Who’s Calling?
Characterizing Robocalls through Audio and Metadata Analysis

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North Carolina State University
Everyone Hates Robocalls

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https://xkcd.com/2053/
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FCC Seeks $225 Million Fine From Telemarketer Accused of Making 1 Billion Robocalls


https://www.washingtonpost.com/technology/2020/03/19/robocalls-coronavirus-test/

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We Received More Robocalls Than You Will Ever Receive!

- Telephony honeypot setup to monitor unsolicited phone calls in the United States

Feb 2019
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Cellular network + Landline phone network + Other voice services

Our telephone service provider

9,071 Abuse Phone Lines

Asterisk Honeypot

Software PBX used to operate a telephony honeypot

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Phone numbers with reported history of abuse

Honeypot action of rejecting a phone call

SIP Logs and CDR

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Addition of clean numbers which were intended for distribution among new subscribers
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![Diagram showing telephone network and honeypot setup]

Recording initiated on 2,949 additional high call-volume phone numbers

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11 Months
66,000 Phone numbers
145,000 Call recordings
1.48 Million phone calls

Feb 2019  April 2019  Aug 2019  Dec 2019

* A detailed discussion of ethical and legal considerations of our data collection and experiments can be found in Section 3.4 of our paper
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Sudden spike in call volume: “Storms”
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Constant call volume despite increase in phone numbers
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Linear model fit over weekly call volume with a slope of $-9 \times 10^{-5}$
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- Robocalls are a major problem in the United States with no signs of decline!

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Will You Receive More Robocalls if You Answer them?

* How-to Geek: https://www.howtogeek.com/413873/tired-of-robocalls-stop-answering-your-phone/

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How-To Geek

Tired of Robocalls? Stop Answering Your Phone

ANDREW HEINZMAN  @andrew_andrew_
MAY 17, 2019, 6:40AM EDT

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Consumer Tips to Stop Unwanted Robocalls and Avoid Phone Scams

Tip Card

- Don't answer calls from unknown numbers. If you answer such a call, hang up immediately.

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- We declined every unsolicited call received on 3000 phone numbers for 6 weeks

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(Cluster Perfection rate = 93.33% and overall Intra-cluster Precision = 96.66%)
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- Campaign identification through audio clustering allowed us to study campaign specific behaviors which were previously impossible to measure
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**Targeted Operation**: Robocalling campaigns are highly targeted and few top campaigns targeted specific numbers

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- We observed an average Spread of 78.30%

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• The largest campaign had 19.60% *Spread* : about 5 calls were made from this campaign to the same number on average
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- Adversaries impersonate government agencies to gain the victim's attention and boost their credibility.
But wait, there’s more!

- Heuristics to detect and measure voicemail spam and Wangiri scams
- How unsolicited phone calls abuse CNAM (Caller ID Name)
- How callers use “*67” to mask their true caller ID and remain anonymous
- How to systematically characterize “Storms” — high call volume events
- Discussion on language-agnostic and noise-resistant audio clustering pipeline
- An in-depth discussion of ethical and legal consideration of our study
- How can our techniques help service providers combat fraudulent robocalls
Key Takeaways

• Robocalling is a major security issue in the United State. We desperately need effective solutions to combat robocalls and protect phone users.

• Even though we suggest users to be cautious when answering calls from unknown numbers, answering a robocall does not necessarily increase the number of robocalls.

• Illegal robocalls are highly targeted. They regularly spoof caller ID or rotate between numbers and perform neighbor spoofing to entice victims.

• Fraudulent robocalls can operate for long durations without being detected. They are designed to target vulnerable population.

Acknowledgements

• We would like to thank Bandwidth Inc. and Nomorobo for their support.

• Link to the paper: https://robocallobservatory.org

• Contact: Sathvik Prasad (snprasad@ncsu.edu)