Are your devices talking behind your back?

Some thoughts on privacy and the IoT

Jelte Jansen | IDnext 2019

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So, about that IoT

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What **is** the IoT?

Wikipedia definition:

"The Internet of things (IoT) is the inter-networking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to collect and exchange data."

What **is** the IoT?

Global Standards Initiative definition:

“a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies"[3] and for these purposes a "thing" is "an object of the physical world (physical things) or the information world (virtual things), which is capable of being identified and integrated into communication networks".”

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What **is** the IoT?

IEEE published a document:

"*Towards a definition of the IoT*"

Only 86 pages!

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What **is** the IoT?

A simpler definition:

“Stuff that was not networked before”

What **is** the IoT?

An even simpler definition:

"*One big mess*"

Smart Devices

"**A smart device is an electronic device**, [snip], **that can operate to some extent interactively and autonomously.**"

- Source: Wikipedia

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Smart Devices

"**A smart device is an electronic device**, [snip], **that can operate to some extent interactively and autonomously.**"

- Source: Wikipedia

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Attributed to @tkadlec

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Dumb to smart, separate to connected

Image created by http://www.blog.spoongraphics.co.uk

Dumb to smart, separate to connected

Image created by http://www.blog.spoongraphics.co.uk

Dumb to smart, separate to connected

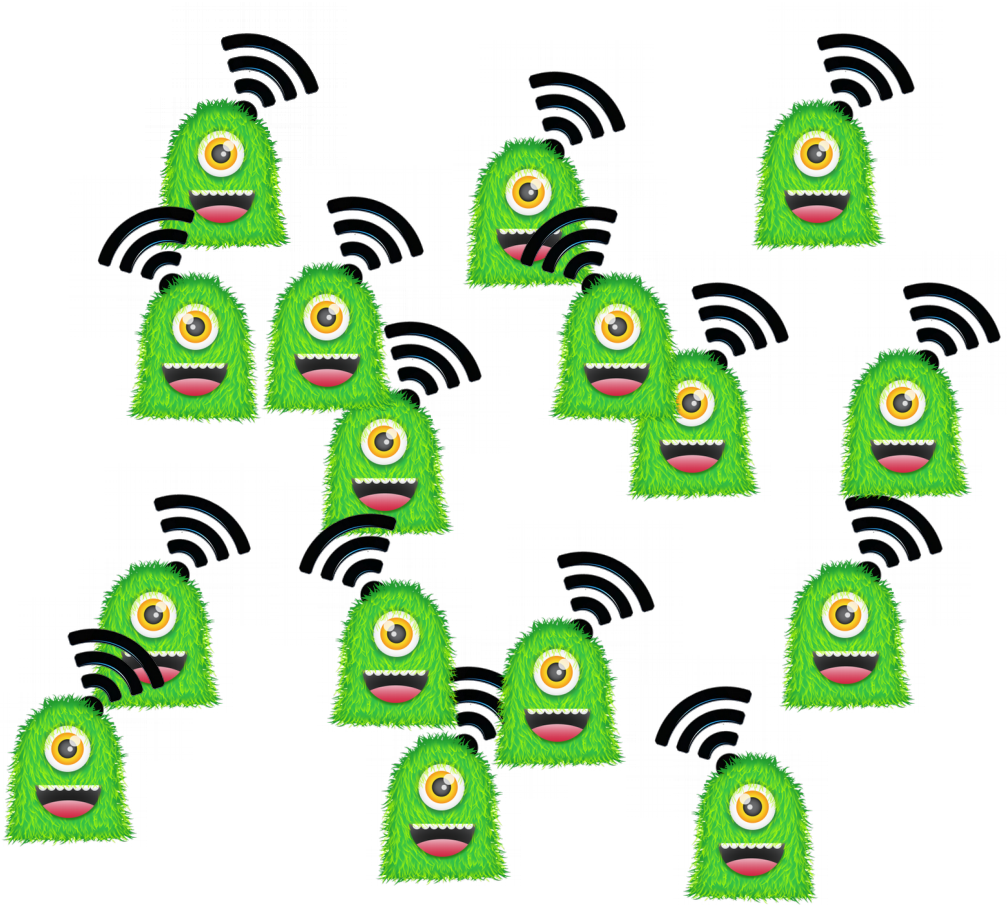


Image created by http://www.blog.spoongraphics.co.uk

Usually, we talk about DDoS

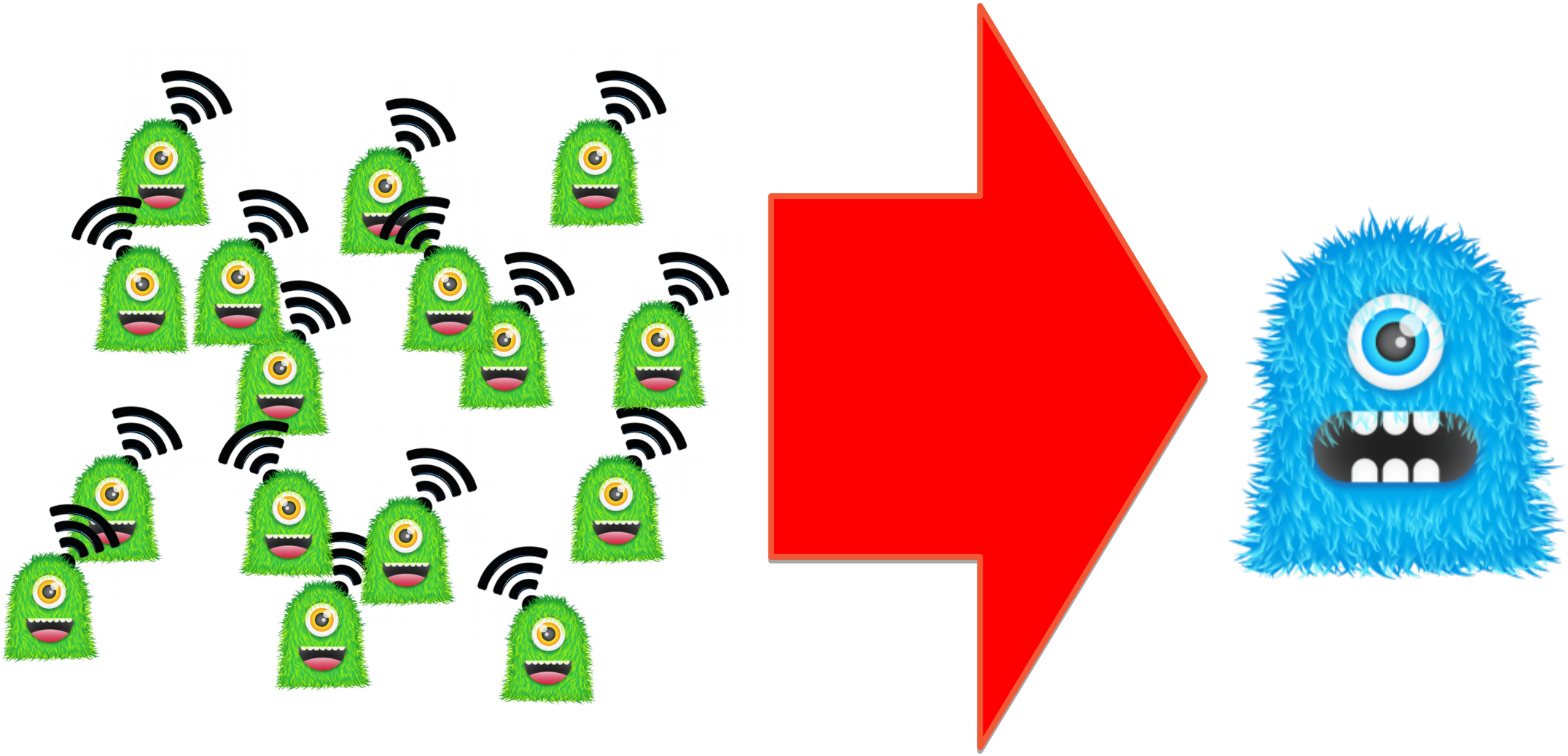


Image created by http://www.blog.spoongraphics.co.uk

Let’s think about privacy

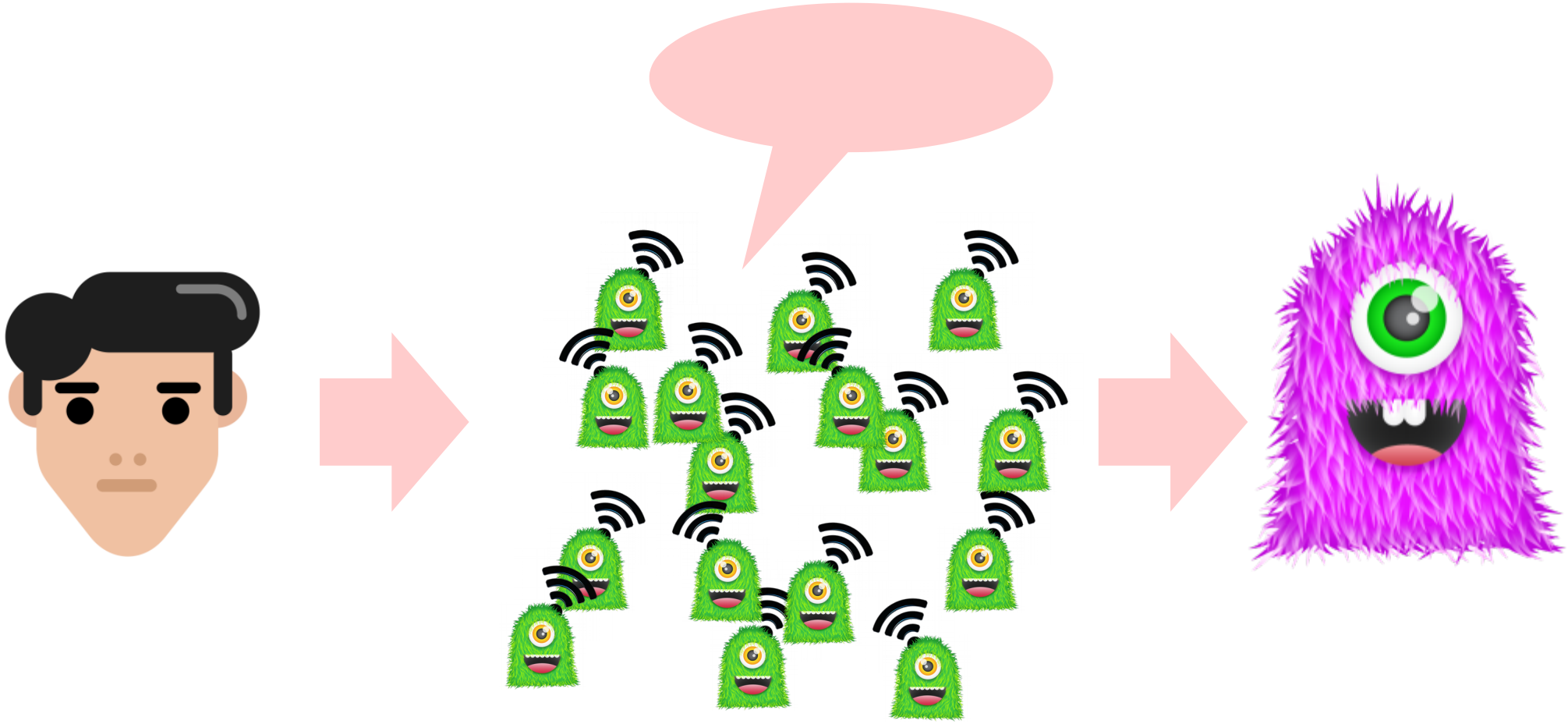


Image created by http://www.blog.spoongraphics.co.uk

These Flip Flops Are 'Smart' for the Dumbest Possible Reason

Christina Warren
3/28/17 5:58pm • Filed to: WHO NEEDS THIS?

28.3K 17 2

Image: Hari Mari

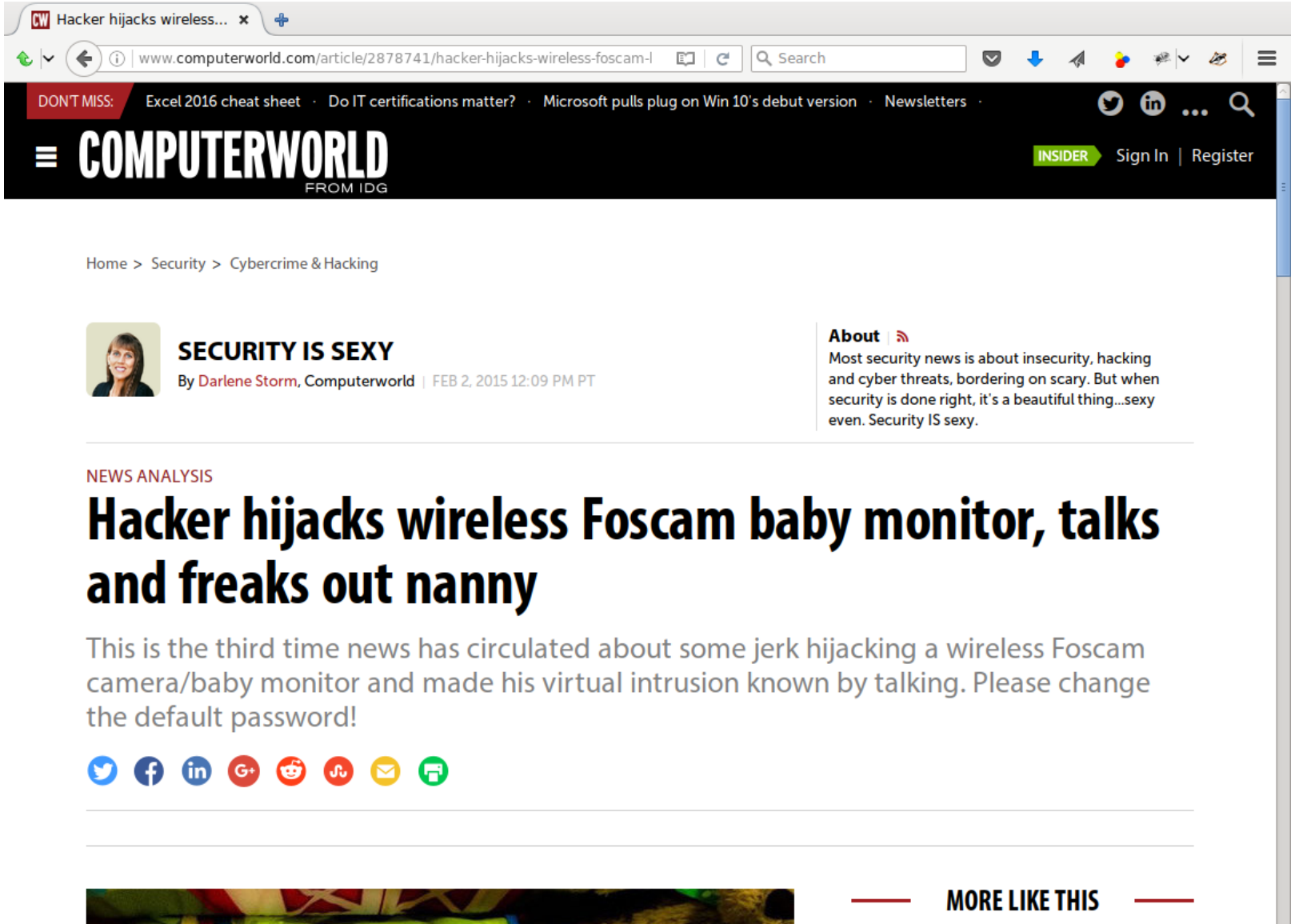
Measures speed, duration, velocity, calory use, etc.

The beta-version has a positions counter!

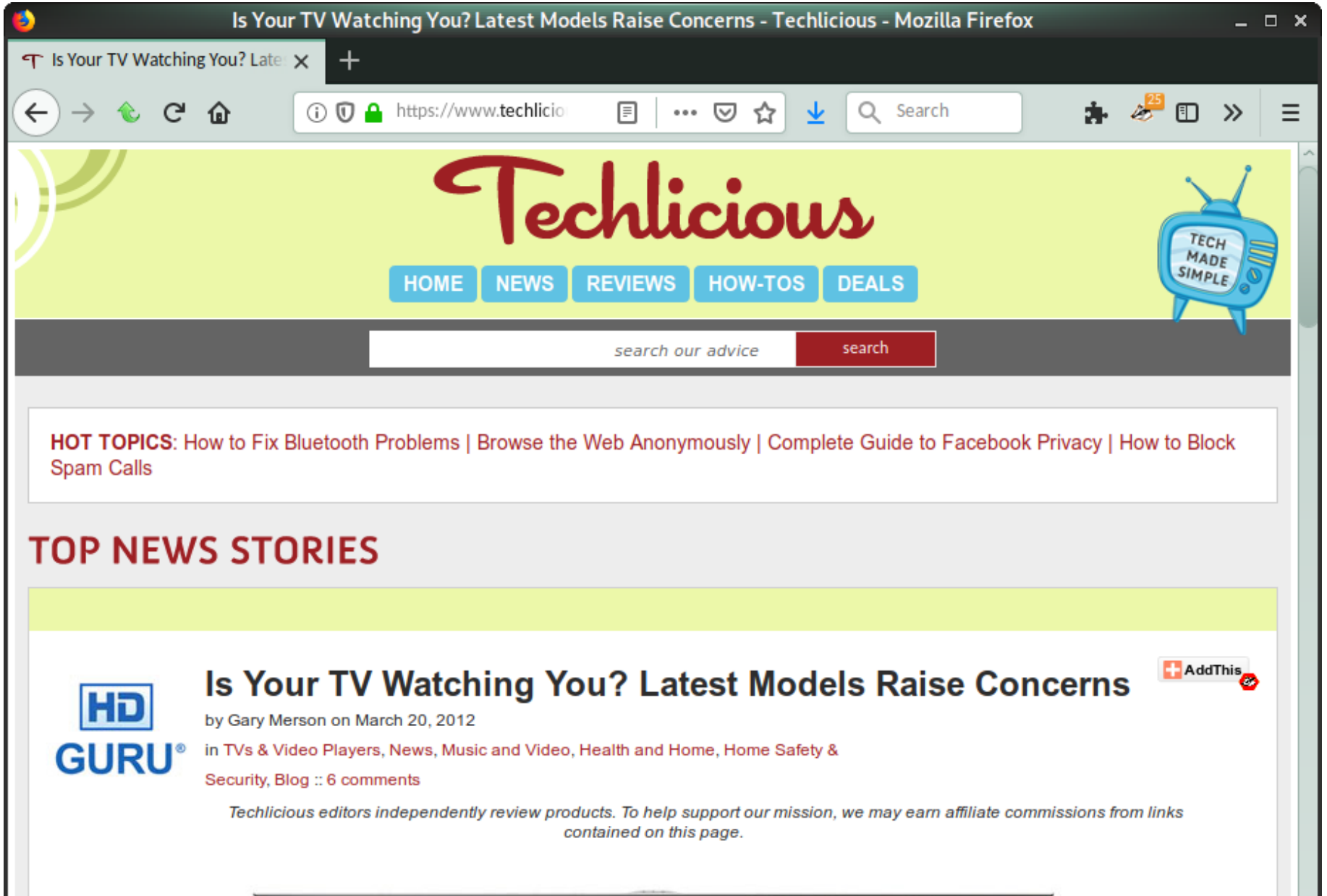
What does i.Con do with its data? Can I use it anonymously?

Absolutely! All data will be kept anonymous but users will have the option to share their recent data with friends, or, indeed the world. You will be able to anonymously access stats that you can compare with i.Con users worldwide.

IoT: Cool or Chilling?



IoT: Cool or Chilling?



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IoT: Cool or Chilling?

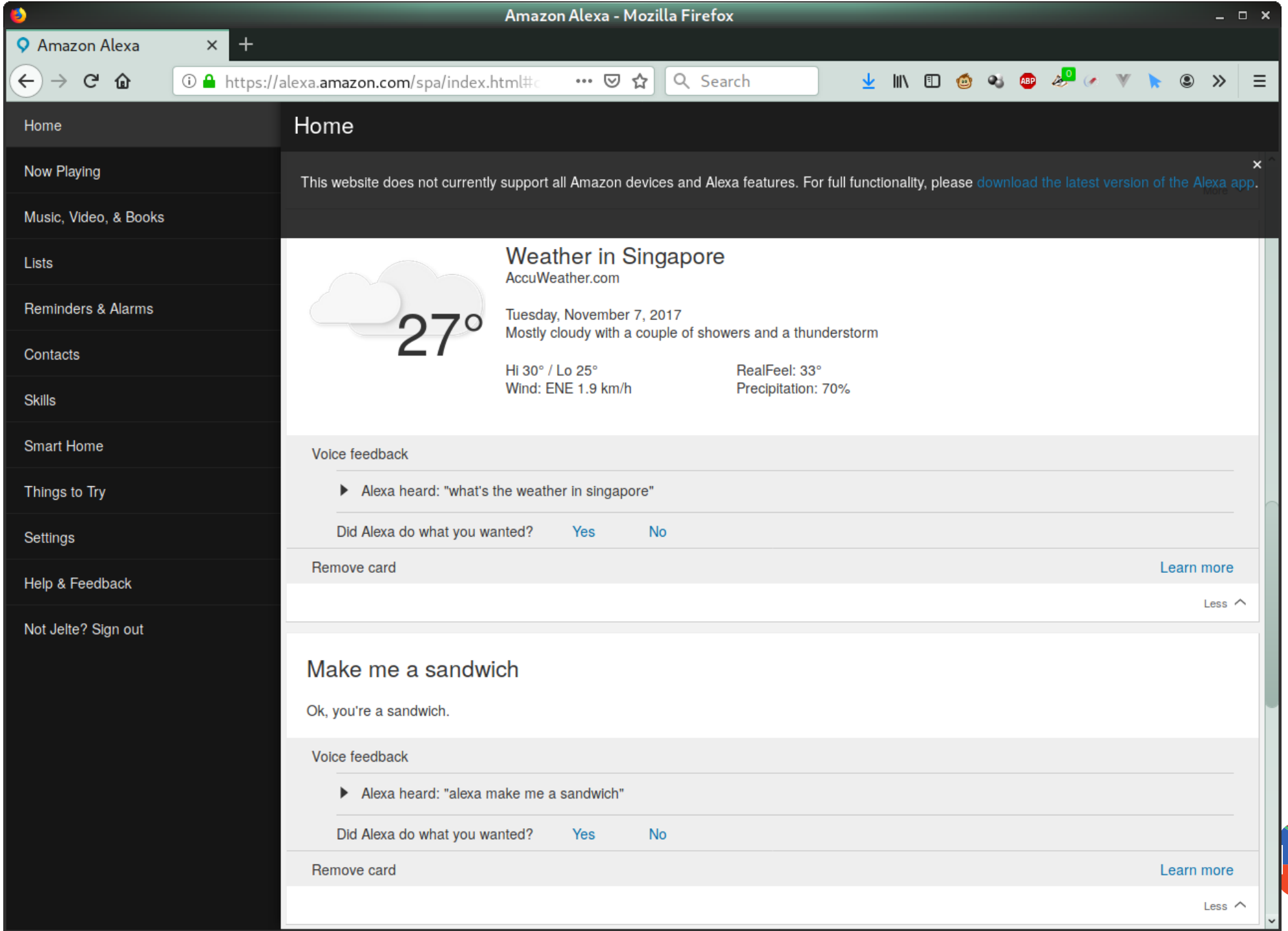
Translation:

Smart meters

My little brother is going to take longer showers, hoping that the inspectors think he has a girlfriend.

IoT: Cool or Chilling?

IoT:


Amazon Alexa - Mozilla Firefox
Amazon Alexa
https://alexa.amazon.com/spa/index.html#
Search
Home
Now Playing
Music, Video, & Books
Lists
Reminders & Alarms
Contacts
Skills
Smart Home
Things to Try
Settings
Help & Feedback
Not Jelte? Sign out
Home
This website does not currently support all Amazon devices and Alexa features. For full functionality, please download the latest version of the Alexa app.
Weather in Singapore
AccuWeather.com
27°
Tuesday, November 7, 2017
Mostly cloudy with a couple of showers and a thunderstorm
Hi 30° / Lo 25°
RealFeel: 33°
Wind: ENE 1.9 km/h
Precipitation: 70%
Voice feedback
Alexa heard: "what's the weather in singapore"
Did Alexa do what you wanted? Yes No
Remove card
Learn more
Less
Make me a sandwich
Ok, you're a sandwich.
Voice feedback
Alexa heard: "alexa make me a sandwich"
Did Alexa do what you wanted? Yes No
Remove card
Learn more
Less

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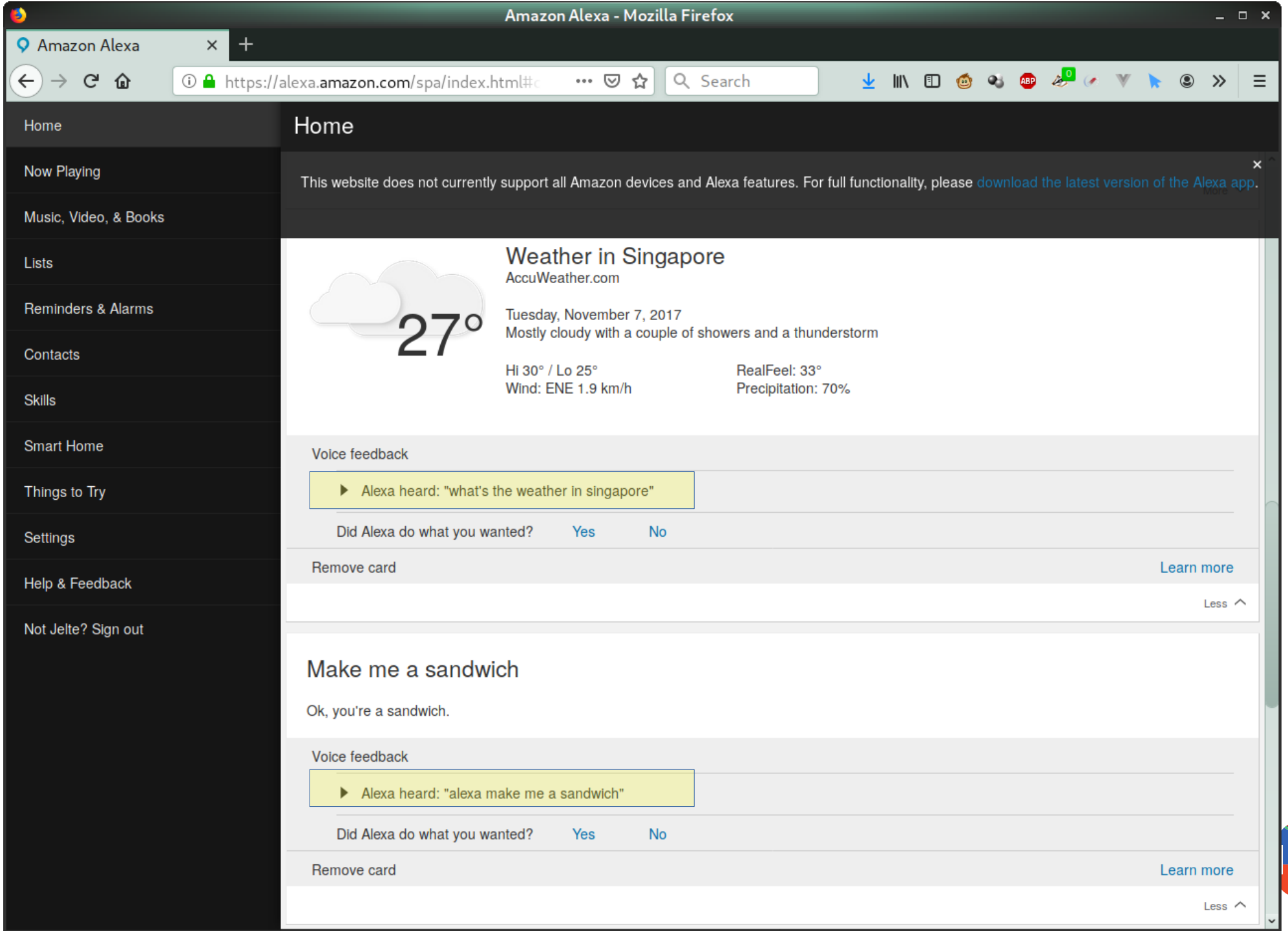
IoT:


Amazon Alexa - Mozilla Firefox
Amazon Alexa
https://alexa.amazon.com/spa/index.html#
Search
Home
Now Playing
Music, Video, & Books
Lists
Reminders & Alarms
Contacts
Skills
Smart Home
Things to Try
Settings
Help & Feedback
Not Jelte? Sign out
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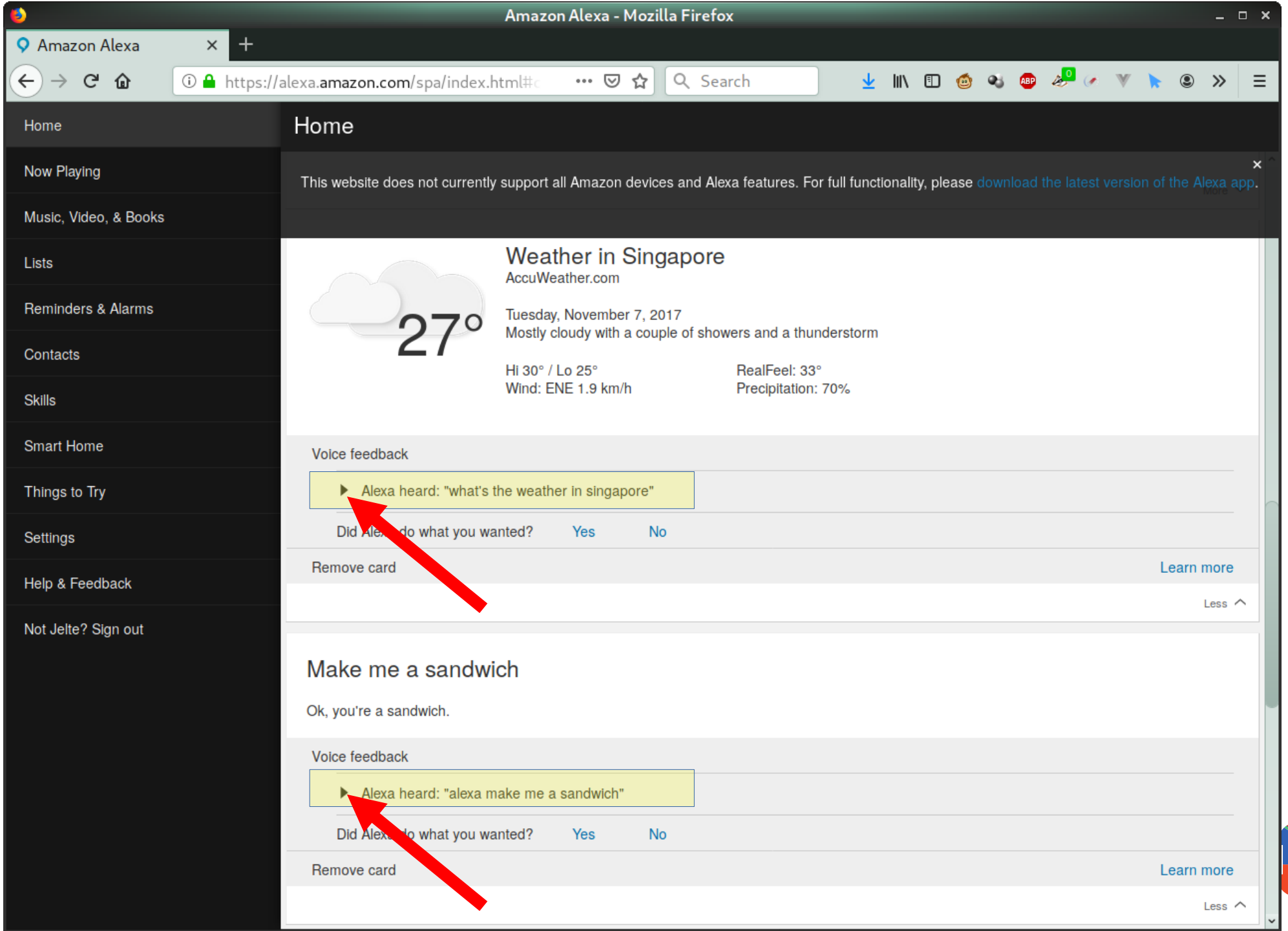
Amazon Alexa - Mozilla Firefox
Amazon Alexa
https://alexa.amazon.com/spa/index.html#
Search
Home
Now Playing
Music, Video, & Books
Lists
Reminders & Alarms
Contacts
Skills
Smart Home
Things to Try
Settings
Help & Feedback
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Remove card
Learn more
Less
Make me a sandwich
Ok, you're a sandwich.
Voice feedback
Alexa heard: "alexa make me a sandwich"
Did Alexa do what you wanted? Yes No
Remove card
Learn more
Less

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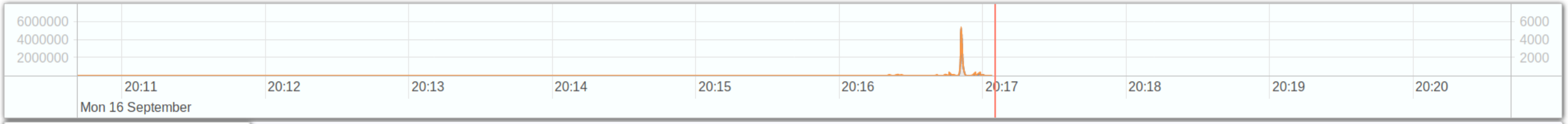
What about a more meta-level?

SPIN Traffic monitor prototype

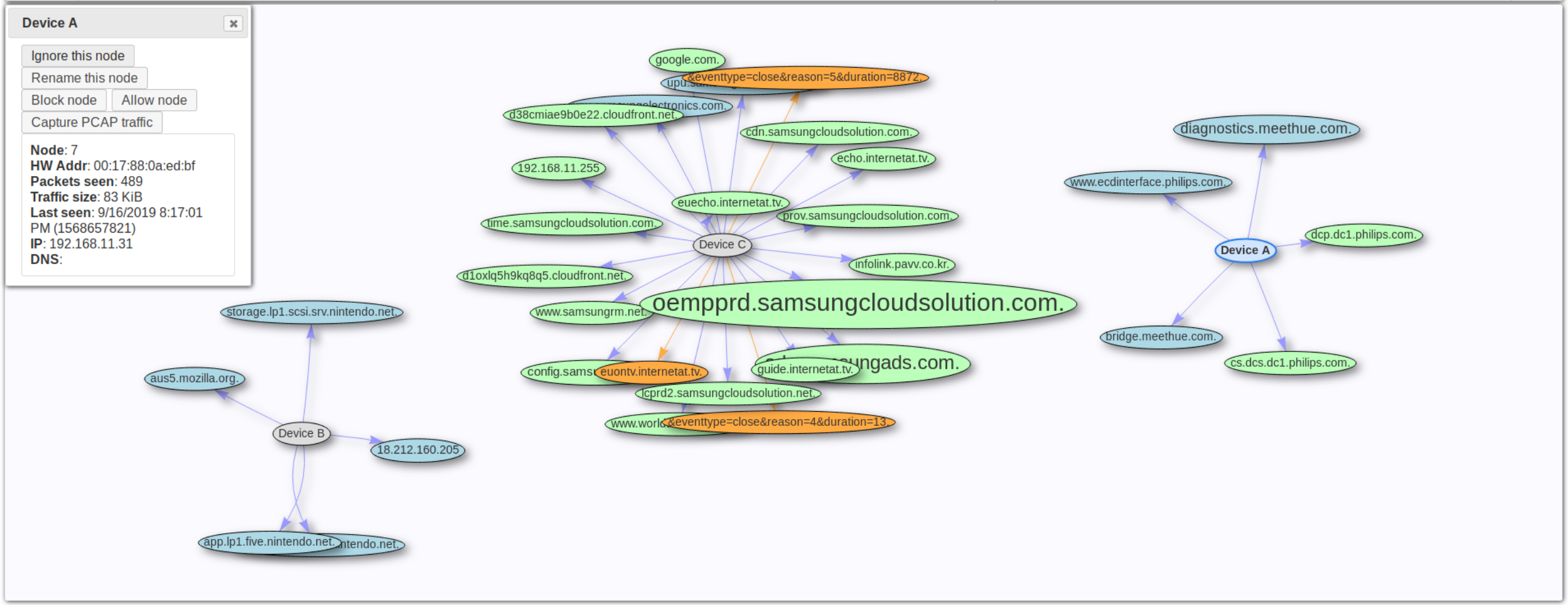
Lock view | Show ignore list | Show blocked list | Show allowed list | Connected

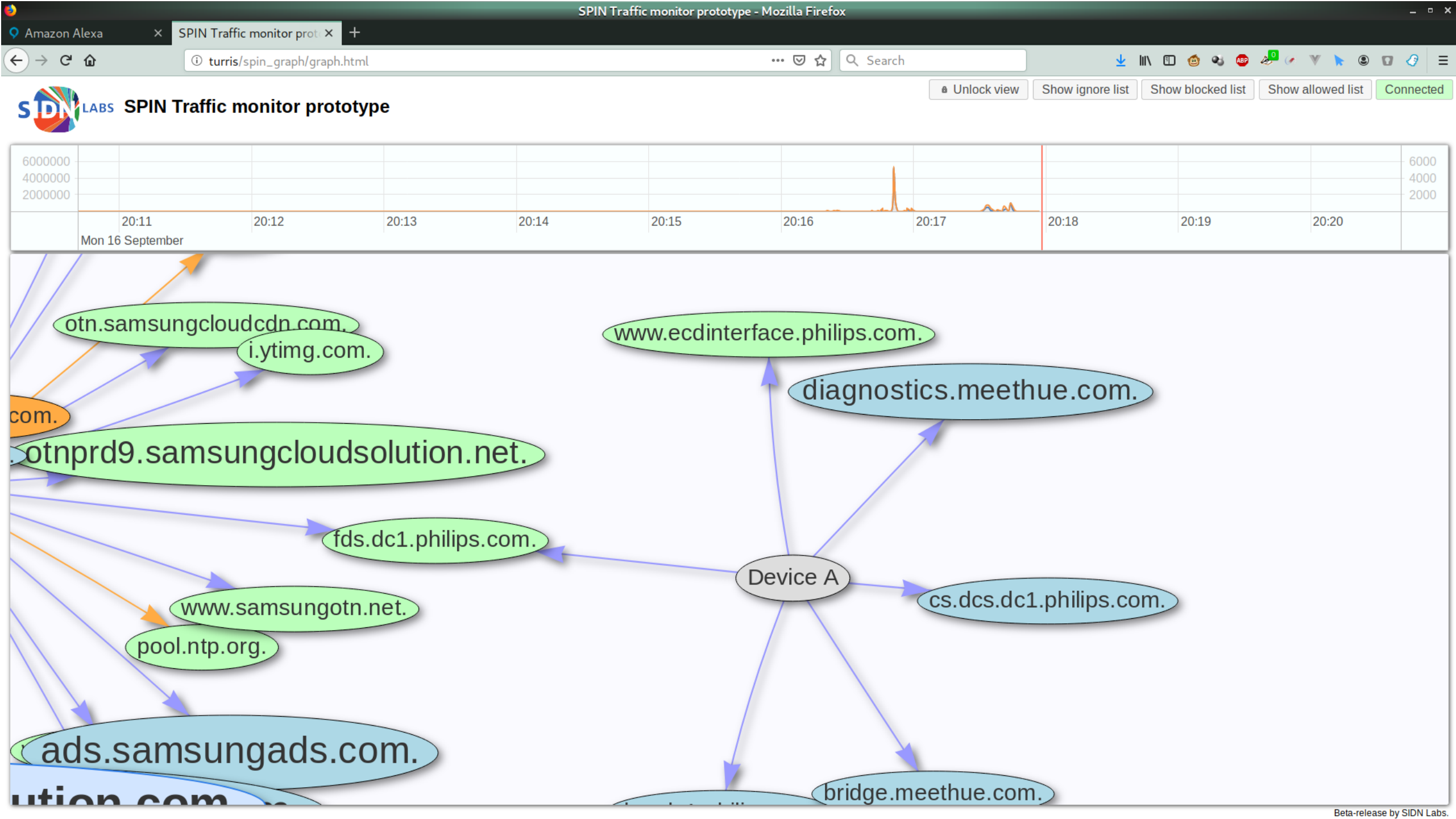


Device A

Ignore this node
Rename this node
Block node | Allow node
Capture PCAP traffic

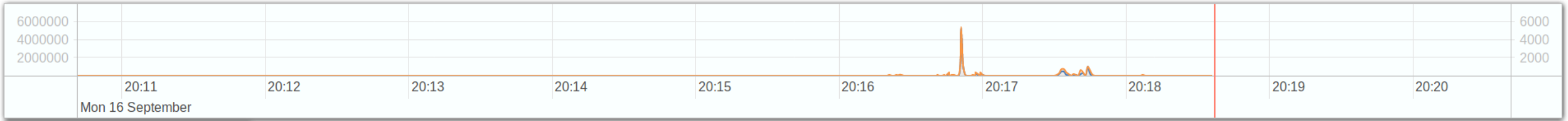
Node: 7
HW Addr: 00:17:88:0a:ed:bf
Packets seen: 489
Traffic size: 83 KiB
Last seen: 9/16/2019 8:17:01 PM (1568657821)
IP: 192.168.11.31
DNS:




SPIN Traffic monitor prototype - Mozilla Firefox
Amazon Alexa
SPIN Traffic monitor prot
turris/spin_graph/graph.html
Search
SPIN Traffic monitor prototype
Unlock view
Show ignore list
Show blocked list
Show allowed list
Connected
6000000
4000000
2000000
6000
4000
2000
20:11
20:12
20:13
20:14
20:15
20:16
20:17
20:18
20:19
20:20
Mon 16 September
otn.samsungcloudcdn.com.
i.ytimg.com.
com.
otnprd9.samsungcloudsolution.net.
www.ecdinterface.philips.com.
diagnostics.meethue.com.
fds.dc1.philips.com.
Device A
cs.dcs.dc1.philips.com.
www.samsungotn.net.
pool.ntp.org.
ads.samsungads.com.
bridge.meethue.com.
Beta-release by SIDN Labs.

SPIN Traffic monitor prototype

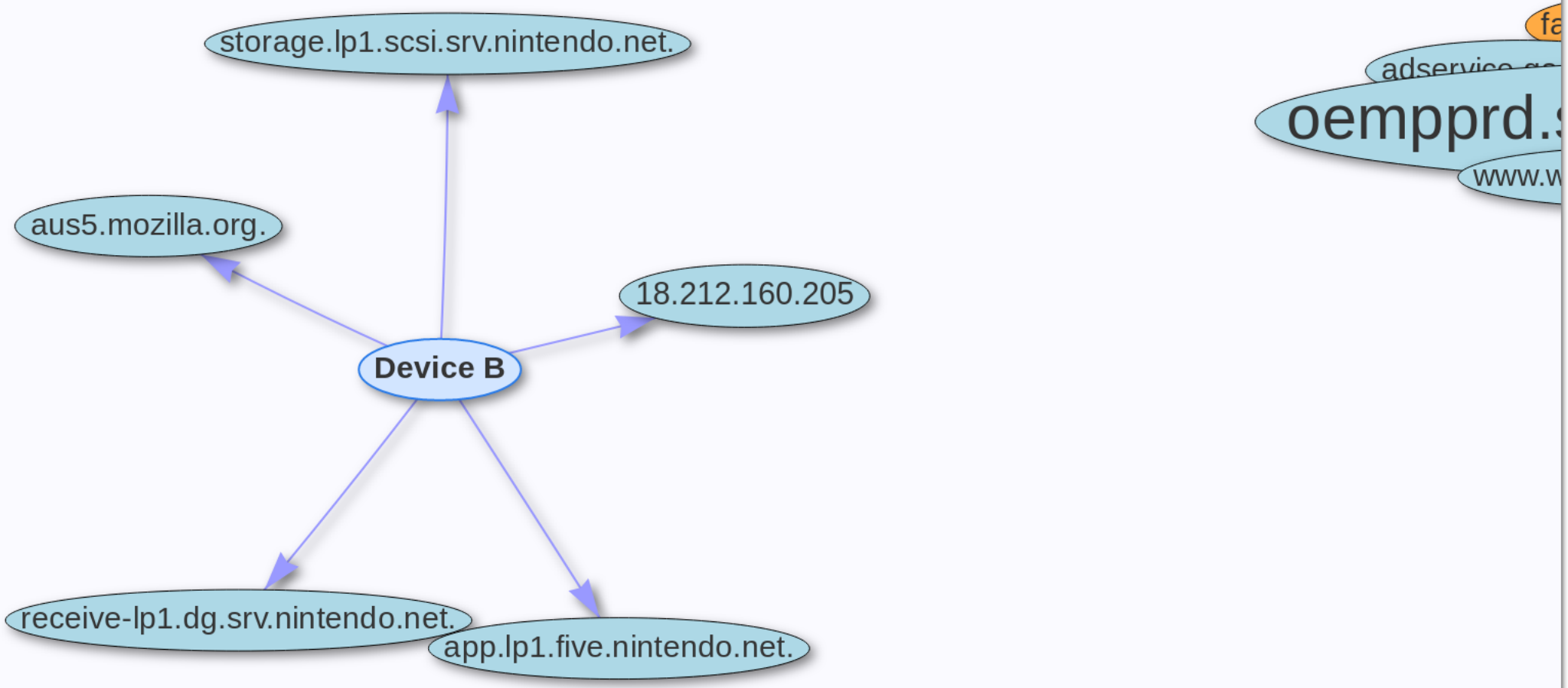
Unlock view | Show ignore list | Show blocked list | Show allowed list | Connected

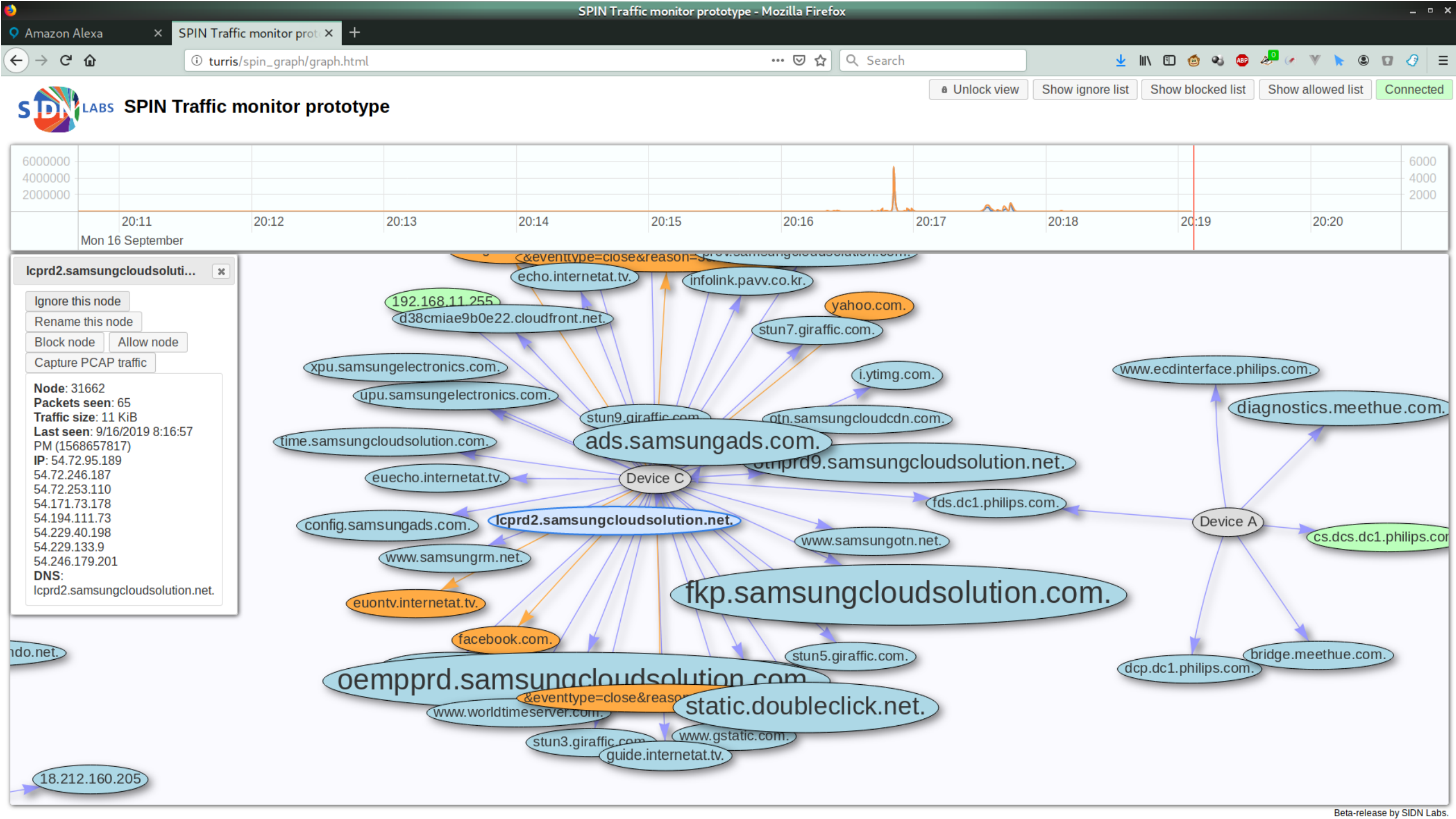


Device B

Ignore this node
Rename this node
Block node | Allow node
Capture PCAP traffic

Node: 10
HW Addr: 98:b6:e9:cb:7c:46
Packets seen: 247
Traffic size: 136 KiB
Last seen: 9/16/2019 8:16:29 PM (1568657789)
IP: 192.168.11.204
DNS:




SPIN Traffic monitor prototype - Mozilla Firefox
Amazon Alexa
SPIN Traffic monitor prot
turris/spin_graph/graph.html
Search
SPIN Traffic monitor prototype
Unlock view
Show ignore list
Show blocked list
Show allowed list
Connected
6000000
4000000
2000000
6000
4000
2000
20:11
20:12
20:13
20:14
20:15
20:16
20:17
20:18
20:19
20:20
Mon 16 September
lcprd2.samsungcloudsoluti...
Ignore this node
Rename this node
Block node
Allow node
Capture PCAP traffic
Node: 31662
Packets seen: 65
Traffic size: 11 KiB
Last seen: 9/16/2019 8:16:57 PM (1568657817)
IP: 54.72.95.189
54.72.246.187
54.72.253.110
54.171.73.178
54.194.111.73
54.229.40.198
54.229.133.9
54.246.179.201
DNS:
lcprd2.samsungcloudsolution.net.
echo.internetat.tv.
infolink.pavv.co.kr.
192.168.11.255
d38cmiae9b0e22.cloudfront.net.
yahoo.com.
stun7.giraffic.com.
xpu.samsungelectronics.com.
upu.samsungelectronics.com.
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www.samsungotn.net.
www.samsungrm.net.
euontv.internetat.tv.
fkp.samsungcloudsolution.com.
facebook.com.
stun5.giraffic.com.
oempprd.samsungcloudsolution.com
www.worldtimeserver.com.
static.doubleclick.net.
www.gstatic.com.
stun3.giraffic.com.
guide.internetat.tv.
18.212.160.205
www.ecdinterface.philips.com.
diagnostics.meethue.com.
Device A
cs.dcs.dc1.philips.com
dcp.dc1.philips.com.
bridge.meethue.com.
Beta-release by SIDN Labs.

And what about the manufacturer itself?

And what about the manufacturer itself?

- Even secure devices may send a lot of data home
  - Where ‘home’ is not your home
- Even if your device is not hacked, the manufacturer can be
- Or it can just sell your data
  - At least the GDPR should help there
    - (in some cases)

Orvibo data leak puts security spotlight on IoT back end

The security of devices that make up the internet of things (IoT) is a top concern for many in the industry, but leaks from an IoT database highlights the importance of back-end security too

Warwick Ashford Senior analyst

Published: 02 Jul 2019 12:15

Should we not use anything then?

"Don't think of it as breaking up, I'm just updating my privacy settings."

What should we do?

- Better practices for manufacturers?
- Free **secure** software stacks?
- International policy, regulation, certificiation?
- Clear up accountability issues?
- Generate market demand for secure products?
- Quarantine bad actors (e.g. at ISP)?
- Educate users?
- Empower users?

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“Yes”

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- Educate users?
- Empower users?

“Yes”

We need to do it all

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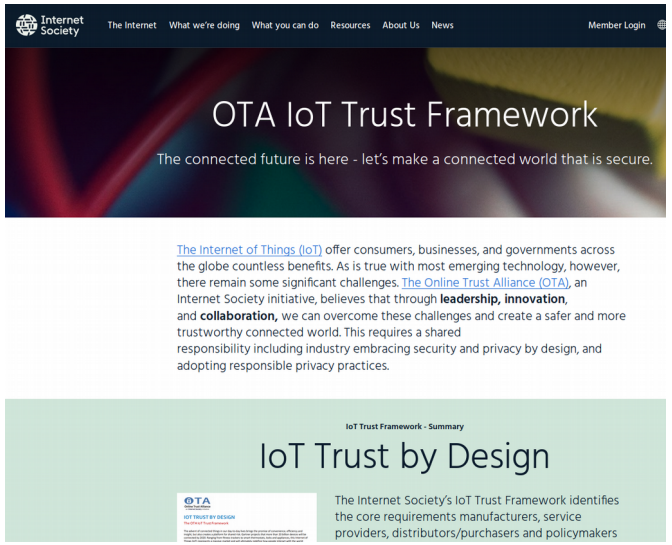
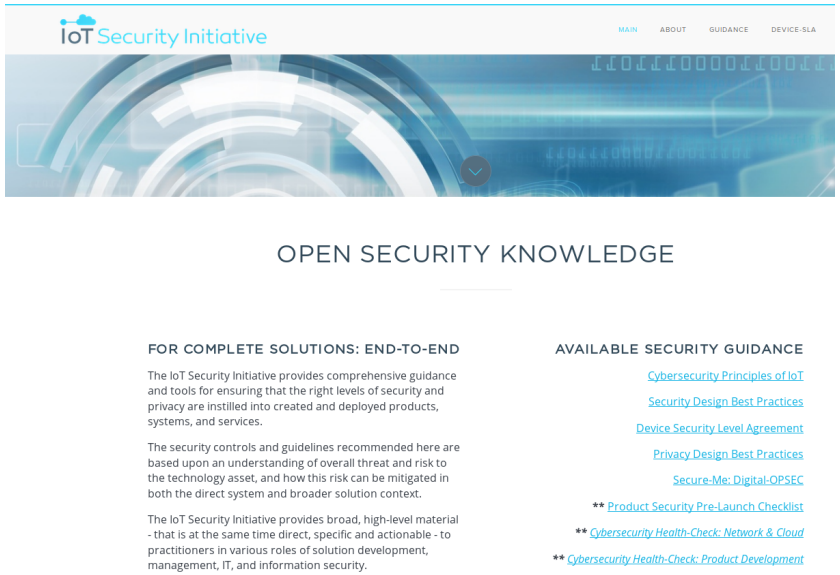
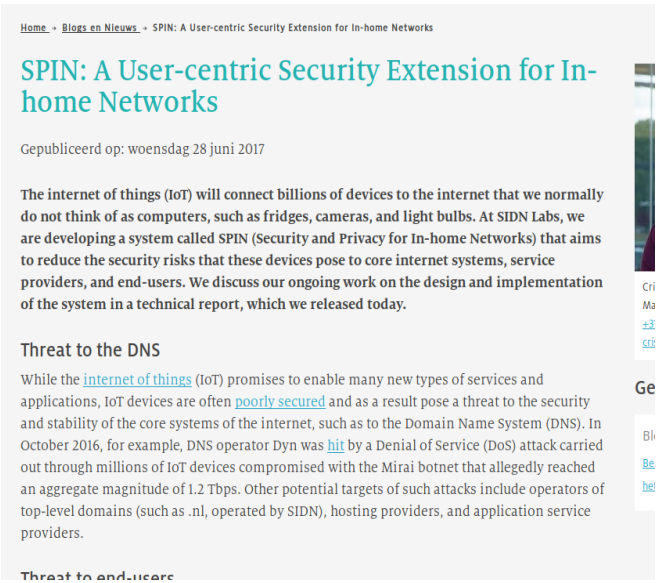
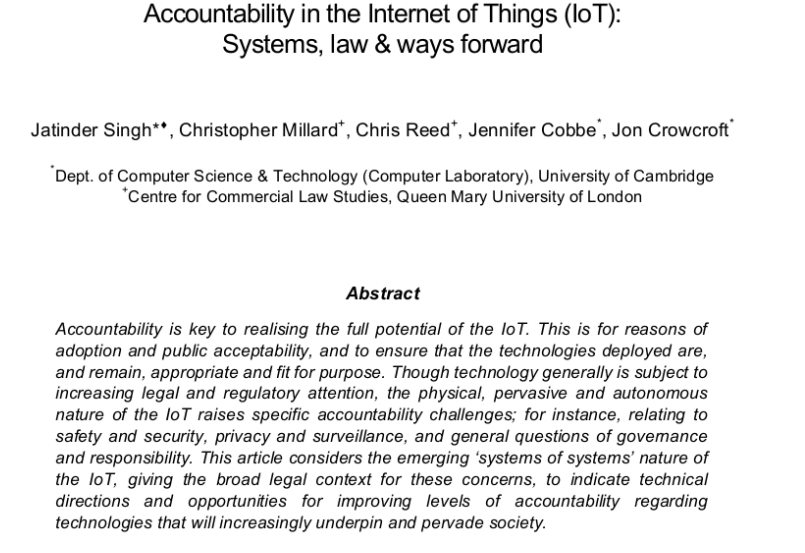
Initiatives around the world, on many levels









Initiative at SIDN: the SPIN project

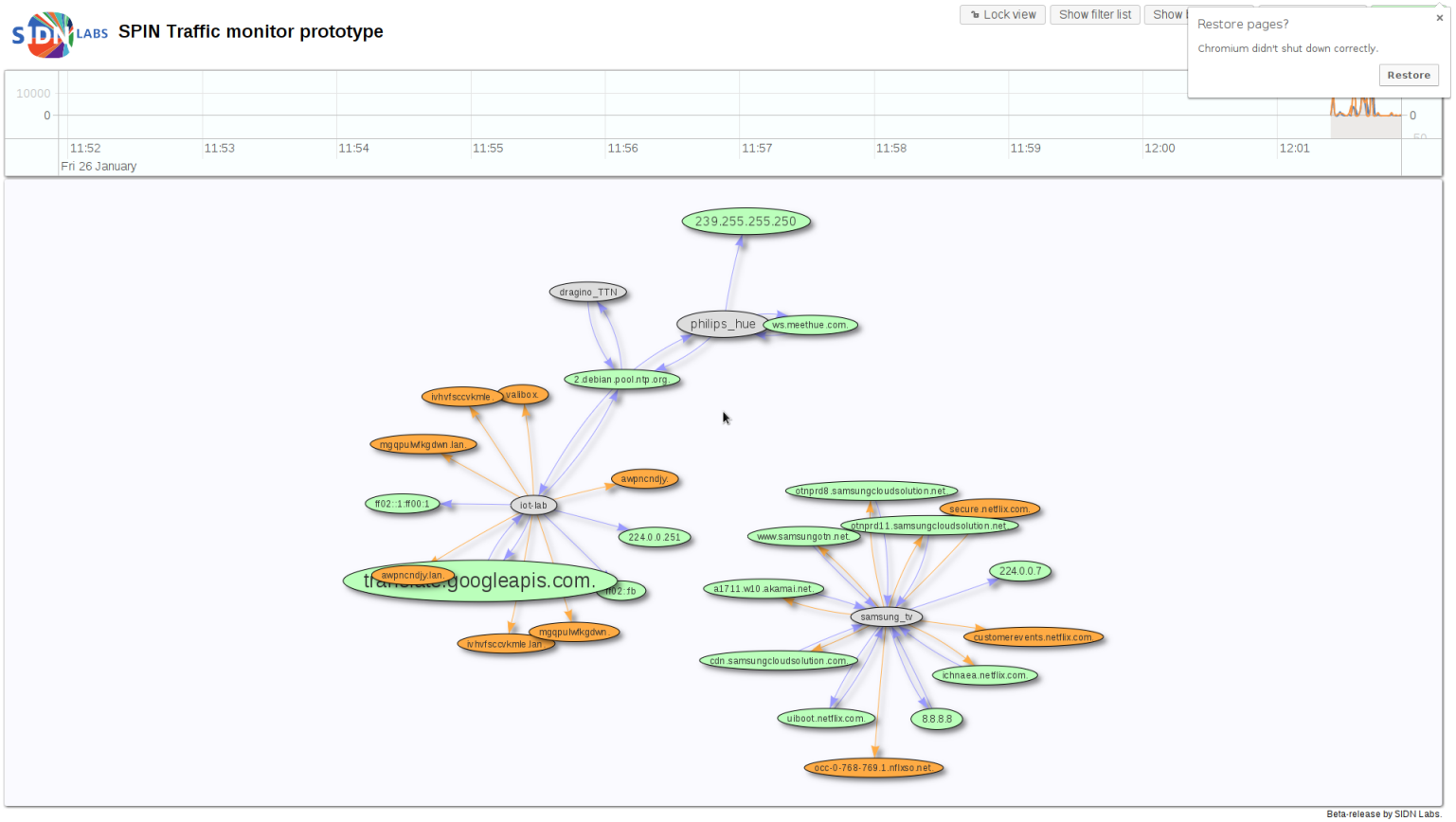
- Security and Privacy for In-home Networks

- Research and prototype of SPIN functionality:
  - Visualising network traffic
  - (Automatic) blocking of 'bad' traffic
  - Traffic capture & analysis research
  - Platform for prototyping things as DOTS (or potenitally MUD)

Running prototype: visualiser

- Shows DNS queries
- Shows data traffic
- User can block traffic based on source or destination
- Select device and capture (live) traffic for selected
- device

- Optional and WIP: upload
- captures for more in-depth analysis



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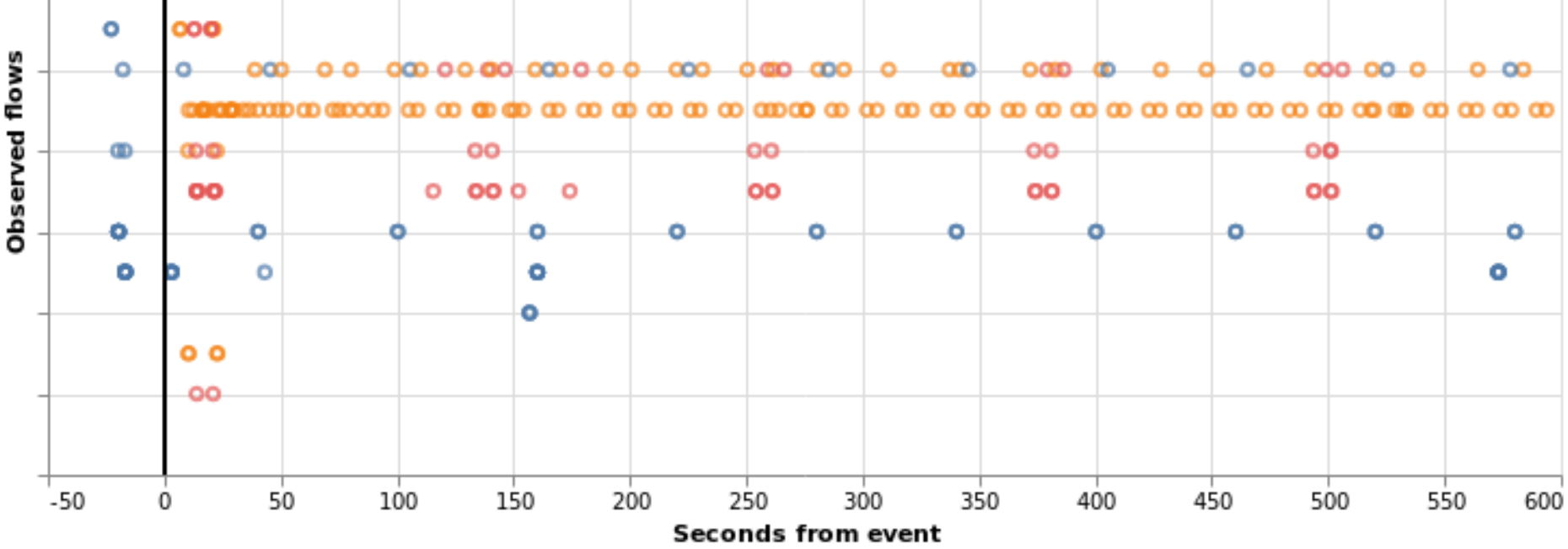
WIP: Initial high-over analysis

```
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Collected data for Tuya_2019-09-08_22-55-40.pcap
Total number of packets in pcap: 36233
Packet types:
    ip: 33339
    icmp: 3
    arp: 2887
    wauth: 4
    unknown: 0
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
First packet seen:      2019-09-08 22:55:47
Last packet seen:       2019-09-09 22:58:47
Duration of trace:      24:02:59
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
IP Packet summary:
```

source	destination	proto	port	#sent_packets	#sent_bytes	#recv_packets	#revc_bytes
0.0.0.0	255.255.255.255	UDP	67	2	700	0	0
192.168.8.1	192.168.8.211	UDP	68	6	2088	4	1400
192.168.8.211	255.255.255.255	UDP	6666	28859	6262403	0	0
192.168.8.211	52.58.217.66	TCP	1883	2915	161970	1470	83267
192.168.8.211	18.194.70.37	TCP	80	46	5356	30	3726
192.168.8.211	192.168.8.1	UDP	53	2	148	2	228
192.168.8.211	224.0.0.1	IGMP	0	1	46	0	0
52.29.251.104	192.168.8.211	TCP	15257	1	54	1	54



Filter_event power_on

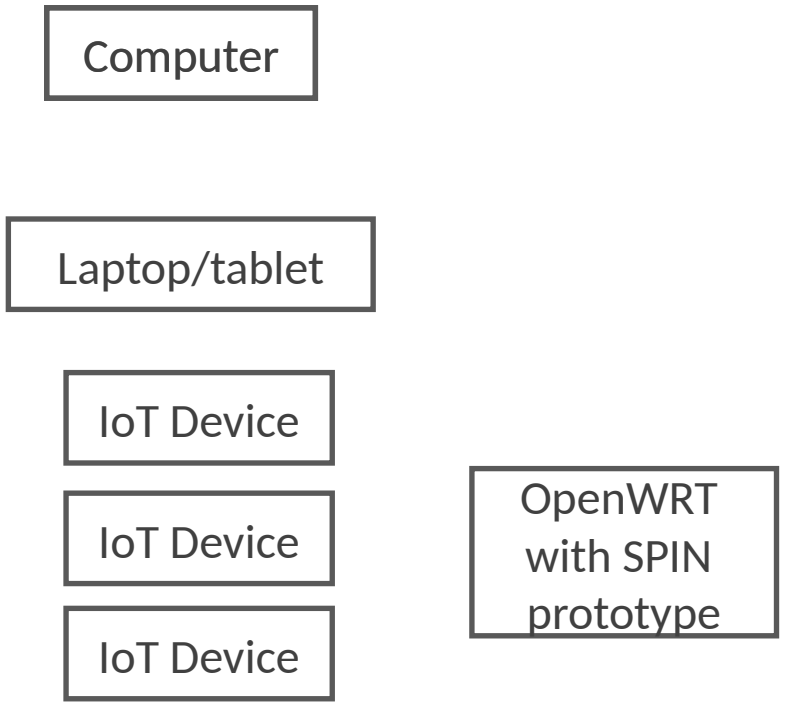
power_on
switch_off
switch_on
download_stop
power_off
turned_off

WIP: Time-series analysis

Prototype built on OpenWRT

- Currently bundled with Valibox: http://valibox.sidnlabs.nl
- Source at https://github.com/SIDN/spin

prototype 2, GL-Inet hardware



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So what can you do?

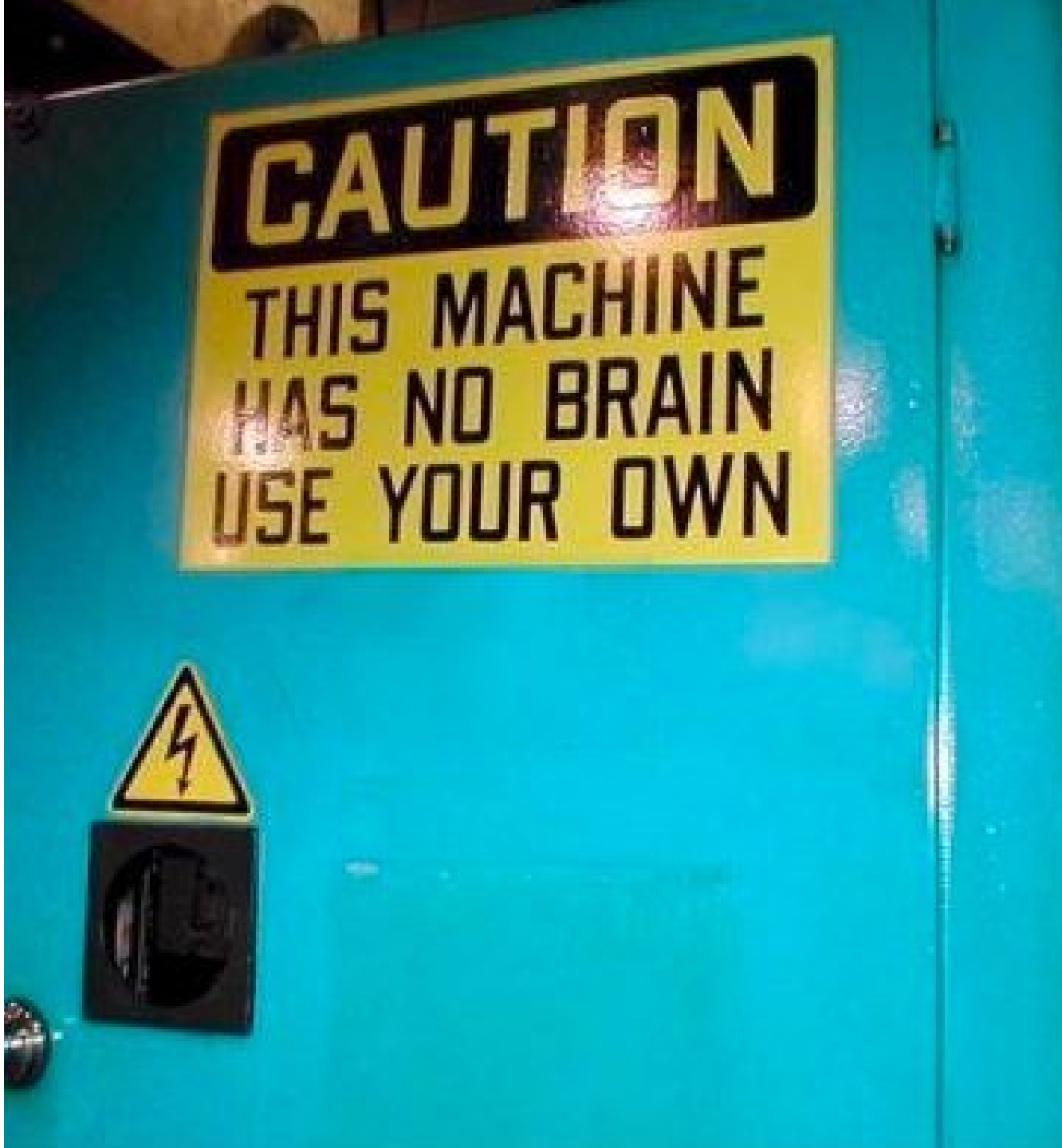
A friend built his own home IoT network

From scratch...

Might be asking a bit much

So what can you do?

- 'Be smart' (your devices are not!)
- Ask (around) for security status
- 'Can it run offline?'
  - Step-up to blocking internet access for (specific) devices by default
- Monitor, update, maintain
  - (yes that still asking a lot)



Your computer and phone leave your fingerprint

And now, so do your devices

What do you want that fingerprint to be?

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Demo!

- Depending on time and local availability

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Thank you for your attention!

Any questions?

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Are your devices talking behind your back?

Some thoughts on privacy and the IoT

Jelte Jansen | IDnext 2019

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- Source: Wikipedia

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- Source: Wikipedia


The "S" in IoT
stands for
SECURITY
Attributed to @tkadlec

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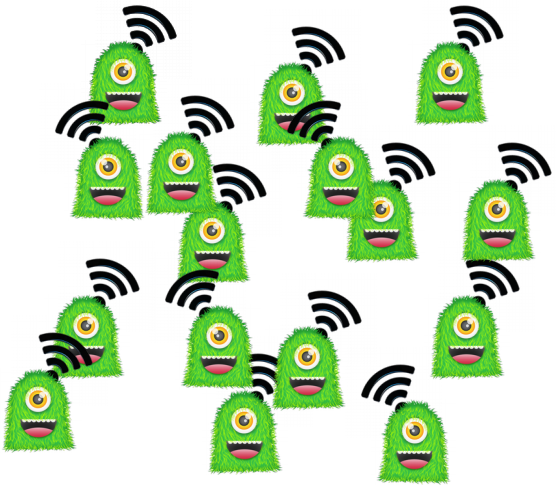

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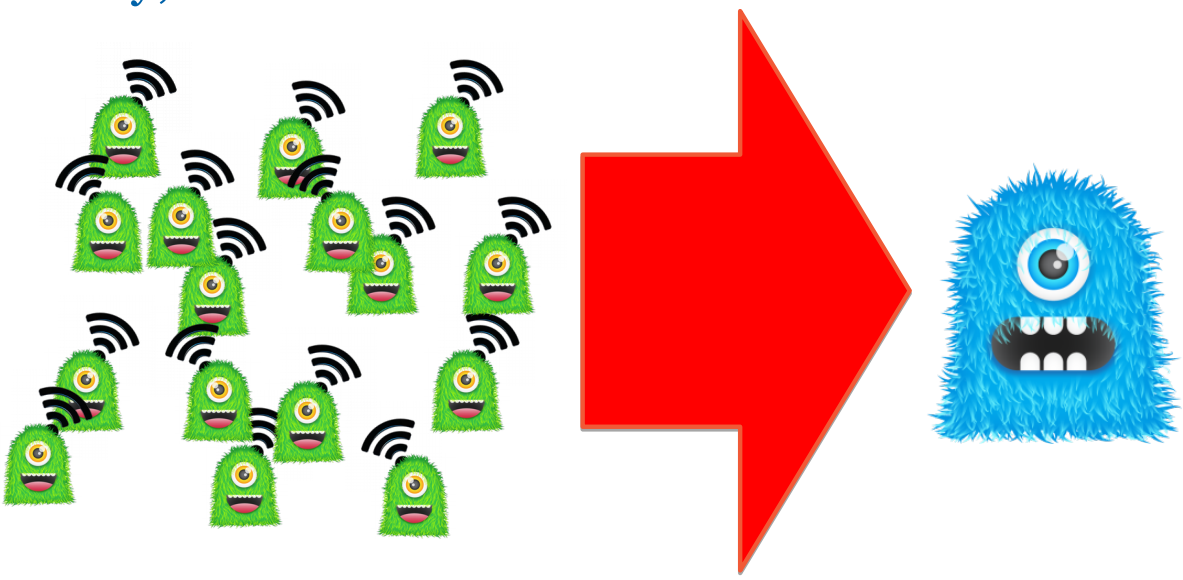


Image created by http://www.blog.spoongraphics.co.uk

Let's think about privacy

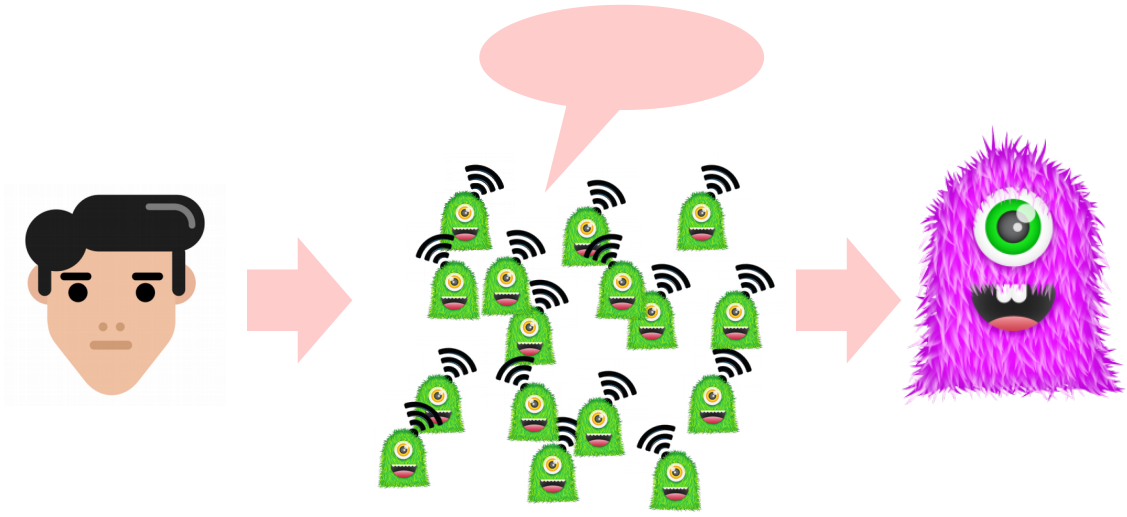


Image created by http://www.blog.spoongraphics.co.uk

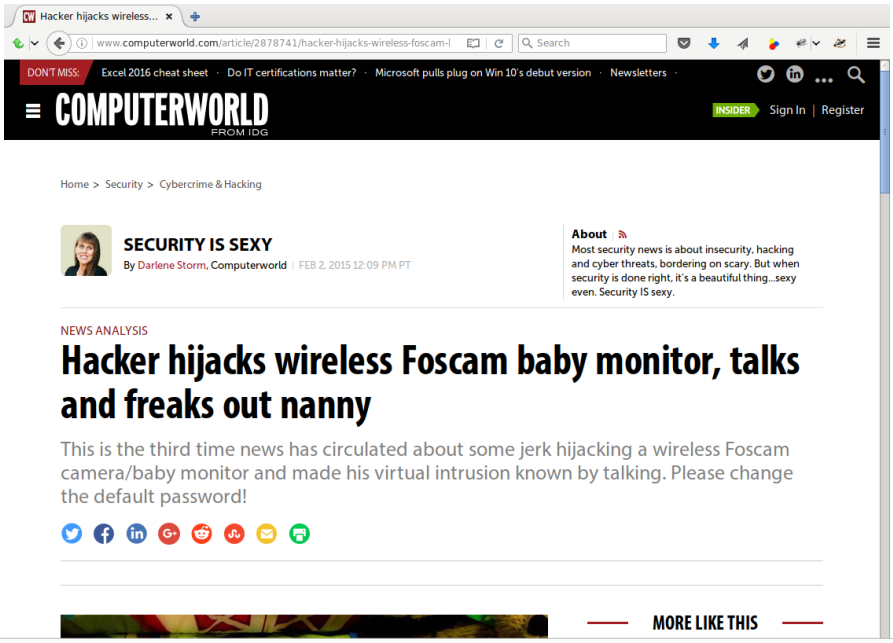
Measures speed, duration, velocity, calory use, etc.

The beta-version has a positions counter!

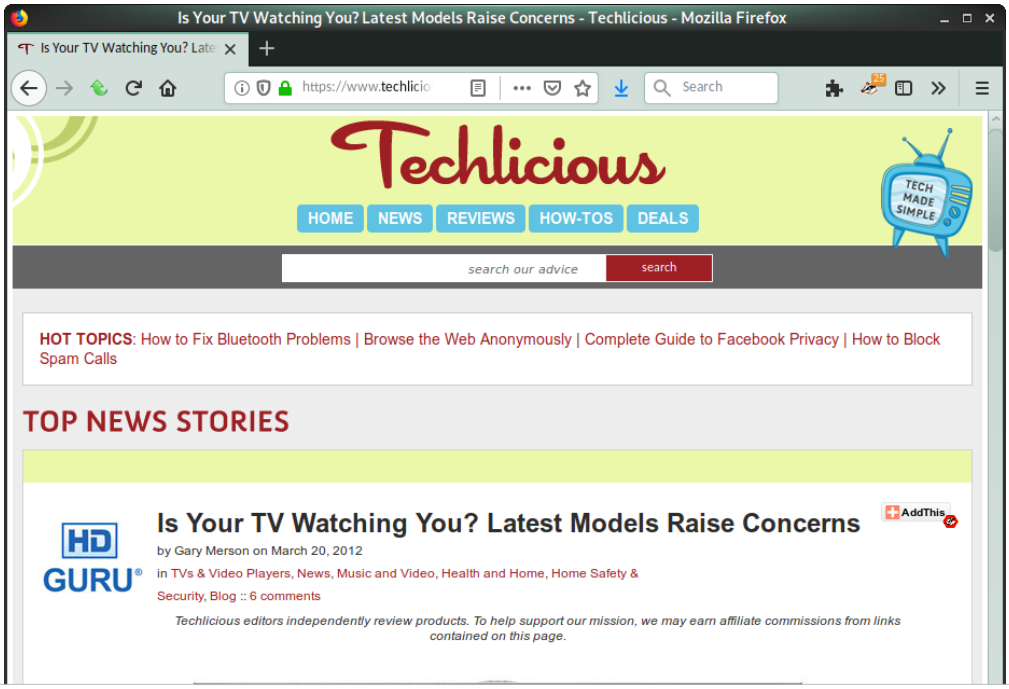
What does i.Con do with its data? Can I use it anonymously?

Absolutely! All data will be kept anonymous but users will have the option to share their recent data with friends, or, indeed the world. You will be able to anonymously access stats that you can compare with i.Con users worldwide.

IoT: Cool or Chilling?



IoT: Cool or Chilling?



IoT: Cool or Chilling?

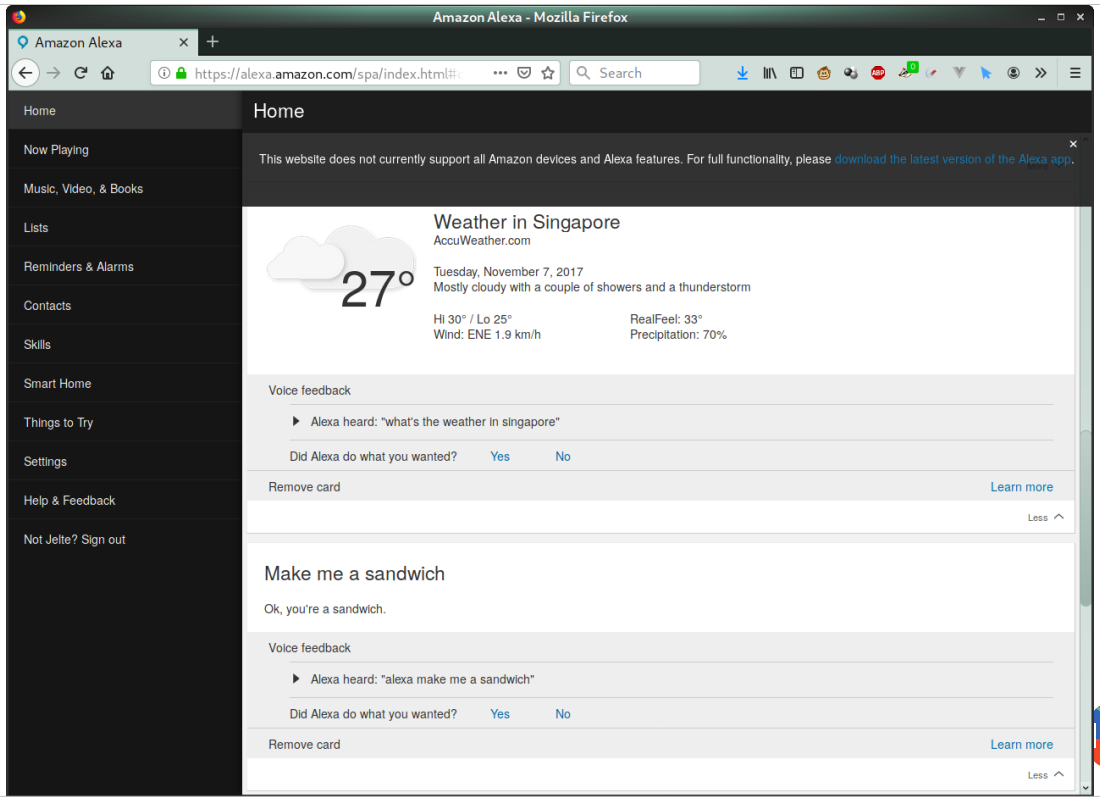
Translation:

Smart meters

My little brother is going to take longer showers, hoping that the inspectors think he has a girlfriend.

IoT: Cool or Chilling?

IoT:


Amazon Alexa - Mozilla Firefox
Amazon Alexa
https://alexa.amazon.com/spa/index.html#
Search
Home
Now Playing
Music, Video, & Books
Lists
Reminders & Alarms
Contacts
Skills
Smart Home
Things to Try
Settings
Help & Feedback
Not Jelte? Sign out
Home
This website does not currently support all Amazon devices and Alexa features. For full functionality, please download the latest version of the Alexa app.
Weather in Singapore
AccuWeather.com
27°
Tuesday, November 7, 2017
Mostly cloudy with a couple of showers and a thunderstorm
Hi 30° / Lo 25°
Wind: ENE 1.9 km/h
RealFeel: 33°
Precipitation: 70%
Voice feedback
Alexa heard: "what's the weather in singapore"
Did Alexa do what you wanted? Yes No
Remove card
Learn more
Less
Make me a sandwich
Ok, you're a sandwich.
Voice feedback
Alexa heard: "alexa make me a sandwich"
Did Alexa do what you wanted? Yes No
Remove card
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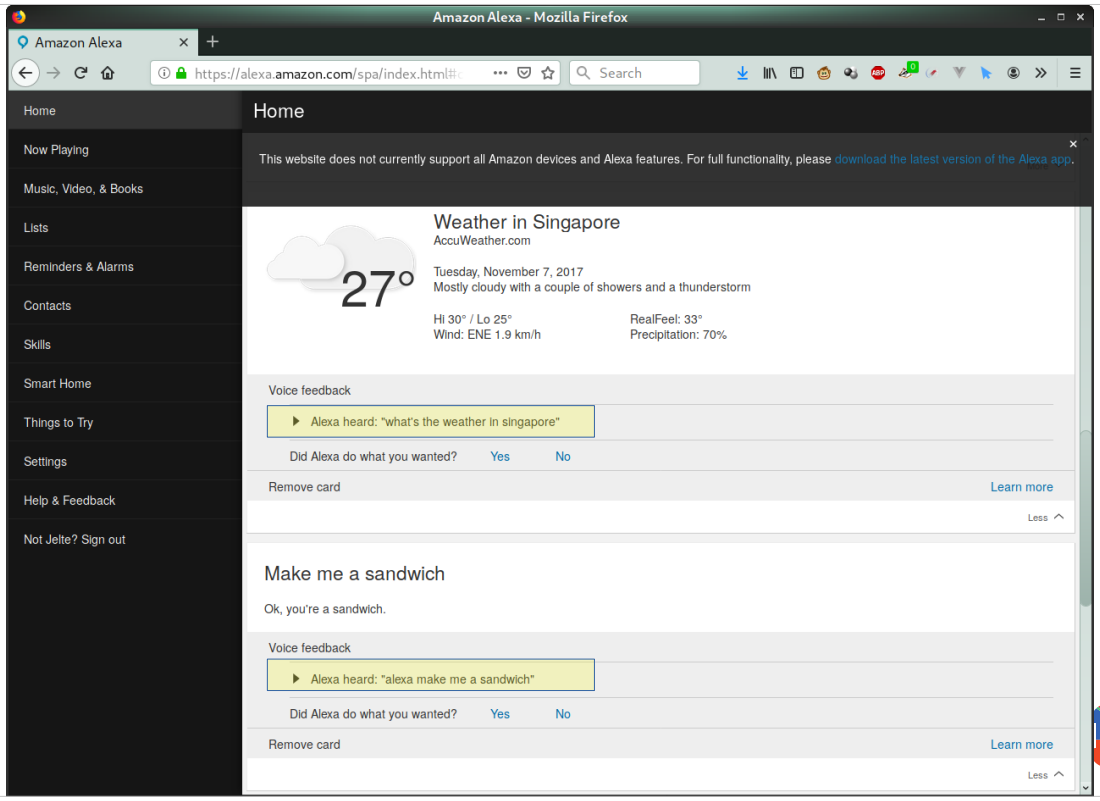
Less

IoT:


Amazon Alexa - Mozilla Firefox
Amazon Alexa
https://alexa.amazon.com/spa/index.html#
Search
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Lists
Reminders & Alarms
Contacts
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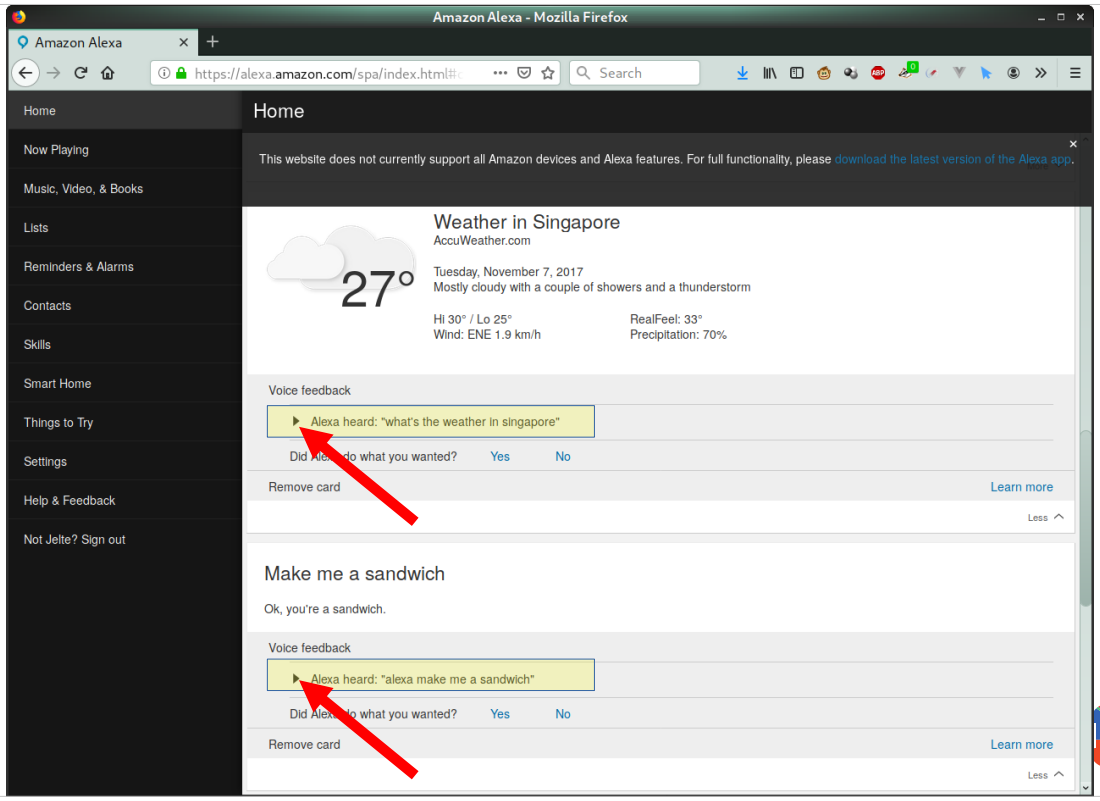
IoT:


Amazon Alexa - Mozilla Firefox
Amazon Alexa
https://alexa.amazon.com/spa/index.html#
Search
Home
Now Playing
Music, Video, & Books
Lists
Reminders & Alarms
Contacts
Skills
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No
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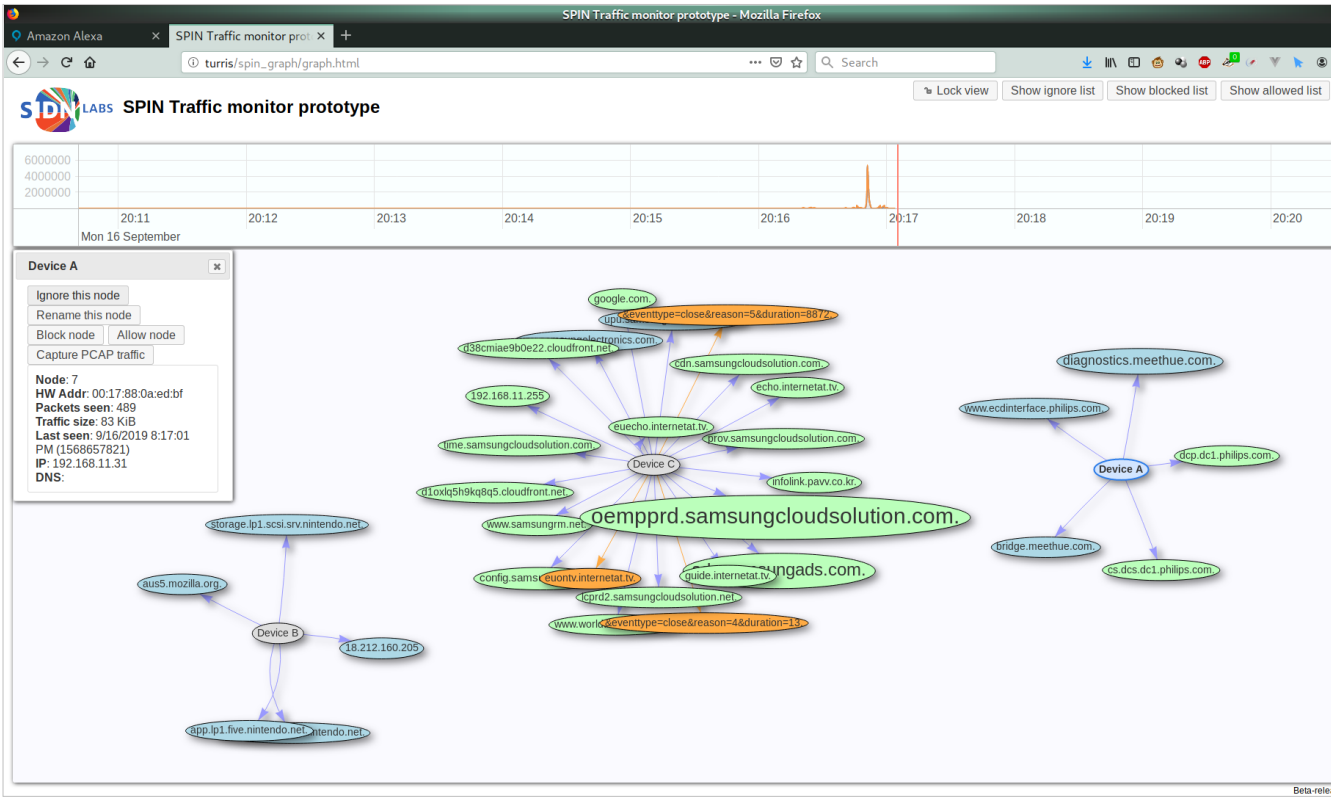
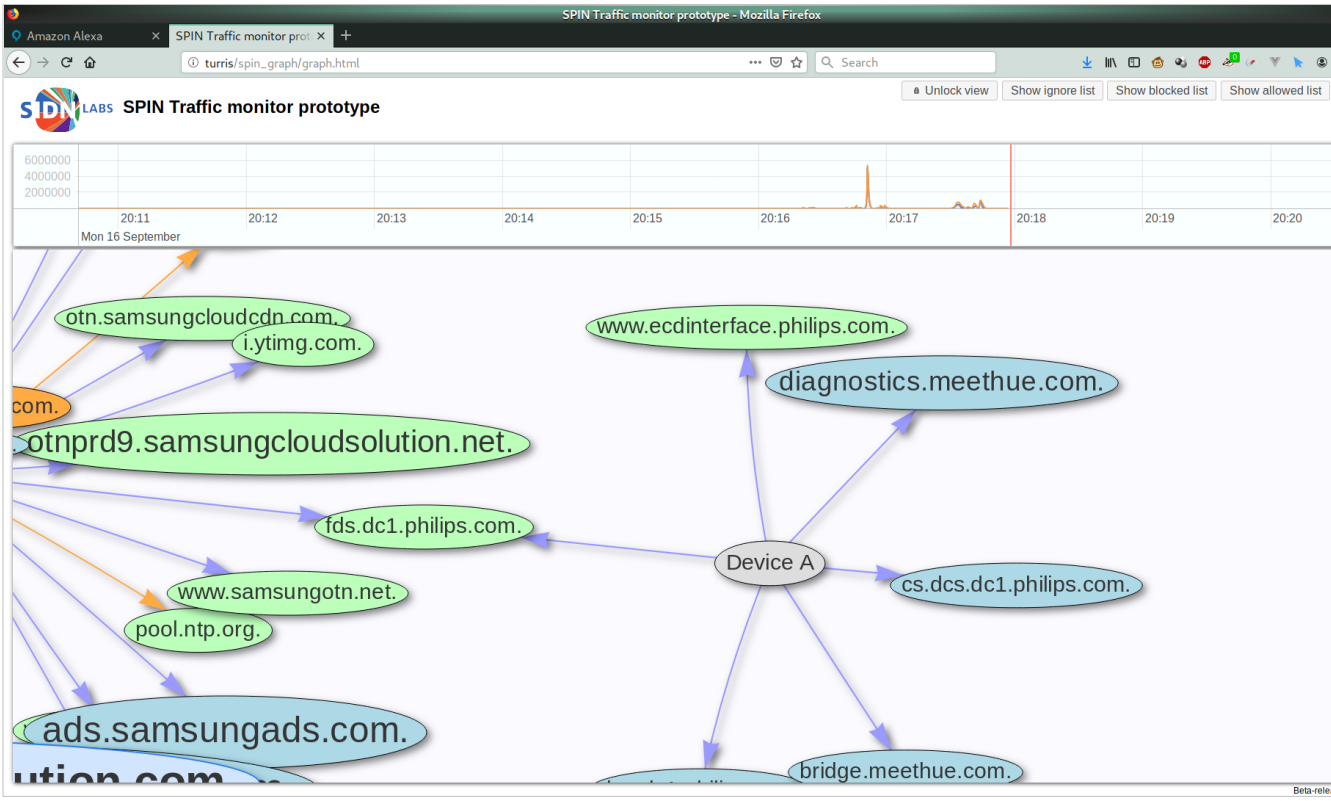
Learn more
Less

What about a more meta-level?


SPIN Traffic monitor prototype - Mozilla Firefox
Amazon Alexa
SPIN Traffic monitor prot
turris/spin_graph/graph.html
Search
SPIN Traffic monitor prototype
Lock view
Show ignore list
Show blocked list
Show allowed list
6000000
4000000
2000000
20:11
20:12
20:13
20:14
20:15
20:16
20:17
20:18
20:19
20:20
Mon 16 September
Device A
Ignore this node
Rename this node
Block node
Allow node
Capture PCAP traffic
Node: 7
HW Addr: 00:17:88:0a:ed:bf
Packets seen: 489
Traffic size: 83 KiB
Last seen: 9/16/2019 8:17:01 PM (1568657821)
IP: 192.168.11.31
DNS:
google.com
d38cmiae9b0e22.cloudfront.net
cdn.samsungcloudsolution.com
echo.internetat.tv
192.168.11.255
euecho.internetat.tv
time.samsungcloudsolution.com
prov.samsungcloudsolution.com
Device C
d1oxlq5h9kq8q5.cloudfront.net
infolink.pavv.co.kr
www.samsungrm.net
oempprd.samsungcloudsolution.com.
guide.internetat.tv
euontv.internetat.tv
lcprd2.samsungcloudsolution.net
diagnostics.meethue.com.
www.ecdinterface.philips.com
dcp.dc1.philips.com
Device A
bridge.meethue.com
cs.dcs.dc1.philips.com
storage.lp1.scsi.srv.nintendo.net
aus5.mozilla.org
Device B
18.212.160.205
app.lp1.five.nintendo.net
Beta-rele


SPIN Traffic monitor prototype - Mozilla Firefox
Amazon Alexa
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SPIN Traffic monitor prototype
Unlock view
Show ignore list
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Mon 16 September
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i.ytimg.com.
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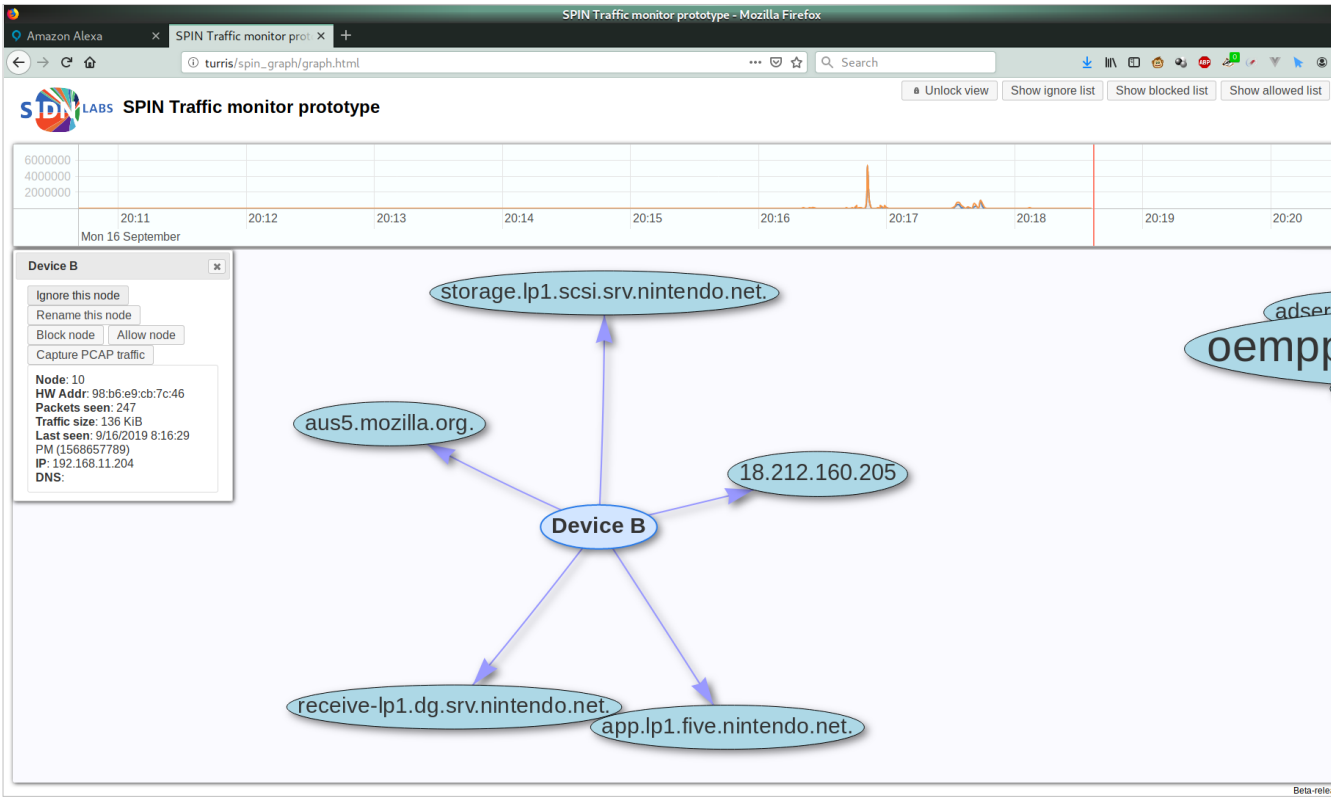
www.ecdinterface.philips.com.
diagnostics.meethue.com.
fds.dc1.philips.com.
Device A
cs.dcs.dc1.philips.com.
www.samsungotn.net.
pool.ntp.org.
ads.samsungads.com.
bridge.meethue.com.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turris/spin_graph/graph.html
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SPIN Traffic monitor prototype
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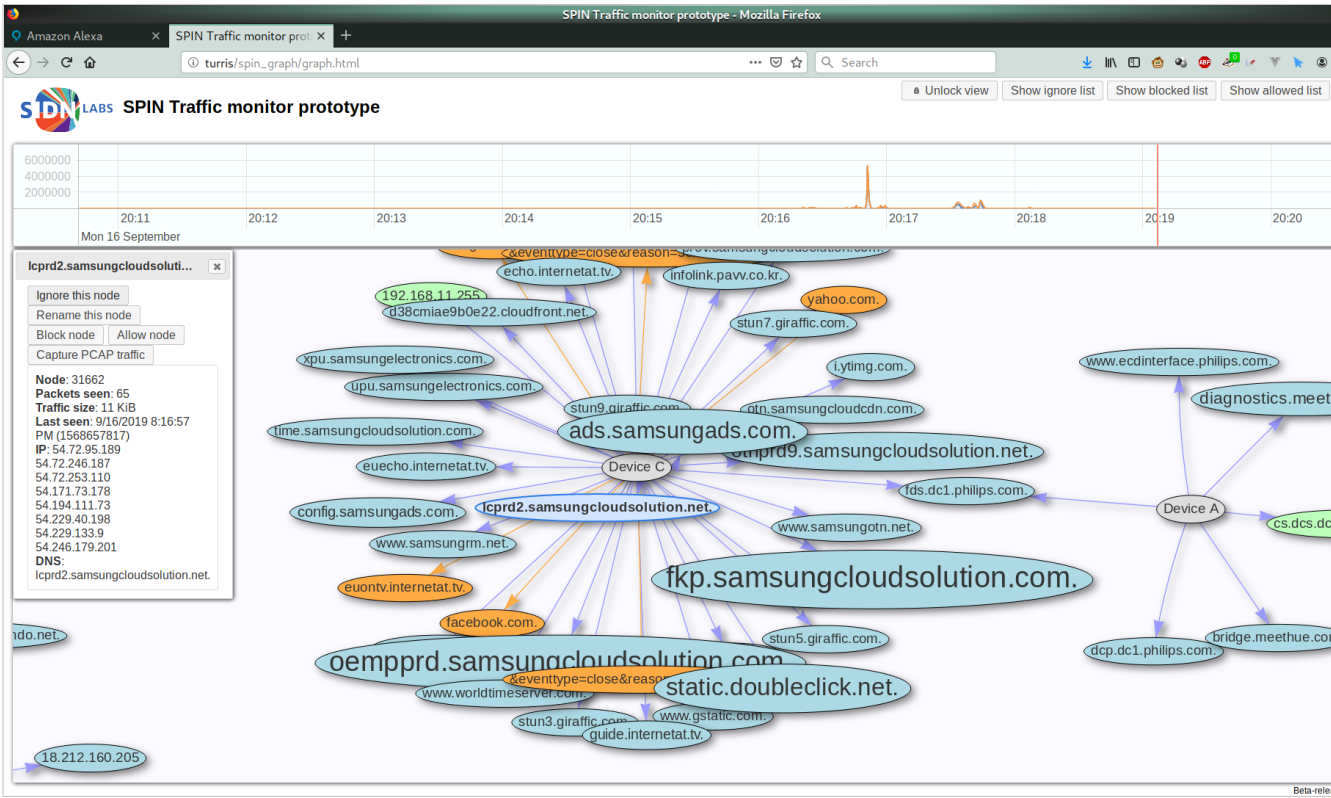
4000000
2000000
20:11
20:12
20:13
20:14
20:15
20:16
20:17
20:18
20:19
20:20
Mon 16 September
Device B
Ignore this node
Rename this node
Block node
Allow node
Capture PCAP traffic
Node: 10
HW Addr: 98:b6:e9:cb:7c:46
Packets seen: 247
Traffic size: 136 KiB
Last seen: 9/16/2019 8:16:29 PM (1568657789)
IP: 192.168.11.204
DNS:
storage.lp1.scsi.srv.nintendo.net.
aus5.mozilla.org.
18.212.160.205
Device B
receive-lp1.dg.srv.nintendo.net.
app.lp1.five.nintendo.net.


SPIN Traffic monitor prototype - Mozilla Firefox
Amazon Alexa
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turris/spin_graph/graph.html
Search
SPIN Traffic monitor prototype
Unlock view
Show ignore list
Show blocked list
Show allowed list
6000000
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20:19
20:20
Mon 16 September
lcprd2.samsungcloudsoluti...
Ignore this node
Rename this node
Block node
Allow node
Capture PCAP traffic
Node: 31662
Packets seen: 65
Traffic size: 11 KiB
Last seen: 9/16/2019 8:16:57 PM (1568657817)
IP: 54.72.95.189
54.72.246.187
54.72.253.110
54.171.73.178
54.194.111.73
54.229.40.198
54.229.133.9
54.246.179.201
DNS:
lcprd2.samsungcloudsolution.net.
echo.internetat.tv.
infolink.pavv.co.kr.
192.168.11.255
d38cmiae9b0e22.cloudfront.net.
yahoo.com.
stun7.giraffic.com.
xpu.samsungelectronics.com.
upu.samsungelectronics.com.
i.ytimg.com.
www.ecdinterface.philips.com.
diagnostics.meet
stun9.giraffic.com.
otn.samsungcloudcdn.com.
time.samsungcloudsolution.com.
ads.samsungads.com.
euecho.internetat.tv.
Device C
fds.dc1.philips.com.
Device A
config.samsungads.com.
lcprd2.samsungcloudsolution.net.
www.samsungotn.net.
www.samsungrm.net.
fkp.samsungcloudsolution.com.
euontv.internetat.tv.
facebook.com.
stun5.giraffic.com.
dcp.dc1.philips.com.
bridge.meethue.com
oempprd.samsungcloudsolution.com.
static.doubleclick.net.
www.worldtimeserver.com.
www.gstatic.com.
stun3.giraffic.com.
guide.internetat.tv.
18.212.160.205

And what about the manufacturer itself?

And what about the manufacturer itself?

- Even secure devices may send a lot of data home
  - Where ‘home’ is not your home
- Even if your device is not hacked, the manufacturer can be
- Or it can just sell your data
  - At least the GDPR should help there
    - (in some cases)

Orvibo data leak puts security spotlight on IoT back end

The security of devices that make up the internet of things (IoT) is a top concern for many in the industry, but leaks from an IoT database highlights the importance of ba end security too

Warwick Ashford Senior analyst

Published: 02 Jul 2019 12:15

Should we not use anything then?

"Don't think of it as breaking up, I'm just updating my privacy settings."

What should we do?

- Better practices for manufacturers?
- Free **secure** software stacks?
- International policy, regulation, certificiation?
- Clear up accountability issues?
- Generate market demand for secure products?
- Quarantine bad actors (e.g. at ISP)?
- Educate users?
- Empower users?

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"Yes"

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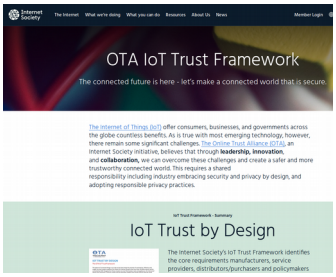
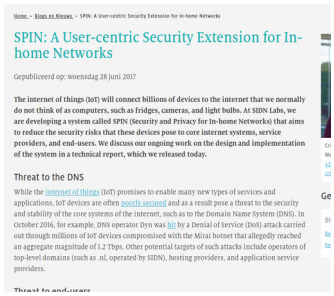
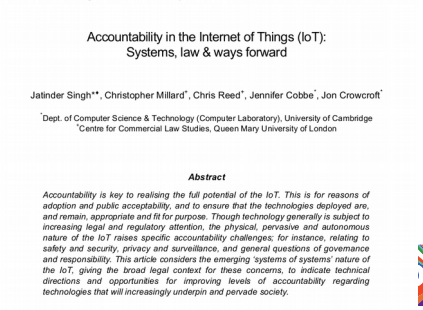
"Yes"

We need to do it all

Initiatives around the world, on many levels







- IoT Trust framework (ISOC)
- RED directive (EU)
- GDPR even (EU)
- Accountability (law scholars)
- IETF: MUD/DOTS/etc.

Initiative at SIDN: the SPIN project

- Security and Privacy for In-home Networks
- Research and prototype of SPIN functionality:
  - Visualising network traffic
  - (Automatic) blocking of 'bad' traffic
  - Traffic capture & analysis research
  - Platform for prototyping things as DOTS (or potenitally MUD)

- research and developt IoT home network behaviour and security.

Initial analysis: basic aggregation of traffic totals to destination and ports.

For example: this devices uses MQTT (port 1883)

Time-series analysis, very early work: can we tell from traffic that an event happened (such as turning on the light)

So what can you do?

A friend built his own home IoT network

From scratch...

Might be asking a bit much

So what can you do?

- 'Be smart' (your devices are not!)
- Ask (around) for security status
- 'Can it run offline?'
  - Step-up to blocking internet access for (specific) devices by default
- Monitor, update, maintain
  - (yes that still asking a lot)

Your computer and phone leave your fingerprint

And now, so do your devices

What do you want that fingerprint to be?

Demo!

- Depending on time and local availability

Thank you for your attention!

Any questions?

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