 91 d4 4c 11 71 b3 61 cb 3d a1 fe dd a8	....L.q.a.=....
0850	6a d4 e3 30 12 06 03 55 1d 13 01 01 ff 04 08 30	j..0...U.....0
0860	06 01 01 ff 02 01 00 30 33 06 08 2b 06 01 05 05	.....03..+....
0870	07 01 01 04 27 30 25 30 23 06 08 2b 06 01 05 05	....'0%0#..+....
0880	07 30 01 86 17 68 74 74 70 3a 2f 2f 6f 63 73 70	.0...http://ocsp
0890	2e 67 6f 64 61 64 64 79 2e 63 6f 6d 30 46 06 03	.godaddy.com0F..
08a0	55 1d 1f 04 3f 30 3d 30 3b a0 39 a0 37 86 35 68	U...?0=0;.9.7.5h
08b0	74 74 70 3a 2f 2f 63 65 72 74 69 66 69 63 61 74	ttp://certificat
08c0	65 73 2e 67 6f 64 61 64 64 79 2e 63 6f 6d 2f 72	es.godaddy.com/r
08d0	65 70 6f 73 69 74 6f 72 79 2f 67 64 72 6f 6f 74	epository/gdroot
08e0	2e 63 72 6c 30 4b 06 03 55 1d 20 04 44 30 42 30	.crl0K..U. .D0B0
08f0	40 06 04 55 1d 20 00 30 38 30 36 06 08 2b 06 01	@..U. .0806..+..
0900	05 05 07 02 01 16 2a 68 74 74 70 3a 2f 2f 63 65	.....*http://ce
0910	72 74 69 66 69 63 61 74 65 73 2e 67 6f 64 61 64	rtificates.godad
0920	64 79 2e 63 6f 6d 2f 72 65 70 6f 73 69 74 6f 72	dy.com/repositor
0930	79 30 0e 06 03 55 1d 0f 01 01 ff 04 04 03 02 01	y0...U.....
0940	06 30 0d 06 09 2a 86 48 86 f7 0d 01 01 05 05 00	.0...*H.....
0950	03 82 01 01 00 d2 86 c0 ec bd f9 a1 b6 67 ee 66	.....g.f
0960	0b a2 06 3a 04 50 8e 15 72 ac 4a 74 95 53 cb 37	...:P.r.Jt.S.7
0970	cb 44 49 ef 07 90 6b 33 d9 96 f0 94 56 a5 13 30	.DL..k3...V..0

Offset	Stream as hexadecimal	Stream as text
0980	05 3c 85 32 21 7b c9 c7 0a a8 24 a4 90 de 46 d3	.;2!{....\$...F.
0990	25 23 14 03 67 c2 10 d6 6f 0f 5d 7b 7a cc 9f c5	%#..g...o.]{z...
09a0	58 2a c1 c4 9e 21 a8 5a f3 ac a4 46 f3 9e e4 63	X*...!Z...F...c
09b0	cb 2f 90 a4 29 29 01 d9 72 2c 29 df 37 01 27 bc	./..))..r).7.'.
09c0	4f ee 68 d3 21 8f c0 b3 e4 f5 09 ed d2 10 aa 53	O.h.!.....S
09d0	b4 be f0 cc 59 0b d6 3b 96 1c 95 24 49 df ce ec	...Y.;...\$L..
09e0	fd a7 48 91 14 45 0e 3a 36 6f da 45 b3 45 a2 41	..H..E.:6o.E.E.A
09f0	c9 d4 d7 44 4e 3e b9 74 76 d5 a2 13 55 2c c6 87	...DNĵ.tv...U,..
0a00	a3 b5 99 ac 06 84 87 7f 75 06 fc bf 14 4c 0e cc	.....u....L..
0a10	6e c4 df 3d b7 12 71 f4 e8 f1 51 40 22 28 49 e0	n..=.q...Q@”(I.
0a20	1d 4b 87 a8 34 cc 06 a2 dd 12 5a d1 86 36 64 03	.K.4.....Z..6d.
0a30	35 6f 6f 77 6e eb f2 85 50 98 5e ab 03 53 ad 91	5oown...P.ˆ.S..
0a40	23 63 1f 16 9c cd b9 b2 05 63 3a e1 f4 68 1b 17	#c.....c:h..
0a50	05 35 95 53 ee 00 04 04 30 82 04 00 30 82 02 e8	.5.S...0...0...
0a60	a0 03 02 01 02 02 01 00 30 0d 06 09 2a 86 48 86	.....0...*.H.
0a70	f7 0d 01 01 05 05 00 30 63 31 0b 30 09 06 03 55	.....0c1.0...U
0a80	04 06 13 02 55 53 31 21 30 1f 06 03 55 04 0a 13	...US1!0...U...
0a90	18 54 68 65 20 47 6f 20 44 61 64 64 79 20 47 72	.The Go Daddy Gr
0aa0	6f 75 70 2c 20 49 6e 63 2e 31 31 30 2f 06 03 55	oup, Inc.110/..U
0ab0	04 0b 13 28 47 6f 20 44 61 64 64 79 20 43 6c 61	...(Go Daddy Cla
0ac0	73 73 20 32 20 43 65 72 74 69 66 69 63 61 74 69	ss 2 Certificati
0ad0	6f 6e 20 41 75 74 68 6f 72 69 74 79 30 1e 17 0d	on Authority0...
0ae0	30 34 30 36 32 39 31 37 30 36 32 30 5a 17 0d 33	040629170620Z..3
0af0	34 30 36 32 39 31 37 30 36 32 30 5a 30 63 31 0b	40629170620Z0c1.
0b00	30 09 06 03 55 04 06 13 02 55 53 31 21 30 1f 06	0...U....US1!0..
0b10	03 55 04 0a 13 18 54 68 65 20 47 6f 20 44 61 64	.U....The Go Dad
0b20	64 79 20 47 72 6f 75 70 2c 20 49 6e 63 2e 31 31	dy Group, Inc.11
0b30	30 2f 06 03 55 04 0b 13 28 47 6f 20 44 61 64 64	0/..U...(Go Dadd
0b40	79 20 43 6c 61 73 73 20 32 20 43 65 72 74 69 66	y Class 2 Certif
0b50	69 63 61 74 69 6f 6e 20 41 75 74 68 6f 72 69 74	ication Authorit
0b60	79 30 82 01 20 30 0d 06 09 2a 86 48 86 f7 0d 01	y0.. 0...*.H....
0b70	01 01 05 00 03 82 01 0d 00 30 82 01 08 02 82 01	.....0.....
0b80	01 00 de 9d d7 ea 57 18 49 a1 5b eb d7 5f 48 86	.....W.I.[..H.
0b90	ea be dd ff e4 ef 67 1c f4 65 68 b3 57 71 a0 5e	.....g.eh.Wq.ˆ
0ba0	77 bb ed 9b 49 e9 70 80 3d 56 18 63 08 6f da f2	w...I.p.=V.c.o..
0bb0	cc d0 3f 7f 02 54 22 54 10 d8 b2 81 d4 c0 75 3d	..?.T”T.....u=
0bc0	4b 7f c7 77 c3 3e 78 ab 1a 03 b5 20 6b 2f 6a 2b	K..w.¿x.... k/j+
0bd0	b1 c5 88 7e c4 bb 1e b0 c1 d8 45 27 6f aa 37 58	... ..E'o.7X

Offset	Stream as hexadecimal	Stream as text
0be0	f7 87 26 d7 d8 2d f6 a9 17 b7 1f 72 36 4e a6 17	..&.-.....r6N..
0bf0	3f 65 98 92 db 2a 6e 5d a2 fe 88 e0 0b de 7f e5	?e...*n].....
0c00	8d 15 e1 eb cb 3a d5 e2 12 a2 13 2d d8 8e af 5f:.....-.....
0c10	12 3d a0 08 05 08 b6 5c a5 65 38 04 45 99 1e a3	.=.....è8.E...
0c20	60 60 74 c5 41 a5 72 62 1b 62 c5 1f 6f 5f 1a 42	“t.A.rb.b..o..B
0c30	be 02 51 65 a8 ae 23 18 6a fc 78 03 a9 4d 7f 80	..Qe..#j.x..M..
0c40	c3 fa ab 5a fc a1 40 a4 ca 19 16 fe b2 c8 ef 5e	...Z..... ^
0c50	73 0d ee 77 bd 9a f6 79 98 bc b1 07 67 a2 15 0d	s..w...y....g...
0c60	dd a0 58 c6 44 7b 0a 3e 62 28 5f ba 41 07 53 58	..X.D{.jb(-A.SX
0c70	cf 11 7e 38 74 c5 f8 ff b5 69 90 8f 84 74 ea 97	.. 8t...i...t..
0c80	1b af 02 01 03 a3 81 c0 30 81 bd 30 1d 06 03 55	.....0..0...U
0c90	1d 0e 04 16 04 14 d2 c4 b0 d2 91 d4 4c 11 71 b3	.....L.q.
0ca0	61 cb 3d a1 fe dd a8 6a d4 e3 30 81 8d 06 03 55	a.=...j..0....U
0cb0	1d 23 04 81 85 30 81 82 80 14 d2 c4 b0 d2 91 d4	.#...0.....
0cc0	4c 11 71 b3 61 cb 3d a1 fe dd a8 6a d4 e3 a1 67	L.q.a.=...j...g
0cd0	a4 65 30 63 31 0b 30 09 06 03 55 04 06 13 02 55	.e0c1.0...U...U
0ce0	53 31 21 30 1f 06 03 55 04 0a 13 18 54 68 65 20	S1!0...U...The
0cf0	47 6f 20 44 61 64 64 79 20 47 72 6f 75 70 2c 20	Go Daddy Group,
0d00	49 6e 63 2e 31 31 30 2f 06 03 55 04 0b 13 28 47	Inc.110/..U...(G
0d10	6f 20 44 61 64 64 79 20 43 6c 61 73 73 20 32 20	o Daddy Class 2
0d20	43 65 72 74 69 66 69 63 61 74 69 6f 6e 20 41 75	Certification Au
0d30	74 68 6f 72 69 74 79 82 01 00 30 0c 06 03 55 1d	thority..0...U.
0d40	13 04 05 30 03 01 01 ff 30 0d 06 09 2a 86 48 86	...0....0...*.H.
0d50	f7 0d 01 01 05 05 00 03 82 01 01 00 32 4b f3 b2	.....2K..
0d60	ca 3e 91 fc 12 c6 a1 07 8c 8e 77 a0 33 06 14 5c	.j.....w.3..
0d70	90 1e 18 f7 08 a6 3d 0a 19 f9 87 80 11 6e 69 e4	.....=.....ni.
0d80	96 17 30 ff 34 91 63 72 38 ee cc 1c 01 a3 1d 94	..0.4.cr8.....
0d90	28 a4 31 f6 7a c4 54 d7 f6 e5 31 58 03 a2 cc ce	(.1.z.T...1X....
0da0	62 db 94 45 73 b5 bf 45 c9 24 b5 d5 82 02 ad 23	b..Es..E.\$....#
0db0	79 69 8d b8 b6 4d ce cf 4c ca 33 23 e8 1c 88 aa	yi...M..L.3#....
0dc0	9d 8b 41 6e 16 c9 20 e5 89 9e cd 3b da 70 f7 7e	..An.. ..;p.~
0dd0	99 26 20 14 54 25 ab 6e 73 85 e6 9b 21 9d 0a 6c	.& .T%.ns...!..l
0de0	82 0e a8 f8 c2 0c fa 10 1e 6c 96 ef 87 0d c4 0f	.....l.....
0df0	61 8b ad ee 83 2b 95 f8 8e 92 84 72 39 eb 20 ea	a....+....r9. .
0e00	83 ed 83 cd 97 6e 08 bc eb 4e 26 b6 73 2b e4 d3	.....n...N&.s+..
0e10	f6 4c fe 26 71 e2 61 11 74 4a ff 57 1a 87 0f 75	.L.&q.a.tJ.W...u
0e20	48 2e cf 51 69 17 a0 02 12 61 95 d5 d1 40 b2 10	H..Qi....a...@..
0e30	4c ee c4 ac 10 43 a6 a5 9e 0a d5 95 62 9a 0d cf	L....C.....b...
0e40	88 82 c5 32 0c e4 2b 9f 45 e6 0d 9f 28 9c b1 b9	...2..+E...(...
0e50	2a 5a 57 ad 37 0f af 1d 7f db bd 9f	*ZW.7.....

