Your Echos are Heard
Tracking, Profiling, and Ad Targeting in the Amazon Smart Speaker Ecosystem

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Overview
- Smart speaker interactions can be used to infer sensitive information about users
- There is limited transparency in data collection and usage practices of smart speaker platforms
- We build an auditing framework to bring transparency in smart speaker platforms
- We test on Amazon smart speaker ecosystem and find that Amazon and third parties collect smart speaker interaction data
- We also find that Amazon processes voice data to infer user interests and uses it to serve targeted ads on platform as well as off-platform

Auditing Framework
- Key idea: Leaks data and measure its collection, usage, and sharing
  - Leaking data
    - Install skills from different categories
    - Interact with skills by uttering sample utterances provided by skills
  - Measuring collection
    - Intercept encrypted network traffic on a custom router
    - Capture unencrypted network traffic by instrumenting Alexa Voice Service SDK
  - Inferring usage: Monitor targeted ads to infer data collection and usage
  - Reference of ad content to leaked data
  - High bids from advertisers when data is leaked

Privacy Issues
- Voice input can leak sensitive information
- Voice recordings: Tone can leak personality traits
- Transcripts: Content can leak personal information
- Metadata: Interaction logs can leak personal information
- Amazon has patented several privacy-inferring practices to monetize smart speaker interactions
- Advertising products based on inferences from physical & emotional characteristics of users’ voices
- Targeting cough-drop ads at users with colds

Data is Used For Targeted Advertising
- Amazon processes Echo interactions to infer interest segments
- First step is targeted ad delivery
- Smart Home: Electronics, Home, Kitchen
- Fashion & Style: Beauty, Personal Care, Fashion

Amazon & Third-Parties Collect User Data
- Collect web ads + bids
- Install & interact with skills
- Collect audio ads
- Collect network traffic on router

Some Disclosures Are Potentially Misleading
- Privacy policy acknowledges collection of Echo interaction data
- No explicit acknowledgment or denial about data usage in privacy policy, Alexa Privacy Hub, and Alexa Device FAQs
- Public statement to NYT: “(This) do not use voice recordings to target ads.”
- Response to our research: “record of” (transaction) may inform relevant ads

Key Takeaways
- Amazon & third-parties (including ad/tracking services) collect Echo interaction data
- Amazon infers user interests from Echo interactions and uses them to target ads
- Interest inference and their usage seems to be inconsistent with Amazon’s public statements
- Users are uncomfortable about ad targeting based on Echo interactions
- More information on the website: alexaspeaks.com

Impact
- Researchers find Amazon uses Alexa voice data to target you with ads
- Amazon keeps growing, and we don’t know the scale of data on you
- Lawsuit claims Amazon using Alexa to target ads at customers

Auditing is hard!
- Problem: Limited transparency from Amazon
- Users may not trust the platform
- Goal: Independent & repeatable audits on unmodified off-the-shelf devices
- Challenge: Smart speakers do not provide any interfaces to analyze data

Health & Fitness personas
- Allan: All $5 gift
- Alex: 50k to 75k
- John: 75k to 100k
- Ashley: 100k to 200k
- James: 200k to 500k
- Sarah: >500k

30X to 27X higher for some personas

Stratifiedly significant higher bids

35-65% don’t expect Amazon to use voice recordings or derived information to target ads

People are uncomfortable with the use of voice recordings (~73%) and derived information (~65%) for targeted ads

“Even when companies say they don’t use your specific voice, they use all your data – including demographics and age and time questions asked – so they might as well use your actual voice recording!”

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