Pi-hole®

Installing a network-wide ad blocker with a Raspberry Pi

LUG @ NCSU
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Preface & Resources

- https://pi-hole.net/
- https://docs.pi-hole.net/
- https://discourse.pi-hole.net
- Most of this presentation was shamelessly taken and condensed from the forums and documentation pages
- This is merely a getting started guide with all the essential information in a convenient format

Why I was initially interested in Pihole

- **Content is blocked in non-traditional locations, such as mobile games, Roku, and other IOT devices on your local network**
- Caching DNS queries does not affect loading times
- Can function as a DHCP server, ensuring all your devices are protected automatically
- Blocks ads over both IPv4 and IPv6
- Free and open-source
- Better and more robust than a browser extension

At a high level, how does Pi-hole work?

- You open your favorite web browser
- You type amazon.com in the address bar
- Pi-hole looks up amazon.com and begins downloading it
- It will detect the domains used to serve advertisements (from crowd sourced databases) and instead of looking up the real address of those sites, it will send a fake address instead
- This allows the legitimate content on amazon.com to load, but prevents the ad images and videos from being downloaded

Prereqs

- **Very lightweight**
  - Min. 2GB free space, 4GB recommended
  - 512MB RAM
- Pi-hole is supported on distributions utilizing *systemd* or *sysvinit*
  - Raspberry Pi OS (formerly Raspbian)
  - Ubuntu
  - Debian
  - Fedora
  - CentOS
- Can also be installed via Docker, but I don’t have much knowledge about this platform

Prereqs

- **Pi-hole needs a static IP address to properly function**

  “Users may run into issues because we currently install *dhcpcd5*, which may conflict with other running network managers such as *dhclient*, *dhcpcd*, *networkmanager*, and *systemd-networkd*.” (documentation)

- **Stable** network connection (ethernet over wifi if possible)
- Your device is essentially a server now
- You may have to edit your firewall config
  - IPv4:
    - *ufw allow 80/tcp*
    - *ufw allow 53/tcp*
    - *ufw allow 53/udp*
    - *ufw allow 67/tcp*
    - *ufw allow 67/udp*
  - IPv6 (including the above IPv4 rules):
    - *ufw allow 546:547/udp*

Installation Overview

- **On your device of choice that is connected to your LAN**
  - *wget -O basic-install.sh https://install.pi-hole.net*
  - *sudo bash basic-install.sh*
  - Install script will guide you through basic setup
- **Three Options**
  - Configure your router to have DHCP clients use Pi-hole as their **internal** DNS server (this is optimal)
  - Use Pi-hole's built-in DHCP server (good backup, complicated)
  - Manually set **each** device to use Pi-hole as their DNS server (pain in the arse)
- **The reason we must change these settings on our network is so that all traffic is routed through the Pi-hole**

Option 1: Setup Pi-hole as internal DNS server

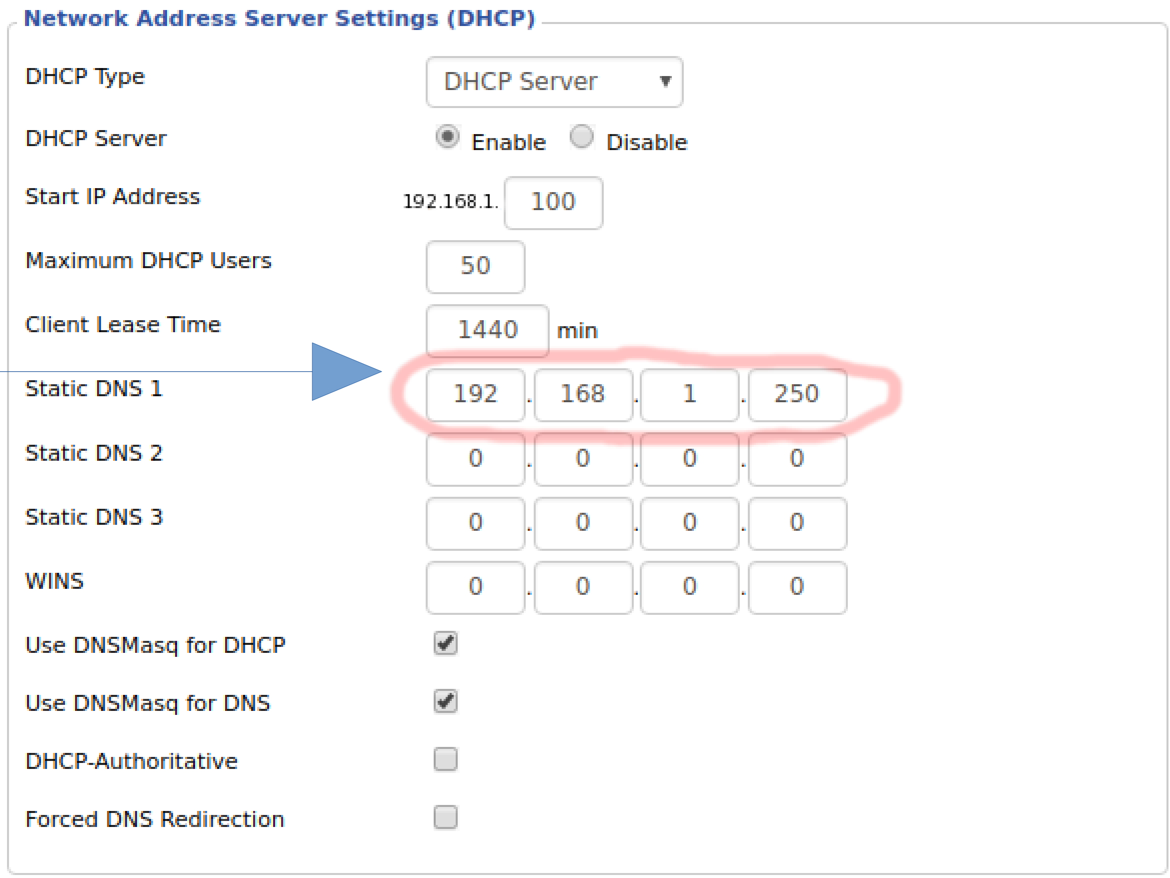
- **Log into your router's configuration page and find the DHCP/DNS settings**
- Make sure you adjust this setting under **your LAN settings** and **NOT the WAN**
- Upstream WAN DNS servers options are configured/chosen in the setup script for Pi-hole (OpenDNS, Google, etc.)

Option 1: Setup Pi-hole as internal DNS server

- **From documentation**

https://discourse.pi-hole.net/t/how-do-i-configure-my-devices-to-use-pi-hole-as-their-dns-server/245

Pi-hole LAN IP Address

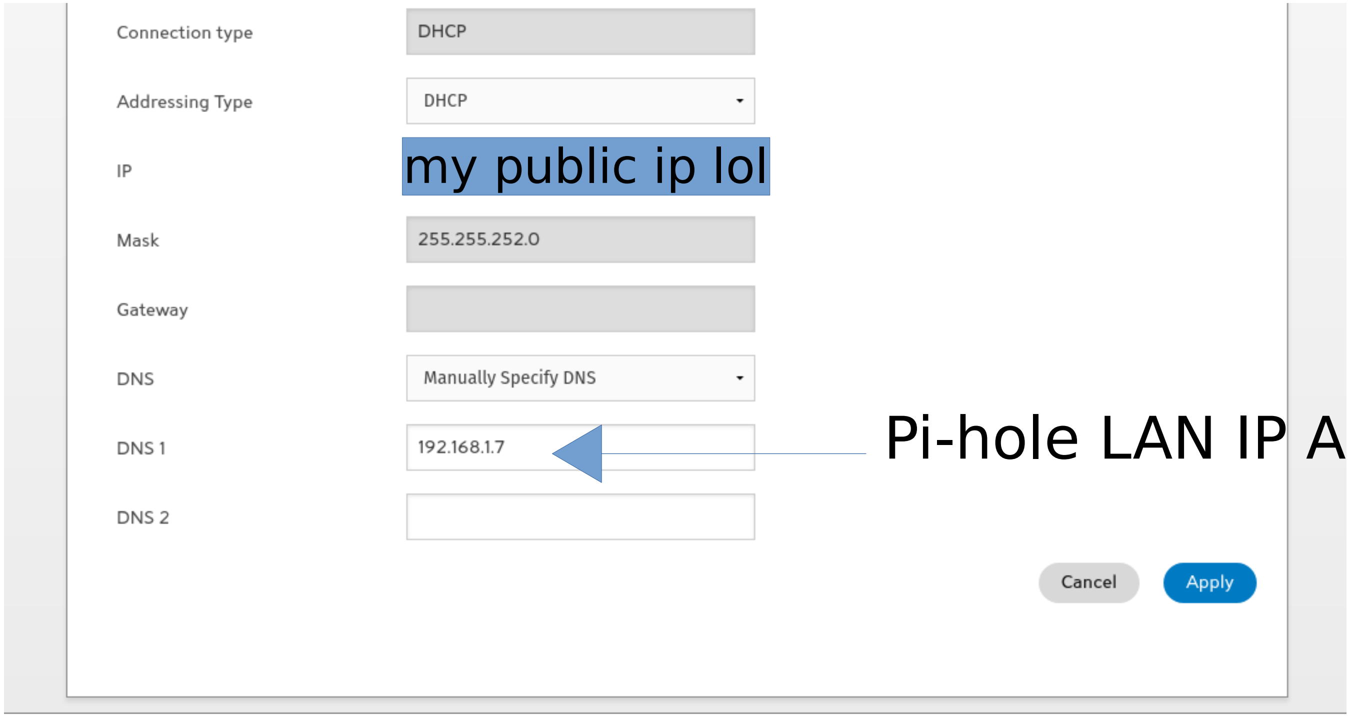


Network Address Server Settings (DHCP)

DHCP Type	DHCP Server ▾
DHCP Server	● Enable ○ Disable
Start IP Address	192.168.1. 100
Maximum DHCP Users	50
Client Lease Time	1440 min
Static DNS 1	192 . 168 . 1 . 250
Static DNS 2	0 . 0 . 0 . 0
Static DNS 3	0 . 0 . 0 . 0
WINS	0 . 0 . 0 . 0
Use DNSMasq for DHCP	☑
Use DNSMasq for DNS	☑
DHCP-Authoritative	□
Forced DNS Redirection	□

Option 1: Setup Pi-hole as internal DNS server

- **Router control panels will vary (kinda like BIOS settings)**
  - ie. my home router



Connection type	DHCP
Addressing Type	DHCP
IP	my public ip lol
Mask	255.255.252.0
Gateway	
DNS	Manually Specify DNS
DNS 1	192.168.1.7
DNS 2	

Pi-hole LAN IP Address

Option 1: Closing reminders

- If you have existing devices on the network, ads will not be blocked until the DHCP lease is renewed
- DHCP leases can range from a couple hours to days, so….
- Usually a renewal of each device’s lease can be forced by restarting the device

Option 2: Using Pi-hole as a DHCP server

- **Like mentioned earlier, very complicated**
- **Uses dns service called** *dnsmasq* to act as replacement for built-in DHCP server that router has
- Be sure to **disable** DHCP on your router first or many issues could occur
  - I made this mistake and my home network came to a grinding halt….
- **More information** is available on their documentation pages
  - https://docs.pi-hole.net/main/post-install/
  - https://discourse.pi-hole.net/t/how-do-i-configure-my-devices-to-use-pi-hole-as-their-dns-server/245
  - Really helpful and complete documentation. Yay!
- For these reasons we will not be going too deep on this option

Option 3: Opting In/Out

- **Hybrid option that allows for hand-picking which device on the LAN is protected by Pi-hole**
  - Think of it is an opt-in/opt-out method (ex. the network is shared with a roommate)
- This means that your Pi-hole was configured either by **option 1 or 2** earlier
- “By manually setting the DNS server to something other than Pi-hole, you override the DHCP options, and thus what DNS server to use, provided by your router.” (documentation)

Option 3: Opting In/Out

- **Getting to DNS settings on each device/OS is a little different but they all kinda follow this**

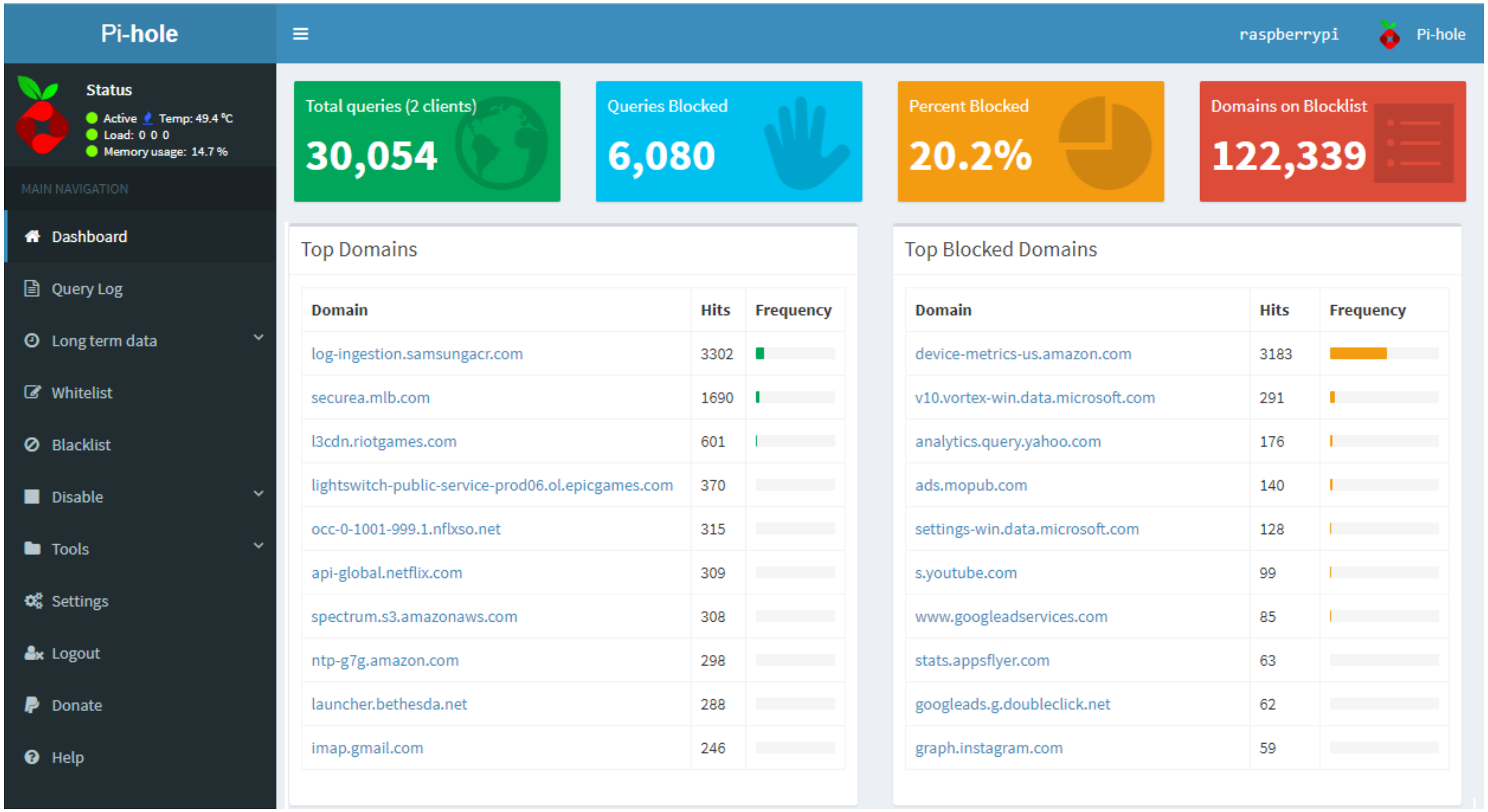
  Control Panel/Settings → Network/Internet → Details/Advanced Settings → DNS/IP Addressing

- **To opt-in: Set your DNS server to the Pi-hole's LAN IP**
- **To opt-out: Set your DNS server(s) to other servers (ex. Google DNS 8.8.8.8)**

We are now done with all the dirty work!

Config

- **GUI Option → this can be accessed at**
  - http://MY_PIHOLE_IP_ADDRESS/admin



Status
● Active Temp: 49.4 °C
● Load: 0 0 0
● Memory usage: 14.7 %

Total queries (2 clients) 30,054

Queries Blocked 6,080

Percent Blocked 20.2%

Domains on Blocklist 122,339

Top Domains

Domain	Hits	Frequency
log-ingestion.samsungacr.com	3302	
securea.mlb.com	1690	
l3cdn.riotgames.com	601	
lightswitch-public-service-prod06.ol.epicgames.com	370	
occ-0-1001-999.1.nflxso.net	315	
api-global.netflix.com	309	
spectrum.s3.amazonaws.com	308	
ntp-g7g.amazon.com	298	
launcher.bethesda.net	288	
imap.gmail.com	246	

Top Blocked Domains

Domain	Hits	Frequency
device-metrics-us.amazon.com	3183	
v10.vortex-win.data.microsoft.com	291	
analytics.query.yahoo.com	176	
ads.mopub.com	140	
settings-win.data.microsoft.com	128	
s.youtube.com	99	
www.googleadservices.com	85	
stats.appsflyer.com	63	
googleads.g.doubleclick.net	62	
graph.instagram.com	59	

Config

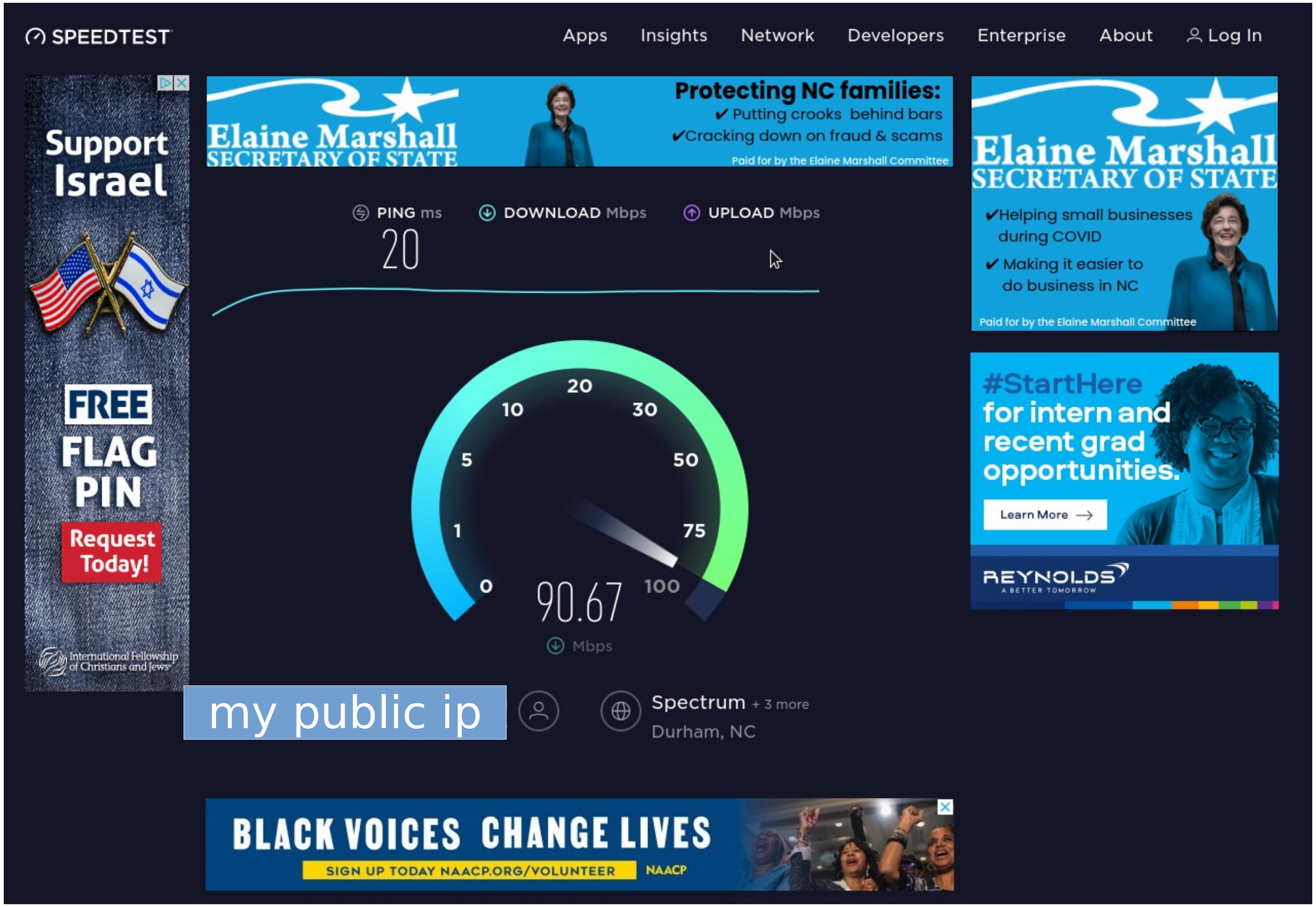
- **CLI option → I typically SSH into my Raspberry Pi when I need to do this**
  - *pihole status*
  - *pihole version*
  - *pihole logging*
  - *pihole updatePihole*
  - *pihole enable*
  - Lots more…. https://docs.pi-hole.net/core/pihole-command/#pi-hole-core

Config

- Custom whitelist and blacklist sites can be added
- Different databases/known advertisement sites can be tweaked
- Log files can be viewed
- Ad blocking can be permanently or temporarily disabled for debug/testing

The Results: Advertisement Heavy Site

- **Before →**


SPEEDTEST
Apps
Insights
Network
Developers
Enterprise
About
Log In
Support Israel
FREE FLAG PIN
Request Today!
International Fellowship of Christians and Jews
Elaine Marshall SECRETARY OF STATE
Protecting NC families:
✔ Putting crooks behind bars
✔Cracking down on fraud & scams
Paid for by the Elaine Marshall Committee
PING ms
DOWNLOAD Mbps
UPLOAD Mbps
20
0
1
5
10
20
30
50
75
100
90.67
Mbps
Spectrum + 3 more
Durham, NC
Elaine Marshall SECRETARY OF STATE
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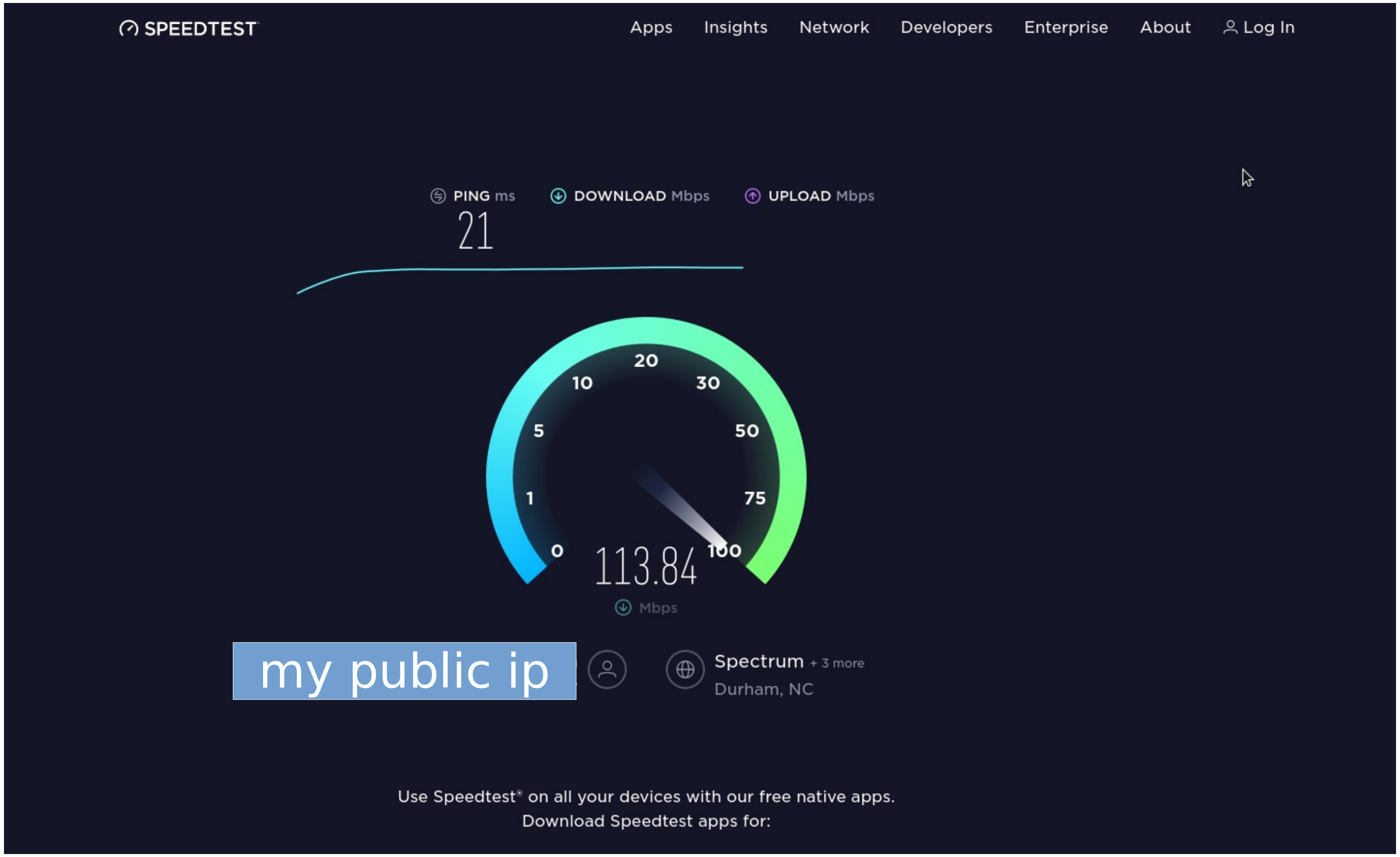
my public ip

The Results: Advertisement Heavy Site

- **After**



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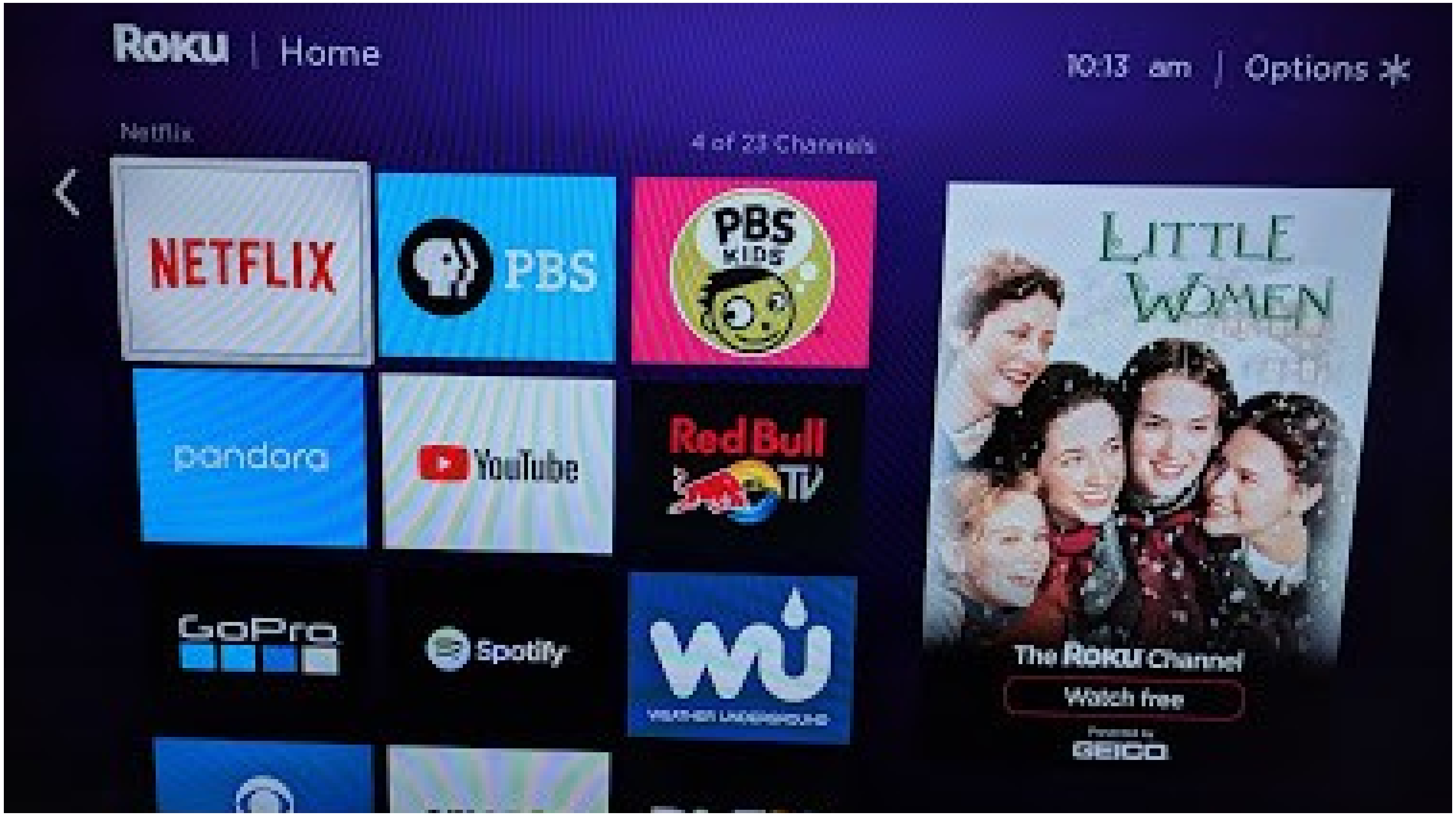
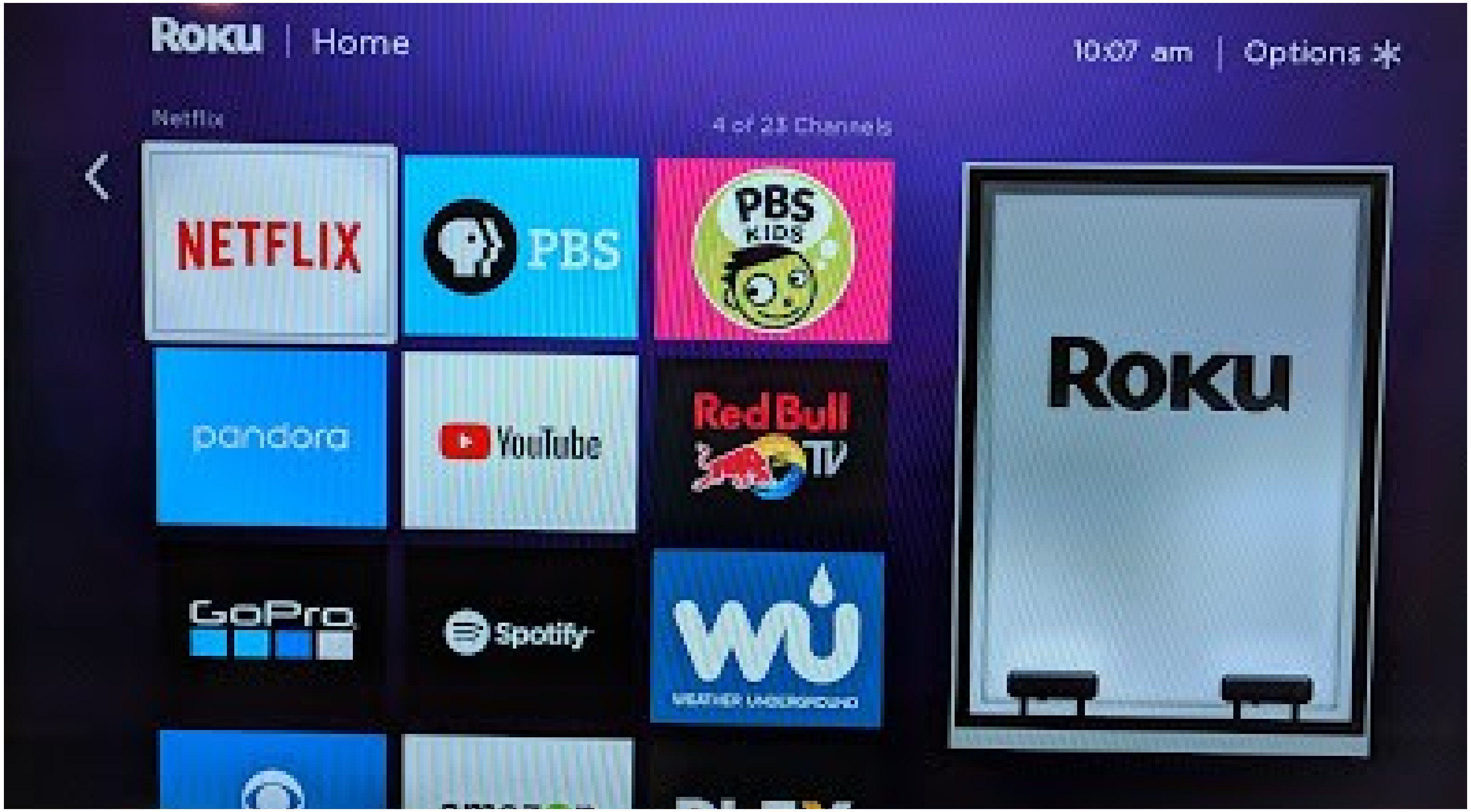
The Results: Roku TV

- **Before →**



The Results: Roku TV

- **After**



Questions?