Toward Designing Privacy and Security Label for IoT Devices

Pardis Emami-Naeini, Henry Dixon, Yuvraj Agarwal, Lorrie Cranor, Hanan Hibshi

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Roadmap to design IoT Privacy and Security Label

• Interviewing average consumers about their IoT-related purchase behavior
• Conducting expert elicitation study with privacy and security experts
• Going back to average consumers to test the usability and effectiveness of IoT privacy and security label
• Incentivizing IoT companies to adopt labeling
Exploring How Privacy and Security Factor into IoT Device Purchase Behavior

Pardis Emami-Naeini, Henry Dixon, Yuvraj Agarwal, Lorrie Cranor
Amazon’s Alexa isn’t just AI — thousands of humans are listening

One of the only ways to improve Alexa is to have human beings check it for errors

By Nick Statt | @nickstatt | Apr 10, 2019, 8:25pm EDT

‘I’m in your baby’s room’: A hacker took over a baby monitor and broadcast threats, parents say
People are really worried about IoT data privacy and security—and they should be

Despite rising spending on IoT security, consumers and businesses are right to worry about how data will be used and protected.
Echo Dot (3rd Gen) - Smart speaker with Alexa - Charcoal
by Amazon

29,879 customer reviews | 1000+ answered questions

Get the Best Deal

List Price: $49.99
With Deals: $29.99 & FREE Shipping. Details
You Save: $20.00 (40%)

In Stock.

Want it Friday, May 31 Order within 1 hr 59 mins and choose Two-Day Shipping at checkout. Details

Ships from and sold by Amazon Digital Services LLC. Gift-wrap available.

Color: Charcoal

Configuration: Echo Dot

- Our most popular smart speaker - Now with a fabric design and improved speaker for richer and louder sound.
- Voice control your music - Stream songs from Amazon Music, Apple Music, Spotify, Sirius XM, and others. You can also listen to audiobooks from Audible.
- Bigger, better sound - Pair with a second Echo Dot (3rd gen) for stereo sound. Fill your home with music with compatible Echo devices in different rooms.
- Ready to help - Ask Alexa to play music, answer questions, read the news, check the weather, set alarms, control compatible smart home devices, and more.
- Connect with others - Call almost anyone hands-free. Instantly drop in on other rooms in your home or make an announcement to every room with a compatible Echo device.
- Use another speaker - Connect to your own speakers over Bluetooth or with a 3.5 mm audio cable.
- Alexa has skills - With 50,000+ skills, Alexa is always getting smarter and adding new skills like tracking fitness, playing games, and more.
- Voice control your smart home - Turn on lights, adjust thermostats, lock doors, and more with compatible connected devices

Jump to: Compare devices | Technical details

Used & new (2) from $26.59 & FREE shipping. Details
<table>
<thead>
<tr>
<th>Setup Technology</th>
<th>Amazon Wi-Fi simple setup enables customers to connect smart devices to their Wi-Fi network in a few easy steps. Wi-Fi simple setup is another way Alexa is always getting smarter. [Learn more]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Warranty and Service</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Accessibility Features</strong></td>
<td></td>
</tr>
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<td></td>
</tr>
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<td><strong>Generation</strong></td>
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<td><strong>Size</strong></td>
<td>3.9” x 3.9” x 1.7” (99 mm x 99 mm x 43 mm)</td>
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<tr>
<td><strong>Weight</strong></td>
<td>10.6 oz. (300 grams) Actual size and weight may vary by manufacturing process</td>
</tr>
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<td><strong>Wi-Fi connectivity</strong></td>
<td>Dual-band Wi-Fi supports 802.11 a/b/g/n/ac (2.4 and 5 GHz) networks. Does not support connecting to ad-hoc (or peer-to-peer) Wi-Fi networks.</td>
</tr>
<tr>
<td><strong>Bluetooth connectivity</strong></td>
<td>Advanced Audio Distribution Profile (A2DP) support for audio streaming from your mobile device to Echo Dot or from Echo Dot to your Bluetooth speaker. Audio/Video Remote Control Profile (AVRCP) for voice control of connected mobile devices. Hands-free voice control is not supported for Mac OS X devices. Bluetooth speakers requiring PIN codes are not supported.</td>
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<td><strong>System Requirements</strong></td>
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privacy? security?
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<td>Dual-band Wi-Fi supports 802.11 a/b/g/n/ac (2.4 and 5 GHz) networks. Does not support Bluetooth Low Energy (BLE) connectivity. Alexa app and Alexa enabled devices required for Wi-Fi connectivity. No access to Wi-Fi networks for customers with accessibility needs related to vision, hearing, mobility, and speech. Learn more about Alexa accessibility.</td>
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Echo Dot comes ready to connect to your Wi-Fi. The Alexa App is compatible with Fire OS, Android, and iOS devices and also accessible via your web browser. A list of supported operating systems can be found [here](#). Certain skills and services may require subscription or other fees.

**no privacy or security information is available**
echo dot
Add Alexa to any room

“Alexa, play today’s top hits”

“Call Mom”

“What’s the weather?”

ALEXA
BLUETOOTH
WIFI
AUDIO LINE OUT
Explore thousands of skills including:

- music
- Spotify
- pandora
- npr
- TUNE IN
- hue
- SmartThings
- tp-link
- and more...

What’s included
Amazon Echo Dot (3rd Generation)
Power adapter (15W)

www.amazon.com/devicesupport

©2018 Amazon.com, Inc. or its affiliates. Amazon, Alexa, Echo, Echo Dot and all related logos are trademarks of Amazon.com, Inc. or its affiliates. Amazon.com Services, Inc., 410 Terry Ave, North, Seattle, WA 98109 USA. Engineered by Amazon, assembled in China.

Add Alexa to any room
Echo Dot connects to Alexa and provides full sound from a compact design that fits anywhere in your home. Enjoy crisp, clear music from your favorite streaming services on the built-in speaker. You can also connect to speakers over Bluetooth or with a 3.5 mm audio cable.

Designed around your voice
Just ask Alexa to play music, read the news, check weather forecasts, set alarms and timers, control smart home devices, call almost anyone, and more. Alexa is always getting smarter and adding new features and skills.

Voice control music throughout your home
Ask Alexa for a song, artist, or genre from Amazon Music, Spotify, Pandora, and more. With multi-room music, you can play music on your compatible Echo devices in different rooms.

Control your smart home hands-free
Use your voice to control thousands of compatible devices. Just ask Alexa to turn on lights, adjust thermostats, lock doors, find TV shows, and more.
no privacy or security information is available
Policymakers called for IoT labels
Policymakers called for IoT labels **but no specific guidelines**
Research questions

• How much do consumers know about the privacy and security of their IoT devices?
• In what way would consumers like to consider privacy and security when making IoT-related purchase decisions?
• How useful and effective would privacy and security labels be for consumers when purchasing IoT devices?
We recruited 24 participants to interview

- One hour semi-structured interview
- 14 female and 10 male
- 8 with technical backgrounds
- Average age: 36
- Compensated with $25 Amazon gift card

most common devices our participants had
Interviews with IoT device owners

• Pre-purchase behavior
• Post-purchase behavior
• IoT device privacy and security
• Value of privacy and security in purchase decisions
• Privacy and security label evaluation
We designed privacy and security labels for 3 hypothetical IoT devices.

- Smart security camera
- Smart toothbrush
- Smart thermostat
Our inspiration

Label for a smart security camera

Factors are from our SOUPS’17 paper: Naeini, Pardis Emami, et al. "Privacy expectations and preferences in an IoT world."
General information

Privacy & Security Facts

Security Camera S200
Smart++, incorporated in United States 2017
Firmware version 3.1.6 (updated June 12, 2018)

CR Consumer Reports
Overall score out of 100 55

Tip(s): Register your device to receive updates

Scan QR code for manufacturer’s privacy and security information
# Privacy Information

<table>
<thead>
<tr>
<th><strong>Collected data</strong></th>
<th>Video, device configuration, login info</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose</strong></td>
<td>Security, maintenance, advertisement</td>
</tr>
<tr>
<td><strong>Retention time</strong></td>
<td>Forever</td>
</tr>
<tr>
<td><strong>Shared with</strong></td>
<td>Manufacturer</td>
</tr>
<tr>
<td><strong>Choices</strong></td>
<td>None</td>
</tr>
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**Independent Privacy Lab Rating:** ★★★★★

**Level of detail for the data that is being used:** Identifiable

**Level of detail for the data that is being collected:** Identifiable
## Security Information

<table>
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<tr>
<th>Feature</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>Automatic updates</td>
<td>No</td>
</tr>
<tr>
<td>Updates lifetime</td>
<td>Until January 1, 2020</td>
</tr>
<tr>
<td>Choices</td>
<td>Configurable updates, purchase extended updates</td>
</tr>
<tr>
<td>Encrypted communication</td>
<td>Yes</td>
</tr>
<tr>
<td>Authentication method</td>
<td>Fingerprint</td>
</tr>
<tr>
<td>Internet connectivity</td>
<td>Required</td>
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<td>Independent IT Security Institute Rating</td>
<td>★★★★★</td>
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Terminology to report small numbers

- a few
- some
- about half
- most
- almost all

- none
- half
- all
Terminology to report small numbers

- a few
- some
- about half
- most
- almost all

0%  25%  45%  50%  55%  75%  100%

none  half  all
Terminology to report small numbers

- a few
- some
- about half
- most
- almost all

- none
- half
- all
Privacy and security knowledge was limited

• Privacy defined as having control over personal data → active
• Security was defined as device getting hacked → passive
• About half were unable to differentiate between privacy and security
  • Most with pre-purchase or post-purchase concerns were better able to differentiate between privacy and security
Privacy and security are valued

- **Almost all** wanted to know about privacy and security before the purchase
- **Almost all** were willing to pay a premium for such info (10%-30%)
  - Assurance of being protected
  - Peace of mind
Positive attitude toward labels

• Interviewees found the labels
  • Understandable
  • Easy to read
  • Useful

• Almost all liked the label concept
  • Independent privacy and security ratings
  • Choices to control privacy and security
More focus on convenience than security

- Almost all liked **automatic** security updates
- Almost all preferred **fingerprint**s over **passwords**
- Almost all favored **optional** Internet connectivity over **required** connectivity

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Privacy and security are latent concerns

• About half had unprompted privacy and security concerns
• Almost all had prompted privacy and security concerns, mostly caused by:
  • Media reports
  • Friends’ opinions
  • Devices acting weird
Design guideline: layered label

- Participants requested more information on some factors
  - Definition of some of the terms (e.g., identifiable data)
  - Encryption protocols
  - Privacy and security star ratings
Labels are promising, but are not enough

• Readily available information at the point of sale
• Labels need to be adopted
  • Mandated by regulations
  • Voluntary adoption
• The default should always be safe
Label design in progress

- Consumers have limited privacy and security knowledge
- All want to know about privacy and security at the point of sale
- All found our labels to be usable and informing
  - Most liked the ratings
  - Most liked the choices
- Currently conducting expert elicitation study (under submission)
- Next to conduct user study with average consumers