

Your Code is 0000

An Analysis of the Disposable Phone Numbers Ecosystem

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How do you get a
temporary phone number?

3 ½ options depending on ...

- What do you want it for?
- What's your threat model?

1

Burner phone

- Physical device
- Pre-paid / no contract
- Mandatory SIM registration in more and more places

2

Virtual phone number

- Cloud-based (VoIP)
- Not useful for account registration
 - Forbidden by ToS
 - Blocked by service providers

New Tab

← → ↻ receive free sms online

Apps


Receive SMS Online
<https://receive-smss.com>

Receive SMS Online | Temporary Phone Number

receive-smss.com is a free service for receiving SMS messages and voice mails online. There is no need to register. Just select your phone number.

India mobile phone number. · +917428723247 India


3



+12342260144

United States


OPEN



+17192098912

United States


OPEN



+447947570472

United Kingdom

OPEN



ID +12342260144

United States mobile phone number.

4

From	Message	Time
74454	Your verification code is 227274 .	13 seconds ago
+1201 [REDACTED]	Votre code Lyft est 119370	1 minute ago
+1719 [REDACTED]	New BY~BTC Login [www.by-btc. com] Username:Xinfeng P***word: 9463364 Balance:56.01BTC	1 minute ago
22000	If someone requests this code, it is a scam. Use code 896398 only in Google Voice app to sign up. g.co/voice/help	1 minute ago
262966	964647 is your Amazon OTP. Do not share it with anyone.	1 minute ago

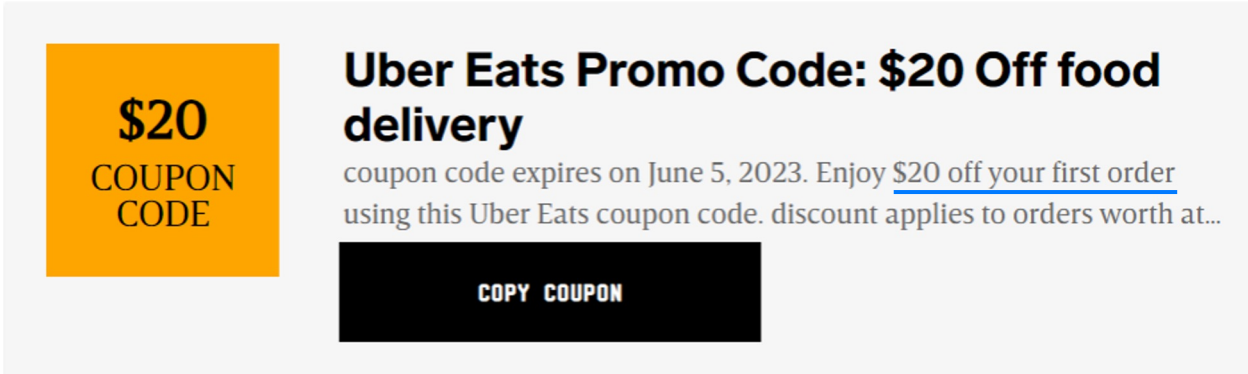
4

What are DPNs?

- Disposable Phone Numbers (DPN)
- **Shared**, non-personal phone numbers
- Mostly intended for **receiving SMS** messages
- Accessible through Public SMS Gateways (PSG)
 - Websites
 - iOS/Android apps

Why use a Disposable Phone Number?

- For privacy reasons (e.g., when trying out a new app)
- Abuse new account bonuses

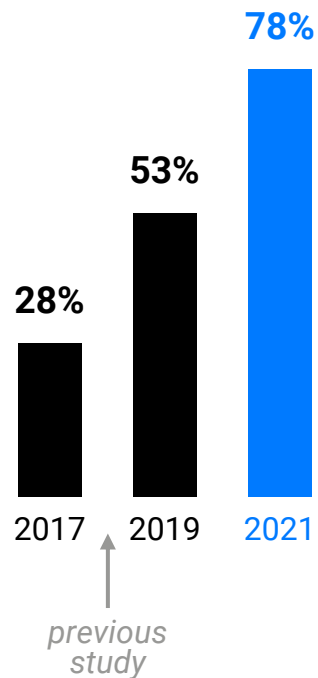


The image shows a screenshot of a promotional offer from Uber Eats. On the left, there is an orange square containing the text "\$20 COUPON CODE" in white. To the right of this square, the text reads "Uber Eats Promo Code: \$20 Off food delivery" in bold black font. Below this, a smaller line of text states "coupon code expires on June 5, 2023. Enjoy \$20 off your first order using this Uber Eats coupon code. discount applies to orders worth at...". At the bottom of the offer area, there is a black rectangular button with the white text "COPY COUPON".

<https://www.wired.com/coupons/ubereats>

Why explore this ecosystem?

- **2FA (ab)use** is on the rise How widely used ?
- SMS is the most common 2FA method (85%)
- Services that use phone number as method of **identification** and **authorization** Which services ?
- Account fraud Potential for abuse ?



<https://duo.com/blog/the-2021-state-of-the-auth-report-2fa-climbs-password-managers-biometrics-trend>

B. Reeves et al., *Characterizing the Security of the SMS Ecosystem with Public Gateways*, 2018, doi.org/10.1145/3268932

To understand this
ecosystem, we first
need data



“Without data you’re just
another person with an
opinion”

- W. Edwards Deming

Identification of Public SMS Gateways

2708745,hutorok-sudak.ru
2708746,jayhanuman.in
2708747,flandersauctions.be
2708748,ozencocom.com
2708749,sms-receive.com
2708750,bottomofthemap.media
2708751,broadviewpsychology.com
2708752,neleryasak.com
2708753,apsco.com.sa
2708754,politicsdigest.ng
2708755,wegroup.co.th

```
>>> import wordsegment as ws  
>>> ws.load()  
>>> ws.segment('sms-  
receive.com')  
['sms', 'receive', 'com']
```

*sms, msg, number, numbers,
phone, free, get, **receive**, online,
temp, otp, inbox, virtual, verify,
verification, code*

- False positive?
- Parked domain?
- Stale gateway?
- Aggregator?

1 Tranco list

2 Keyword matching

3 Manual verification

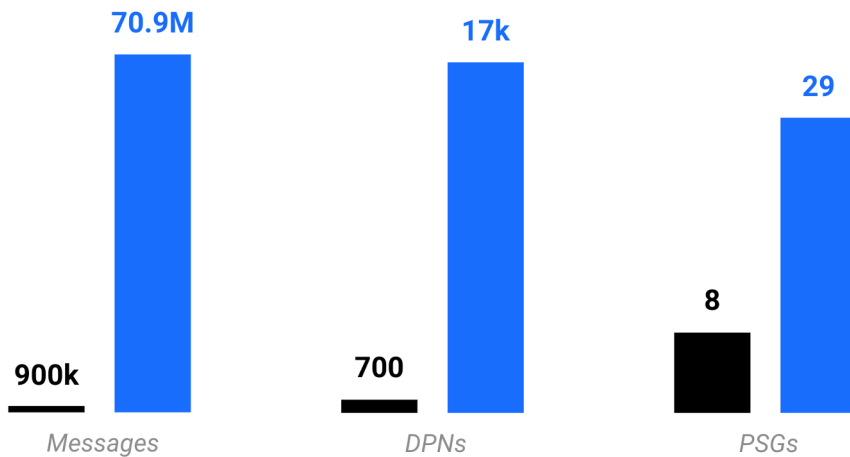
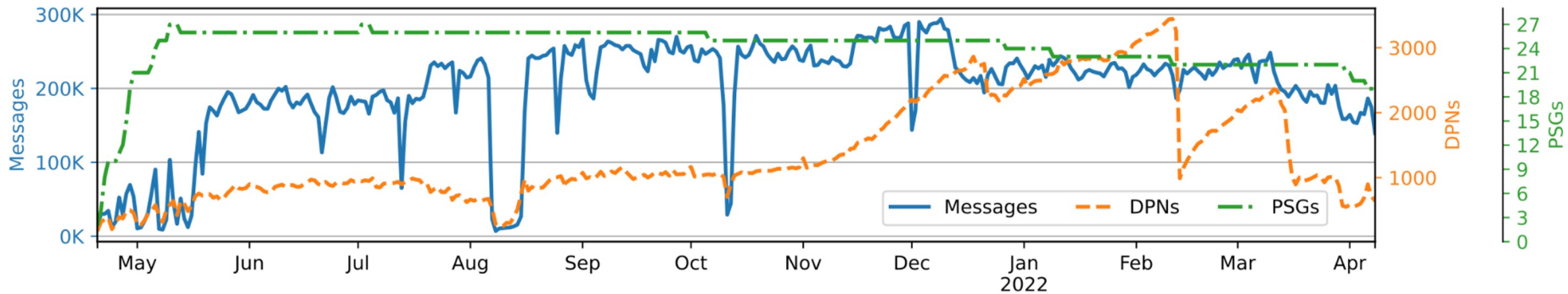
<https://tranco-list.eu/list/NK2W/3000000>
<https://pypi.org/project/wordsegment/>

29 gateways

Almost 4x than previous study

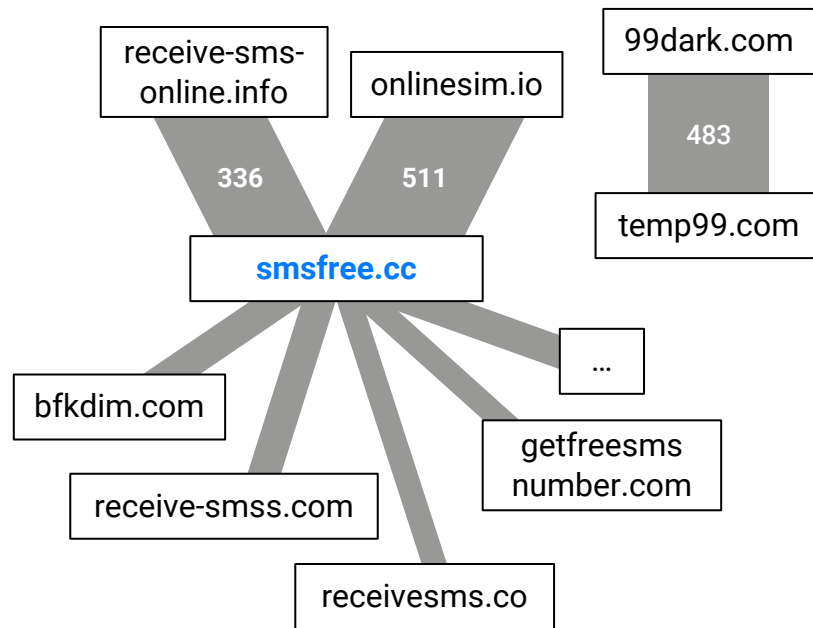
Gateway	Source
99dark.com	Google
bfkdim.com	Google
bulk-pva.com	Google
cloakmobile.com	Google
freebulksmsonline.com	Tranco
freephonenum.com	Tranco
getfreesmsnumber.com	Tranco
onlinesim.io	Google
receive-sms-online.com	Tranco
receive-sms-online.info	Tranco
receive-sms.com	Tranco
receive-smss.com	Tranco
receivefreesms.net	Tranco
receivesms.cc	Tranco
receivesms.co	Tranco

Gateway	Source
receivesms.org	Tranco
sms-online.co	Tranco
sms-receive.com	Tranco
sms-receive.net	Tranco
sms-verification.online	Tranco
sms.sellait.com	Google
sms.visatk.com	Google
smsfinders.com	Google
smsfree.cc	Google
temp-sms.org	Tranco
temp99.com	Google
tempsms.net	Tranco
virtnumber.com	Google
www.spoofbox.com	Google



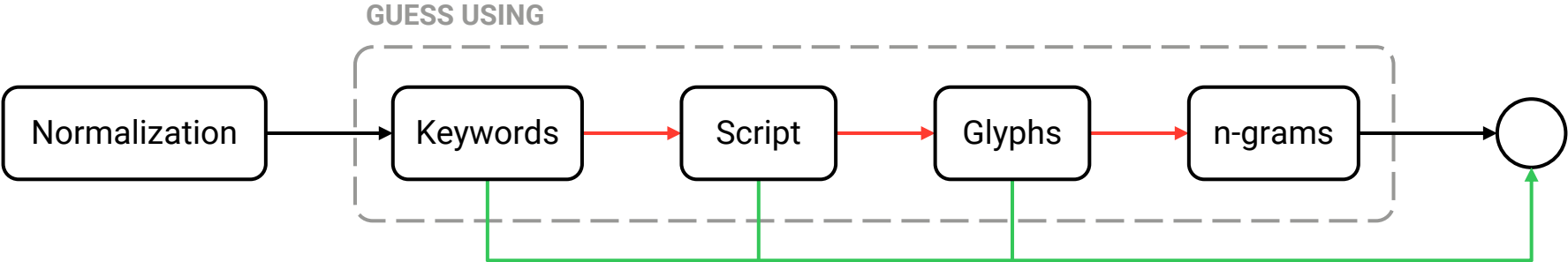
Some preliminary findings

- PSGs have a **lifespan of ~1 year**
- Most DPNs (58%) last several weeks
- Some PSGs share DPNs, specially **smsfree.cc**
- PSGs usually have links to underground markets selling **Phone Verified Accounts (PVAs)**

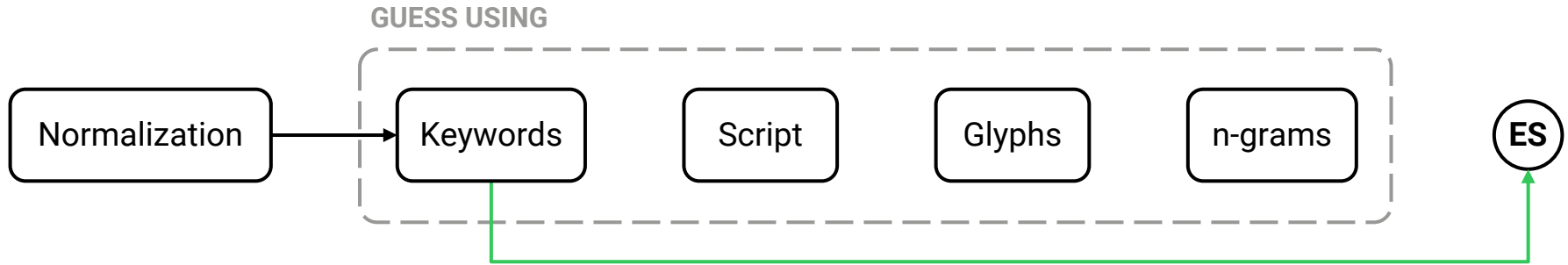


How do we **analyze**
71M **short** messages?

Language identification



Language identification



1

Su código de verificación para Stripe es: 911-851

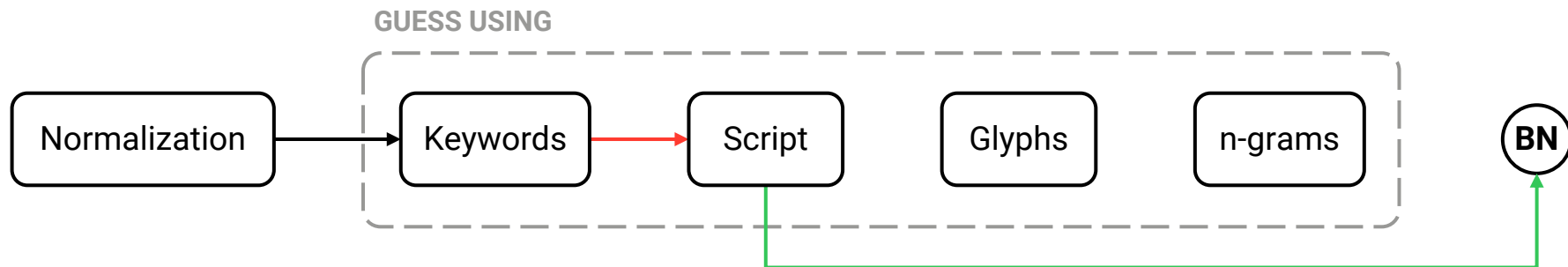
2

su código de verificación para stripe es 000000

3

su **codigo de verificacion** para stripe es 000000

Language identification



1

G-226720 হল
আপনার Google
যাচাইকরণ কোড

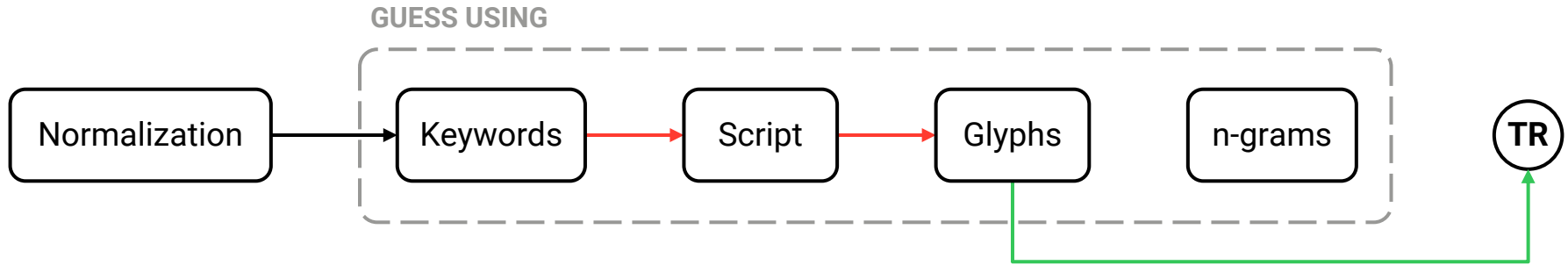
2

g 000000 হল
আপনার google
যাচাইকরণ কোড

3

g 000000 হল
আপনার google
যাচাইকরণ কোড

Language identification



1

Onay kodu:
470766. Kodu giriş
alanına yazın.

2

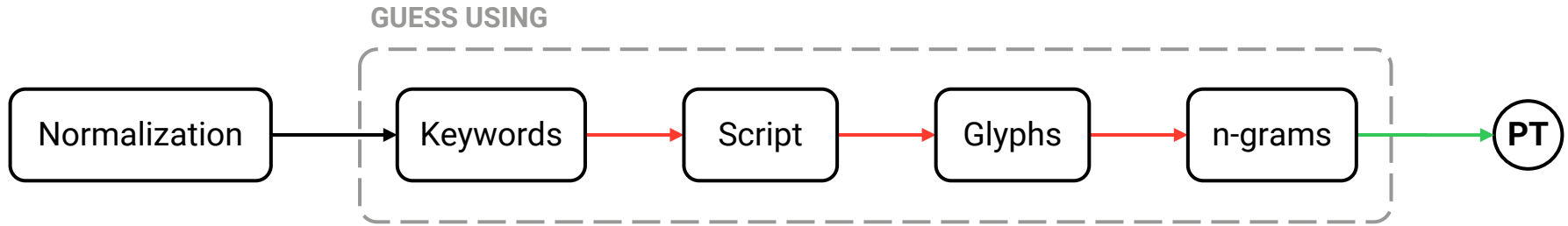
onay kodu 000000
Kodu giriş alanına
yazın

3

onay kodu 000000
Kodu giriş alanına
yazın



Language identification



1

*Toque para
redefinir a senha
do Instagram:
<https://ig.me/1HABBJK2KwIHek0>*

2

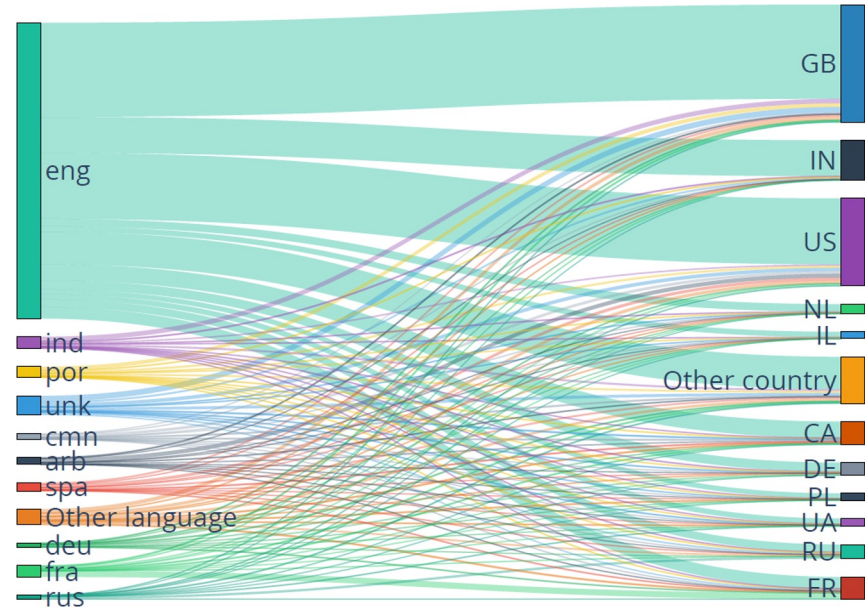
*toque para
redefinir a senha
do Instagram
ig.me*

3

*toq oqu que ue_ e_p
pa par ara ra a_r
_re red ede def efi
fin ini nir ir_ r_a _a_
a_s _se sen enh*

Country and language diversity

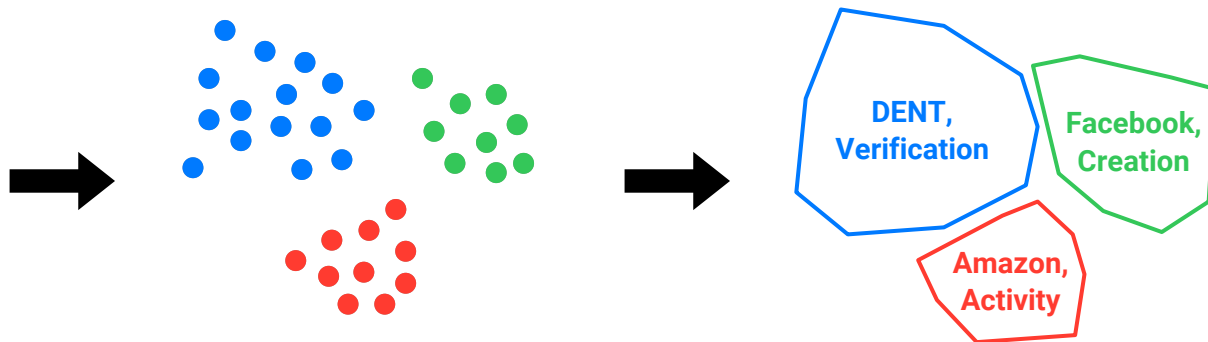
- 31 languages
- 57 countries
- English accounts for **75%** of messages
- No 1-to-1 mapping between country and spoken language
- **International scope** of this ecosystem



Service and purpose identification

- Even **more difficult** than language detection 🙄
- Best shot: **automated clustering** of messages, then manual labeling

imo code: 9790
Seu código de verificação é 705487
Your DENT code is: 604039
655922 is your Facebook code
As2in1 Mobile 7799



Approach

SERVICE IDENTIFICATION

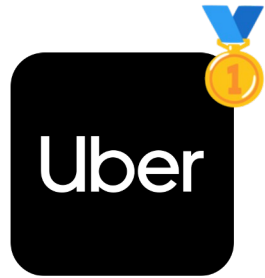
1. **Extract top** most occurring keywords
2. Manually look for **service names** in top 10k
3. Use selected keywords to **label** all messages

PURPOSE IDENTIFICATION

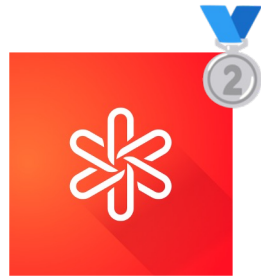
1. **Normalize** message
2. Calculate **SimHash**
3. **Cluster** similar digests with Hamming distance
4. Manually **label** clusters

Top services

- Managed to label the **top 212** most popular services
- Account for a subset of **46M messages** (65% of the dataset)
- Spans across several sectors (e.g., telecommunications, finance, etc.)



10% of messages
58% of DPNs



8.4% of messages
4.1% of DPNs



3.7% of messages
77% of DPNs



2.8% of messages
69% of DPNs



2.8% of messages
68% of DPNs

But are DPNs
actually used to
register accounts?

OTPs and Single-use Links

- **77% of messages** contain a One-Time Password (OTP)
- That's a 10% increase since the previous study from 2018
- Single-use Links are merely used in **2.18%** of messages

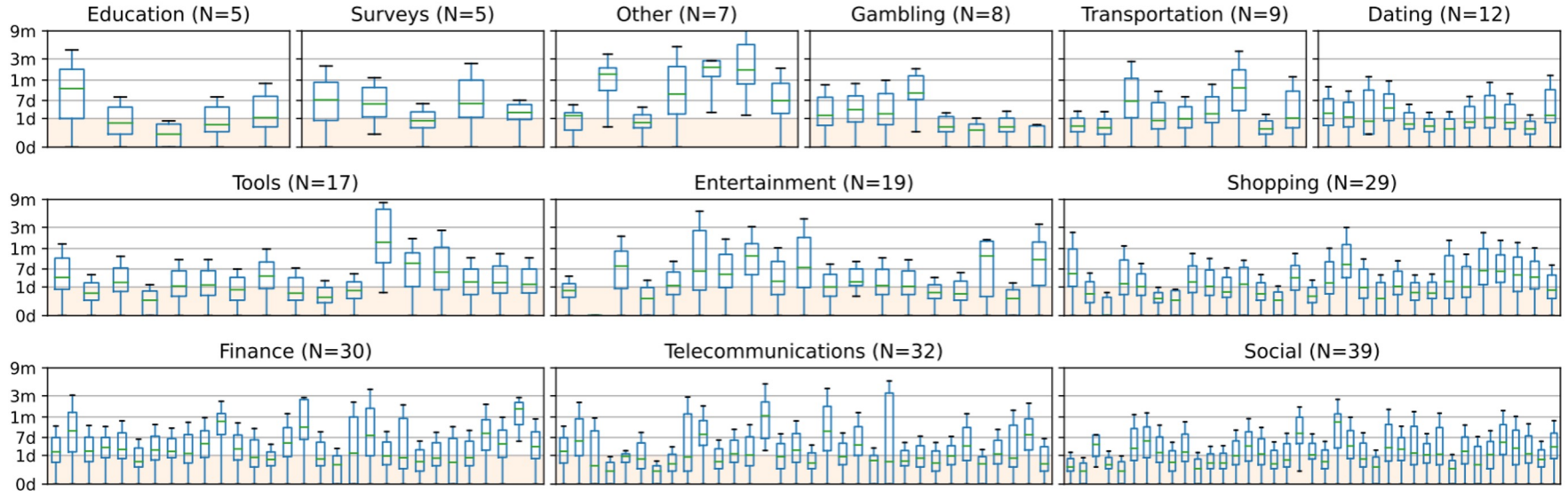
Your WhatsApp Business code [458-851](https://www.whatsapp.com/business/codes/458851)

You can also tap this link to verify your phone:

b.whatsapp.com/458851

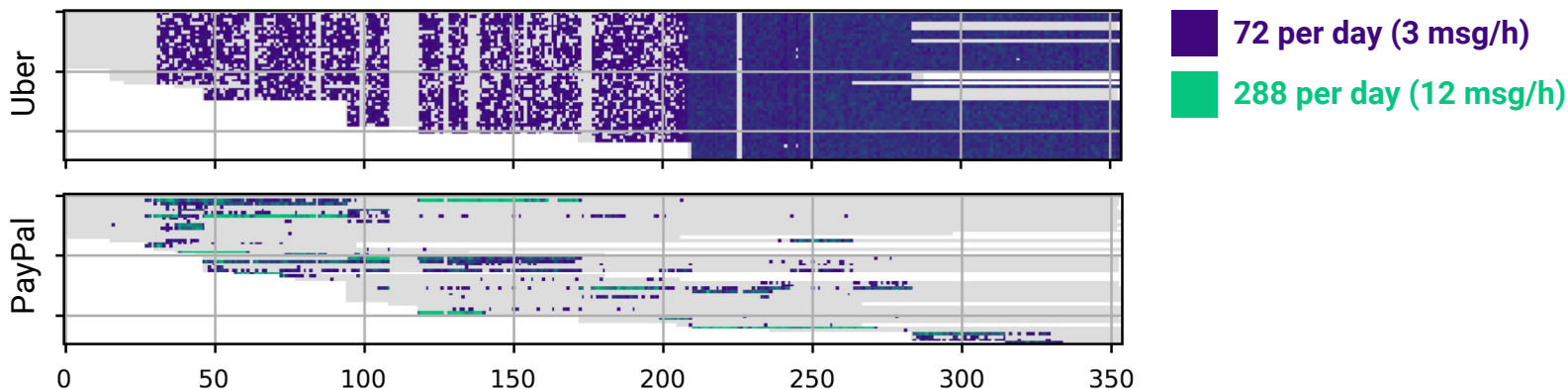
Don't share this code with others

Time to First Message (TTFM)



Potential for abuse

- We measure the **rate** at which services send messages to DPNs
- Abnormal for a legitimate user to request multiple OTP codes **per hour**
- **Automation** is a good indicative of abuse



Show me some
examples!

Case studies: discounts and free trials

Congratulations John, Your free 1-hour Physics demo class has been confirmed for 10 January at 8:00 PM.

FREE TRIALS - BYJU'S

Case studies: discounts and free trials

Welcome to Flix! Here is your new customer discount code: NCVK74LP This voucher is valid until the Jan 16, 2022
Hurry up!

New customer discount code - FlixBus

Case studies: discounts and free trials

Welcome to our
Here is your vac

<http://carw.sh/>

2021-05-17 10:56:29.000	2021-05-17 10:56:29.000	Welcome to our car wash SMS program. Here is your vacuum dis
2021-05-17 11:48:33.000	2021-05-17 11:48:33.000	Welcome to our car wash SMS program. Here is your vacuum dis
2021-05-17 11:49:07.000	2021-05-17 11:49:07.000	Welcome to our car wash SMS program. Here is your vacuum dis
2021-05-17 12:43:26.000	2021-05-17 12:43:26.000	Welcome to our car wash SMS program. Here is your vacuum dis
2021-05-18 10:01:53.000	2021-05-18 10:01:53.000	Welcome to our car wash SMS program. Here is your self serve d
2021-05-18 10:01:53.000	2021-05-18 10:01:53.000	Welcome to our car wash SMS program. Here is your vacuum dis
2021-05-18 10:51:38.000	2021-05-18 10:51:38.000	Welcome to our car wash SMS program. Here is your self serve d
2021-05-18 10:51:48.000	2021-05-18 10:51:48.000	Welcome to our car wash SMS program. Here is your self serve d
2021-05-18 10:51:48.000	2021-05-18 10:51:48.000	Welcome to our car wash SMS program. Here is your self serve d
2021-05-18 11:41:42.000	2021-05-18 11:41:42.000	Welcome to our car wash SMS program. Here is your self serve d
2021-05-18 11:41:49.000	2021-05-18 11:41:49.000	Welcome to our car wash SMS program. Here is your self serve d
2021-05-18 11:41:49.000	2021-05-18 11:41:49.000	Welcome to our car wash SMS program. Here is your self serve d
2021-05-18 13:21:46.000	2021-05-18 13:21:46.000	Welcome to our car wash SMS program. Here is your vacuum dis
2021-05-18 13:21:46.000	2021-05-18 13:21:46.000	Welcome to our car wash SMS program. Here is your vacuum dis
2021-05-18 13:21:46.000	2021-05-18 13:21:46.000	Welcome to our car wash SMS program. Here is your vacuum dis
2021-05-18 13:21:54.000	2021-05-18 13:21:54.000	Welcome to our car wash SMS program. Here is your vacuum dis
2021-05-18 13:21:54.000	2021-05-18 13:21:54.000	Welcome to our car wash SMS program. Here is your vacuum dis
2021-05-18 13:21:54.000	2021-05-18 13:21:54.000	Welcome to our car wash SMS program. Here is your self serve d
2021-05-18 15:51:50.000	2021-05-18 15:51:50.000	Welcome to our car wash SMS program. Here is your vacuum dis
2021-05-18 15:51:50.000	2021-05-18 15:51:50.000	Welcome to our car wash SMS program. Here is your vacuum dis
2021-05-18 15:51:50.000	2021-05-18 15:51:50.000	Welcome to our car wash SMS program. Here is your vacuum dis
2021-05-18 15:51:58.000	2021-05-18 15:51:58.000	Welcome to our car wash SMS program. Here is your vacuum dis
2021-05-18 15:51:58.000	2021-05-18 15:51:58.000	Welcome to our car wash SMS program. Here is your vacuum dis
2021-05-18 16:41:59.000	2021-05-18 16:41:59.000	Welcome to our car wash SMS program. Here is your vacuum dis
2021-05-18 16:41:59.000	2021-05-18 16:41:59.000	Welcome to our car wash SMS program. Here is your vacuum dis

Case studies: phishing

DHL EXPRESS: Debes pagar 1,99 € antes del 27/04/2021 para que tu paquete sea enviado a través del enlace: <http://bit.ly/dhl-401125>

CORREOS: Su paquete no se ha podido entregar 06/01 porque no se han pagado las tasas de aduanas 2 Euro. Siga las instrucciones: <https://bit.do/fS5pP>

Case studies: phishing

[WIZINK BANK] Por su seguridad su tarjeta esta bloqueada WIZINK. Haga clic aqui para resolver su problema

<https://tinyurl.com/mu8pdv5e>

[CAIXABANK] Por su seguridad su tarjeta esta bloqueada. Haga clic aqui para resolver su problema

<https://u.to/m5W4GA/>

Case studies: phishing

Hemos decidido que le corresponde un reembolso del impuesto en valor de 1184,56 Eur.

<https://agenciatributaria.yourltn.co.za> dc

Case studies: phone chaining in Google Voice

<#> 145859 is your Google Voice verification code. Don't share it with anyone else. <https://goo.gl/UERgF7owBEk0tbefD>

Case studies: health services - NHS

Jane You have tested positive for COVID-19 and must now self-isolate. [...]

Case studies: gov services – Aadhaar

OTP is [633306](#) and is valid for 10 minutes.
eAadhaar/mAadhaar are as valid as
physical Aadhaar Letter.

Case studies: gov services – Cl@ve

Bienvenido a Cl@ve, el procedimiento de registro se ha completado correctamente.

El código de activación para la APP
Cl@vePIN es: 74N

Case studies: gov services – MAUC

El Ministerio de Asuntos Exteriores, Union Europea y Cooperacion le informa de su codigo de activacion para el alta:
a3882902

Case studies: financial services

[Binance] P2P Order (last 4 digit: 5824) has been completed. The seller has released 14.8 USDT to your P2P wallet.

CRYPTOCURRENCY TRANSACTIONS - Binance

Codigo de seguridad: K5AJEGDZ.
Confirmacion para completar el alta de usuario en la contratacion de cuenta de Empresas de Banco Santander

Tu clave para firmar el contrato de tu nueva Cuenta Online Santander es: P333P436.

Online account application - Banco Santander

HSBC : To complete your HSBC bank account application online, please enter the code [4173](#)

Account application - HSBC

Hi from Cuentas Prepaid Mastercard! To get free card to card transfers, free long distance, discounted gift cards and more, please finish your registration.

Prepaid card application - Mastercard

Your OTPs used to verify certain transactions will now be sent to this mobile number. Never share these codes with anyone, not even Santander staff

Online account application - Banco Santander

Case studies: potential fraud

NEVER share this code, even with [REDACTED] staff. OTP 32607 REGISTER YOUR DEVICE FOR MOBILE BANKING. Please call us if this wasn't you.

[REDACTED] A/C ending 0503. We've refused a payment due to lack of funds. No fees will be charged. Please pay enough money into your account to make payments.

+1202949 [REDACTED]	10907	2021-04-27 08:10:30.000	Your purchase at Discount Store for \$444.00 qualifies to be paid
+1202949 [REDACTED]	10907	2021-04-27 08:10:30.000	Your purchase at Discount Store for \$222.00 qualifies to be paid
+1202949 [REDACTED]	10907	2021-04-27 08:10:30.000	Your purchase at Discount Store for \$333.00 qualifies to be paid
+1202949 [REDACTED]	10907	2021-04-27 08:10:30.000	Your purchase at Discount Store for \$389.00 qualifies to be paid
+1202949 [REDACTED]	10907	2021-04-27 08:10:30.000	Your purchase at Discount Store for \$89.00 qualifies to be paid
+1202949 [REDACTED]	10907	2021-04-27 08:10:30.000	Your purchase at Discount Store for \$189.00 qualifies to be paid
+1202949 [REDACTED]	10907	2021-04-27 08:10:30.000	Your purchase at Discount Store for \$289.00 qualifies to be paid
+1202949 [REDACTED]	10907	2021-04-27 08:10:31.000	Your purchase at Discount Store for \$589.00 qualifies to be paid
+1202949 [REDACTED]	10907	2021-04-27 08:10:31.000	Your purchase at Discount Store for \$150.00 qualifies to be paid
+1202949 [REDACTED]	10907	2021-04-27 08:10:31.000	Your purchase at Discount Store for \$789.00 qualifies to be paid

Your OTPs used to verify certain transactions will now be sent to this mobile number. Never share these codes with anyone, not even [REDACTED] staff

OTP to request an AMENDMENT TO YOUR OVERDRAFT. Please call us if this wasn't you. NEVER share this code, not even with [REDACTED] staff MGH3JDHL

Case studies: potential fraud

banca digital. El codigo para autorizar la operacion de Modificacion de correo electronico es 228337

banca digital. El codigo para autorizar la operacion de Transfer money from card to account de 170,00 EUR a la cuenta acabada en 065 es: 654546.
banca digital. El codigo para autorizar la operacion de Transfer money from card to account de 180,00 EUR a la cuenta acabada en 065 es: 722715.
banca digital. El codigo para autorizar la operacion de Transfer money from card to account de 10,00 EUR a la cuenta acabada en 065 es: 158146.
banca digital. El codigo para autorizar la operacion de Transfer money from card to account de 10,00 EUR a la cuenta acabada en 065 es: 405050.
banca digital. El codigo para autorizar la operacion de Transfer money from card to account de 20,00 EUR a la cuenta acabada en 065 es: 262226.
banca digital. El codigo para autorizar la operacion de Transfer money from card to account de 242,00 EUR a la cuenta acabada en 065 es: 397191.
banca digital. El codigo para autorizar la operacion de Transfer money from card to account de 485,00 EUR a la cuenta acabada en 065 es: 327985.

autorizar la operacion de Sign Configuration es 815516

banca digital. El codigo para autorizar la operacion de Generate Sign Code es 662323

Conclusions

- We find a **780% increase in DPN** usage since 2018
In terms of volume of messages
- DPNs are being used **to register accounts**
Nearly 80% of messages contain an OTP code
- Both global/well-known and local **services are impacted**
Everyone seem to lack effective protection against abuses

Your Code is 0000: An Analysis of the Disposable Phone Numbers Ecosystem

José Miguel Moreno Srdjan Matic Narseo Vallina-Rodriguez Juan Tapiador
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Madrid, Spain Madrid, Spain Leganes, Spain Madrid, Spain
josemore@pa.uclm.es srdjan.matic@imdea.org narseo.vallina@imdea.org jestesvez@inf.uc3m.es

Abstract—Short Message Service (SMS) is a popular channel for online service providers to verify accounts and authenticate users registered to a particular service. Specialized applications, called Public SMS Gateways (PSGs), offer free Disposable Phone Numbers (DPNs) that can be used to receive SMS messages. DPNs allow users to protect their privacy when creating online accounts. However, they can also be abused for fraudulent activities and to bypass security mechanisms like Two-Factor Authentication (2FA). In this paper, we perform a large-scale and longitudinal study of the DPN ecosystem by monitoring 17,141 unique DPNs in 29 PSGs over the course of 12 months. Using a dataset of over 70M messages, we provide an overview of the ecosystem and study the different services that offer DPNs and their relationships. Next, we built a framework that (i) accurately identifies and classifies the purpose of an SMS, and (ii) accurately attributes every message to more than 200 popular internet services that require SMS for creating registered accounts. Our results suggest that the DPN ecosystem is globally abused for fraudulent account creation and access, affecting all major Internet platforms and online services.

1. INTRODUCTION

Originating in the late 1990s, Short Message Service (SMS) have experienced a resurgence among online service providers (e.g., Alphabet, Meta) to deliver notifications, enable Two-Factor Authentication (2FA) and enhancing the security of online accounts [15], [23], [33]. Online services using SMS-based 2FA technologies assume that phone numbers are uniquely linked to an individual. However, this assumption does not hold with Disposable Phone Numbers (DPNs). DPNs are shared phone numbers that any individual can use to receive SMS messages on a public website, so their metadata and content is published for anyone to see. Users can take advantage of DPNs to register at online services without giving their true personal phone number, either for privacy reasons or to conduct fraudulent actions.

Despite its potential for abuse, the DPN ecosystem remains relatively unexplored. The most recent prior systematic study of DPNs and their usage dates back to 2018 [37], a time before the expansion in popularity of SMS-based 2FA for web and mobile services. According to Duo Labs, 2FA usage has increased from 20% in 2017 to 78% in 2021, becoming the preferred user authentication method [8]. As a result, the key findings of [37] have become obsolete.

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These reasons, and their potential impact on web services, motivate us to systematically measure and investigate the current DPN ecosystem and the evolution of the purpose it supports in the context of 2FA. Specifically, we seek answers to the following research questions: (i) How widely used are DPNs? (ii) What services are sending messages to DPNs? And (iii) What is their potential for abuse? To answer these questions, we develop a methodology to automatically gather and process a large-scale and longitudinal dataset containing 70,95M messages received by 17,141 unique DPNs, collected over a time span close to 12 months. Using this dataset, we make the following contributions:

- (i) *Study on the usage of DPNs.* We measure the volume of messages received by DPNs over time. We find that these numbers receive collectively more than 1.4M messages per week. A language analysis of message contents suggest a wide international user base.
- (ii) *Service attribution.* We develop a framework to accurately attribute an SMS message to more than 200 popular global internet services that require a registered account. We observe in our dataset messages sent by online service providers of all sectors, sizes, and geographical scope, including global companies (e.g., Uber, Facebook, Amazon, WhatsApp), security-sensitive industries (e.g., banking), and services developed by smaller and more geographically localized organizations (e.g., Paytm in India).
- (iii) *Measuring the potential for abuse.* We develop a framework to infer and classify the purpose of an SMS as a proxy to measure their potential for abuse. We observe that nearly 80% of messages contain a One-Time Password (OTP), a single-use link, or both. This figure presents a significant increase with respect to the trend reported in the 2018 measurement [37], where this metric was at 67.6%. As these messages are closely related to 2FA processes, we hypothesize that DPN usage is closely related to anonymity or account fraud.

Our findings suggest that the DPN ecosystem is an expanding and thriving field, and that the global SMS-based 2FA industry is oblivious to—or chooses to ignore—potential account abuses arising from it.

Ethics issues and dataset release. The dataset gathered and analyzed in this study might contain sensitive data since it

Thanks for your attention

Any questions?

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