

---

layout: page  
title: "Measuring networks"  
module: "5"  
contents:

- [\\_articles/module-5/presentation.md](#)
  - [\\_articles/module-5/pdf-assets.md](#)  
following: [\\_articles/module-5/presentation.md](#)
- 

## Module 5: Measuring networks

Section	Length
<a href="#">1: Topic introduction</a>	15 min
<a href="#">2: Hands-on and material exploration</a>	40 min
<a href="#">3: Discussion and reflection activity</a>	20 min
<a href="#">4: Wrap-up and week ahead</a>	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 \(https://github.com/phillymesh/802.11s-adapters\)](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 bwm-ng (Bandwidth Monitor - Next Generation) on a mesh node and describe what it is:

- Information provided
- How to toggle between items

Break into smaller groups:

- Connect to the node

- SSH into the node
- Run small web server
- Run bwm-ng
- Stream a video file that is located on a node's local webserver and observe the metrics
- Use tc (Traffic Control) to limit the bandwidth and observe what and how the metrics change

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 \(https://tomesh.net/map/\)](https://tomesh.net/map/))
  - Virtual peering topology (e.g. [fc00.org \(https://www.fc00.org/\)](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/) (<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) (<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:
  - [Propagation](https://www.youtube.com/watch?v=7bDyA5t1ldU) (<https://www.youtube.com/watch?v=7bDyA5t1ldU>)
  - [Directivity](https://www.youtube.com/watch?v=md7GjQQ2YA0&) (<https://www.youtube.com/watch?v=md7GjQQ2YA0&>)
  - [Bandwidth](https://www.youtube.com/watch?v=9iV_YICgifA&) ([https://www.youtube.com/watch?v=9iV\\_YICgifA&](https://www.youtube.com/watch?v=9iV_YICgifA&))