

# Bufferbloat

or why you can't torrent and Netflix at the same time

# Has this happened to you?

- Have you ever tried to stream Netflix only to have it start buffering because your roommate was downloading a game?
- Have you ever been gaming and had lag because your roommate was torrenting?
- Have you had trouble keeping your streams working in quarantine because the rest of your household is also doing the same thing?



# Problem: Bandwidth Contention



Bandwidth is limited



Common applications use a lot of it

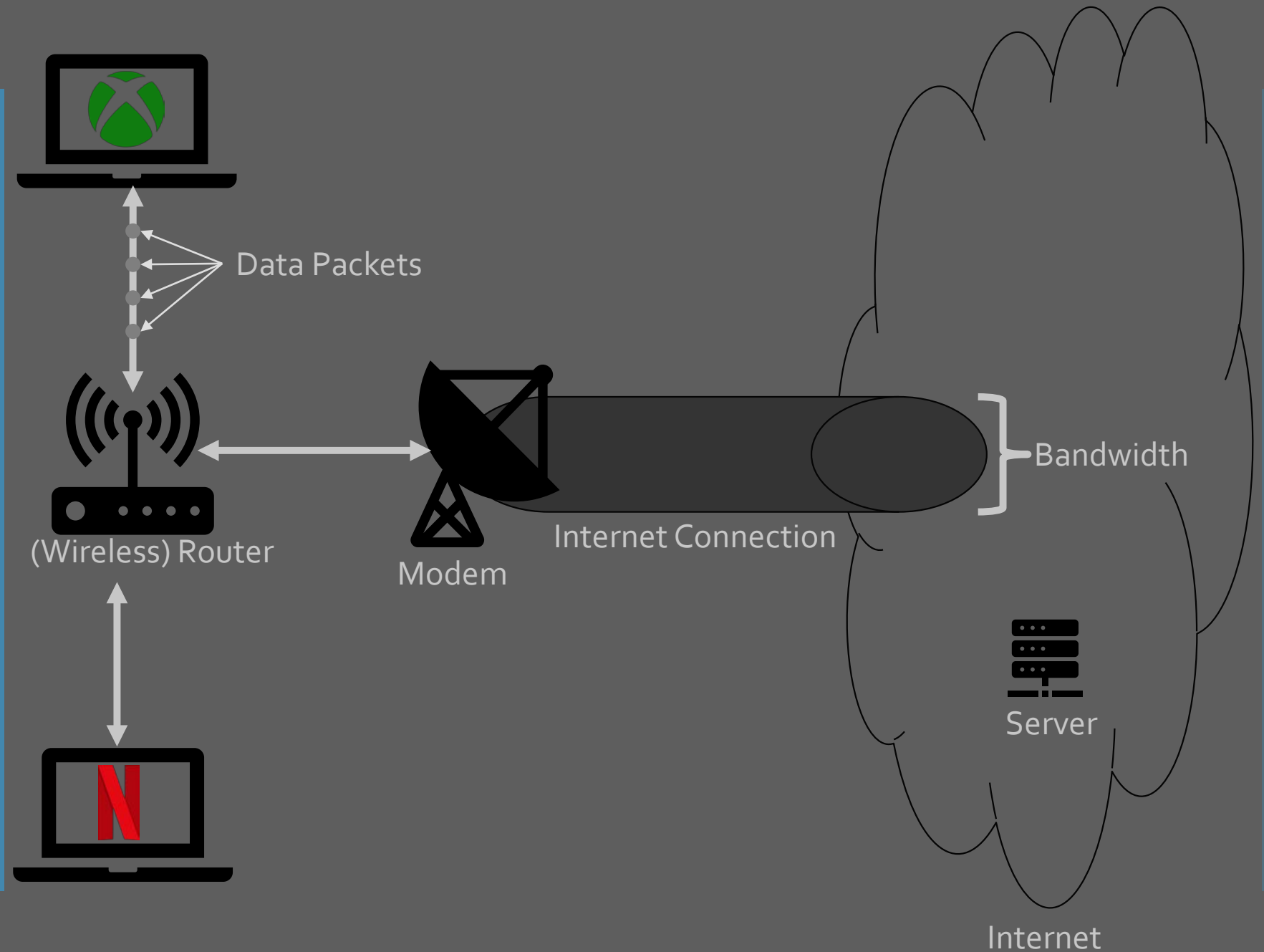


The naïve way of sharing is a free-for-all

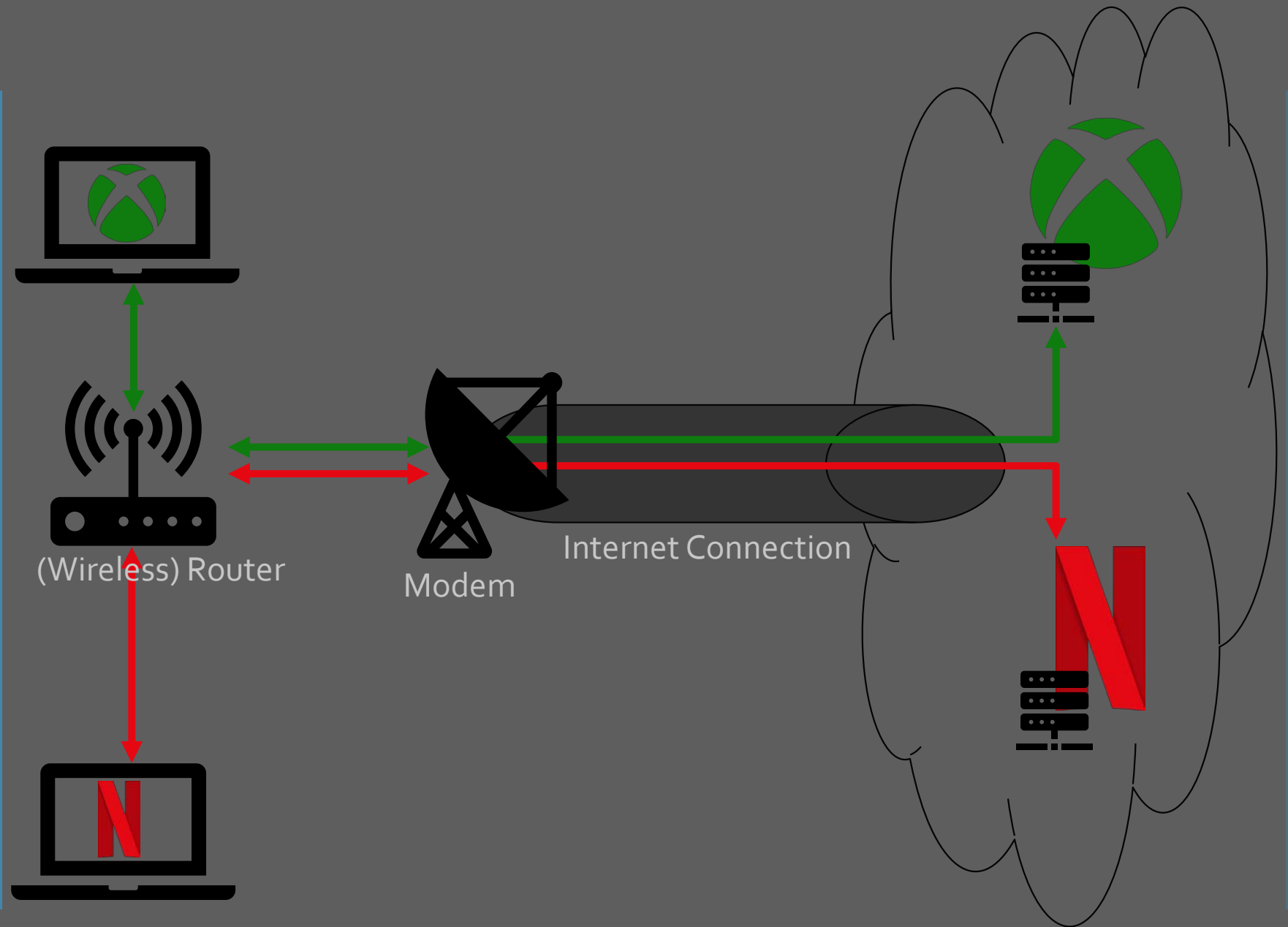


This leads to lag and sadness

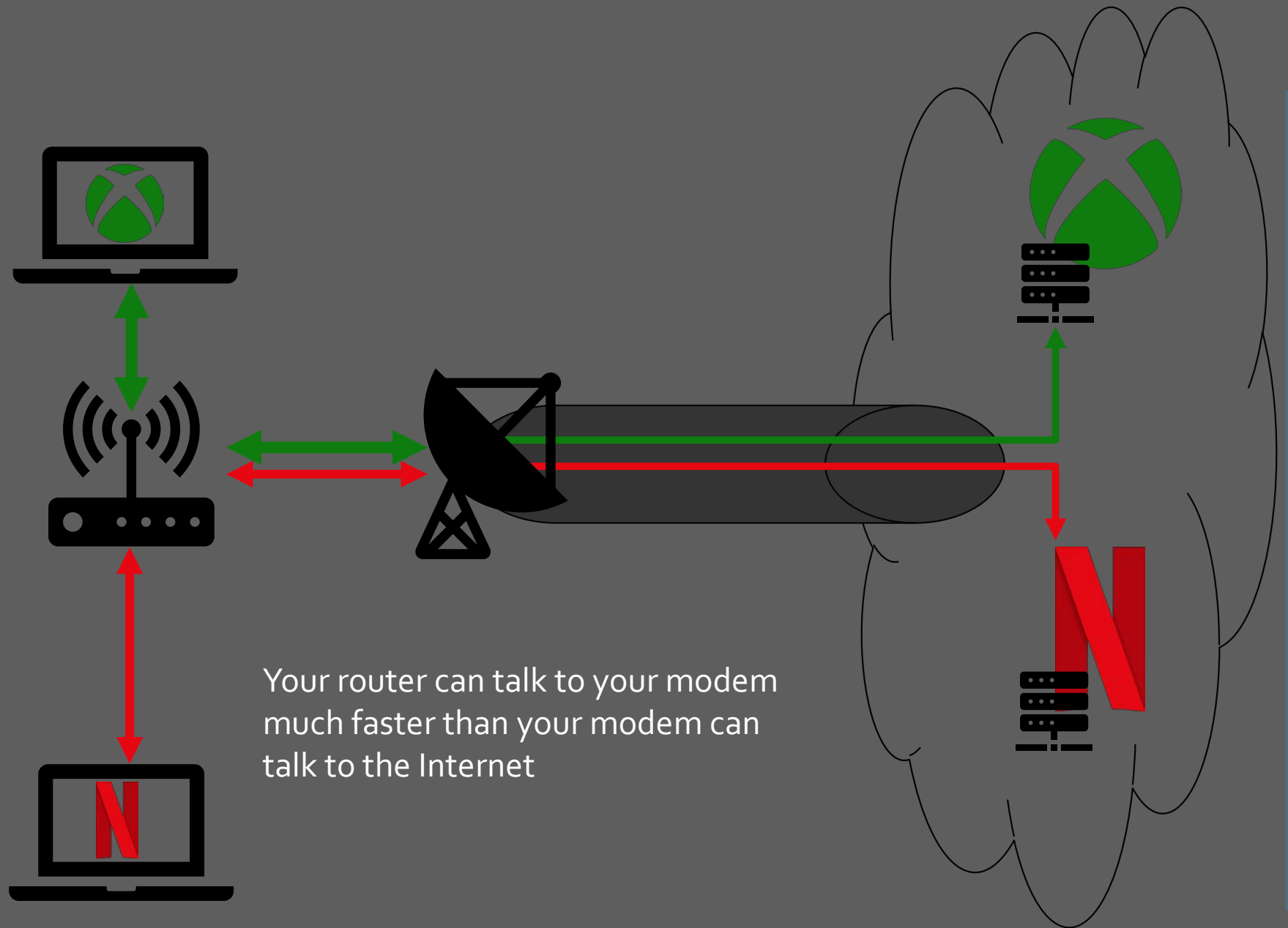
# Terminology



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# Bandwidth Contention

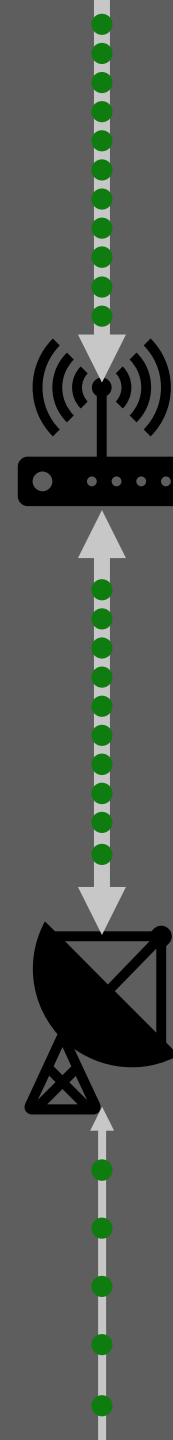


# Bandwidth Contention

- Your computer(s) can talk to your router much faster than your router can talk to the Internet
- How does that get managed?

# Buffering

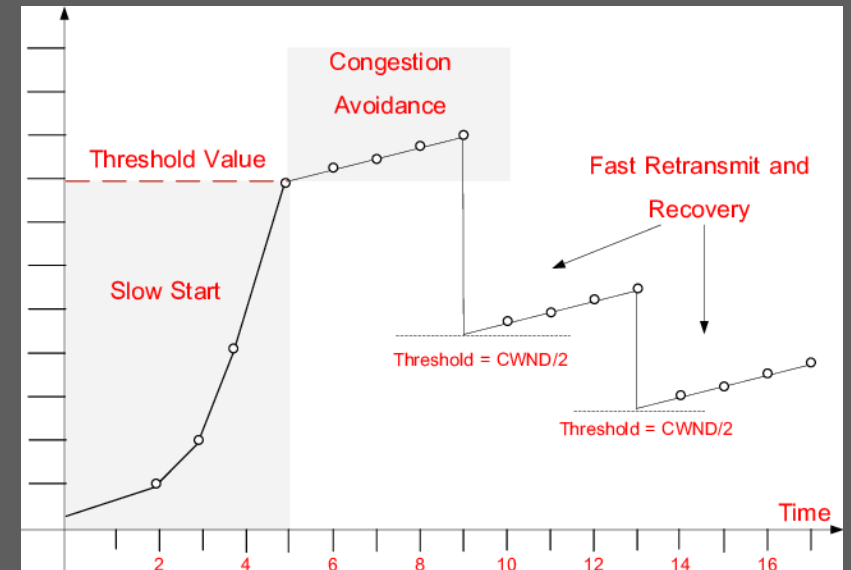
- Modem keeps packets in a queue
  - Queue is first-in first-out (FIFO)
  - Like an IRL queue
- If it receives data slower than it can send, all is well
- If there's a spike in usage, it builds up a backlog
  - Sends when it can, but takes a while
- If it's consistently backlogged, experience high latency





# Congestion Control

- Each connection starts slow
- Ramps up slowly until data is lost
  - Data is “lost” if it spends too long in a queue
  - Or if the queue overflows
- When data is lost, drop down
- If multiple connections are doing this, never stabilizes
  - Ineffective bandwidth usage
  - Lag
- Newer congestion control methods help, but not perfect

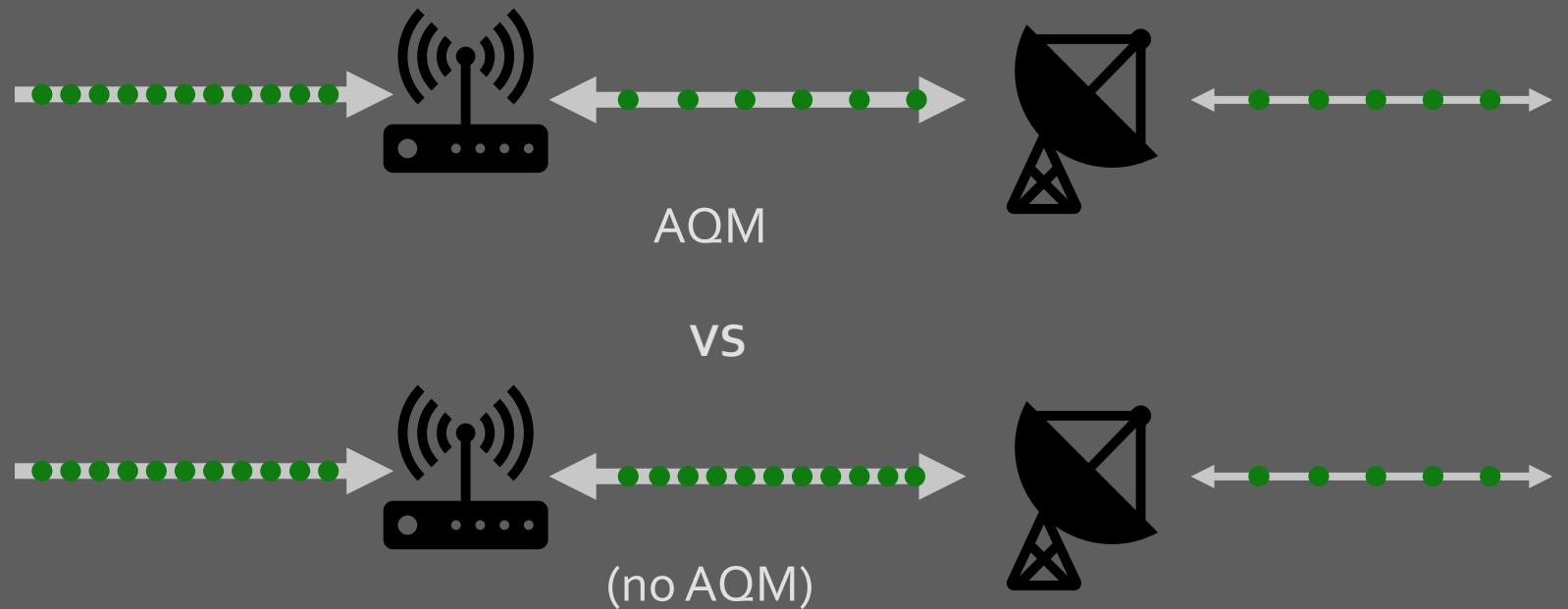


# Solution: Active Queue Management (AQM)

(AKA QoS)

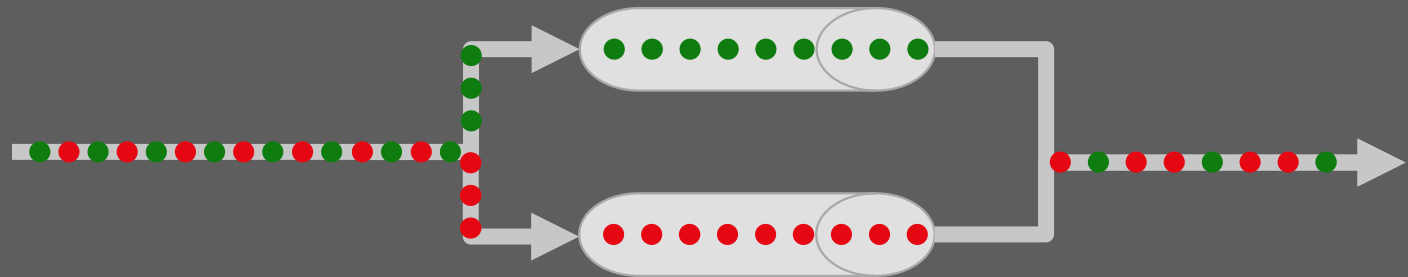
# Active Queue Management

- Basically, you want your router to *actively* decide how to forward data, rather than just passing it upstream
- This means you're enforcing your own bandwidth limit
- Router has to make decisions about what traffic to forward and what to drop



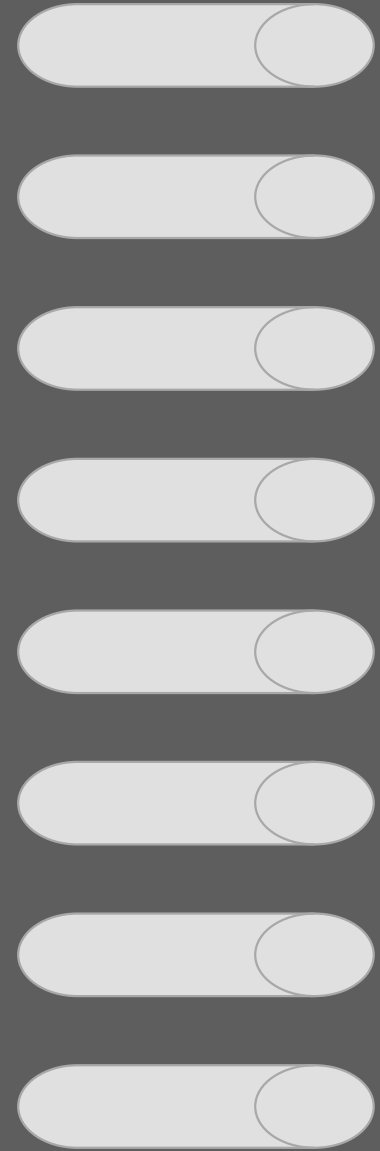
# Old Way: *Simple Fair Queueing* (SFQ)

- SFQ is simple and fair
- You define buckets with different characteristics and priorities
  - E.g., Voice communication bucket > Netflix traffic bucket > game download bucket
- Router puts traffic into buckets according to characteristics
- Router forwards traffic according to the priorities



# Problems with SFQ

- Classifying traffic is a lot of work
- Deciding on priorities is a lot of work
- Lots of kinds of traffic = lots of buckets
- If your priorities change, your configuration has to change
- Can still end up with bad results at the end of the day



# New way: FlowQueue + CoDel + Explicit Congestion Notification

## FlowQueue

- Knob-less queue management
- Automatically makes 1 queue per traffic stream
- No need to classify anything

## Explicit Congestion Notification

- Instead of allowing clients to find congestion through data loss, actively notify them of impending congestion
- Clients preemptively throttle to share fairly

## CoDel

- “Controlled Delay”
- Automatically re-prioritises buckets based on how “well-behaved” they are
- Bandwidth hogging buckets get low priority
- Low bandwidth buckets higher priority
- Still tries to keep everything as low latency as it can



Net Result: Completely knob-less AQM

So how do I actually set  
this up?



# “Normal” Routers

- Newer normal routers have *some kind* of AQM
- They usually call it QoS
- It probably is either SFQ or SQM
  - SQM is less-knobs SFQ
  - Doesn't work as well as CoDel but does help
- Depending on how fast your connection is, might actually be worse :(
  - AQM takes a lot of CPU that cheaper routers don't have

# “Normal” Routers with Custom Firmware

- FQ+CoDel is merged into Linux as fq\_codel queue manager, so...
- OpenWRT, dd-wrt have it
- Most routers have support for either of those two nowadays, so you can probably go play with it
- But if you're savvy enough to do that, better off...

# “Real” Routers



- PFSense, OPNsense, Unifi, etc. all have fq\_codel queue manager
- Join us in #homelab for more info ;)



# Questions?

Thank you.