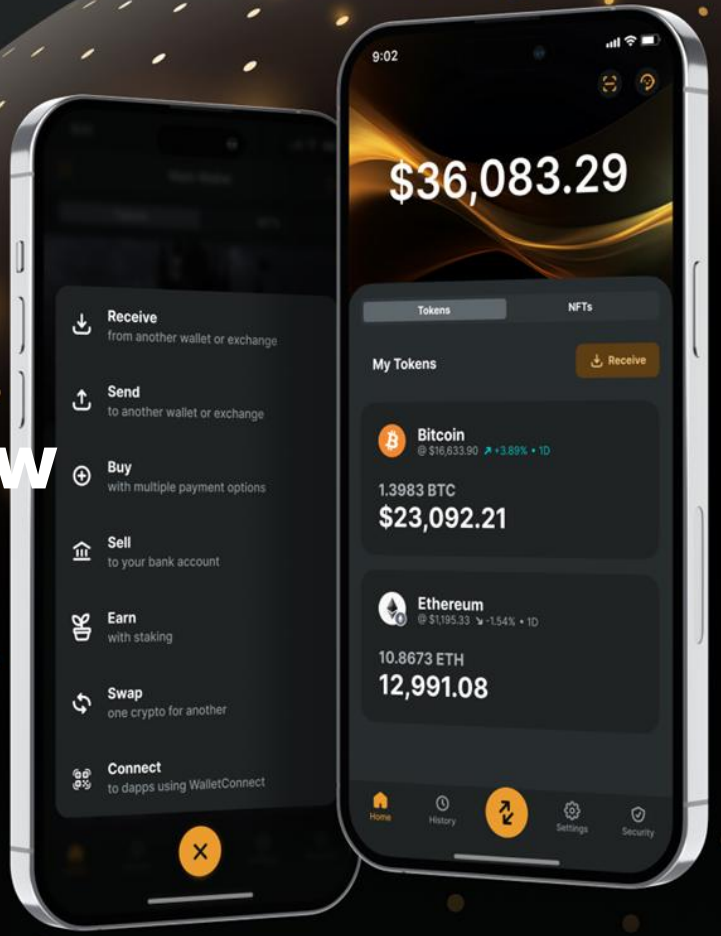
zengo

4 Exploits and a Funeral

Exploring WhatsApp's "View Once" Media

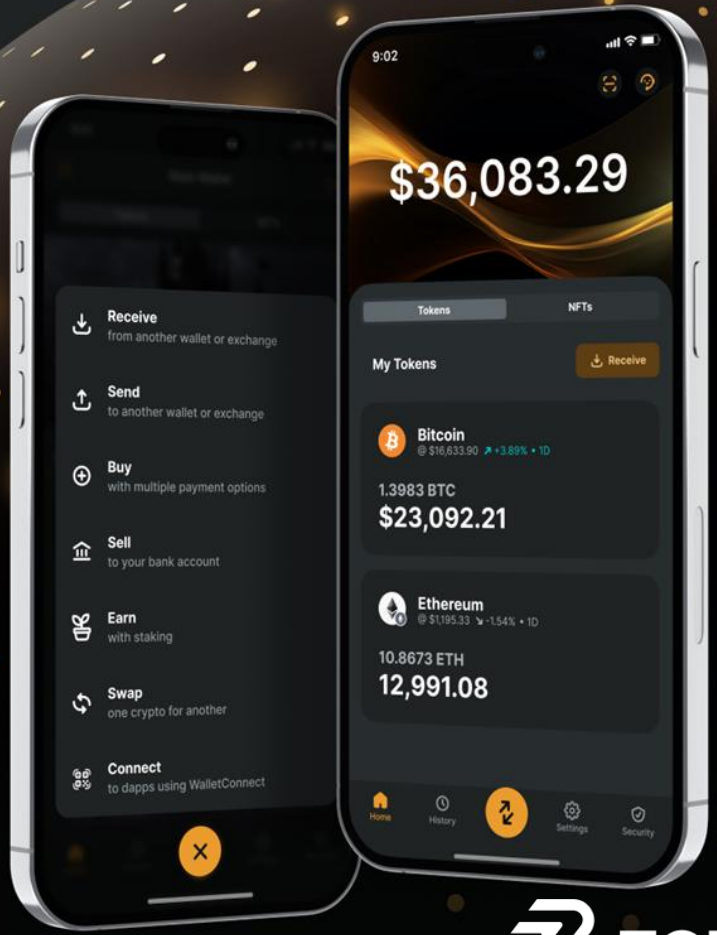


TROOPERS

Troopers 26

👋 Hi, I'm Tal Be'ery

- Co-Founder, CTO @ Zengo
- Recently, acquired by eToro
- 20+ years cyber security
- 10 times Black Hat Speaker
- 1st time Troopers speaker!
- @talbeerysec



eToro

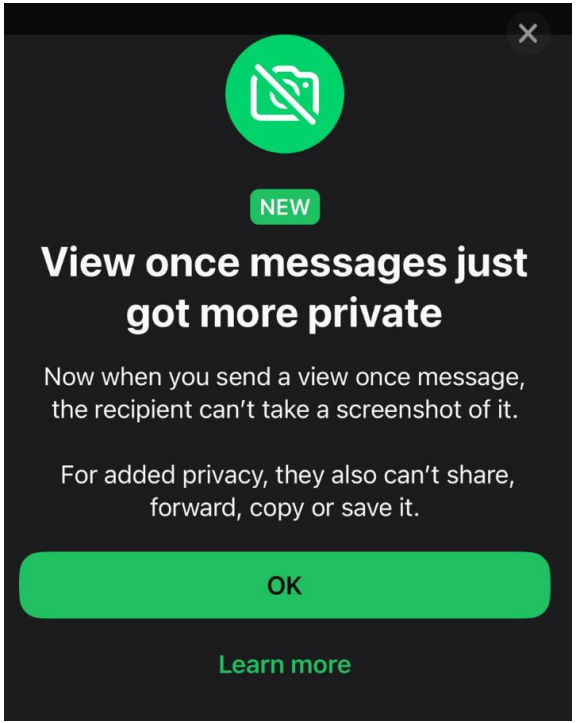
zengo

TL;DR

View Once: presented by WhatsApp

https://x.com/WhatsApp/status/1617578925022138369

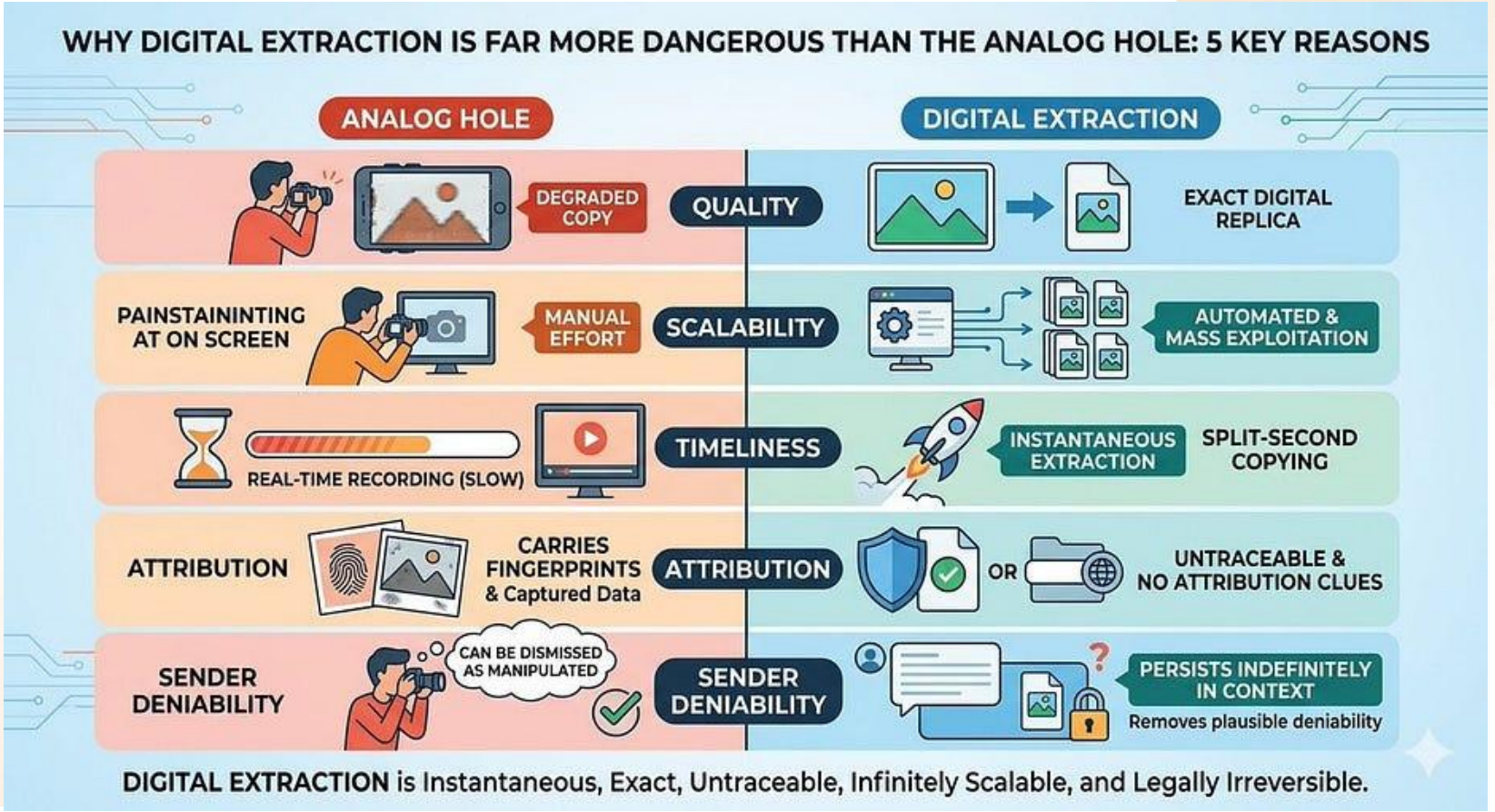
View Once: Privacy!



TL;DR:

- **We broke Meta's WhatsApp's View Once 4 times 2024-26:**
  - → **Creating an instant digital copy with no restrictions**
  - → **As easy as installing a browser extension**
- Meta fixed 3, WONT FIX 4th

But you can still photo it with another camera”



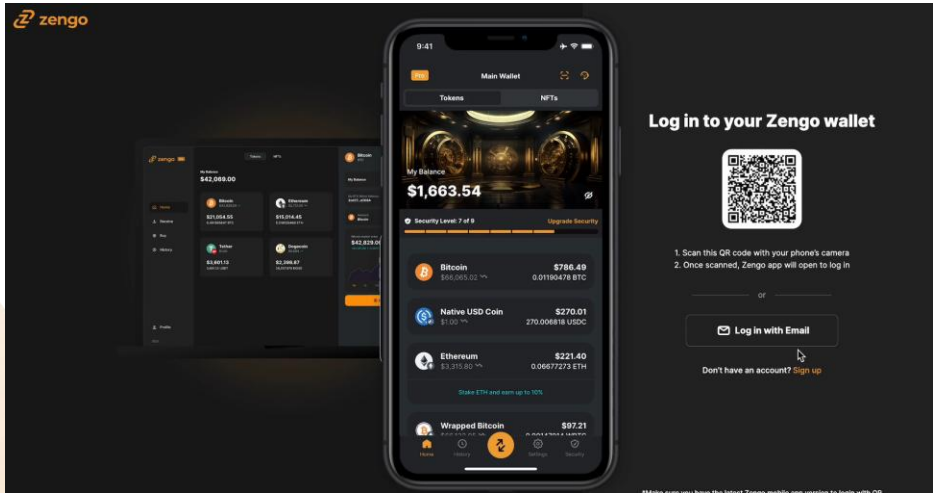
Agenda

- WhatsApp intro: threat modelling, security, E2EE
- WhatsApp over the wire: With a new Open-Source research tool
- Exploits 1,2,3,4
- Funeral: Meta’s WONT FIX
- Resurrection: How it should work
- Q&A

Cryptowallets → View Once ???

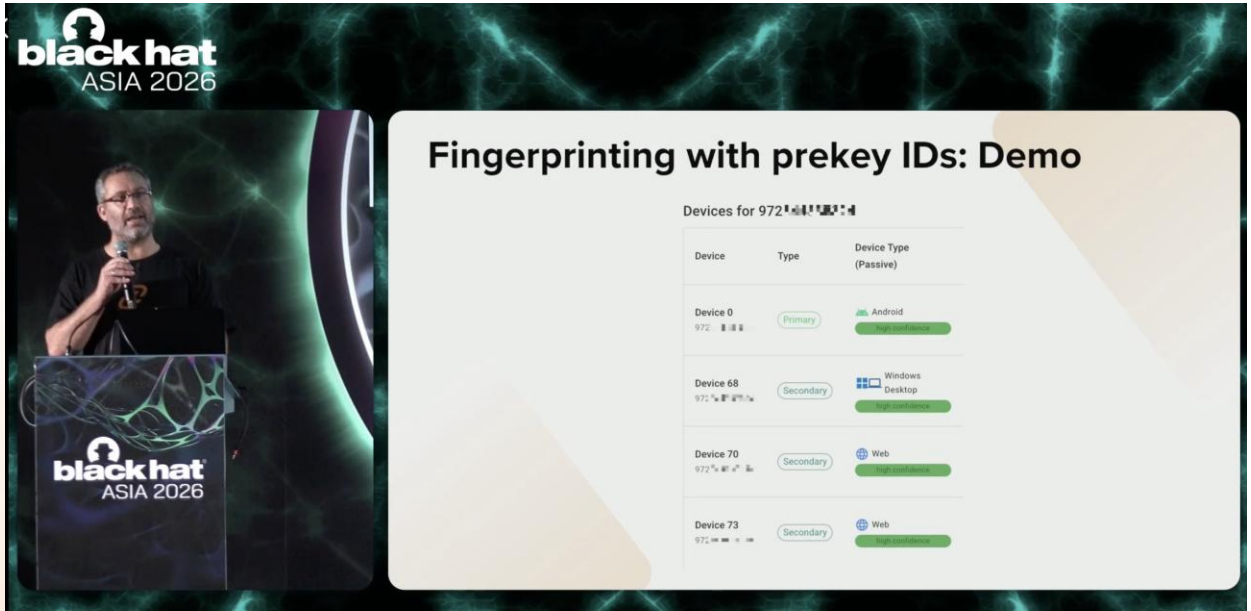
IM: Wallet's brother from another mother

- Sending digital money is yet another format of P2P comms
- Public Key cryptography
- Started Mobile, went Multi-Device



WhatsApp some other research

BlackHat ASIA 2026: [Your Number Is Up: When 3.5 Billion Strangers Can Exploit Your WhatsApp Devices]




ME TRYING
TO DO
A NORMAL
PRODUCTIVE
E2EE IN THE
WILD RESEARCH
WHATSAPP
PRIVACY
ISSUES
imgflip.com

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WhatsApp Security

Intro

WHATSAPP IS THE IM GORILLA

A Giant in Instant Messaging

OVER 3 BILLION
MONTHLY ACTIVE USERS WORLDWIDE

100 MILLION
MONTHLY ACTIVE USERS IN THE US

RANKED MOST USED
MOBILE MESSENGER APP IN THE WORLD

MORE THAN
100 BILLION
MESSAGES SENT EACH DAY

MORE THAN
7 BILLION
VOICE MESSAGES SENT DAILY

*Data sourced from backlinko.com/whatsapp-users (Conceptual representation)

I rob banks because that's where the money is.

— Willie Sutton —

AZ QUOTES

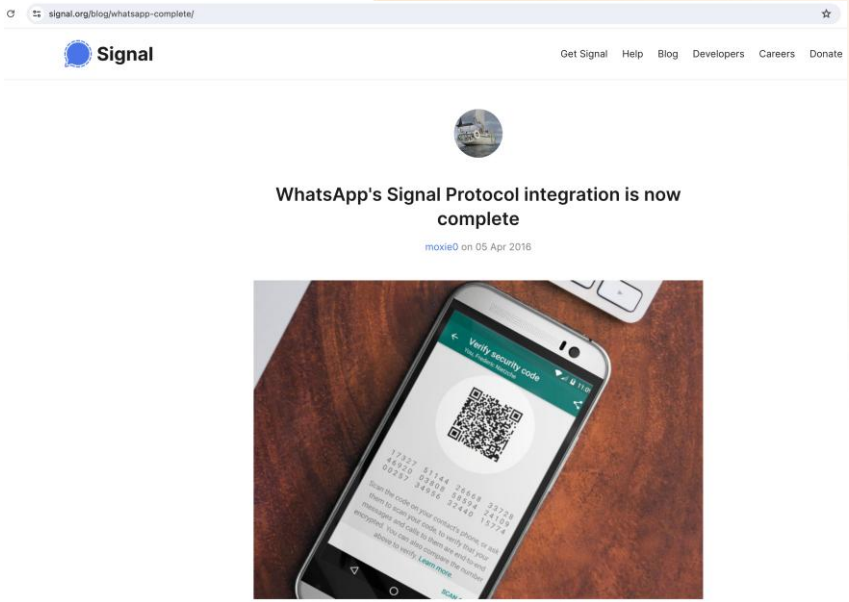
I hack WhatsApp because that's where the data is.

— Willie Sutton —

AZ QUOTES

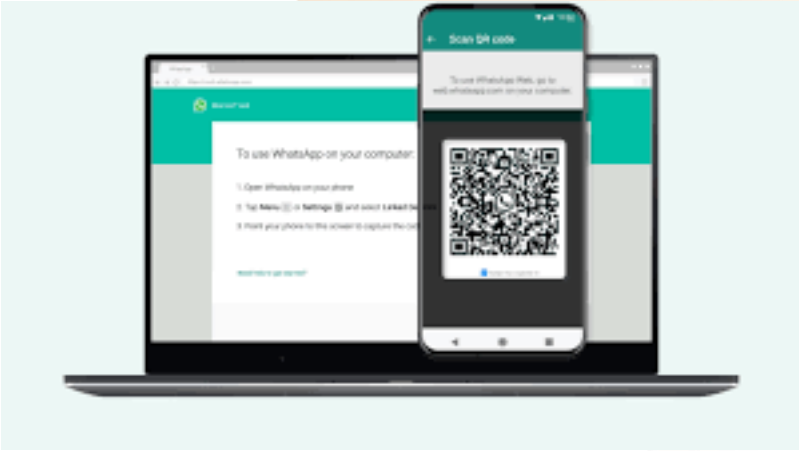
WhatsApp Signal E2EE

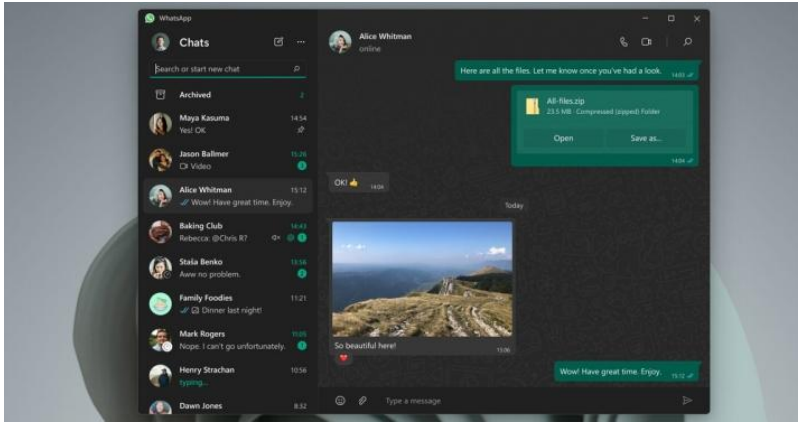
- Introduced in 2016
- Based on Signal Protocol
- https://signal.org/blog/whatsapp-complete/
- https://www.whatsapp.com/security/WhatsApp-Security-Whitepaper.pdf



WhatsApp Multi-device

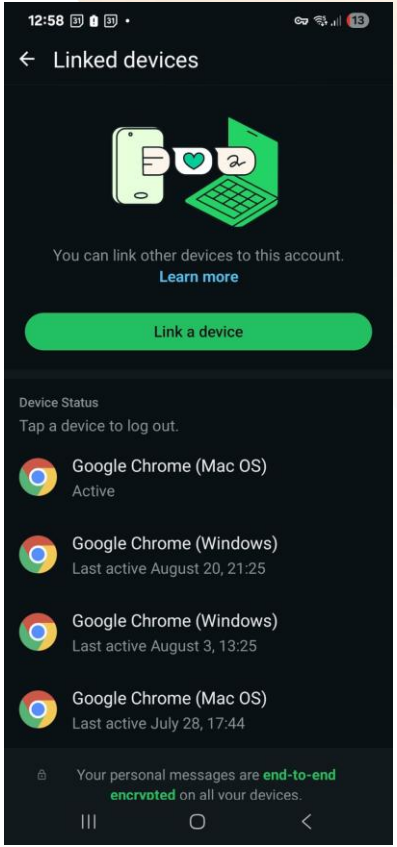
- Primary device: mobile
- Identity: phone #
- Companions: Web, desktops, another mobile, ...
- To add, scan primary's QR





How to E2EE with Multi-devices?

- Signal Sesame : Multiple sessions
- Each device generates Key bundles
- Sender creates a session with:
  - → Each receiver device
  - → All other sender devices
- Sender sends message on all sessions



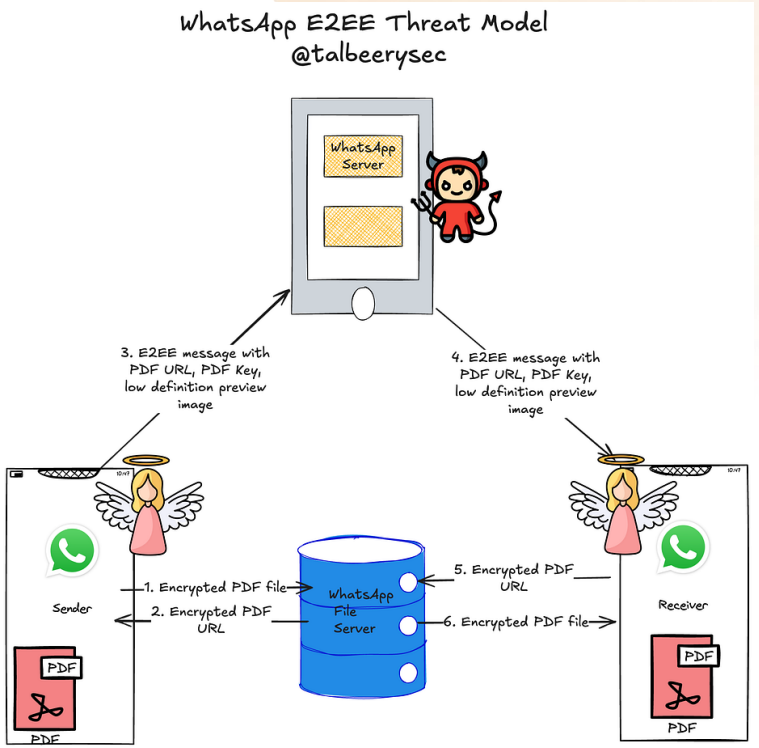
WhatsApp Threat Model: Rogue Server

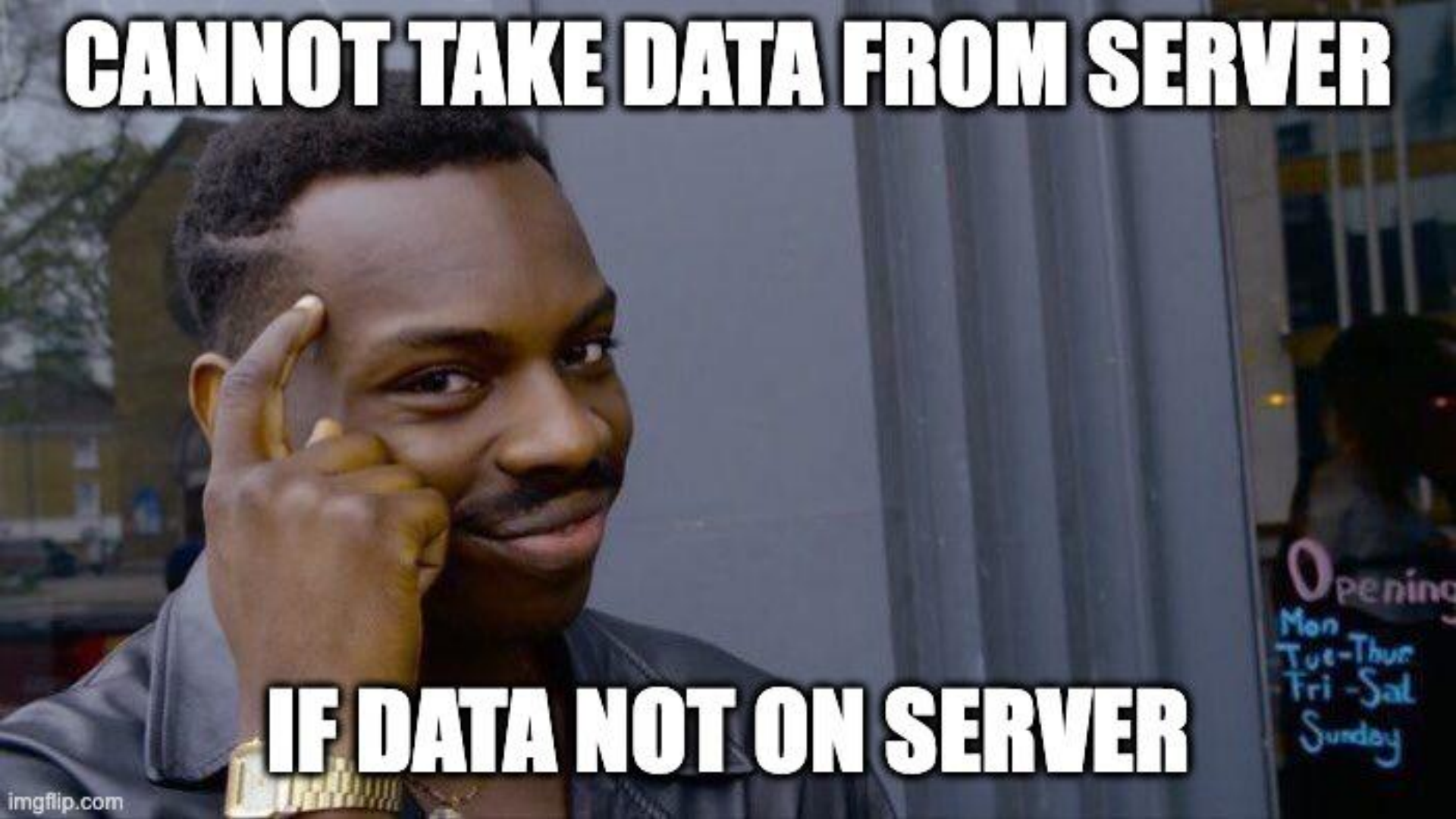
- No data on server

  → Metadata remains

- Prevents mass surveillance

- Server is a less attractive target now




CANNOT TAKE DATA FROM SERVER
IF DATA NOT ON SERVER
Opening
Mon
Tue-Thur
Fri -Sat
Sunday
imgflip.com

WhatsApp Threat Model: Rogue Client

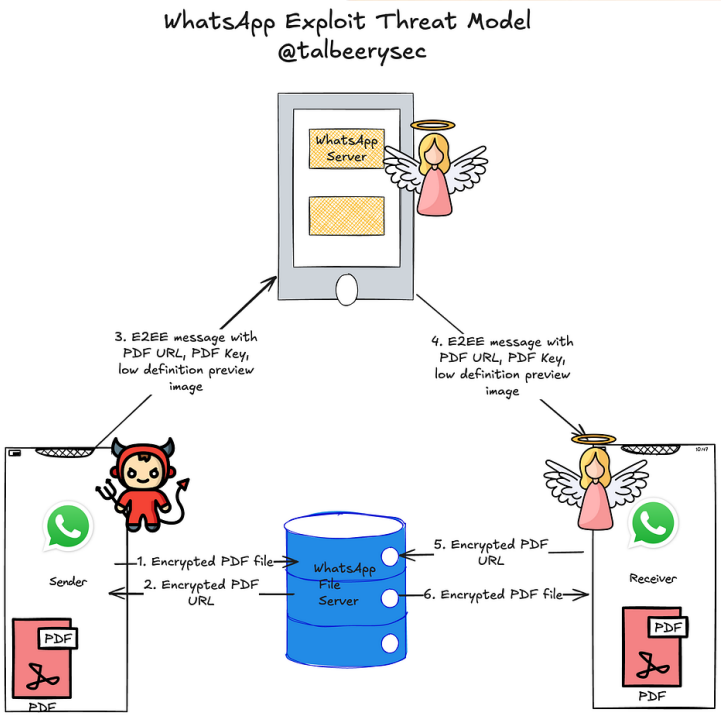
- Server is a less attractive target now

  → Client is a more attractive target

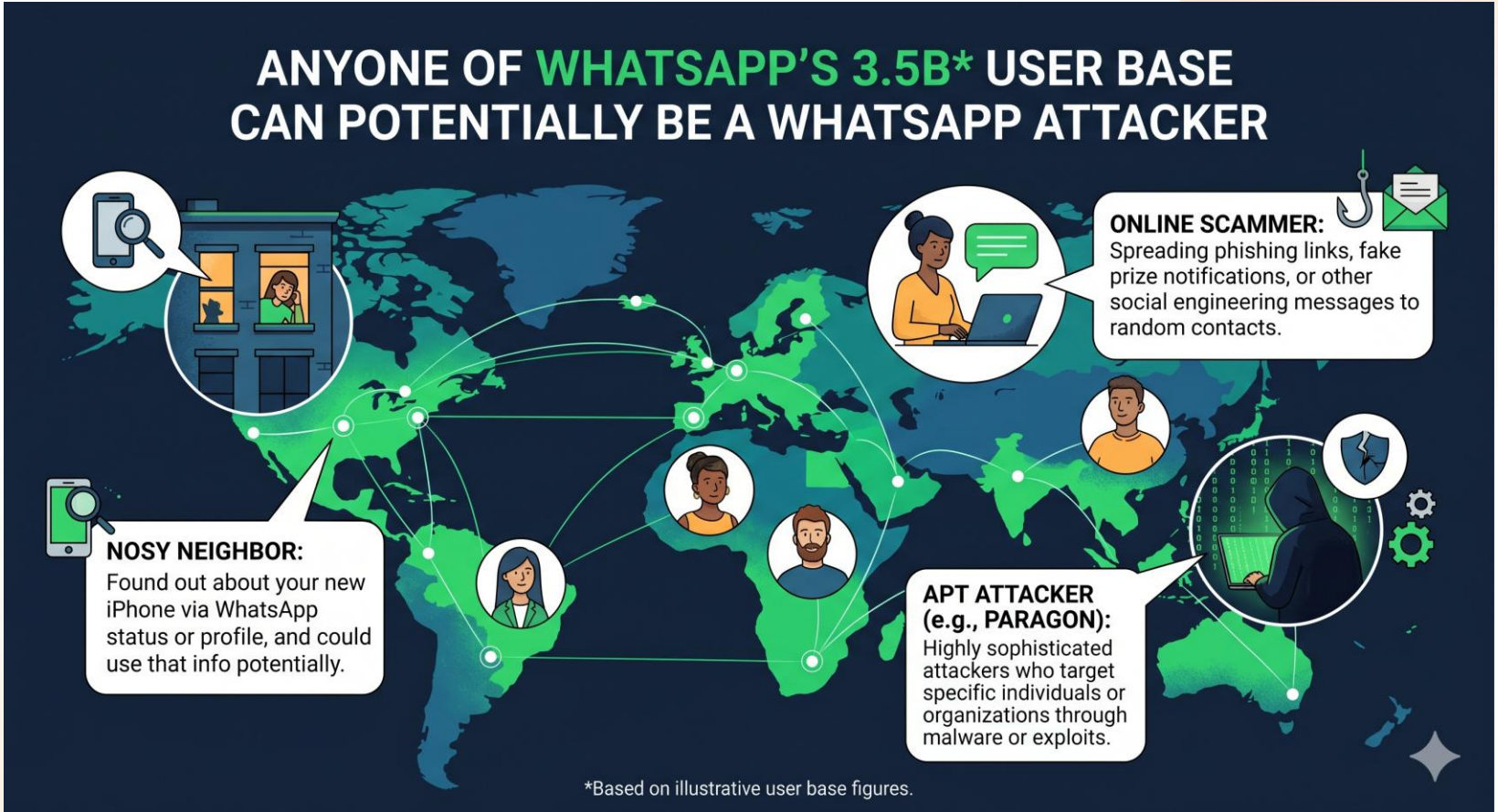
- Server is a “dumb pipe”

  → Cannot see malicious traffic

  → Cannot terminate sessions: Client is directly “exposed”



WhatsApp Threat Model: Rogue Client



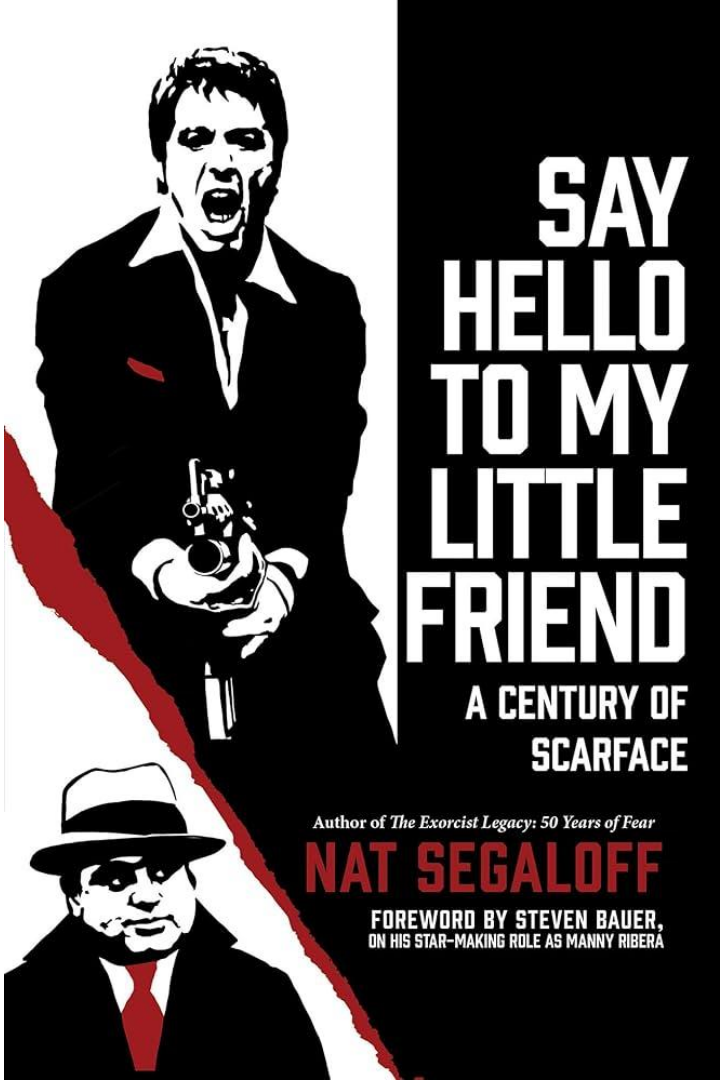
WhatsApp

Over the wire

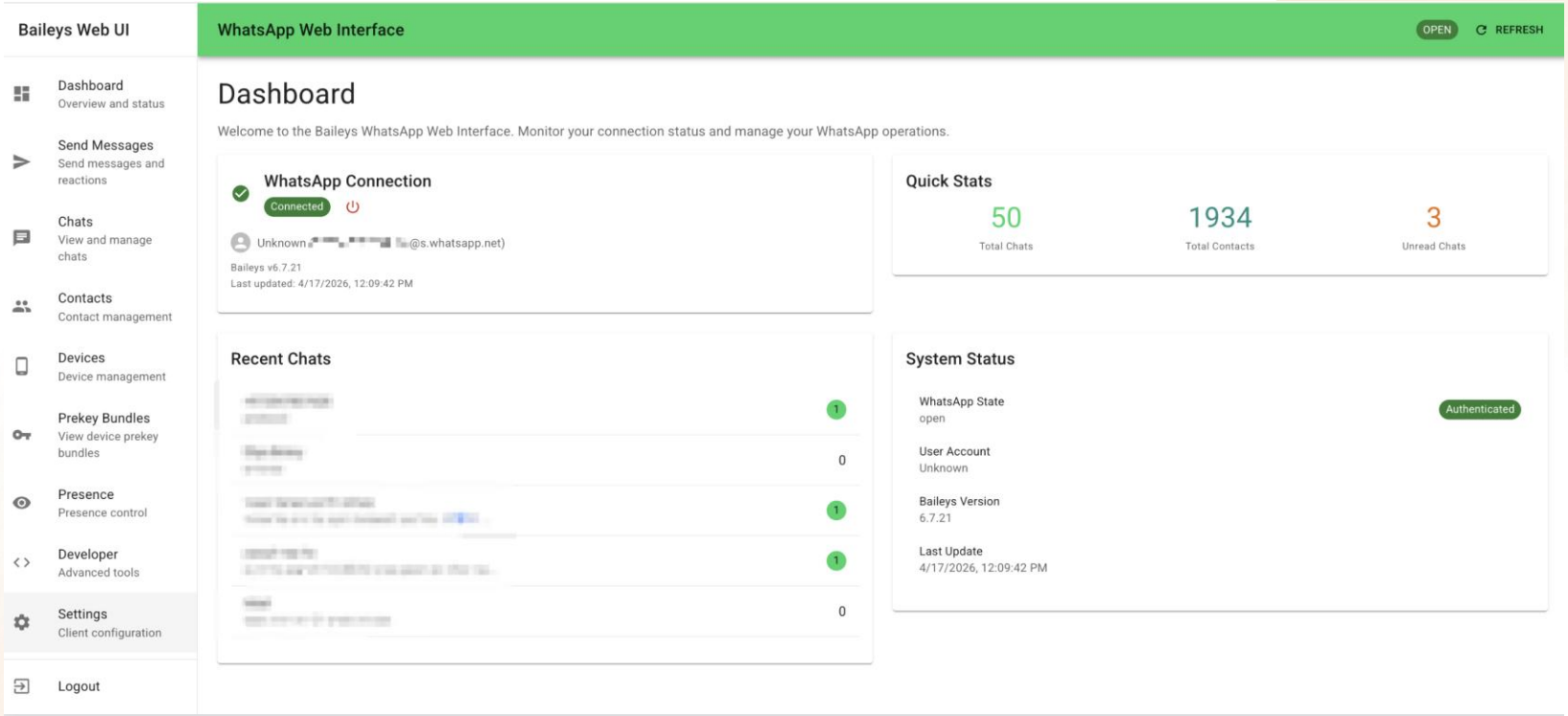
wiresharkfoundation.org

Looking under the hood

- The client does not let us see all the action
- We need a client that does!
- Based on Baileys open-source project
- https://github.com/WhiskeySockets/Baileys
- New client is added as another companion device


SAY HELLO TO MY LITTLE FRIEND
A CENTURY OF SCARFACE
Author of *The Exorcist Legacy: 50 Years of Fear*
NAT SEGALOFF
FOREWORD BY STEVEN BAUER,
ON HIS STAR-MAKING ROLE AS MANNY RIBERA

WhatsApp Bailey’s Device Toolkit



github.com/talbeerysec/WhatsApp-baileys-device-toolkit

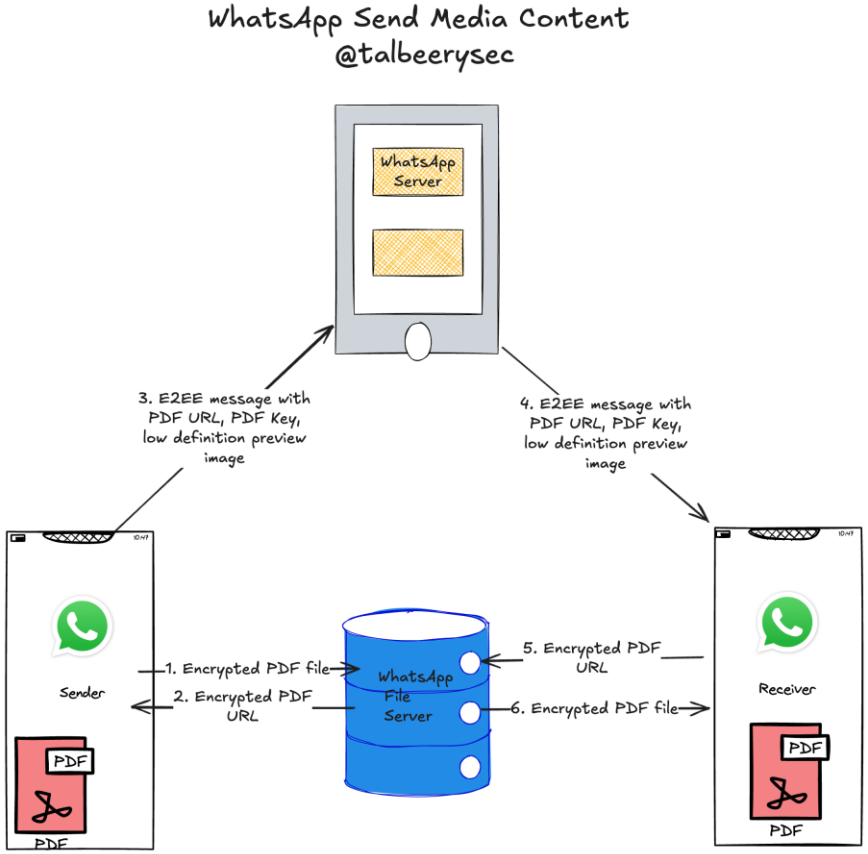
Say hello to my eldest son

Encrypted message on wire

- XMPP envelope
  - → Extensible Messaging and Presence Protocol
  - → Originally named Jabber (hence JID)
- Metadata in plaintext
- Content E2EE

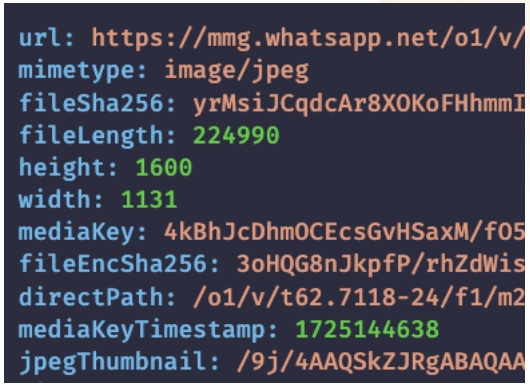
Media message send and receive

- Sender generates a random key
- Encrypt + upload file to file server
- Sends URL + key under E2EE
- Receiver: download + decrypt



Decrypted Media message

- Protofbuf encoded
  - → URL
  - → TYPE
  - → Dimensions (for image)
  - → Key
  - → Preview



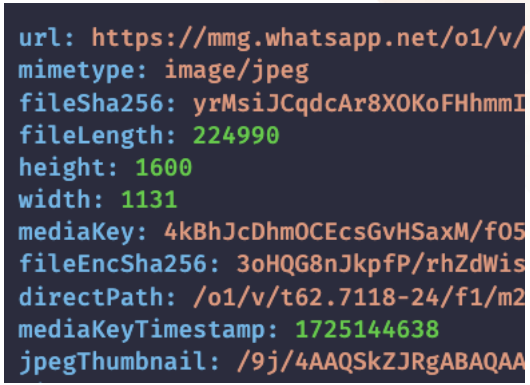
Decrypting Media: DIY

- CURL URL
- HKDF(base64(media key))

  → IV

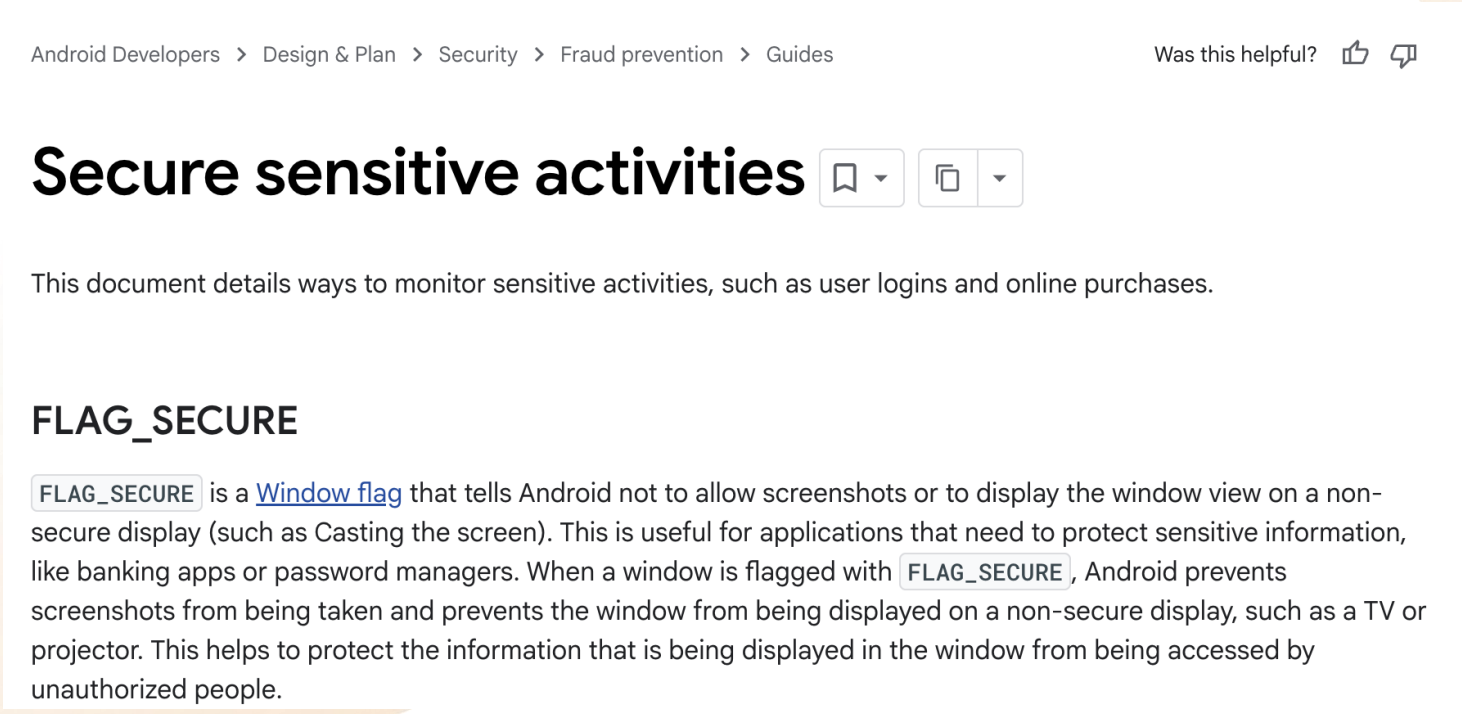
  → KEY

  → MAC
- openssl enc -aes-256-cbc –d



View Once in mobile

- **WhatsApp relies on mobile OS to block screenshots**



Android Developers > Design & Plan > Security > Fraud prevention > Guides

Was this helpful?

Secure sensitive activities

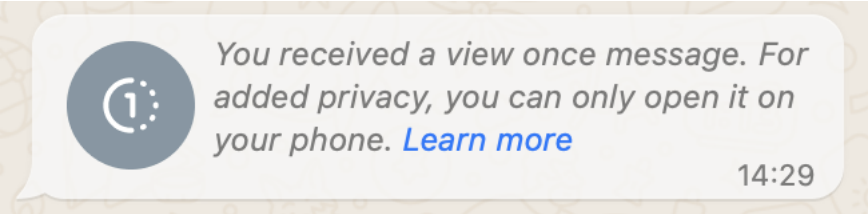
This document details ways to monitor sensitive activities, such as user logins and online purchases.

FLAG_SECURE

`FLAG_SECURE` is a Window flag that tells Android not to allow screenshots or to display the window view on a non-secure display (such as Casting the screen). This is useful for applications that need to protect sensitive information, like banking apps or password managers. When a window is flagged with `FLAG_SECURE`, Android prevents screenshots from being taken and prevents the window from being displayed on a non-secure display, such as a TV or projector. This helps to protect the information that is being displayed in the window from being accessed by unauthorized people.

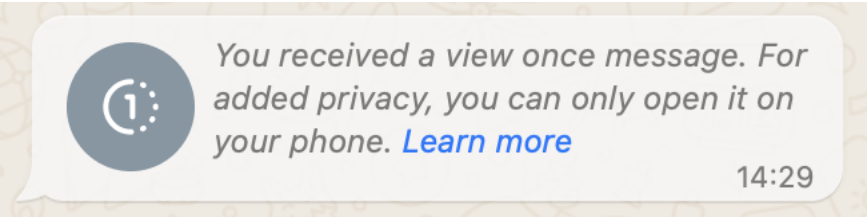
View Once + Multiple device

- **WhatsApp allows receiving View Once only in devices in which the app can control screenshots**
- **In other devices (e.g. Web) users are told to open it on supporting devices**



View Once: Device fingerprinting potential?

- **Hypothesis: WhatsApp server tells sender to which devices it can send View Once and to which it cannot**
- **If true, a fingerprinting potential!**



View Once message JSON

View Once message JSON analysis

- **Contains**
  - → Media URL
  - → Media key material
  - → Thumbnail (???)
  - → View once = true
- Regular media message + View Once = True

Exploit 1

Aug 24: View ~~Once~~ stored messages

Let’s view infinitely…. #1

- **WhatsApp Web stores View Once in chat history, as is**

  → Display is blocked by the ViewOnce flag

- **Let’s make a Chrome Extension to toggle it!**
- **Let’s check WhatsApp Chrome extension in GitHub…**
- **https://github.com/Schwartzblat/WhatsApp-Web-Plus !**

Code

```
const view_once_handler = (message) => {
    if (!message?.isViewOnce) {
        return false;
    }
    message.isViewOnce = false;
};

const initialize_renderer_hook = () => {
    const handle_message = (message) => {
        if (message?.isViewOnce !== true) {
            return;
        }
        console.log(message);
        message.isViewOnce = false;
    };
    const original_function = mR.modules[WA_MODULES.MESSAGES_RENDERER].default;
    mR.modules[WA_MODULES.MESSAGES_RENDERER].default = function () {
        handle_message(arguments[0]?.msg);
        return original_function(...arguments);
    }
};
```

Normal WhatApp Web Sender

אבא

Type a message

Manipulated WhatsApp Web Receiver

Hadar Be'ery

Type a message

Responsible disclosure to Meta

View once: uploaded media is not deleted from server after 14 days

Informative · Last updated 7 weeks ago · #122174562572159209

WhatsApp view once - file URL issues

Informative · Last updated 7 weeks ago · #122173211618159209

WhatsApp View once image message includes preview information

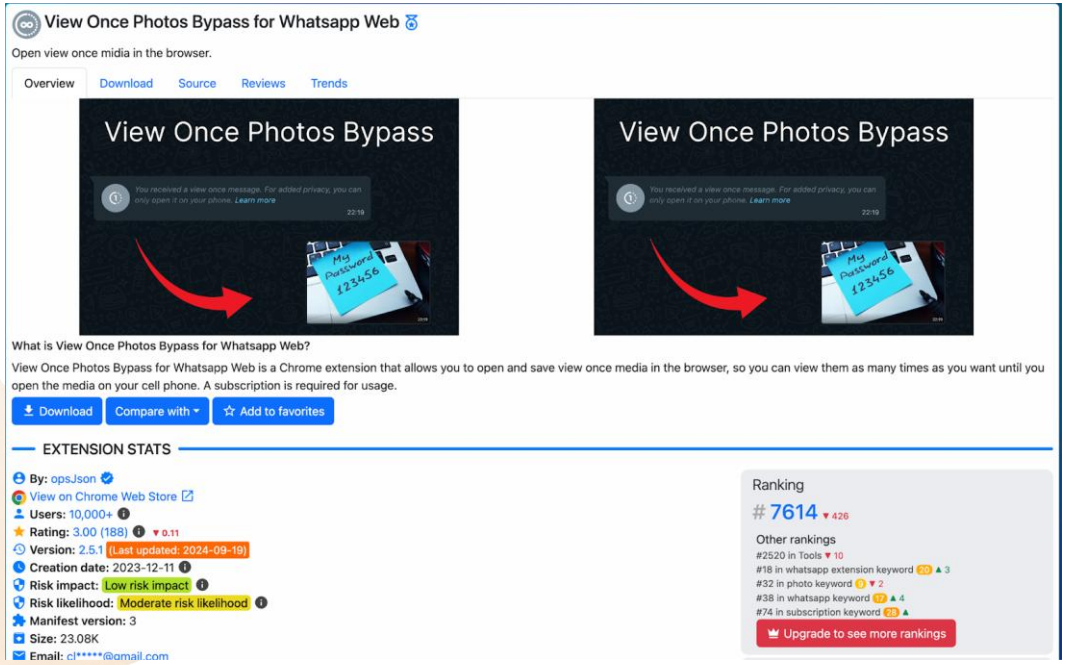
Informative · Last updated 7 weeks ago · #122171855396159209

View once media privacy issues

Informative · Last updated 7 weeks ago · #122171558132159209

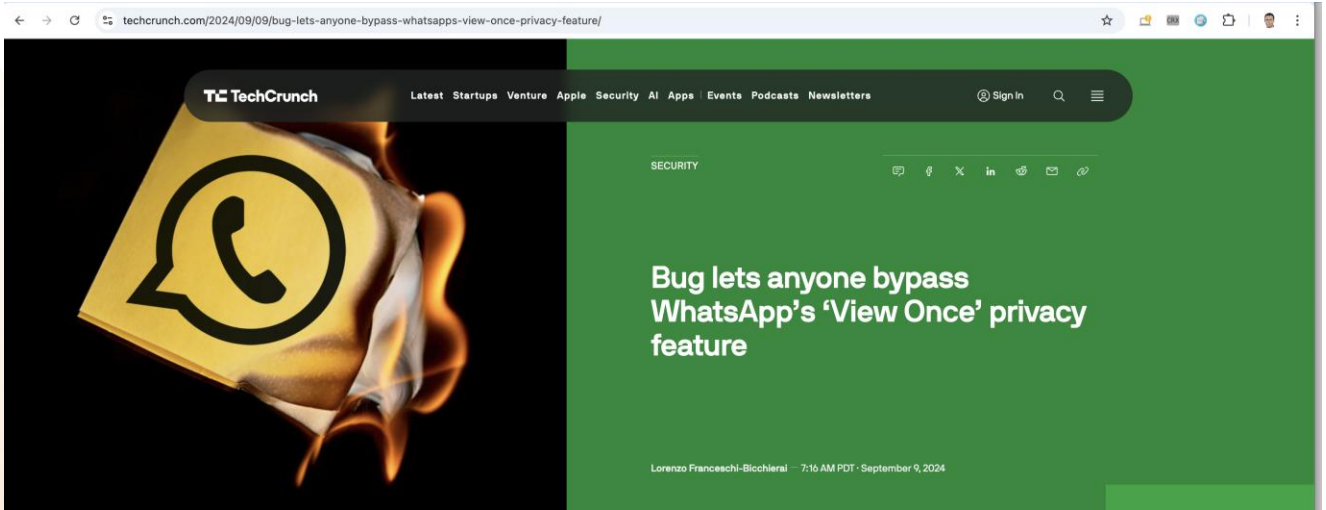
Exploited in the wild!

- Let’s check if such extensions exist in Chrome Store
- Boom! Since 2023 (chrome-stats.com)



Publish

- No word from Meta for a while
- Exploited in the wild
- Published in TechCrunch , others (9.9.24)



Meta response

Informative · Wednesday, September 18, 2024 at 6:55 PM

Our reply

Hi Tal,

Thank you for your bug bounty submission.

We appreciate your research and have reviewed your findings, which were informative. Prior to your submission, we were already in the process of rolling out updates to view once on Web. Those updates are forthcoming and will be rolled out soon. Given that, your submission does not qualify for a monetary reward.

Additionally, we would like to remind you of our guidance that we provide immediately after a submission is made to the program, which is a requirement that we also outline on our website's Program Terms: "Please give us reasonable time to investigate and mitigate the issue before sharing information with others." In the future, please give us reasonable time to investigate and respond to your report prior to sharing your report with others.

Thanks,

Meta Bug Bounty Team

Meta’s fix

- **12.9.24 update to web app**
- **WhatsApp Web redacts ViewOnce in chat history**

  → **URL, Key are not saved**
- **Saved messages are safe now!**

Exploit 2

Sept 24: View ~~Once~~ received messages

Let’s view infinitely…. #2

- **WhatsApp Web redacts View Once in chat history**

  → **URL, Key are not saved**

- **Let’s toggle ViewOnce “upstream” on message itself, before it gets saved, so it will not get rdacted**
- **Contributed code to [WhatsApp-Web-Plus] extension**
- **[Blogpost]**

Code

```
const initialize_protobuf_hook = () => {
    const handle_message = (message) => {
        if (message?.viewOnceMessageV2?.message?.imageMessage?.viewOnce === true) {
            message.viewOnceMessageV2.message.imageMessage.viewOnce = false;
        } else if (message?.viewOnceMessageV2?.message?.videoMessage?.viewOnce === true) {
            message.viewOnceMessageV2.message.videoMessage.viewOnce = false;
        } else if (message?.viewOnceMessageV2Extension?.message?.audioMessage?.viewOnce === true) {
            message.viewOnceMessageV2Extension.message.audioMessage.viewOnce = false;
        }
        return message;
    };

    const original_processor = MODULES.PROTOBUF_HOOK.verifyProtobufMessageObjectKeys;
    MODULES.PROTOBUF_HOOK.verifyProtobufMessageObjectKeys = function (message) {
        const modified_message = handle_message(message);
        return original_processor(modified_message);
    };
};
```

Responsible disclosure to Meta

Monday, September 16, 2024 at 2:22 PM

What you submitted

Title
View Once is vulnerable even after 12.924 fix

Vuln Type
Read Data Improperly

Product Area
Web

Description/Impact
The original issue is that the View Once media messages are identical to ordinary media messages, with the addition of a single field that tells the client this media should be viewed once. Once received, these messages are stored in the app's database, just like ordinary media messages.

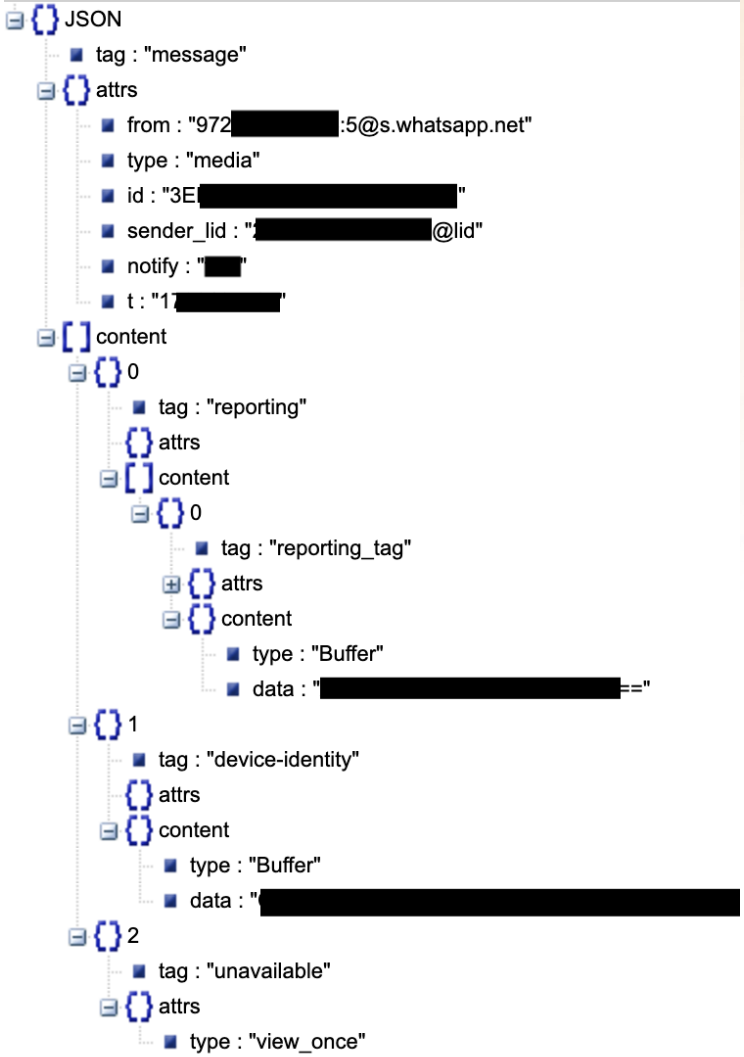
As a result, exploiting extensions could just change the View Once field to false in the database and make the official WhatsApp web app show them.

Circa 12.9.2024, WhatsApp released an update to their Web App, that changes the way View Once media messages are saved to the application's databases and redact some of the information that enables the media viewing. As a result, the media becomes technically unviewable even if the View Once field was set to false.

To bypass the fix, exploiters just need to go "upstream" and toggle the View Once flag to false when it is received by the app and before it is stored in the database.
See
https://medium.com/@TalBeerySec/whatsapp-view-once-privacy-issue-initial-fix-assessment-the-good-the-bad-and-the-ugly-be97ec1cc2e5
See demo https://www.youtube.com/watch?v=uEG0mIdUSZ8

Meta’s fix

- **Silent server fix 15.11.24**
- **ViewOnce flag was added to the unencrypted header**
- **WhatsApp Server redacts View Once message content that are sent to non-supporting devices**

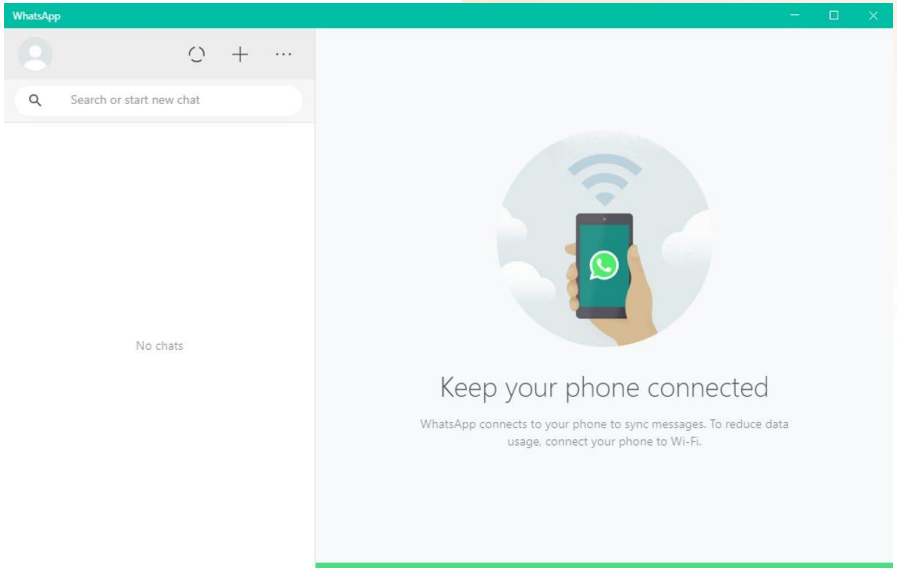


Exploit 3

Feb 25: View ~~Once~~ synced messages

What is history sync?

- New device is added
- History resides on the primary device
- New device asks for it



How it works?

- The primary device creates a file of chunked messages
- Pretty much like any other media
- Did Meta remember to redact view once there too?
- Apparently not!


```
"protocolMessage":{
   "type":"HISTORY_SYNC_NOTIFICATION",
   "historySyncNotification":{
      "fileSha256":"imczkkPcrx1wCkf/J6d
      "fileLength":"1570203",
      "mediaKey":"/2T+z2Eqnuaag6LQG/WFH
      "fileEncSha256":"llm+YPZCtWf5WJGz
      "directPath":"/v/t62.31111-24/306
      "syncType":"RECENT",
      "chunkOrder":4,
      "progress":100,
      "oldestMsgInChunkTimestampSec":"1
   }
```

Let’s view infinitely…. #3

- Create sync request
- View Once message are not redacted!

Responsible disclosure to Meta

Thursday, February 6, 2025 at 2:34 PM

What you submitted

Title
View Once feature can still be bypassed with history sync

Vuln Type
Privacy / Authorization

Product Area
WhatsApp

Description/Impact
Following our previous research on WhatsApp View Once feature privacy and security, which led to WhatsApp multiple fixes, we have found yet another issue that was not addressed.

The gist of these fixes was to allow the view once message to reach only the primary mobile device of the recipient and prevent it from reaching to companion devices. This is due to the fact that on companion devices, such as WhatsApp Web, the bypass of the view once property is trivial and can be easily automated at scale with browser extensions.

We found a way to bypass this protection with WhatsApp history sync feature. A companion device can request to sync its history with messages from the primary device. This happens naturally when a device is added and needs to populate its history, or when older messages that were not previously synced are requested by the user. When such happens the primary device serializes the requested message and sends them to the companion device. When doing so the primary device fails to redact the View once message, which allows it to get to the companion device and allow its full abuse as before.

Meta response

Friday, March 21, 2025 at 1:11 PM

Our reply

After reviewing this issue, we have decided to award you a bounty of $500. Meta fulfills its bounty awards through Bugcrowd.

Thank you again for your report. We look forward to receiving more reports from you in the future!

Meta’s fix

- **21.3.25**
- **View Once messages are redacted for non-supporting devices**

Exploit 4

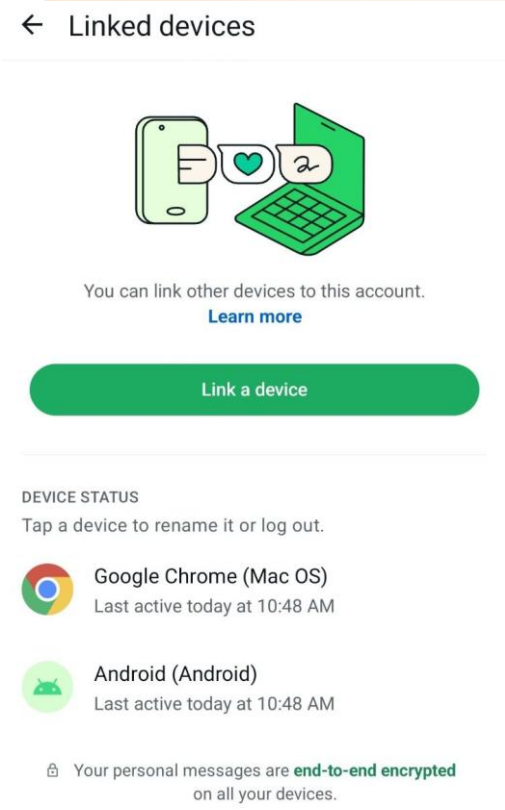
Feb 26: View ~~Once~~ as Android

Device identification

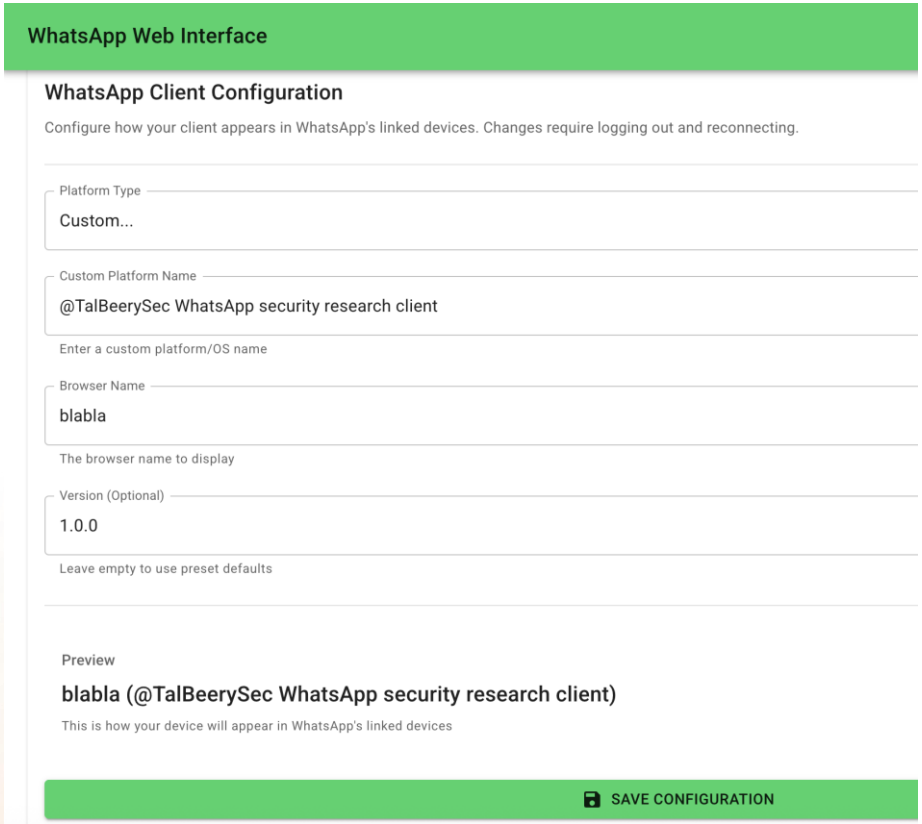
- **WhatsApp trusts Android with ViewOnce**

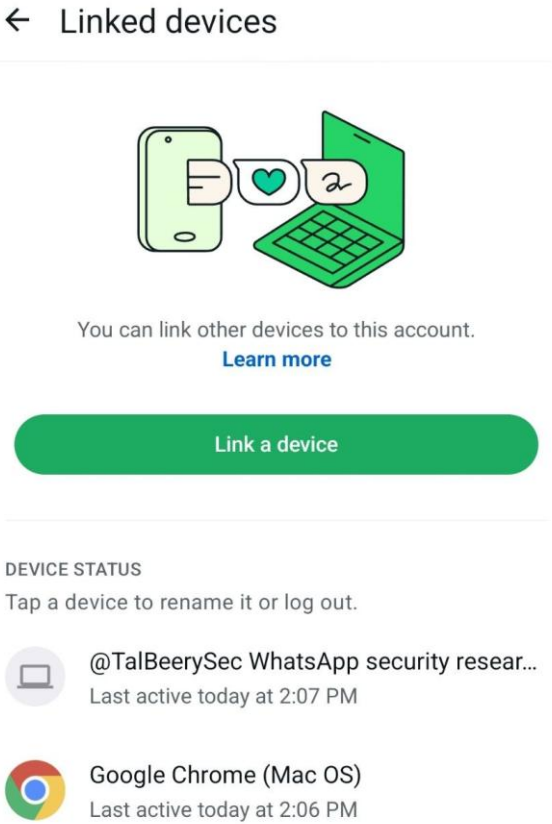
  → **Even if non-primary**

- **What prevents a client from lying?**



Device identification manipulation

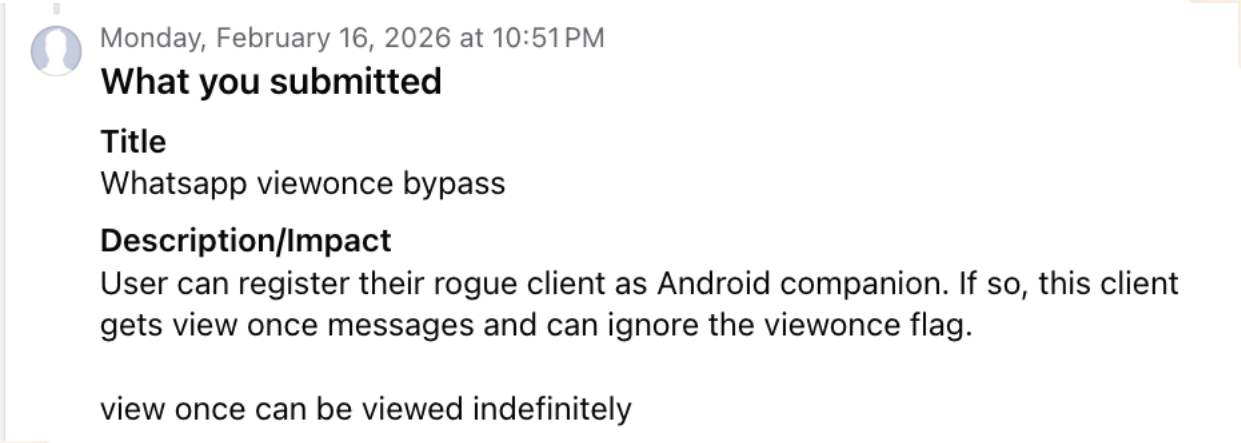




Let’s view infinitely…. #4

- **Set device type to Android via standalone app or Web extension**
- **View once is defeated**

Responsible disclosure to Meta



Monday, February 16, 2026 at 10:51 PM

What you submitted

Title

Whatsapp viewonce bypass

Description/Impact

User can register their rogue client as Android companion. If so, this client gets view once messages and can ignore the viewonce flag.

view once can be viewed indefinitely

Meta response: WONT FIX

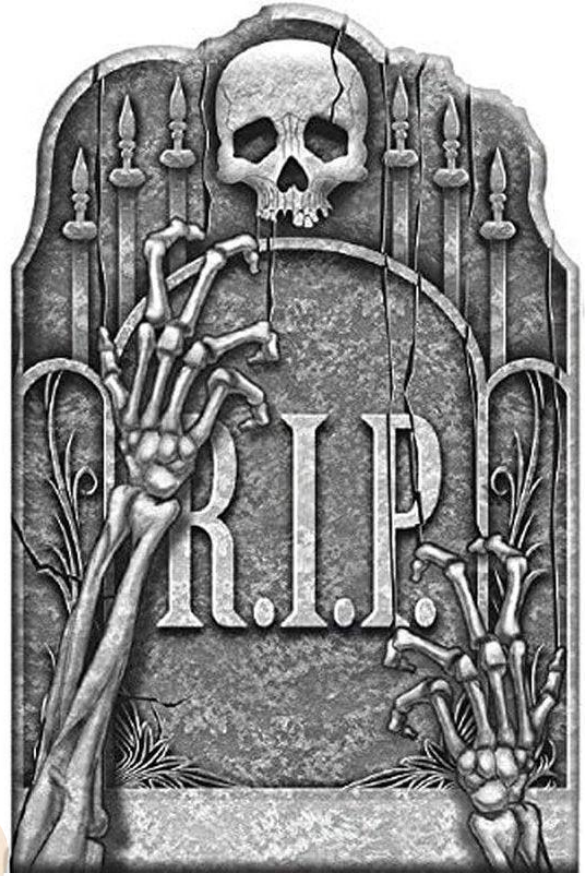
Not Applicable · Tuesday, March 10, 2026 at 12:13 PM

Our reply

Thank you for reaching out. From the security standpoint, we consider one-time-view media as a "best effort" feature, meaning that we do not consider our protections here to be hard security/privacy controls. This is because unfortunately there will always be ways to view/listen to a received media more than once. Some of these ways are outside of our control and we are unable to prevent (e.g. a person taking a photo/video of the media with another phone or capturing the media using a modified client). As such, we are unable to qualify this submission for our bug bounty program.

Although this issue does not qualify as a part of our bounty program, we appreciate your report. We will follow up with you on any security bugs or with any further questions we may have.

Meta response: WONT FIX



View Infinity → Lessons

A proper View Once solution: DRM

- This is a DRM problem
- Successfully (or at least to some extent) solved by Netflix, others
- Exploit 1,2: Solved with encryption + Hardware support
- Exploit 3: Solved with encryption
- Exploit 4: Solved with device attestation
- See Blog

General Vendors

- Talk to security researchers reporting bugs
- Closing your eyes will not make it go away

Users

- **View Once does not live to its promise**

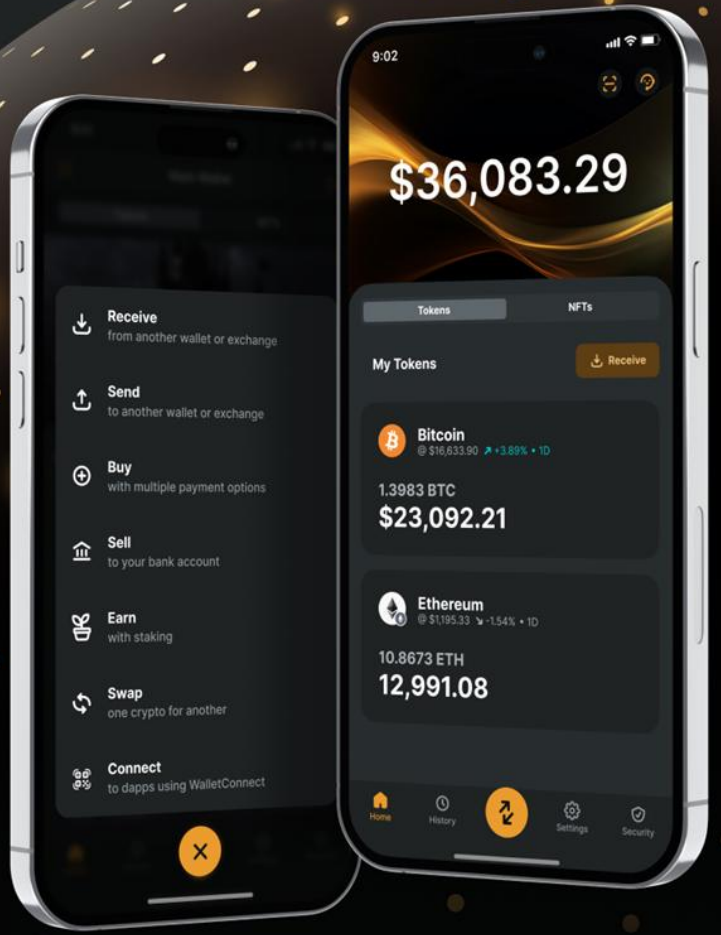
Researchers

- **Responsibly disclose, but publish when it becomes irresponsible**
- **Be ready to be surprised when you are researching**

zengo

etoro

- @talbeerysec
- Tal at Zengo dot com
- Talbe at etoro dot com



TROOPERS