5: Measuring networks

Section	Length
1: Topic introduction	15 min
2: Hands-on and material exploration	40 min
3: Discussion and reflection activity	20 min
4: Wrap-up and week ahead	5 min
Workshop length	1:30 min

1: Topic introduction

- Review of homework on Net Neutrality:
    - Did you know about Net Neutrality?
    - Did you think it was a good thing?
    - Did you think about the negative aspects of it being put into law?
    - Are there reasons for traffic shaping or blocking connections
    - Why are large tel-cos interested in treating different internet traffic differently
    - How may this affect peer-to-peer applications?
    - How may a community mesh network affect this?
- Network is a limited resource that is determined by the infrastructure
- Discuss the need for keeping a pulse of the network
    - What attributes are important to monitor
    - How are these attributes measured?
    - Identify units and what they mean
    - Where have we seen it in our daily lives?

2: Hands-on and material exploration

Monitor flow of network traffic using different tools as we do every day digital things.

Objectives

Learn how these metrics affect us in our day to day lives, and in contrast how the same metrics affect others.

Materials

- Your cellphone
- Some sort of public WiFi or internet connection
- A Raspberry Pi 3 for each participant labeled with the SSID for the node
- SD cards with pre-flashed images with all required software
- Laptops that can establish a SSH session to each Raspberry Pi (each running a Host AP with unique SSID)
- USB WiFi radio that is ad-hoc or 802.11s-capable (https://github.com/phillymesh/802.11s-adapters) for each Raspberry Pi 3

Format

Groups (or pairs) to start, class discussion then back to groups again

Activity

As the whole class:

a. Review your cell phone usage:

- Identify your apps' data usage
- Record a few of the top apps that took up the most data
- Was this data cellular, or WiFi?

b. Public WiFi speed test:

- Use a speed test tool (e.g. speedtest.net) to test the speed of the public WiFi, record the result
- Is it faster or slower than the connection you have at home?
- Run the speed test again, record the result

c. Discuss measurements and units:

- What unit is the data usage of your apps measured in?
- What does MB mean?
- What was some of the top app and how much MB did it use?
    - Have participants volunteer their info if they feel comfortable doing so
- Was that surprising?
- Would you be more/less surprised if it was cellular data? What if it was WiFi data?
    - Are different data sources worth more?
    - Why? What is your cell data limit?
- What unit was the WiFi speed measured in?
- What does Mbps mean?
- How does this relate to the MB from apps?
- Why was the speed different between tests?

d. Show Grafana functioning on a mesh node and describe what it is:

- Access via web interface
- Show how to select nodes

Break into smaller groups:

- Connect to the node
- Access the Grafana interface and look around
- Stream a music file that is located on a node's local webserver and observe the metrics
- Stream a video file that is located on a node's local webserver and observe the metrics
- Observe what metrics change if you do the same from a remote node (over the mesh)
- Can you measure both nodes at the same time?

Discuss results in larger group and ask the following questions:

- Did difficulty increase measuring two nodes at the same time?

- What would happen if we have a city-wide mesh?
    - Ping time
    - Throughput
    - CPU usage
- Are some metrics more important than others?
- How do you represent a mesh network?
    - Physical network topology (e.g. Toronto Mesh map (https://tomesh.net/map/))
    - Virtual peering topology (e.g. fc00.org (https://www.fc00.org/))

3: Discussion and reflection activity

Q & A about sharing broken Internet experiences, understanding failure points and why we measure

- Break into 3 groups
- Each group is assigned a user profile
    - Gamer
    - Streamer (Youtube, Netflix, etc.)
    - Web user with occasional video conferencing calls (web, email, instant messaging, Skype, Hangout, etc.)
- Spend 10 minutes discussing the characteristics of this user and what metrics are important to them and why. Consider some of these questions:
    - What are the most used services by the user?
    - How would the user be affected if internet access becomes unavailable?
    - What would the user consider as "internet went down"?
    - What is the threshold for the user?
        - Packet loss / poor link quality
        - Latency / ping
        - Bandwidth speed
        - Bandwidth allotment
    - Does network traffic trend change throughout the day for the user's connection?
    - Look at your local internet provider (Bell, Rogers, etc.), which plan would you suggest for them and why?
    - Does wired vs wireless affect the experience?
- Have each group spend 2 minutes presenting their user profile and their findings
- Make the assumption that the 3 profiles live in the same household, does that change any of the recommendations is so how?
- How will things change if services are accessed through / hosted on a community mesh network?

4: Wrap-up and week ahead

- Read Sonia Bussu's perspective on public engagement in the development of IoT (http://blogs.lse.ac.uk/usappblog/2014/12/13/public-engagement-on-the-internet-of-things-is-essential-if-we-are-to-put-societal-values-at-the-centre-of-technological-developments/)
- Browse Public Lab's website of DIY science projects (https://publiclab.org/methods). Are there

any projects of your own that you might want to use technology to explore?

- Optional: Watch the National Film Board series on Antennas:
    - Propogation (https://www.youtube.com/watch?v=7bDyA5t1ldU)
    - Directivity (https://www.youtube.com/watch?v=md7GjQQ2YA0&)
    - Bandwidth (https://www.youtube.com/watch?v=9iV_YICgifA&)