

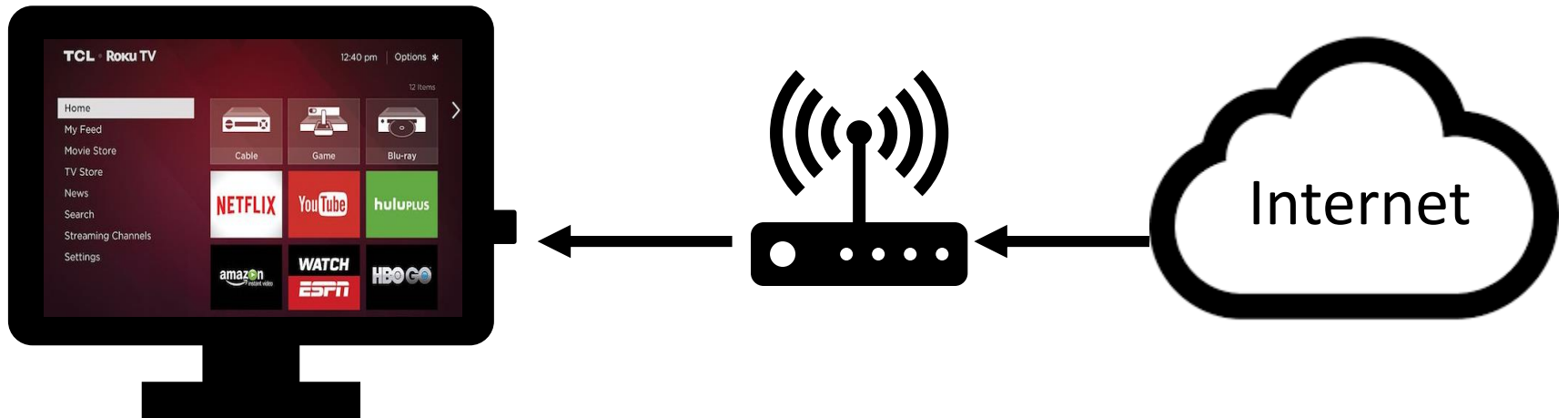
A First Look at Performance of TV Streaming Sticks

Ayon Chakraborty, **Arani Bhattacharya**,
Santosh Ghosh, Samir R. Das



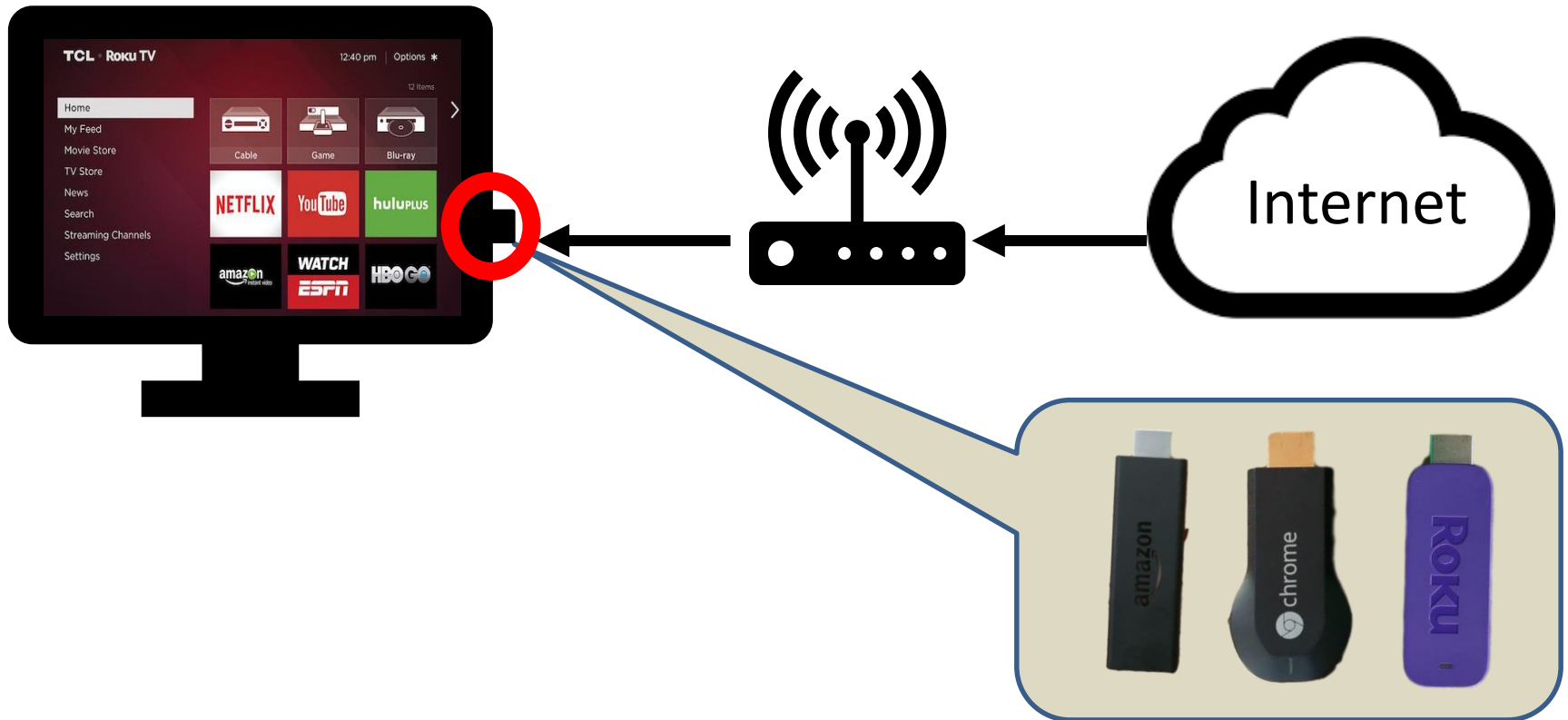
Stony Brook **University**

Smart TVs Increasingly Popular



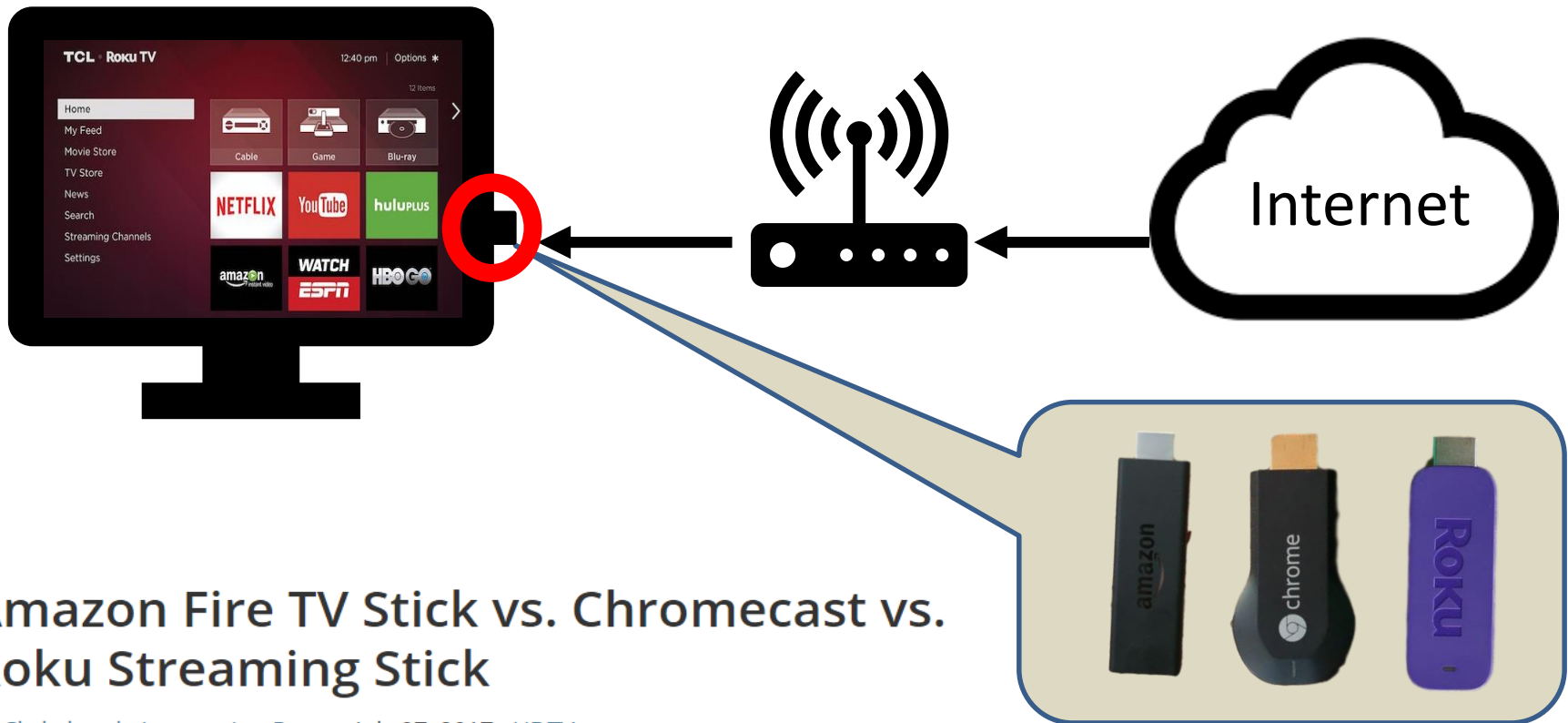
Smart TVs Increasingly Popular

... and so are streaming sticks!



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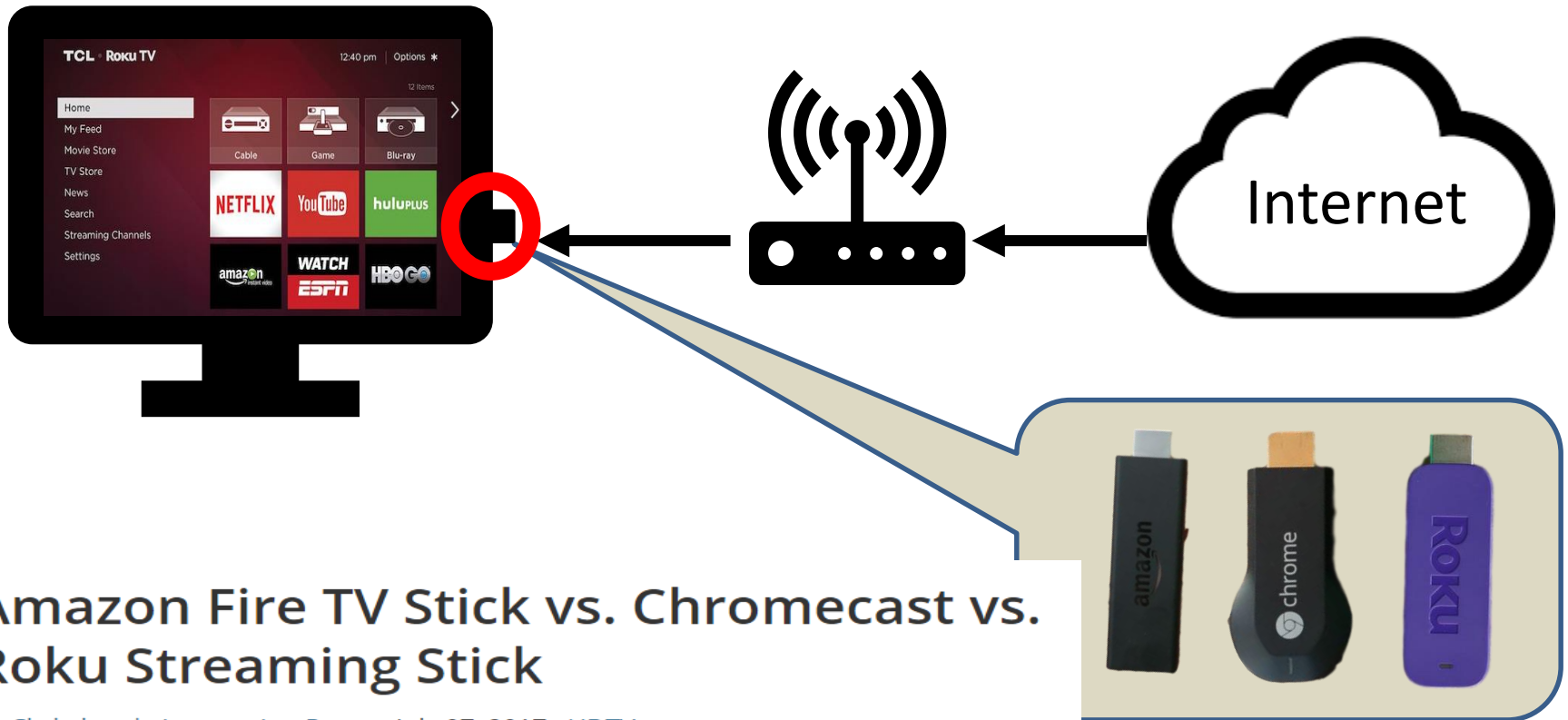
Amazon Fire TV Stick vs. Chromecast vs. Roku Streaming Stick

By Christian de Looper, Jon Porter July 07, 2017 HDTV

Which ultra-portable streaming device reigns supreme?



Lots of User Concerns



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Lots of User Concerns

The collage includes several elements:

- A Roku TV screen displaying the home menu.
- A browser window showing a Reddit post titled "Slow loading?" (self.Roku) submitted 3 days ago by jb_3333, with 4 comments and a share/report button.
- A speech bubble containing the text "Can't stream anything, I..." and another post snippet: "(self.Roku) submitted 2 days ago by JonWood007, 8 comments, share, report".
- A box containing three streaming devices: Amazon Fire TV Stick, Chromecast, and Roku Streaming Stick.
- An "Internet" label with an arrow pointing towards the devices.

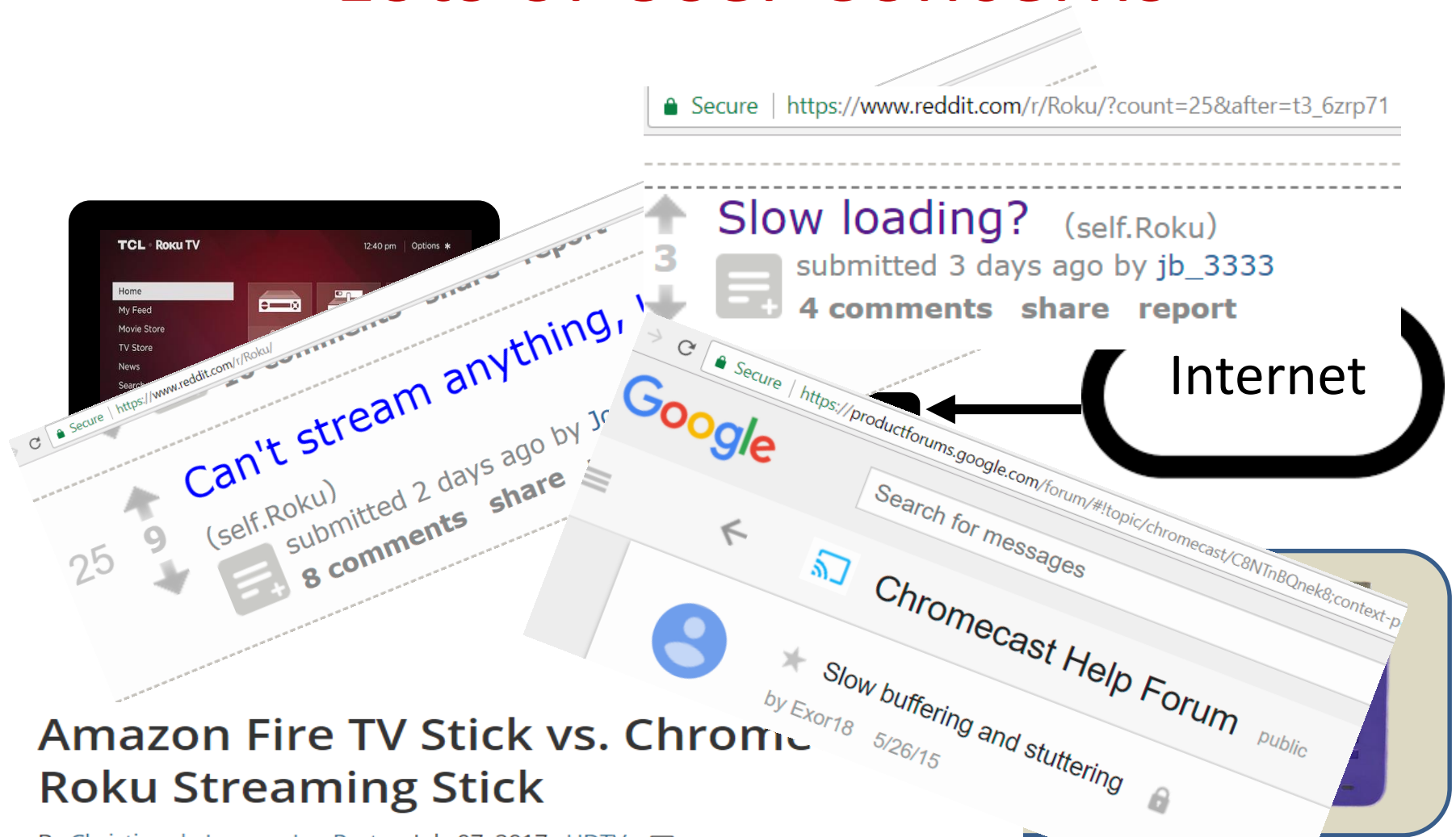
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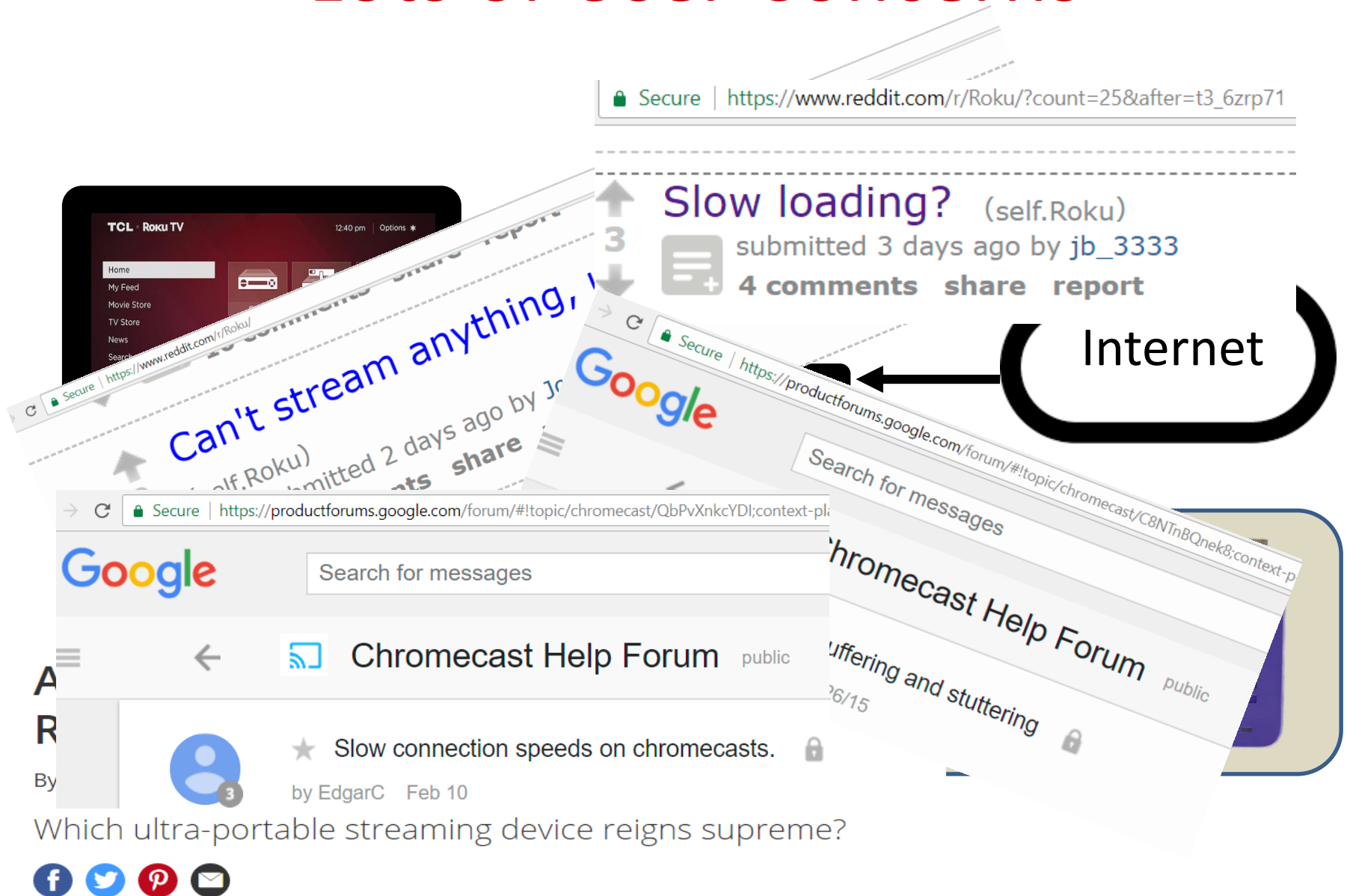
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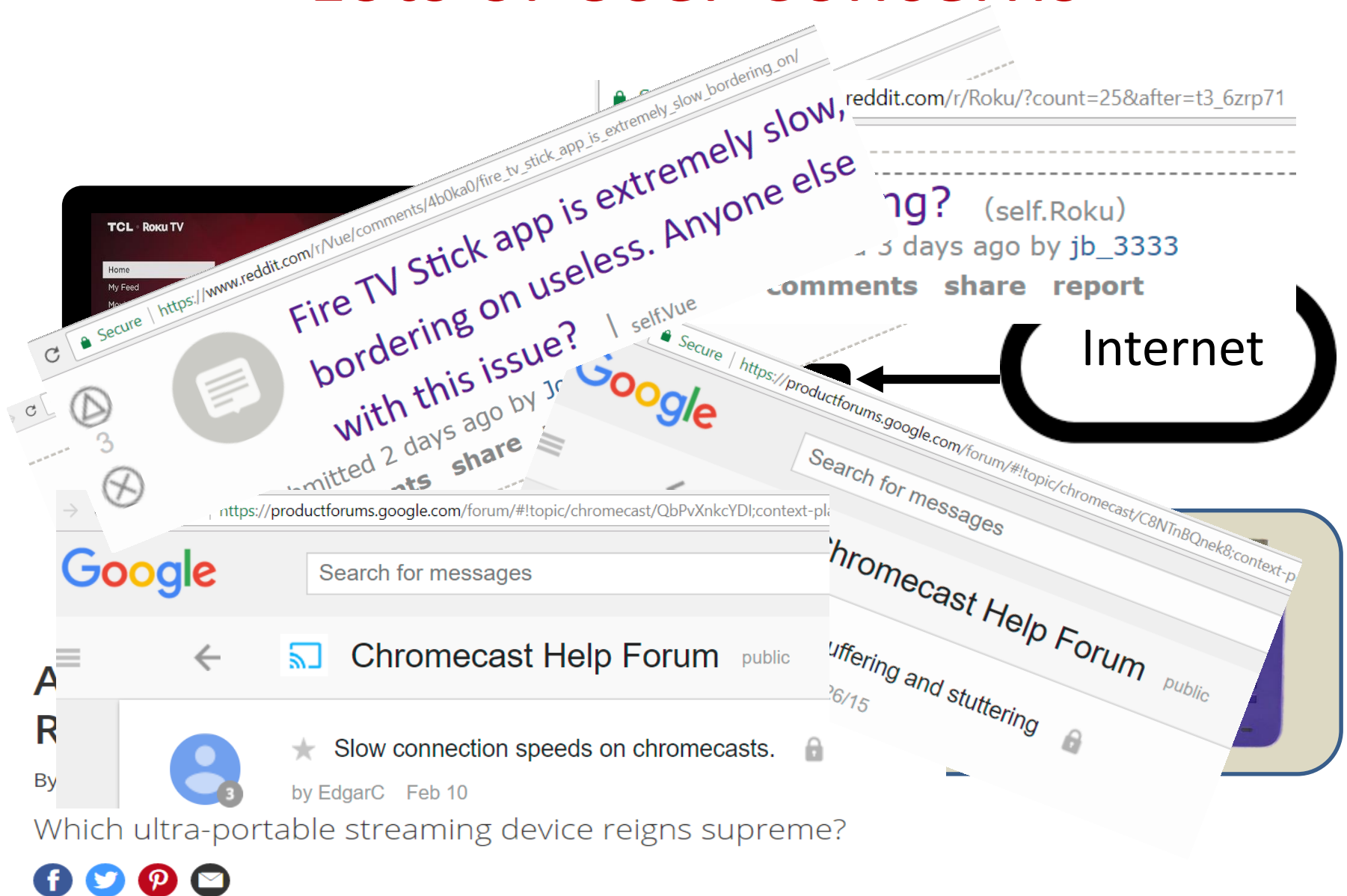
Which ultra-portable streaming device reigns supreme?



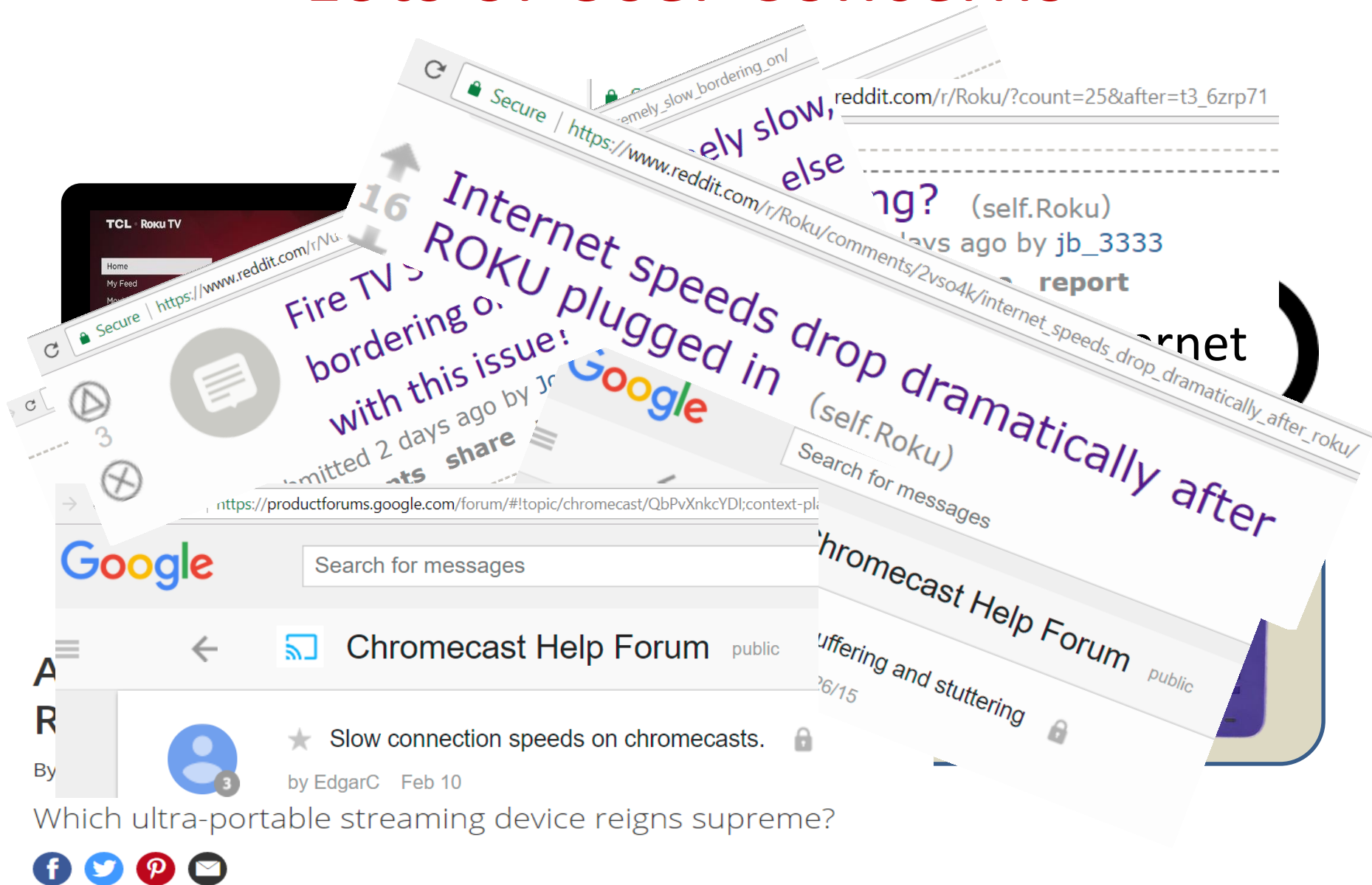
Lots of User Concerns



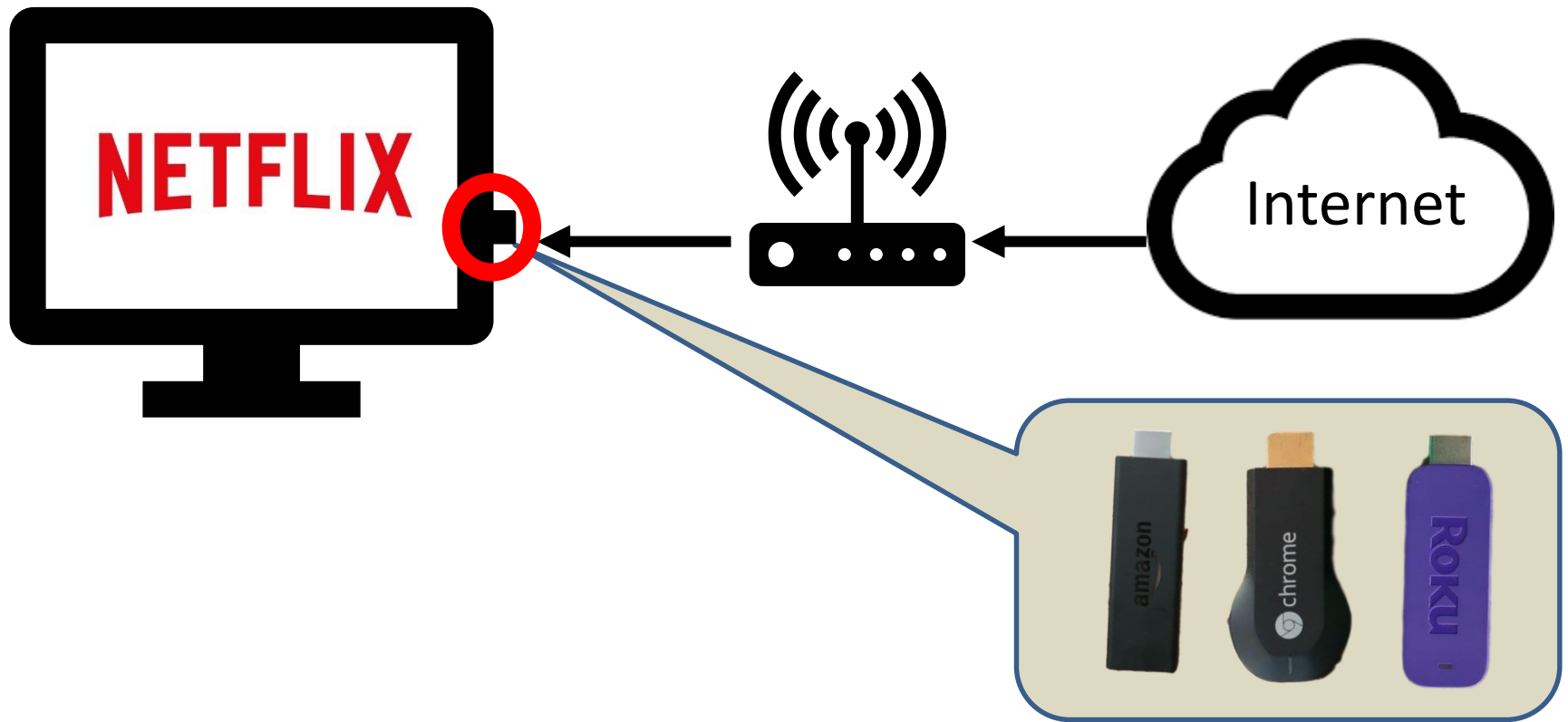
Lots of User Concerns



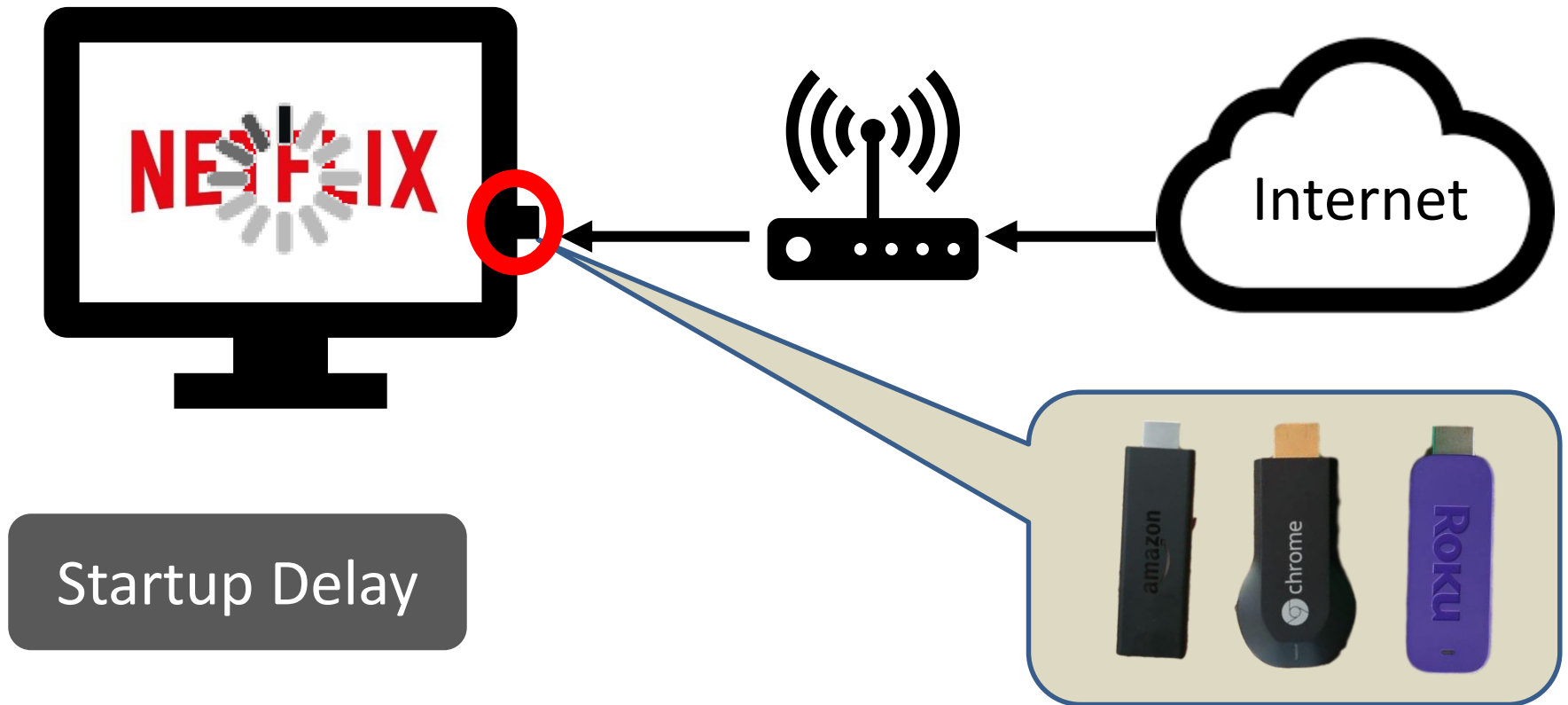
Lots of User Concerns



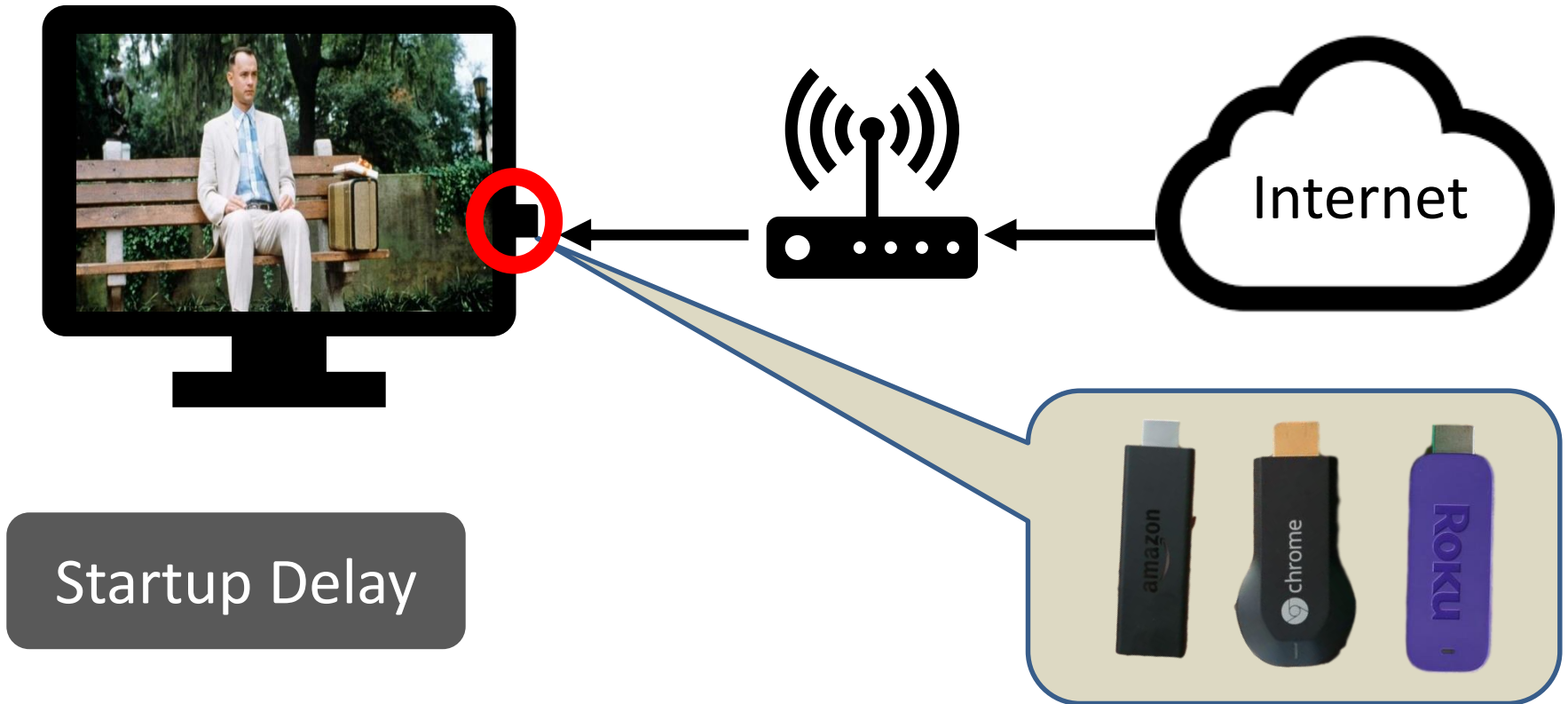
Quality of Experience Affected



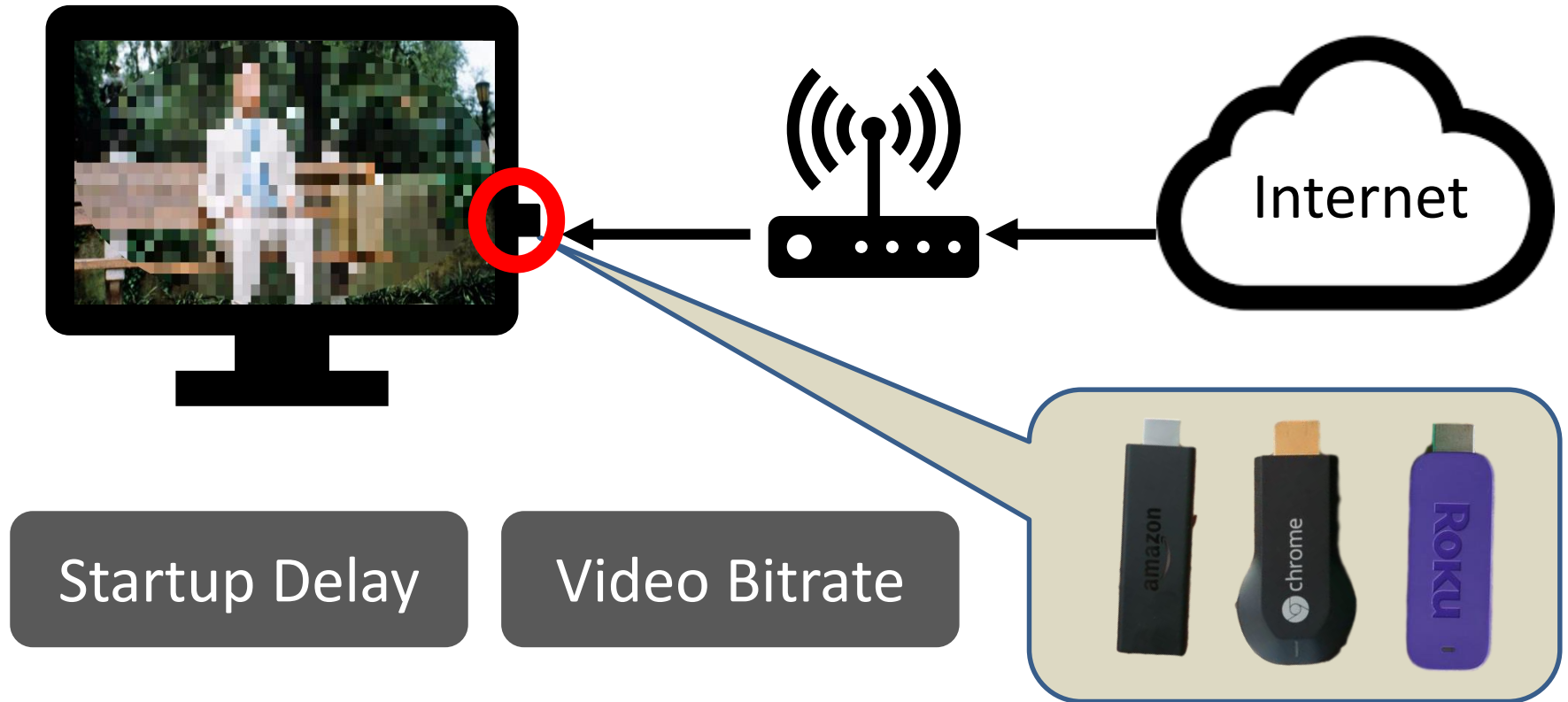
Quality of Experience Affected



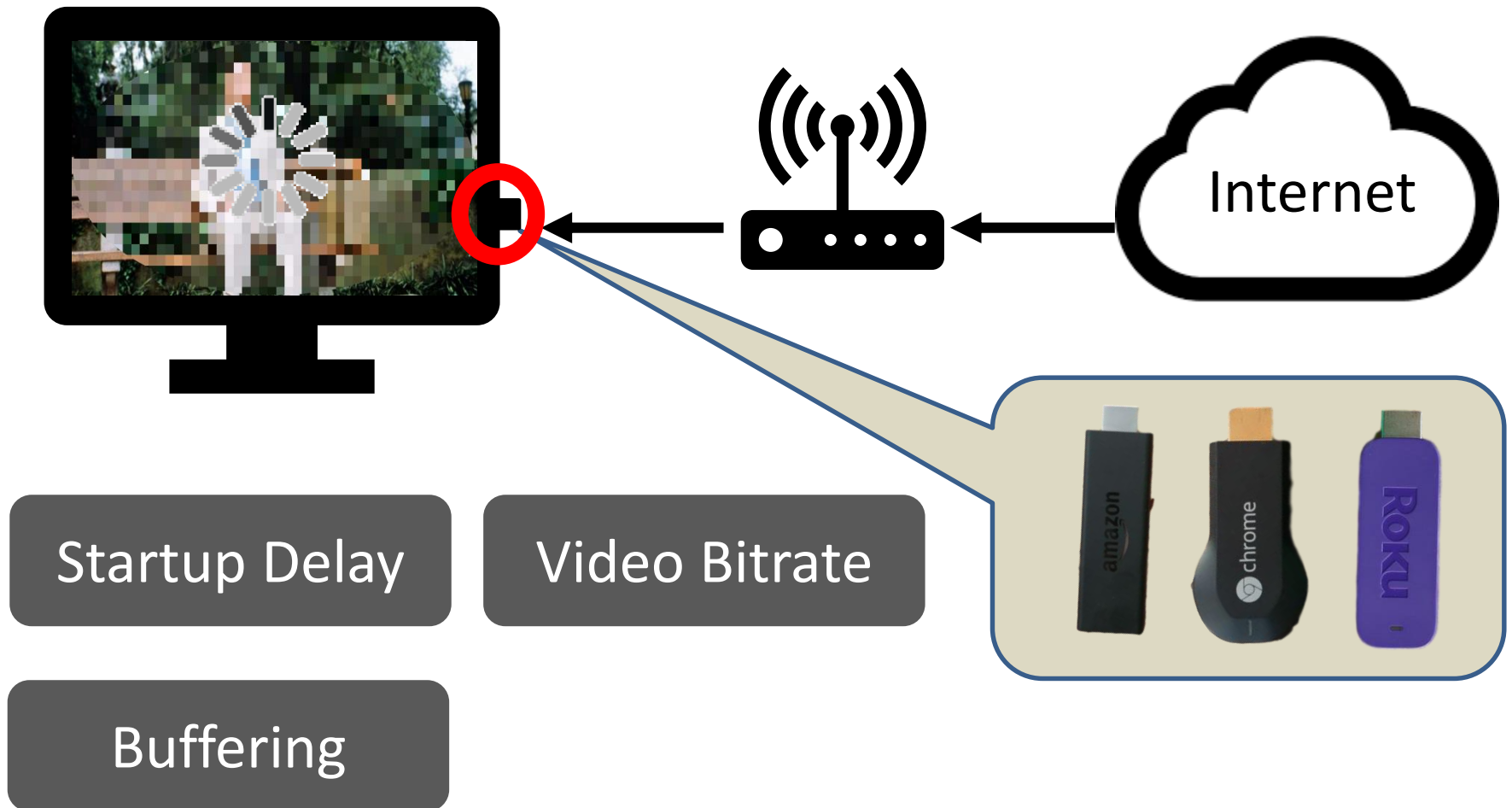
Quality of Experience Affected



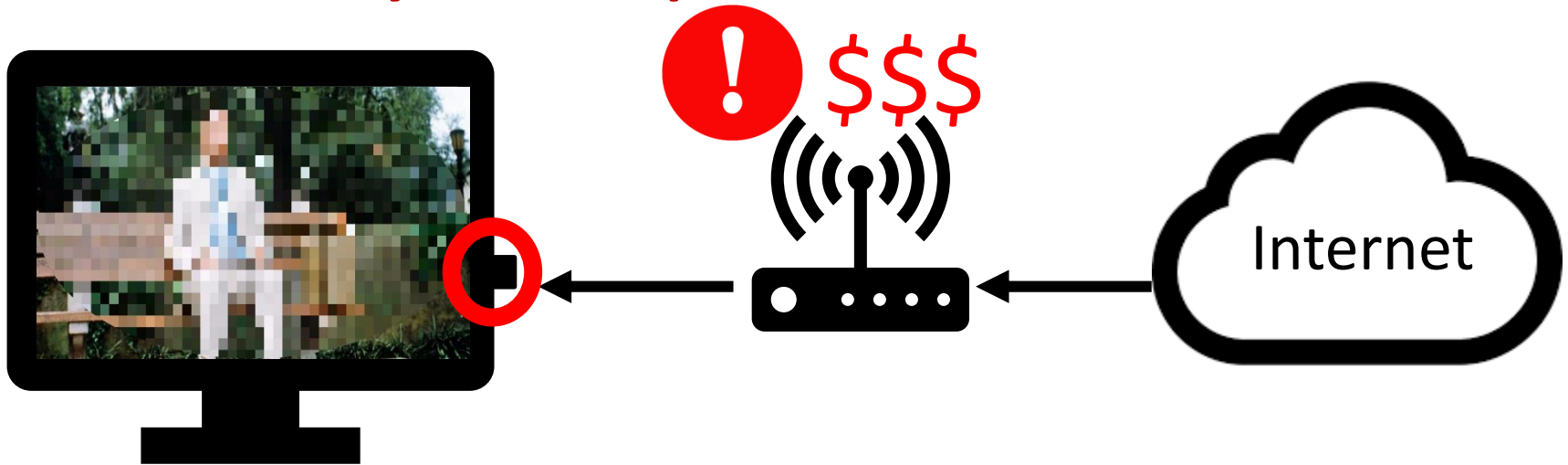
Quality of Experience Affected



Quality of Experience Affected



Quality of Experience Affected



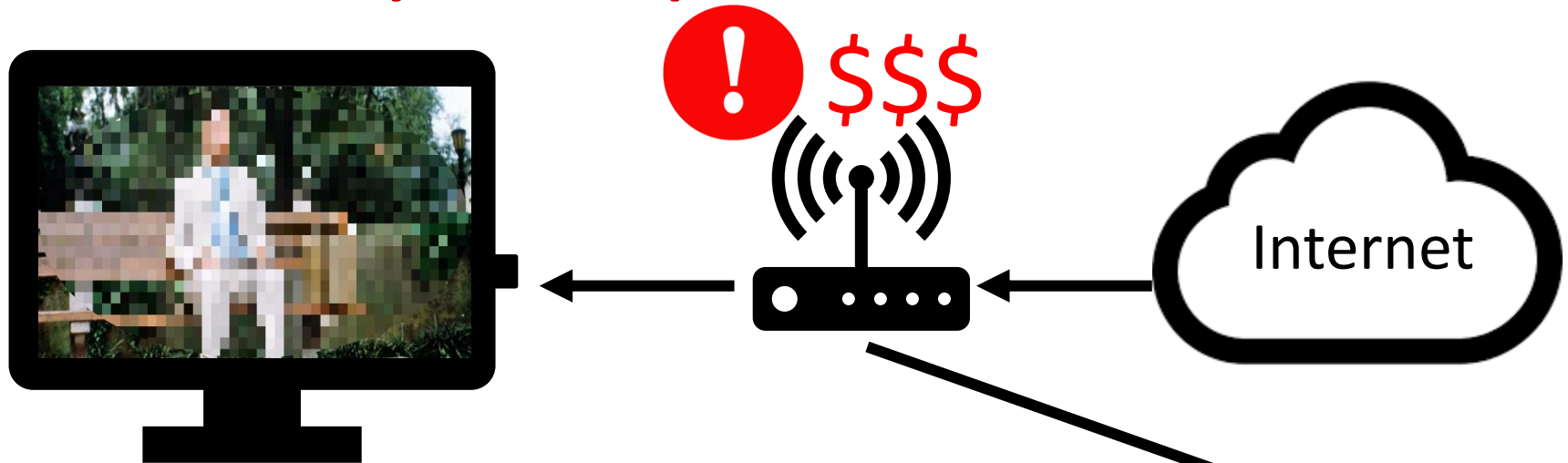
Startup Delay

Video Bitrate

Buffering

Data Usage

Quality of Experience Affected



Startup Delay

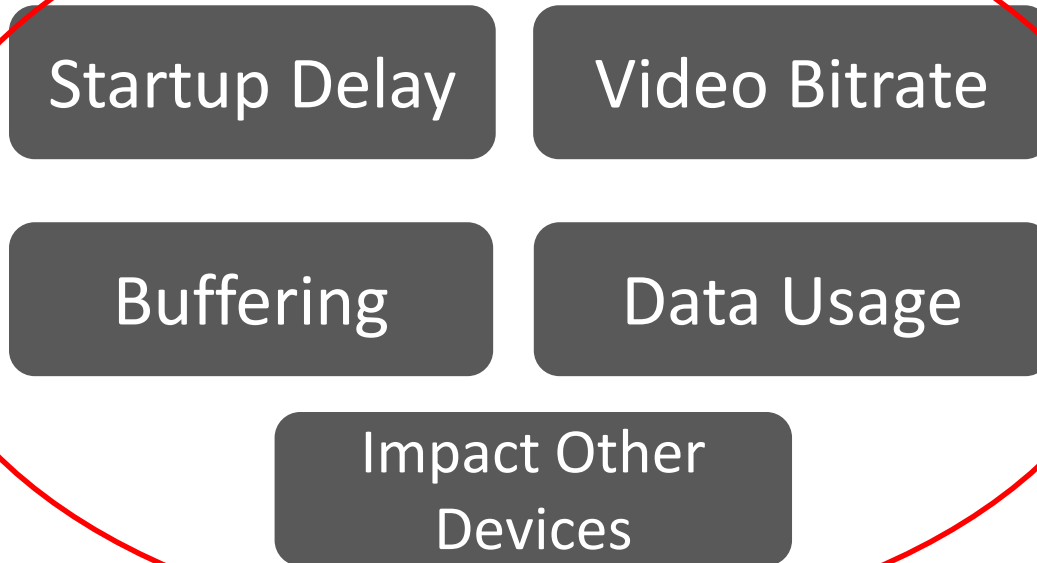
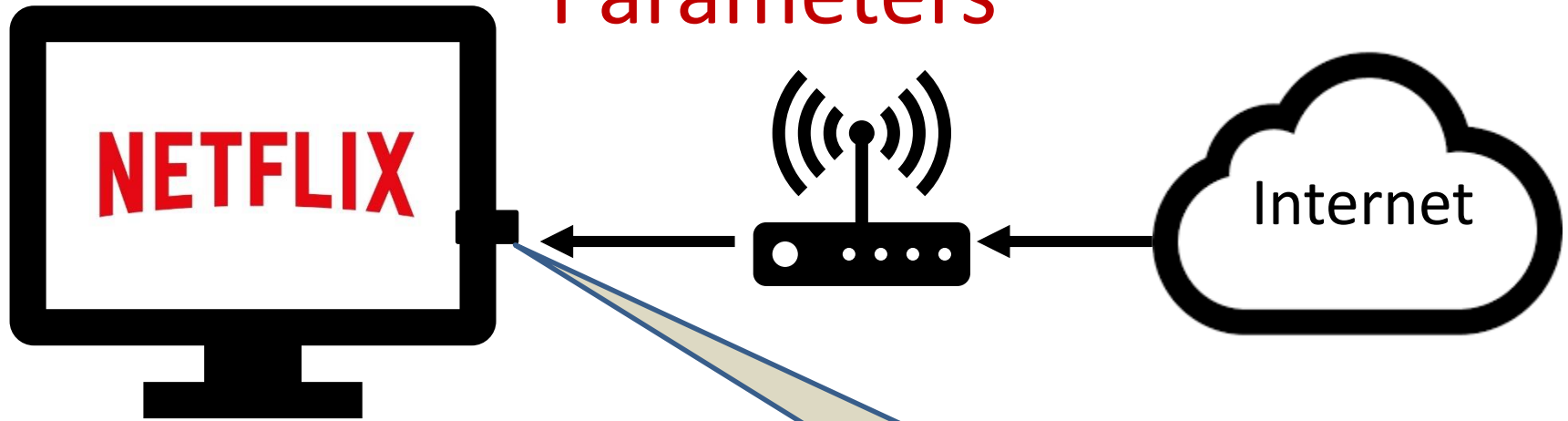
Video Bitrate

Buffering

Data Usage

Impact Other
Devices

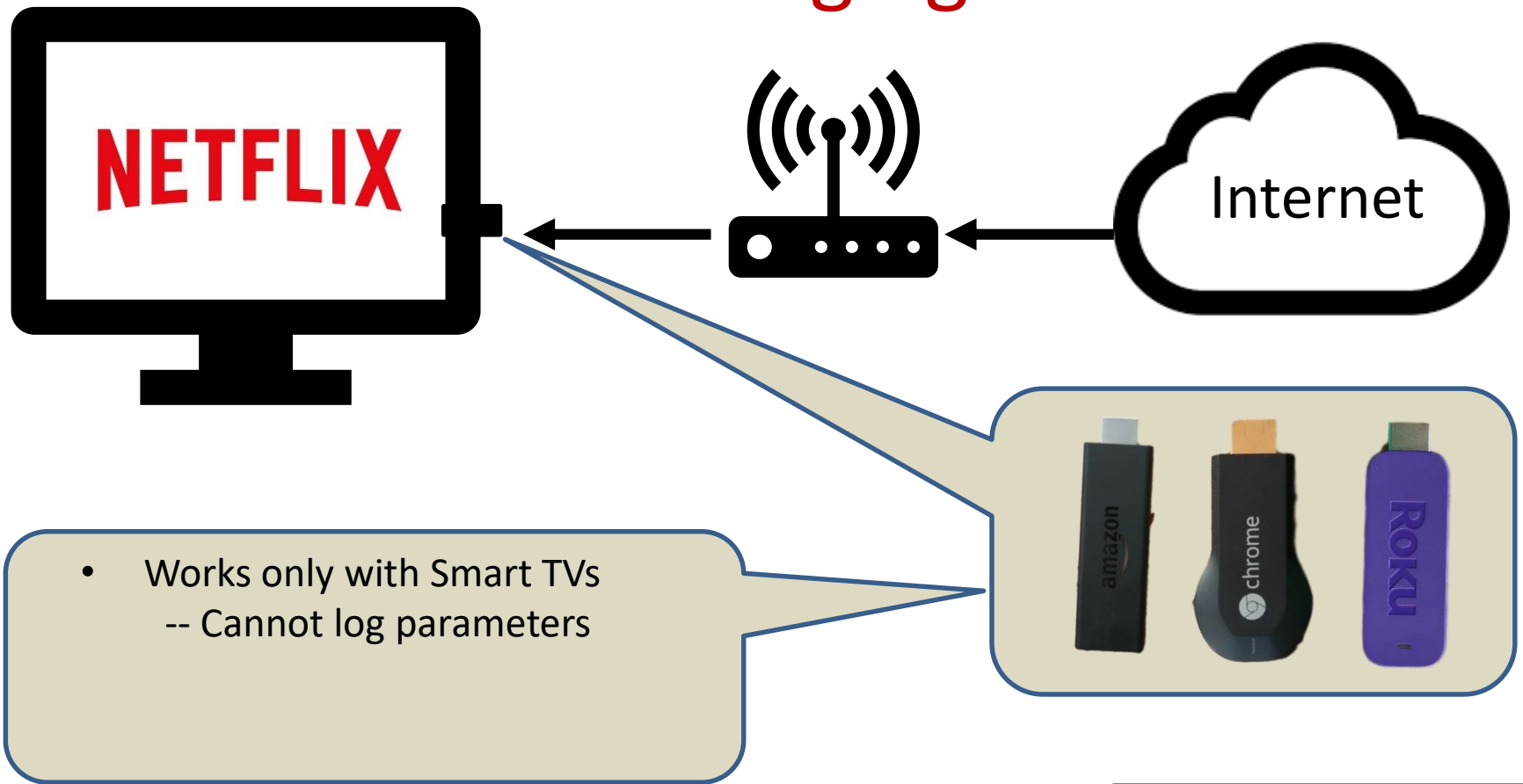
Measuring the Quality of Experience Parameters



How can we measure parameters of different devices?

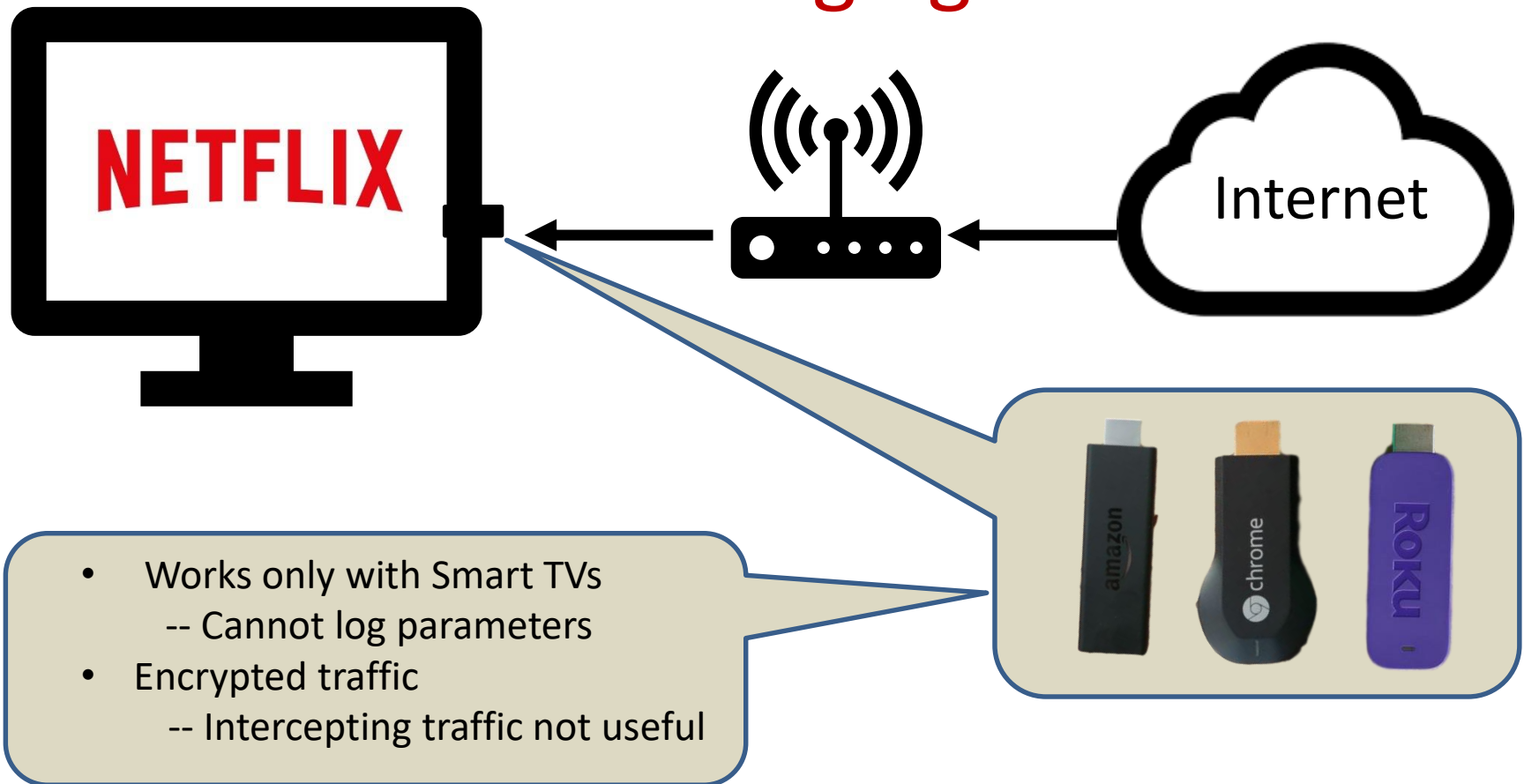
Getting Bitrate and Resolution

Challenging



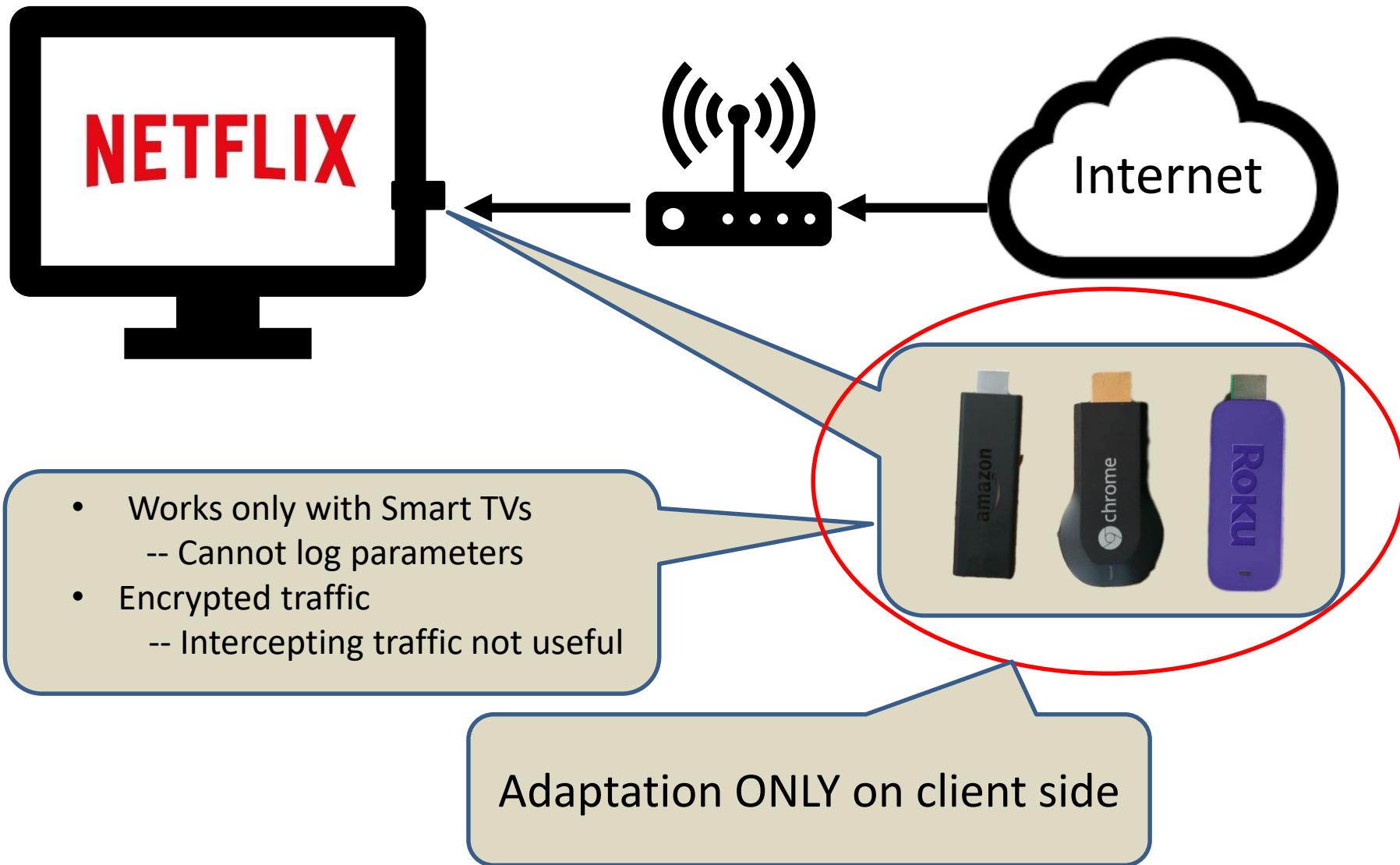
Getting Bitrate and Resolution

Challenging

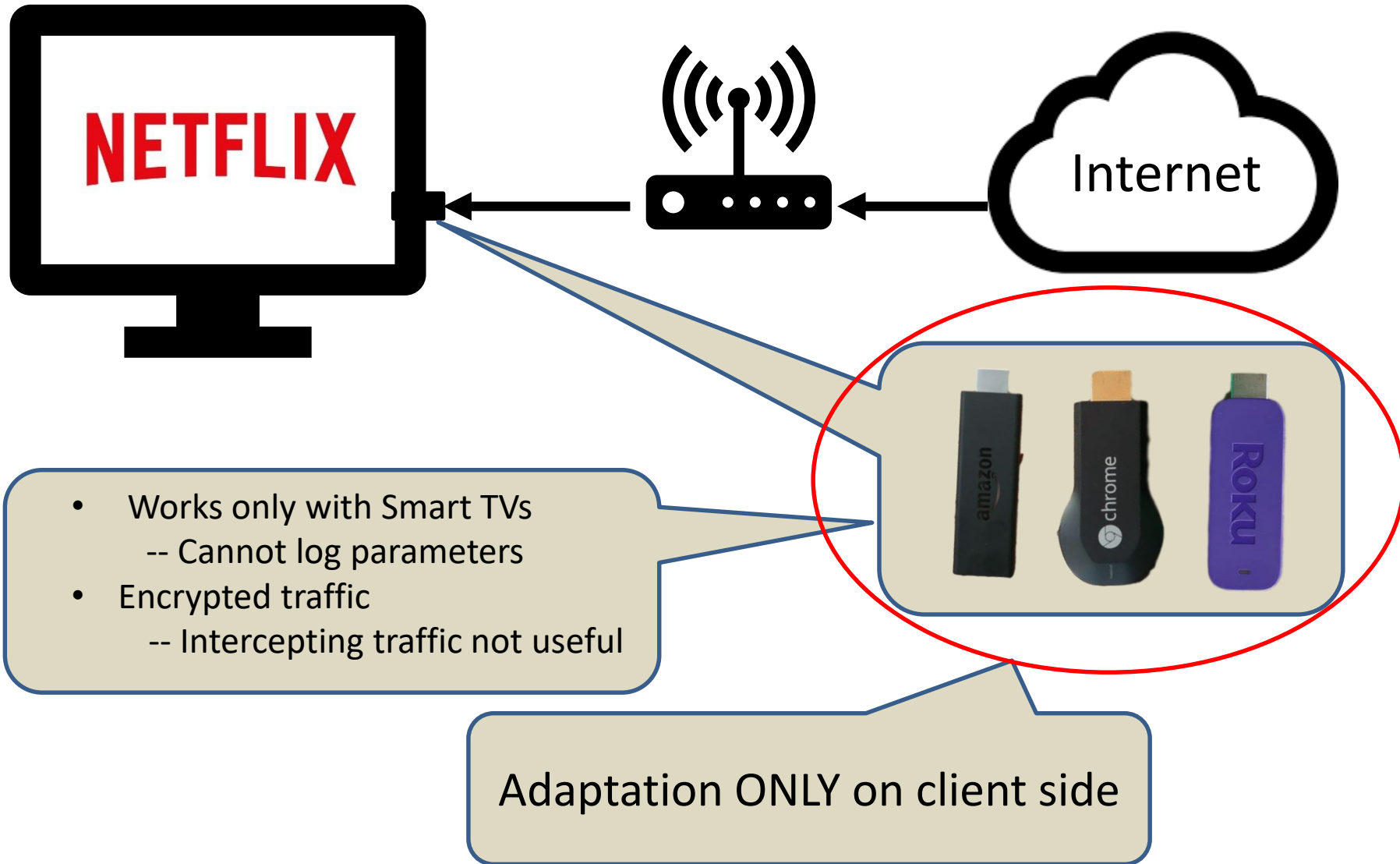


How can we measure parameters of different devices?

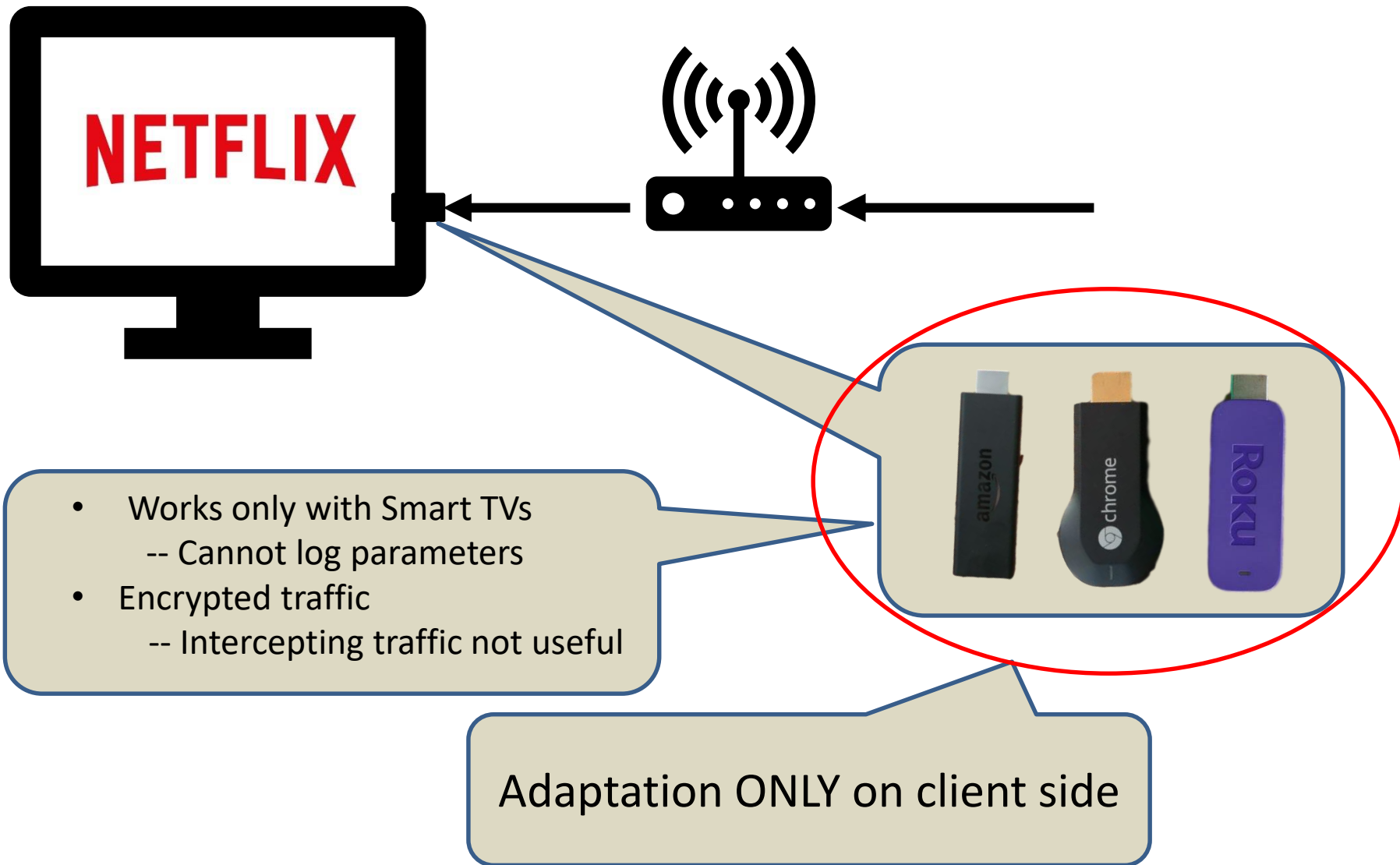
Adaptation Technique in Streaming Sticks



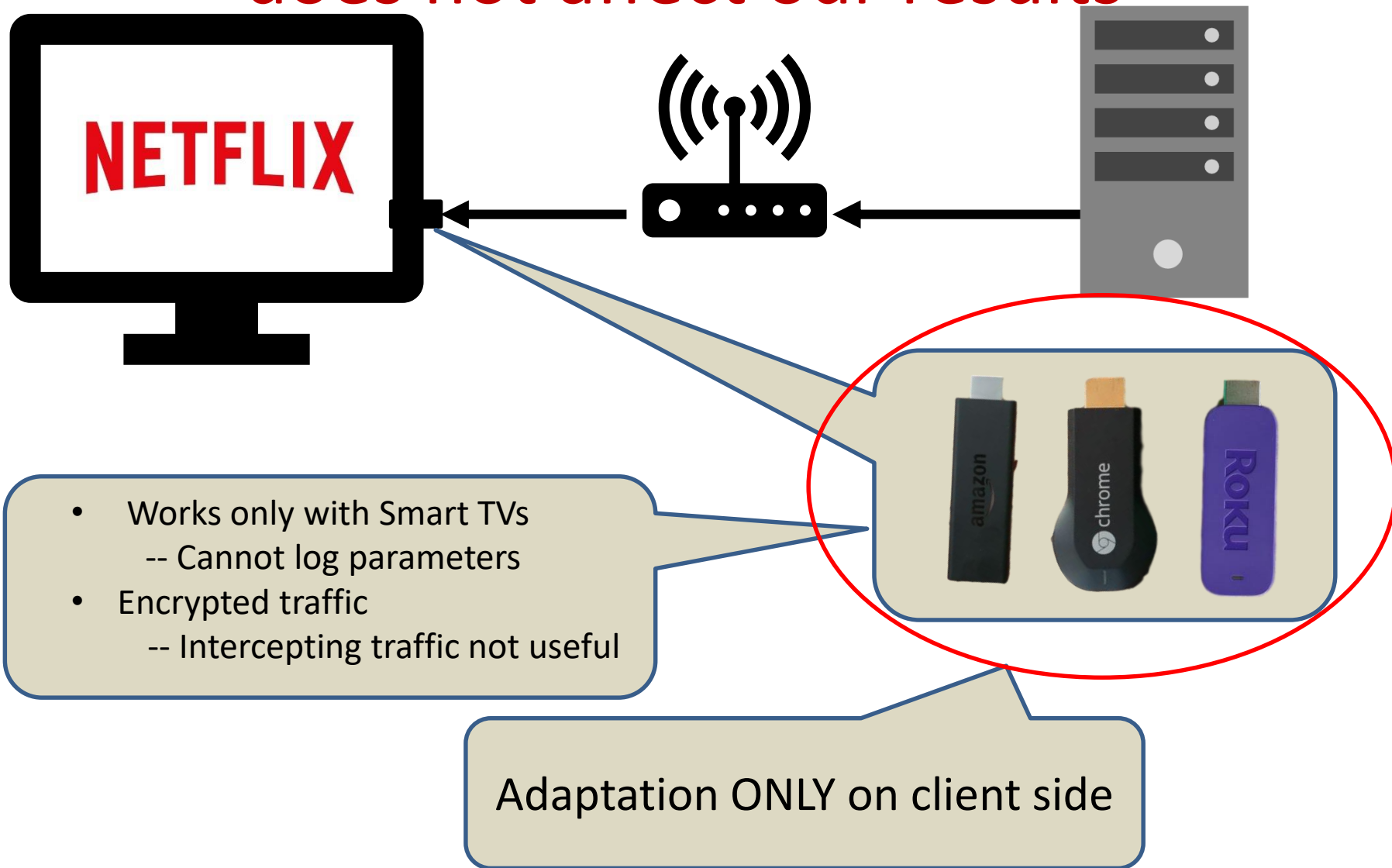
Replacing Internet channel by our server does not affect our results



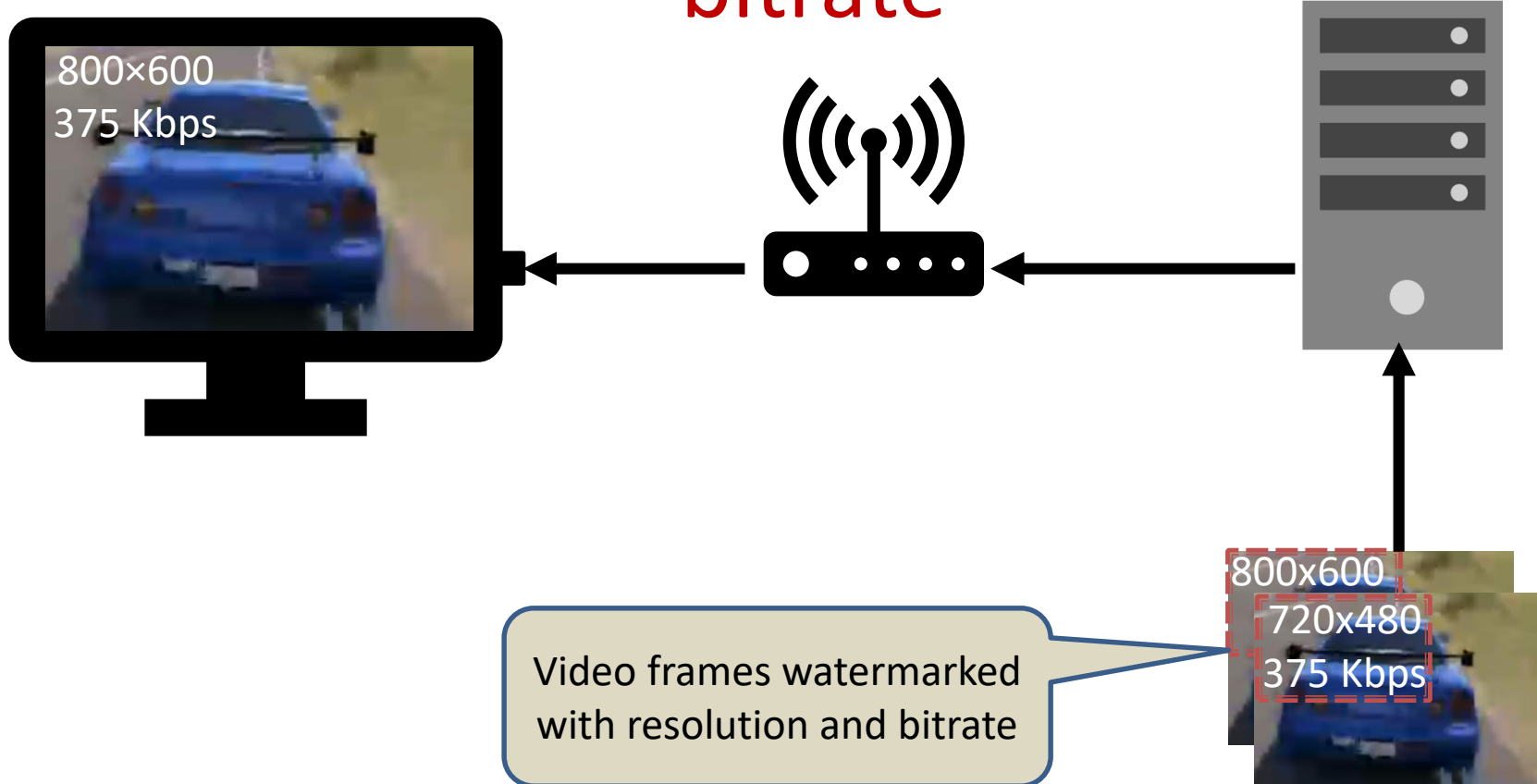
Replacing Internet channel by our server does not affect our results



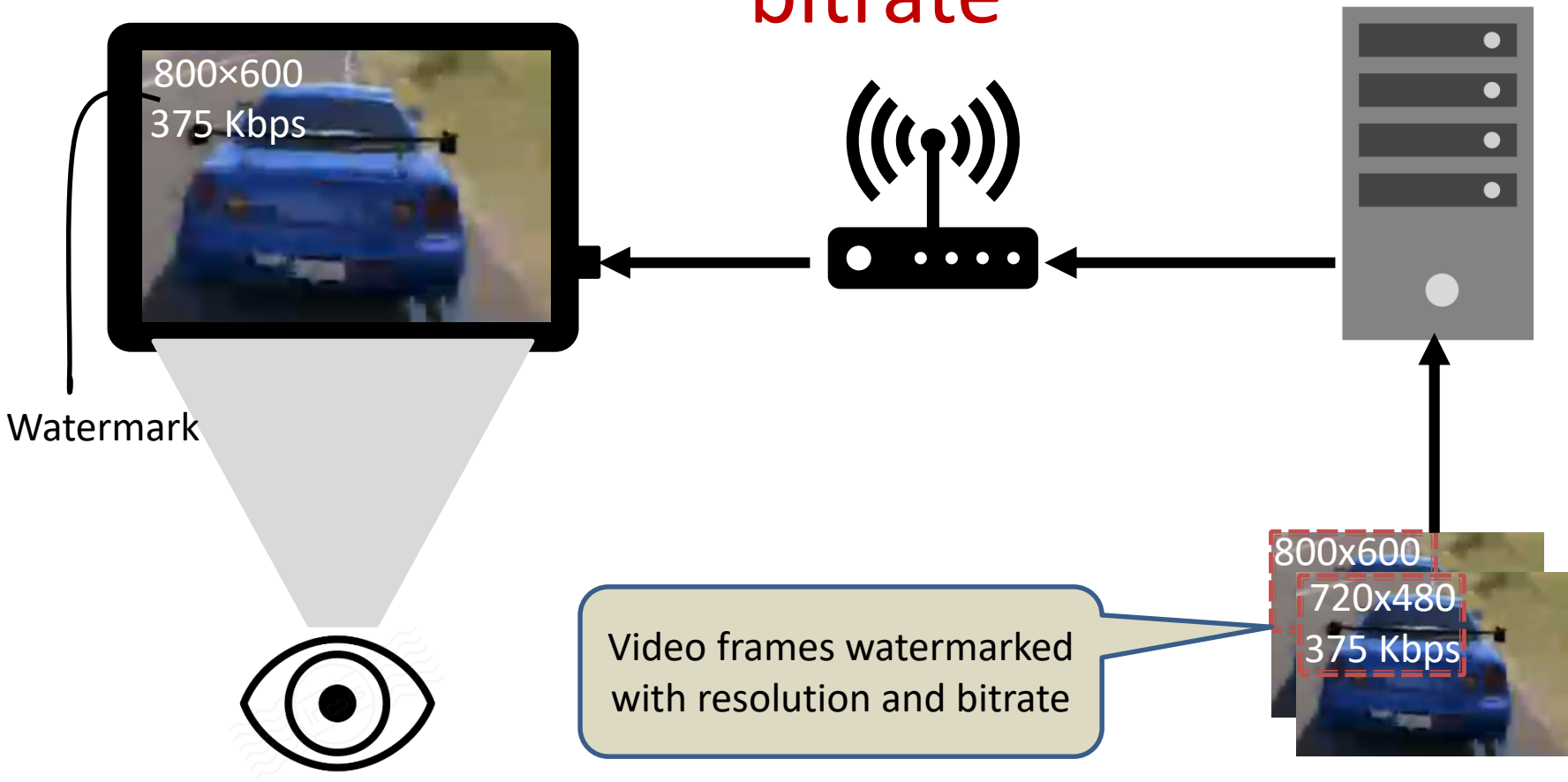
Replacing Internet channel by our server does not affect our results



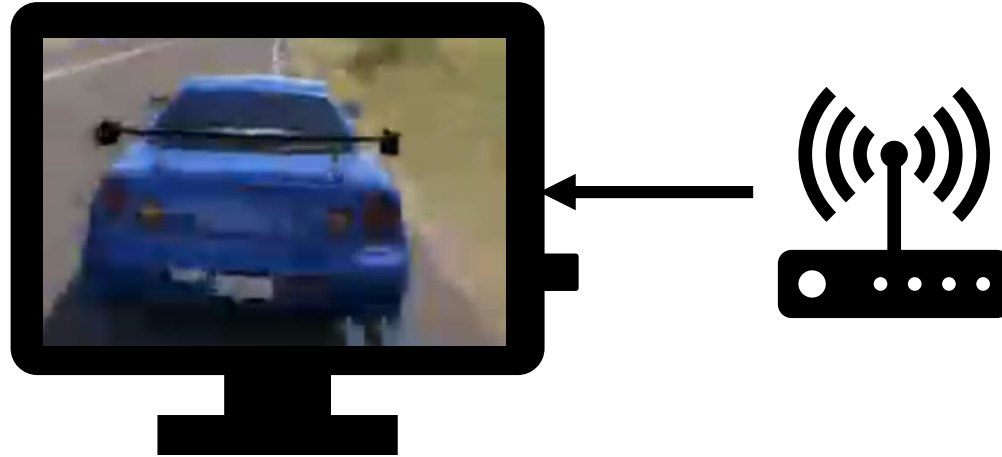
Viewer can see the resolution and video bitrate



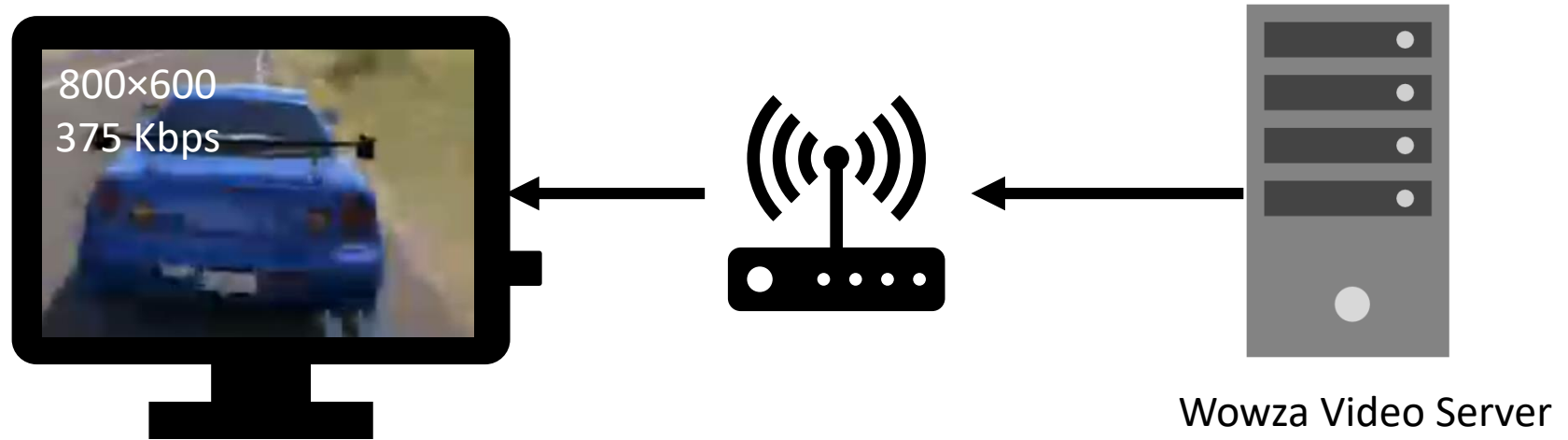
Viewer can see the resolution and video bitrate



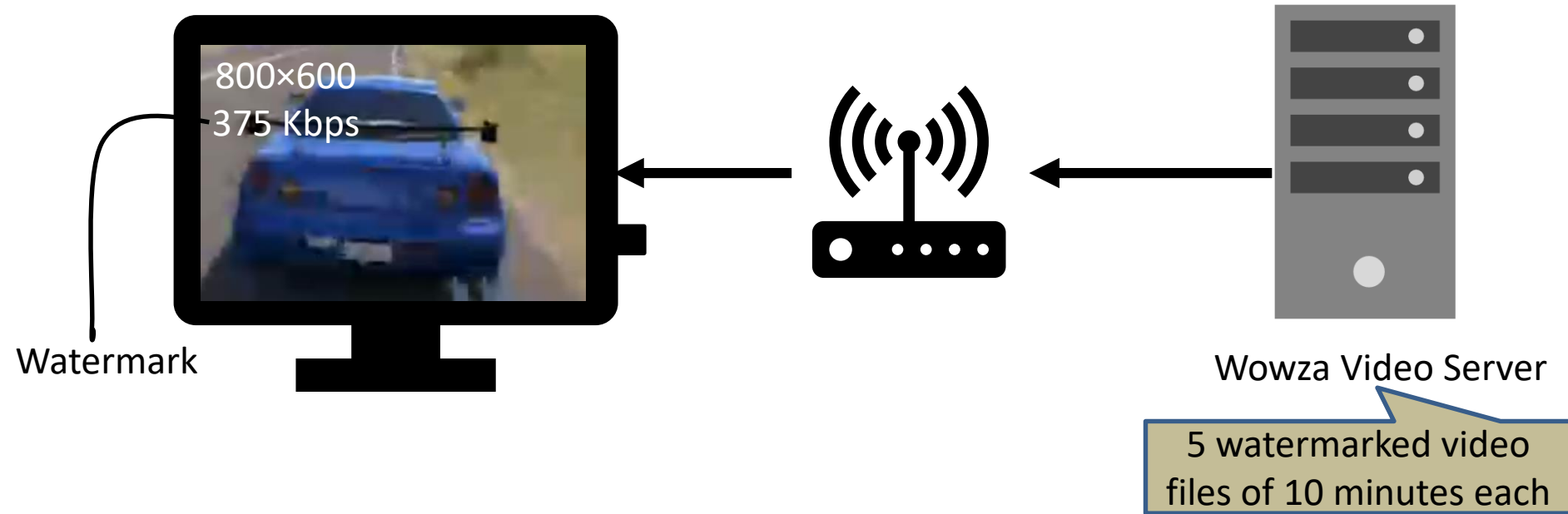
Measurement Setup



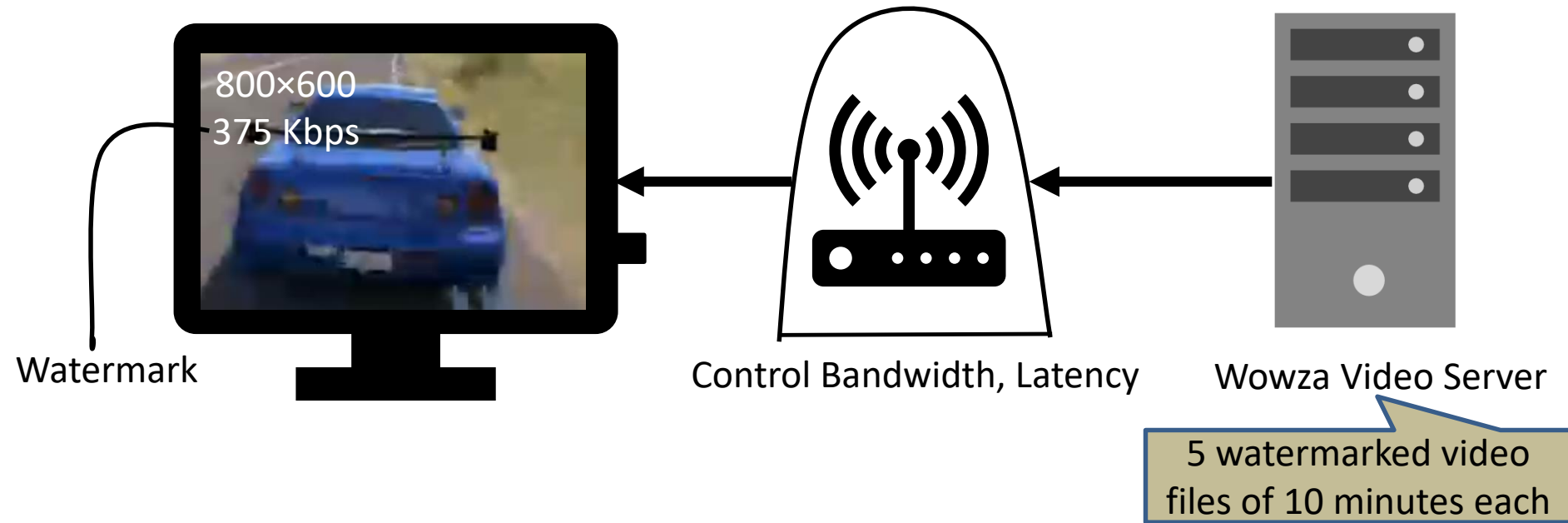
Measurement Setup



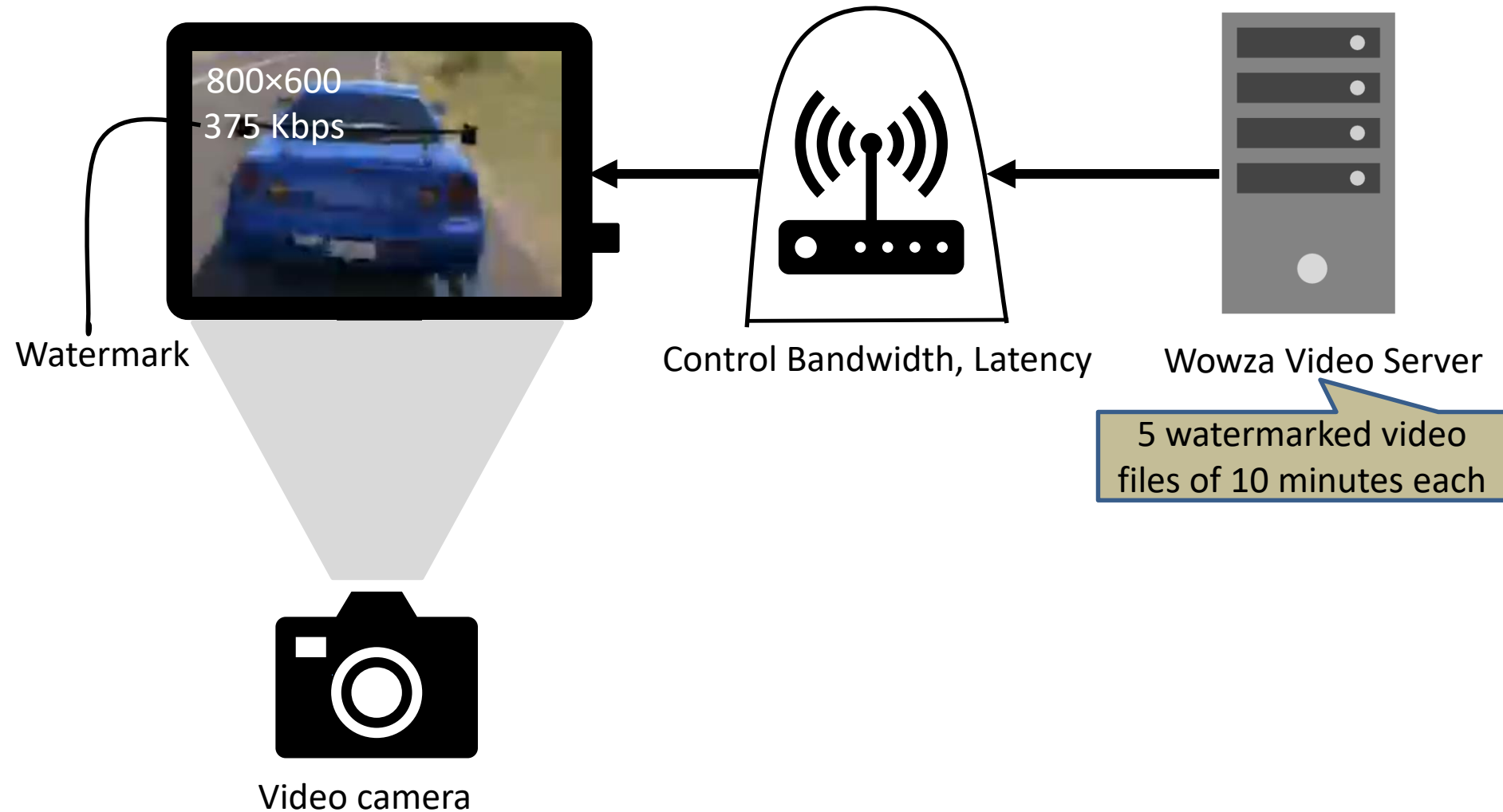
Measurement Setup



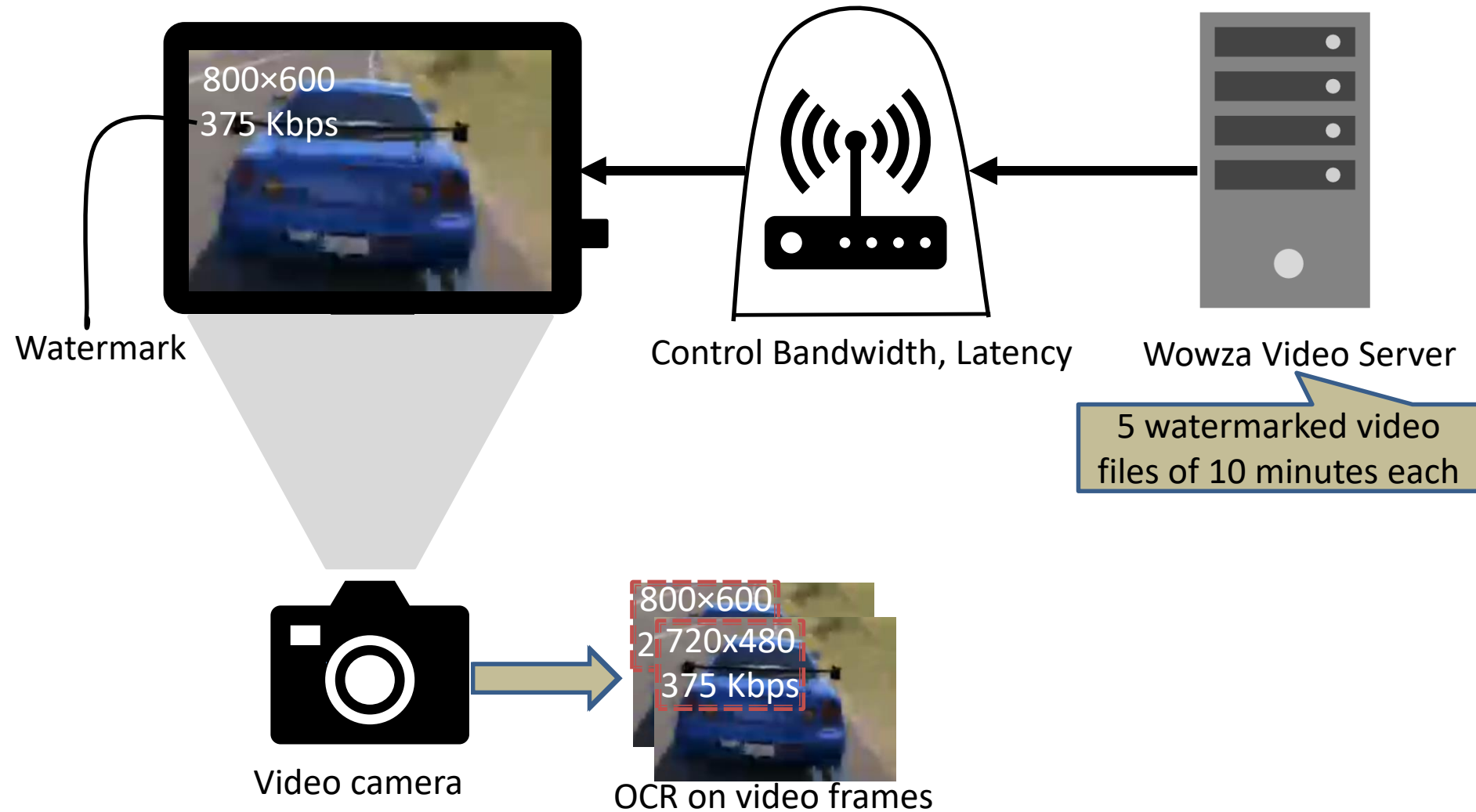
Measurement Setup



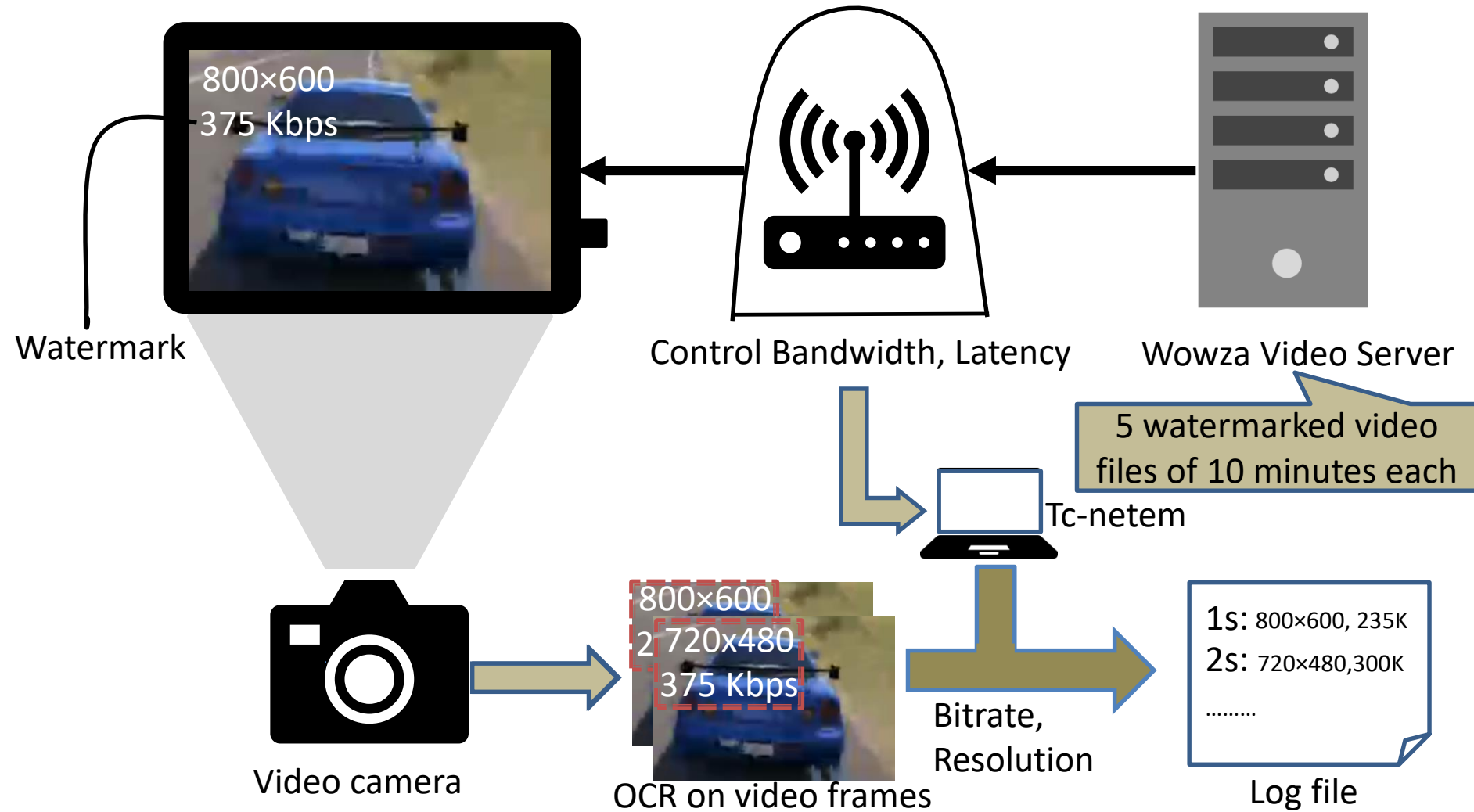
Measurement Setup



Measurement Setup



Measurement Setup



Stick Performance Metrics

Stick Performance Metrics

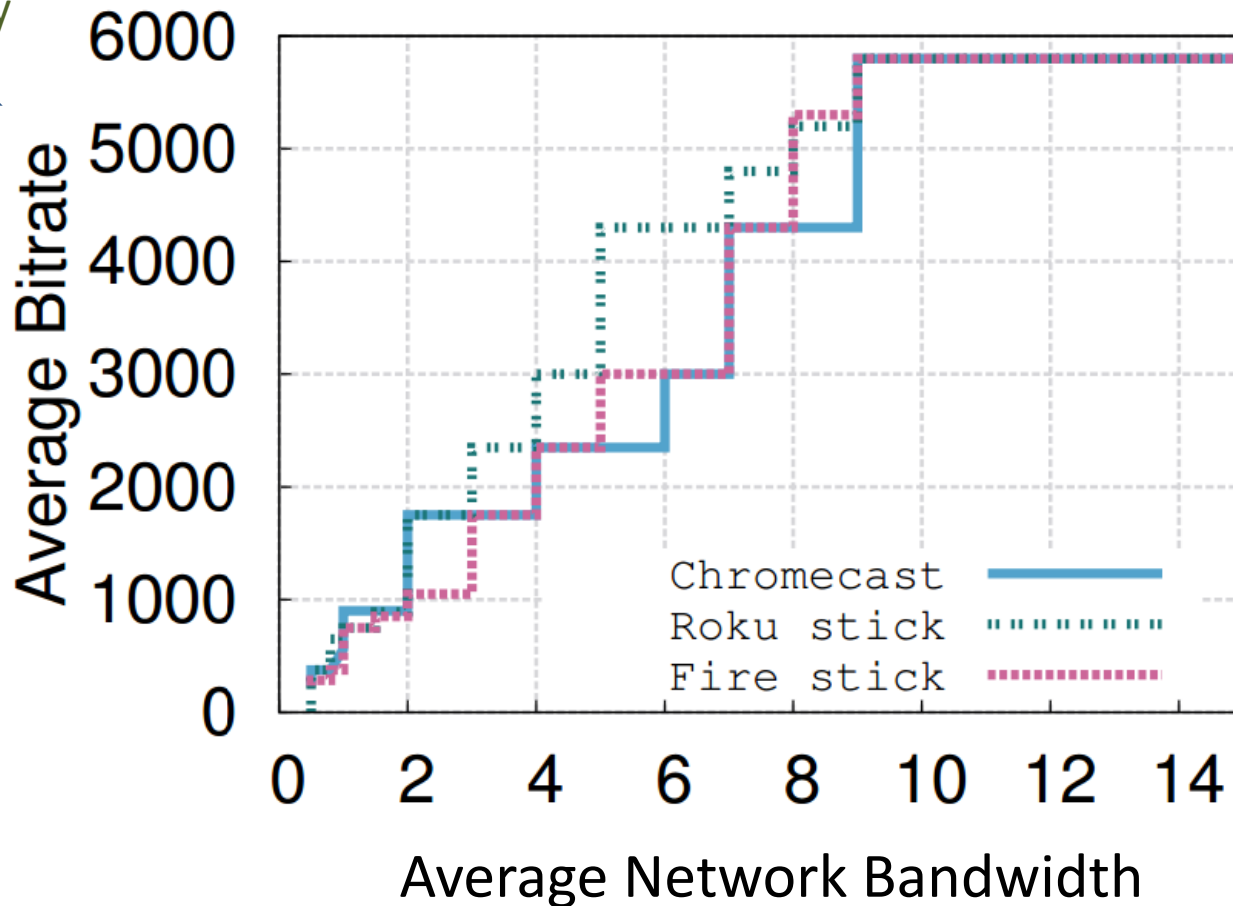
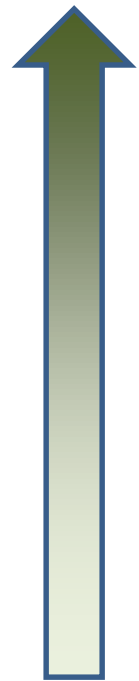
- Streaming Performance
 - Average Bitrate
 - Video Startup Delay
 - Video Stalls

Stick Performance Metrics

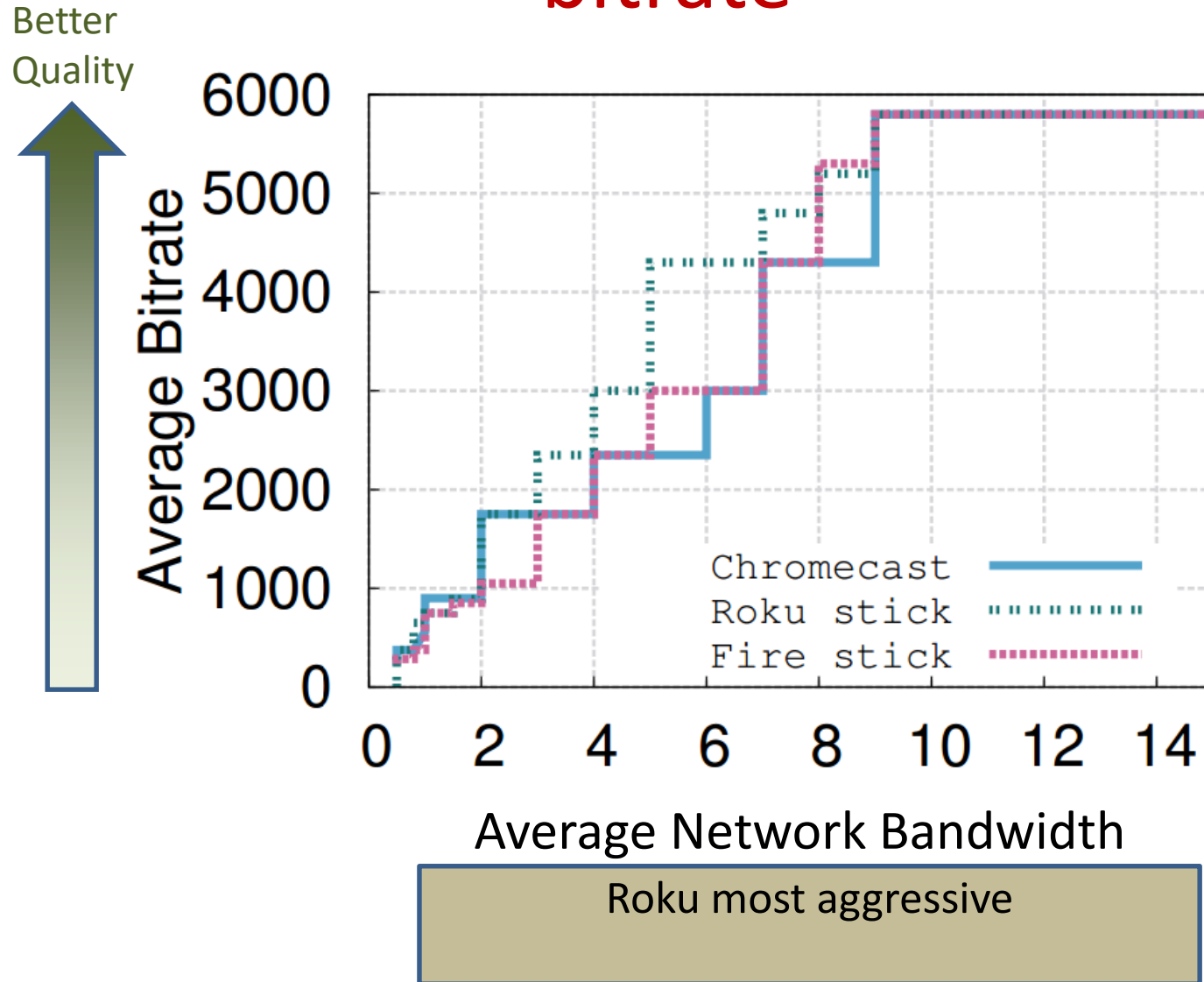
- Streaming Performance
 - Average Bitrate
 - Video Startup Delay
 - Video Stalls
- Network Load
 - Data Wastage on Abandonment
 - Effect of Background Traffic

Roku provides the highest average bitrate

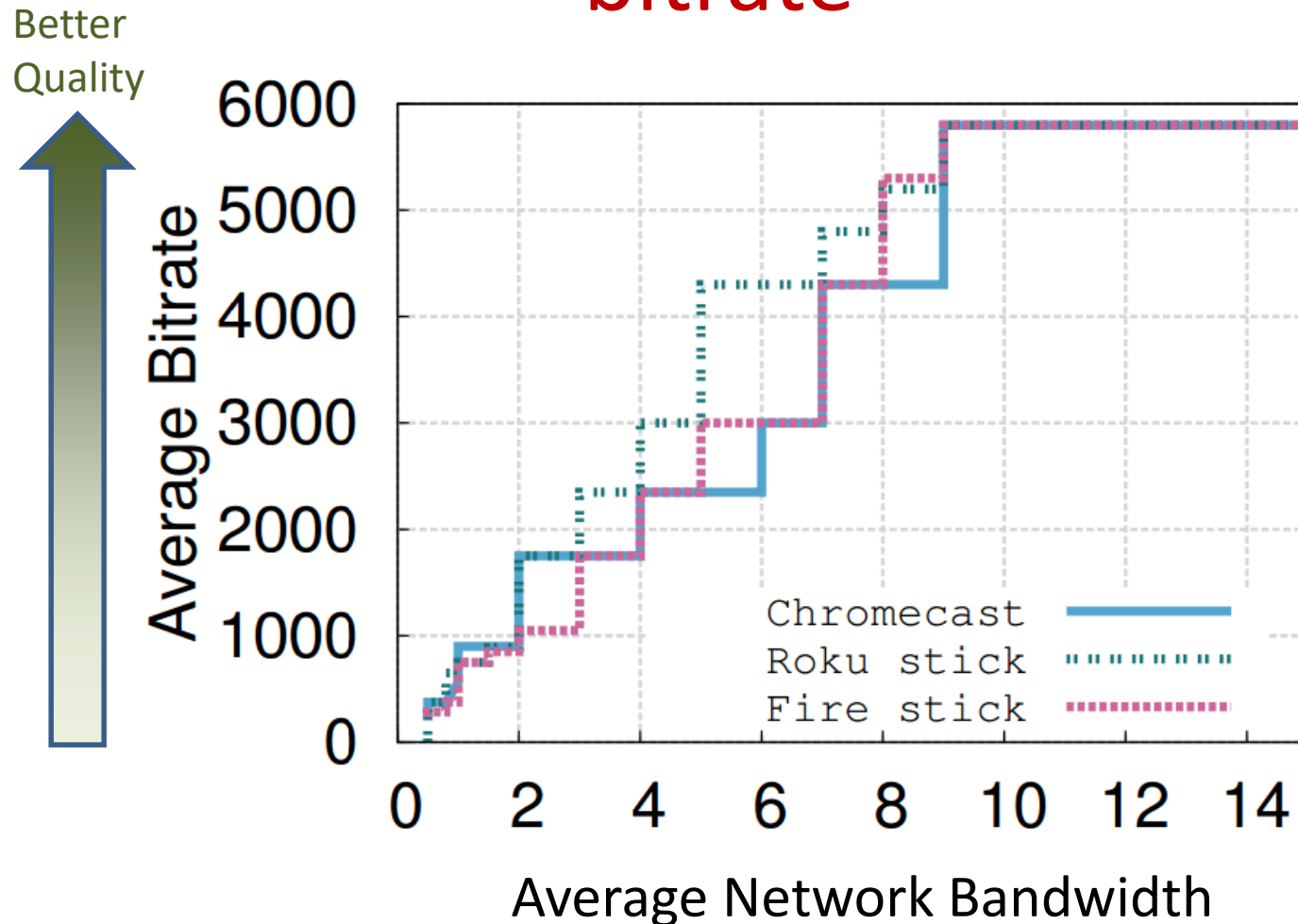
Better
Quality



Roku provides the highest average bitrate

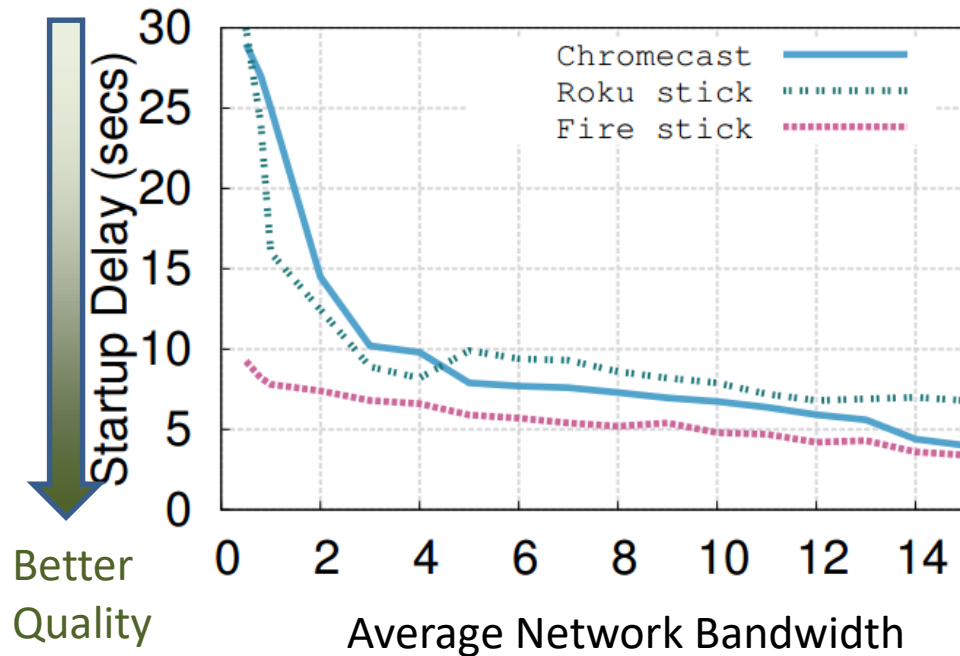


Roku provides the highest average bitrate



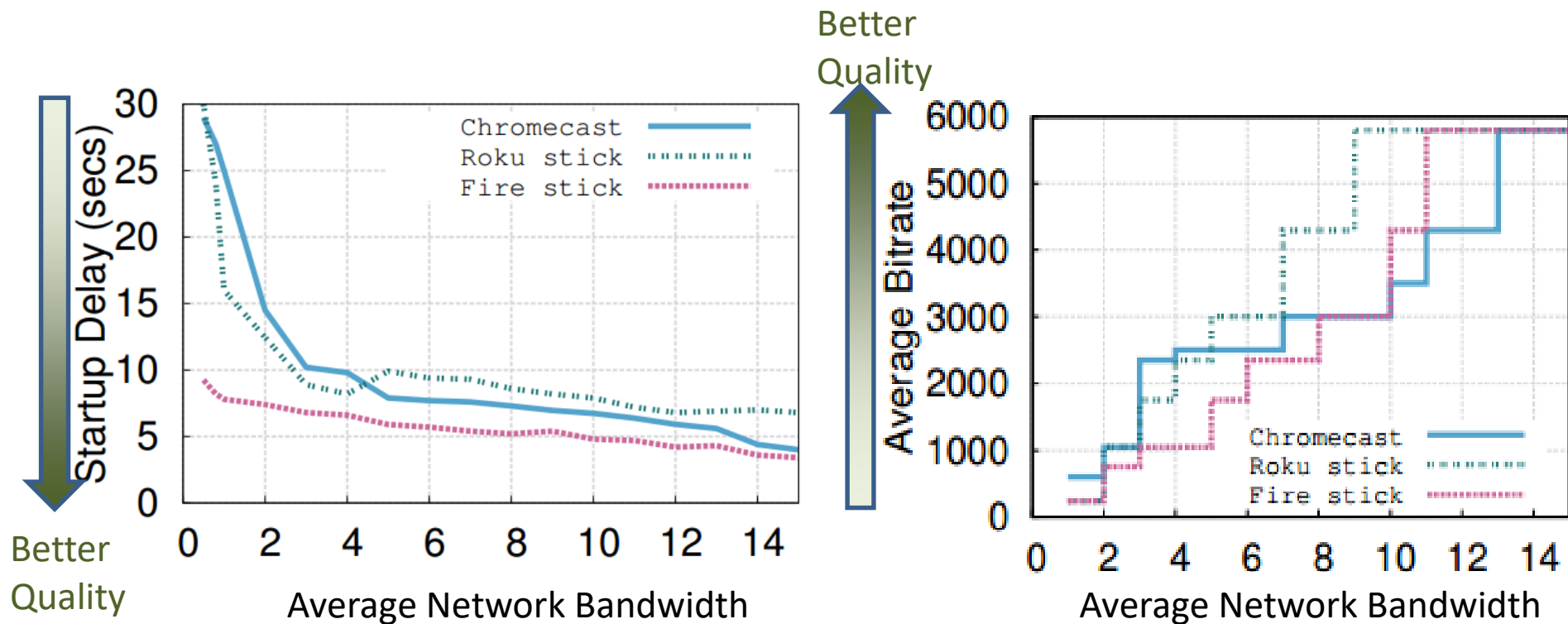
Roku most aggressive
Chromecast targets an average bitrate

Increase in bitrate delays startup

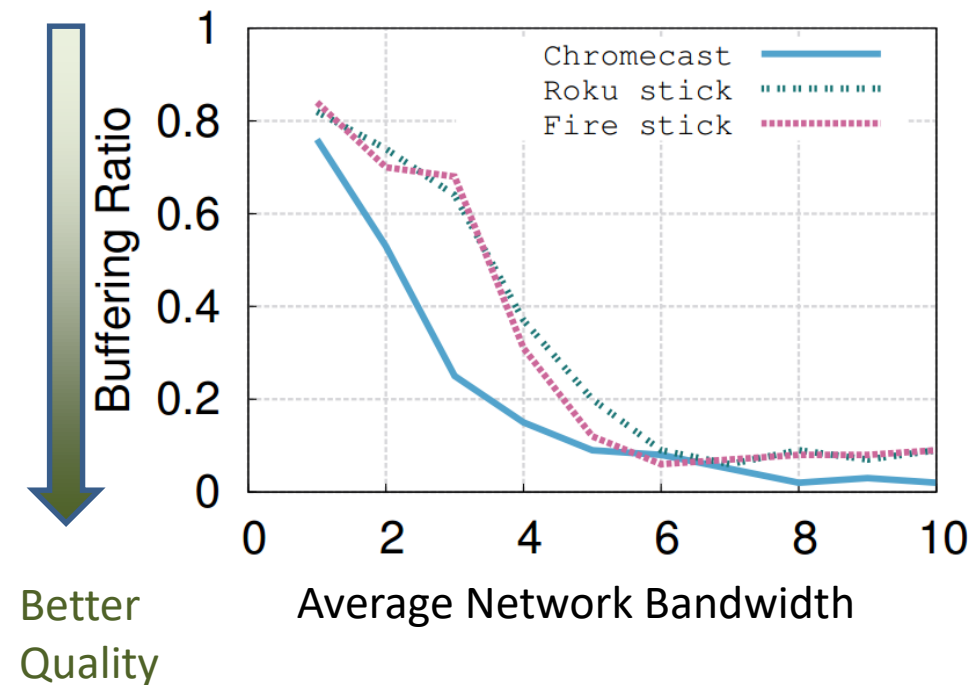


Average Network Bandwidth

Increase in bitrate delays startup

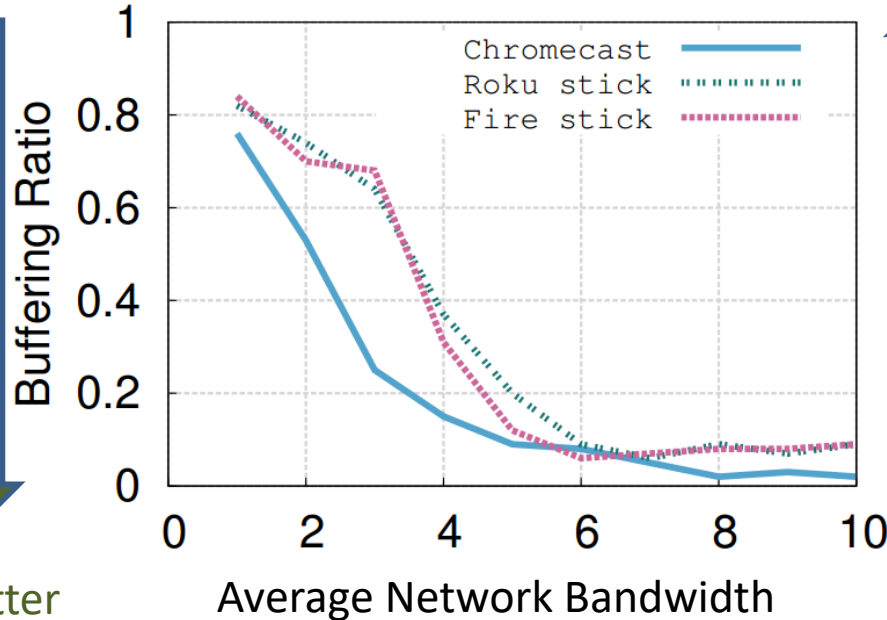


Chromecast has the lowest amount of buffering



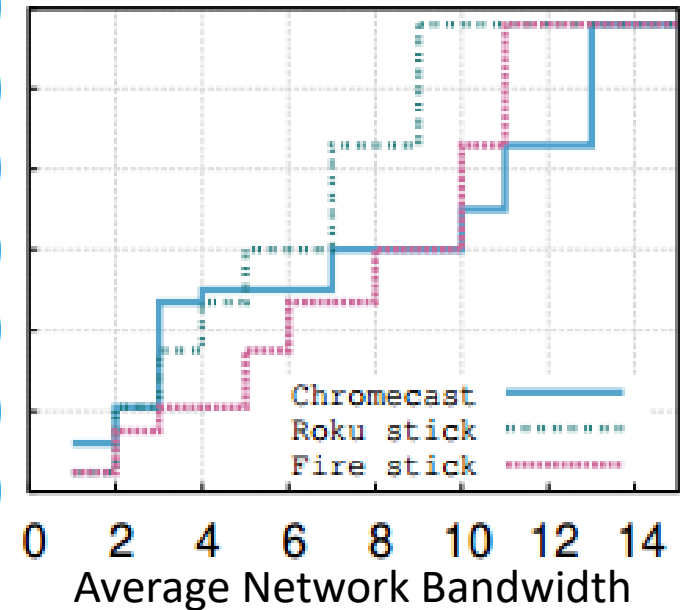
Chromecast has the lowest amount of buffering

Better
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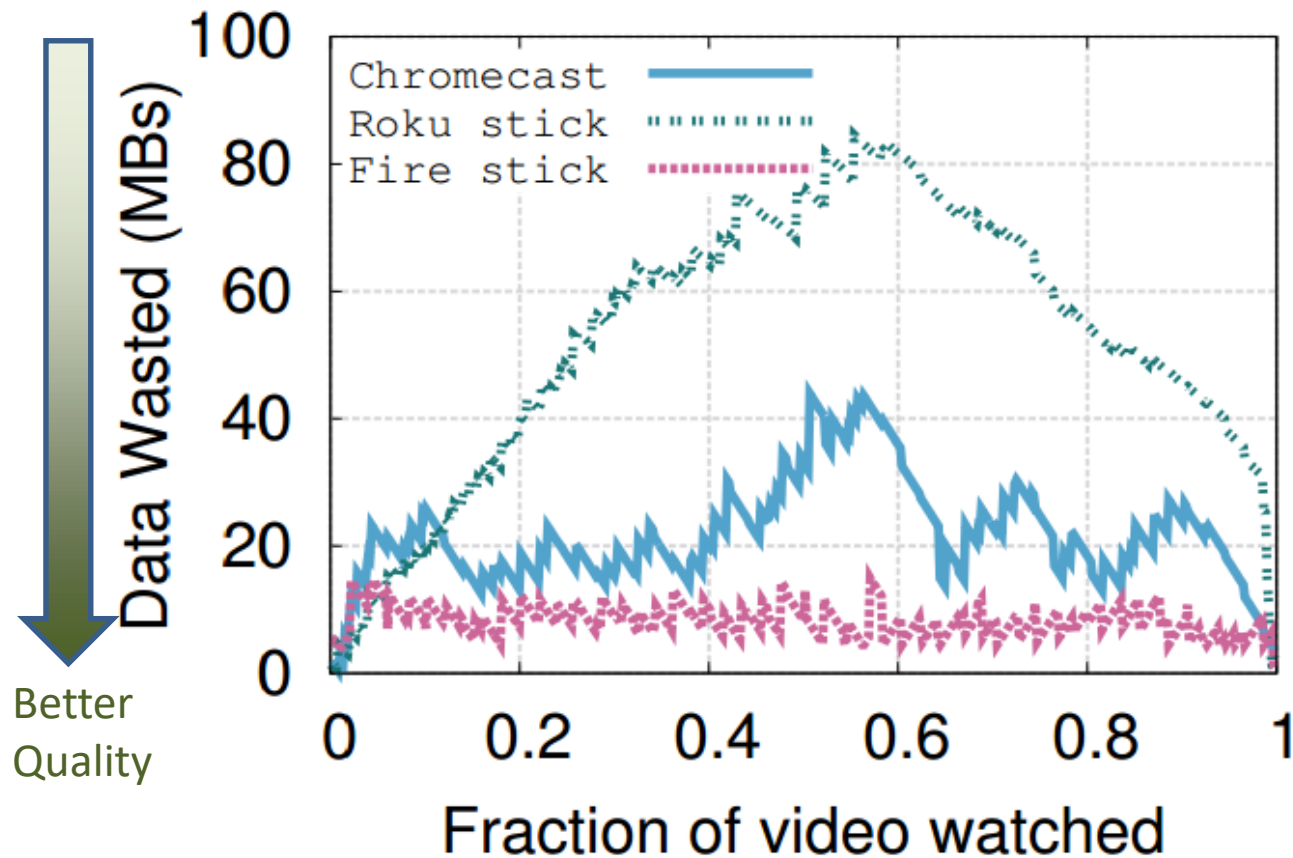
Better
Quality

Average Bitrate

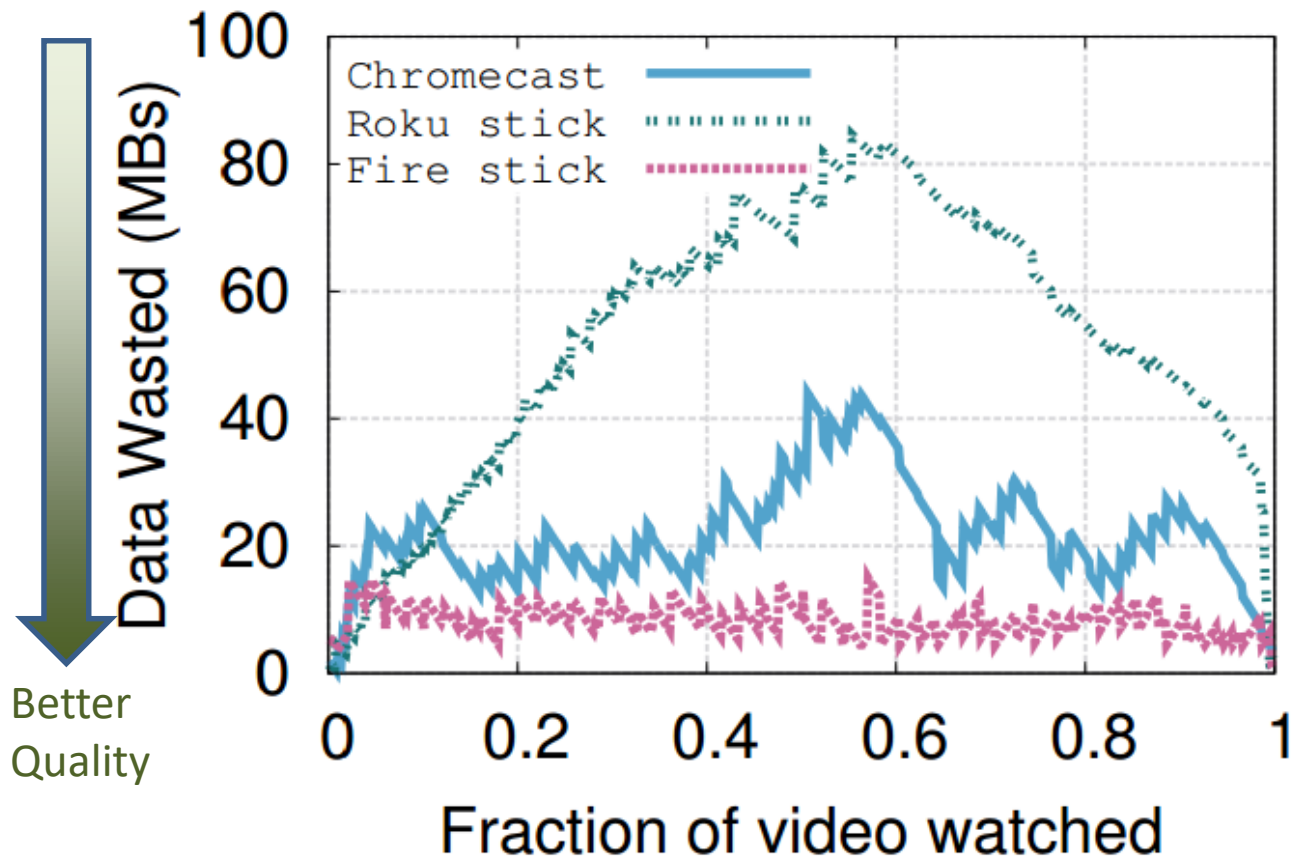


Better
Quality

Roku prefetches data most aggressively

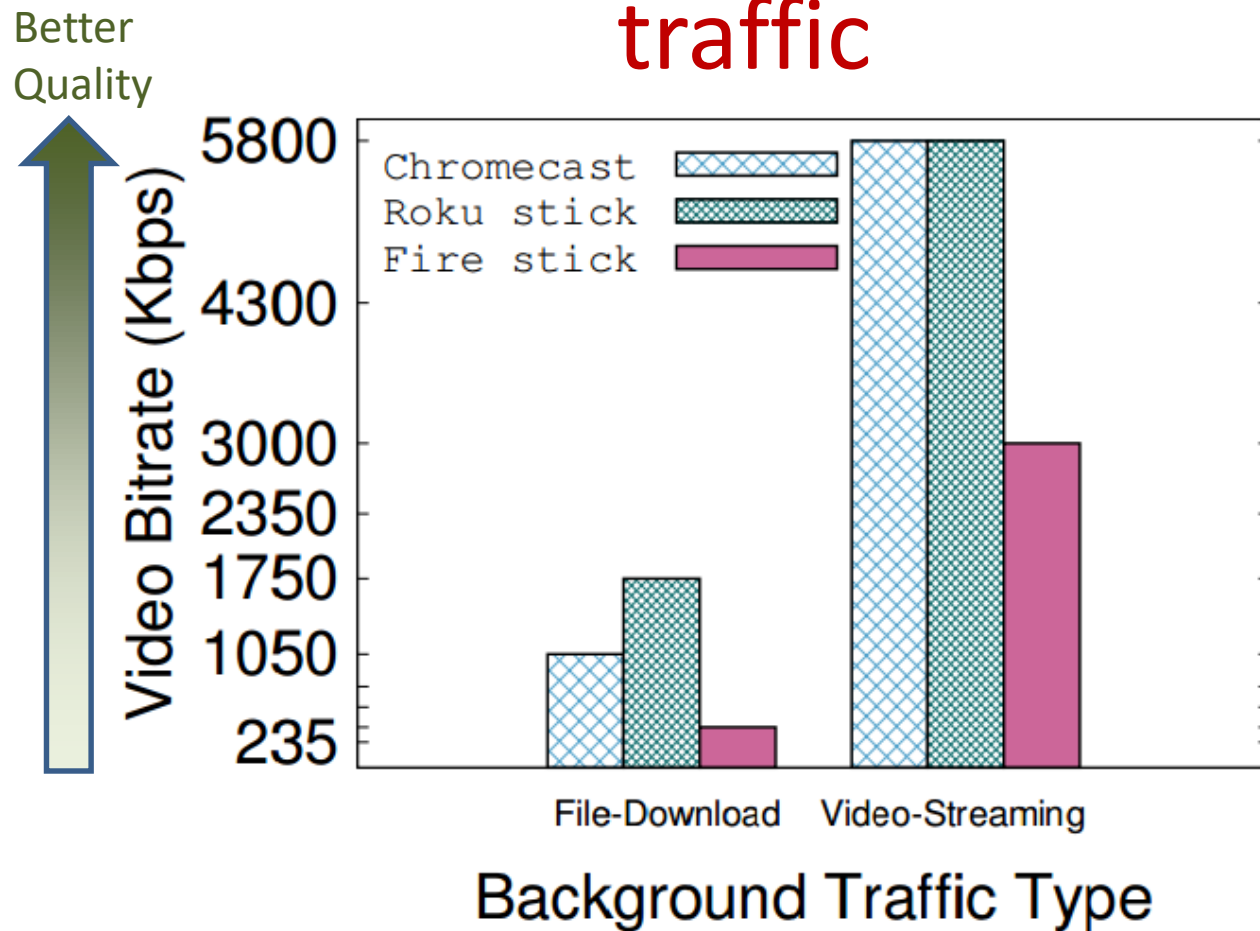


Roku prefetches data most aggressively

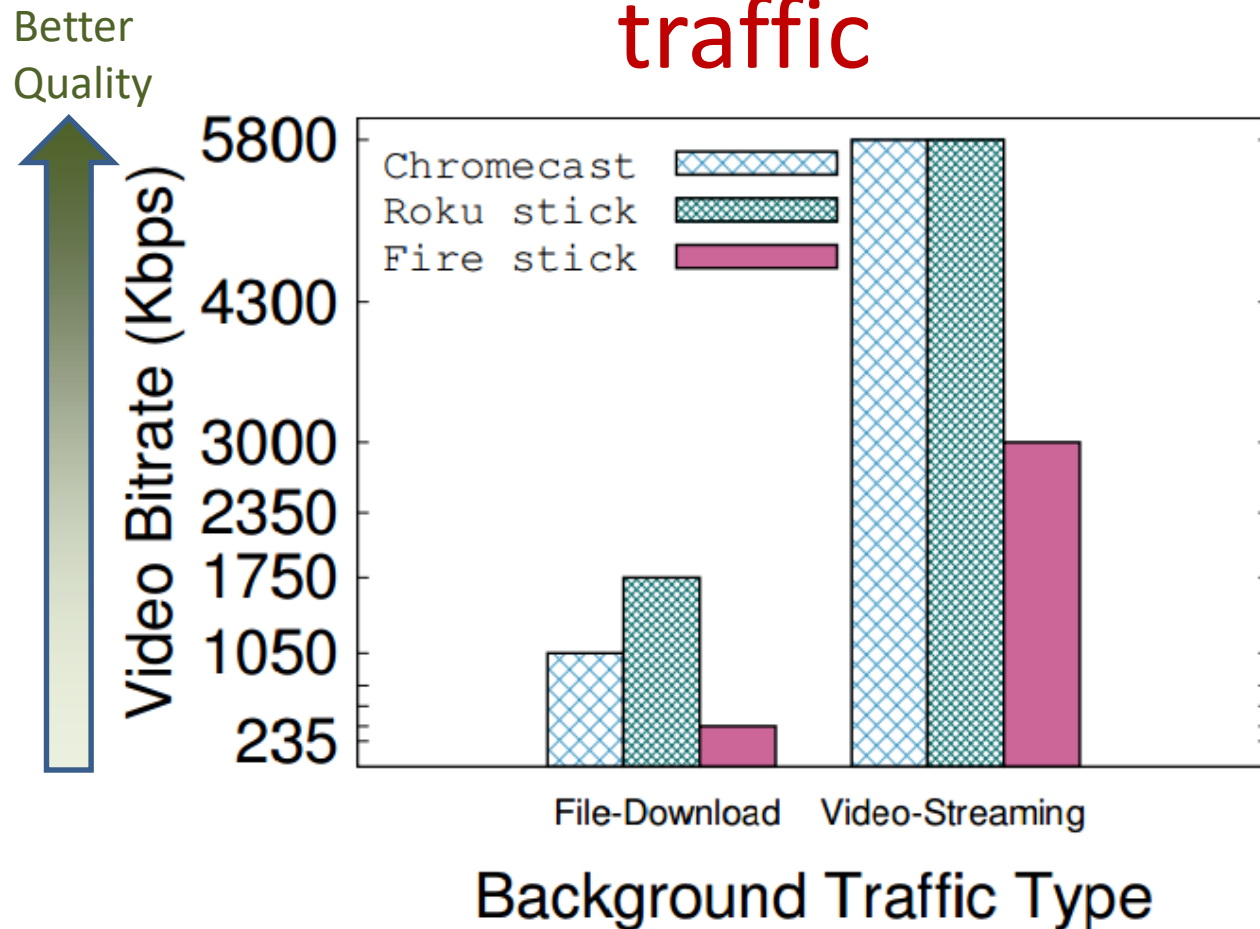


Roku prefetches most, followed by Chromecast and Fire

Fire is most affected by background traffic

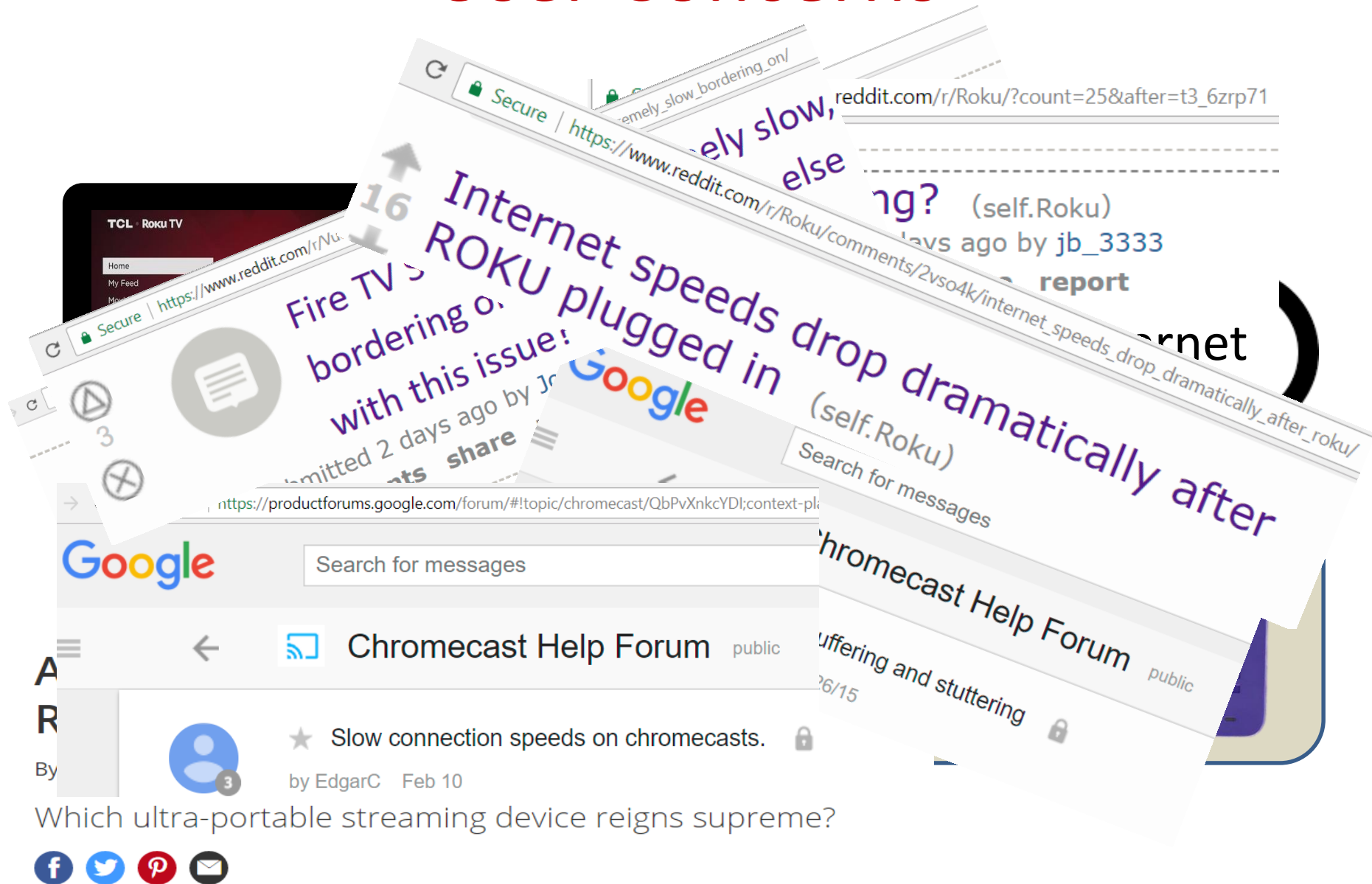


Fire is most affected by background traffic

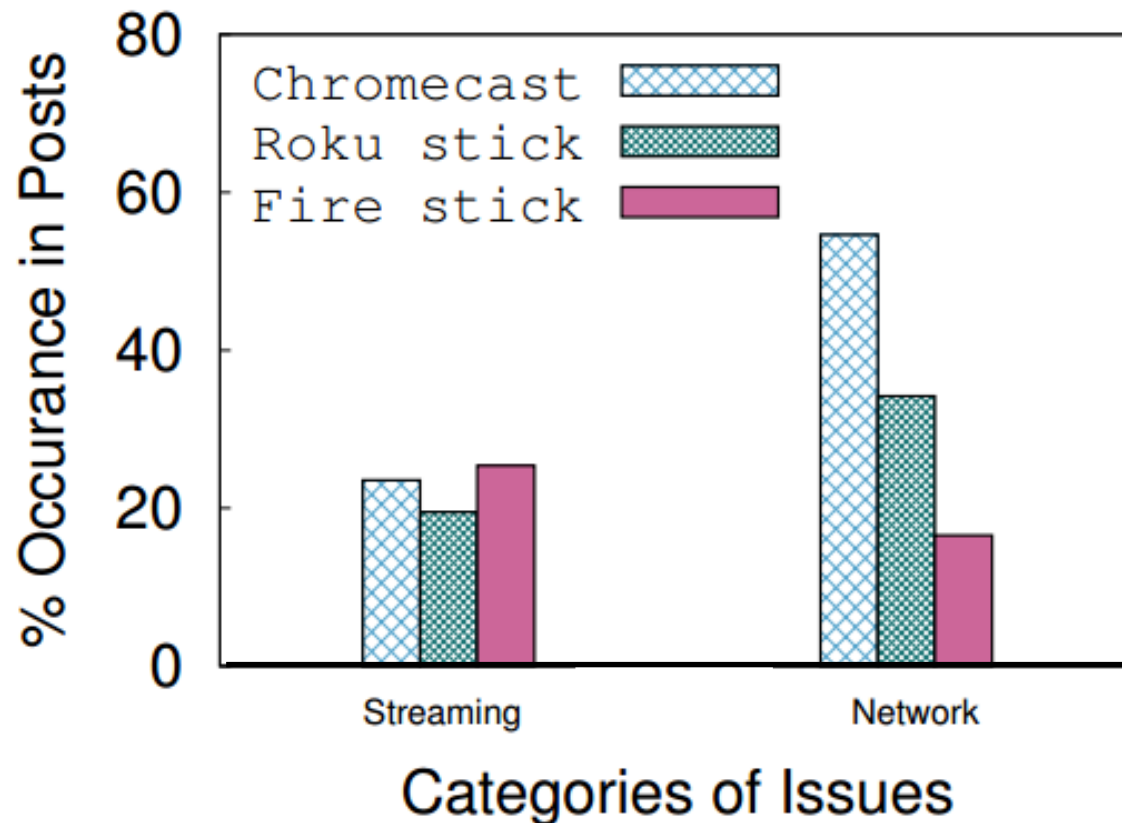


Fire reduces its utilization the most.
Chromecast and Roku gets much less affected.

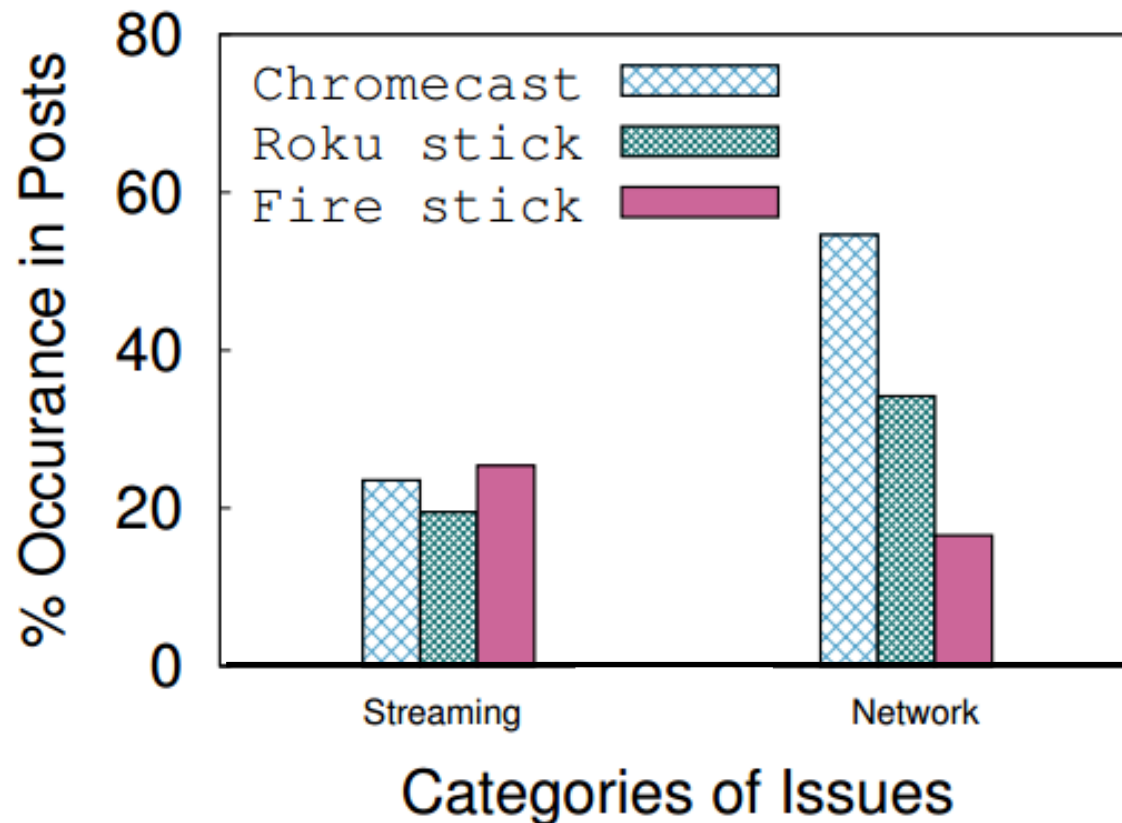
User Concerns



Analysis of User Complaints Confirm Our Measurement Study

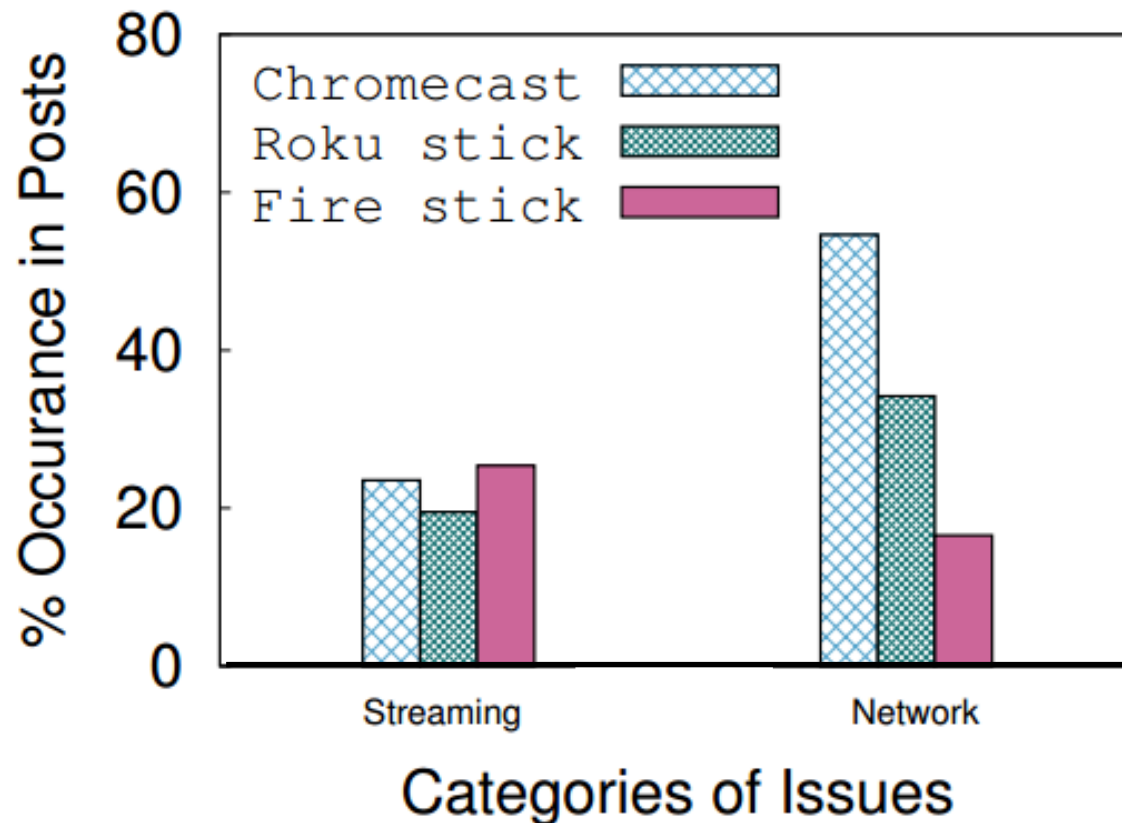


Analysis of User Complaints Confirm Our Measurement Study



Amazon has fewest complaints related to network, Roku has most.

Analysis of User Complaints Confirm Our Measurement Study



Amazon has fewest complaints related to network, Roku has most. Overall complaints about streaming are roughly similar.

Takeaways

- A systematic way of understanding the complaints of TV stick users
- We showed how streaming sticks prioritize different aspects of Quality of Experience:
 - Roku tries to fetch higher bitrates, loses on startup
 - Fire minimizes usage of network bandwidth

THANK YOU

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