User Control of Quality of Experience in Home Networks using Software-defined Networking

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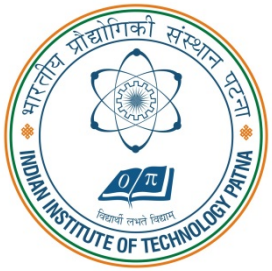

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Overview

- This paper is about service quality
- Investigating whether SDN can add some value
- Focus less on Technology
- and more on architecture and interface

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Motivation: Home Network

- Complexity of Home networks
- Growing number of household devices
  - Computers, tablets, smart-phones, TVs, IoT, …
  - Increased peak-load and congestion on access link
- Yes indeed users want better quality!
  - Providing end-users some means to control service quality
  - Employing SDN to ISP expose programmatic interface for the users

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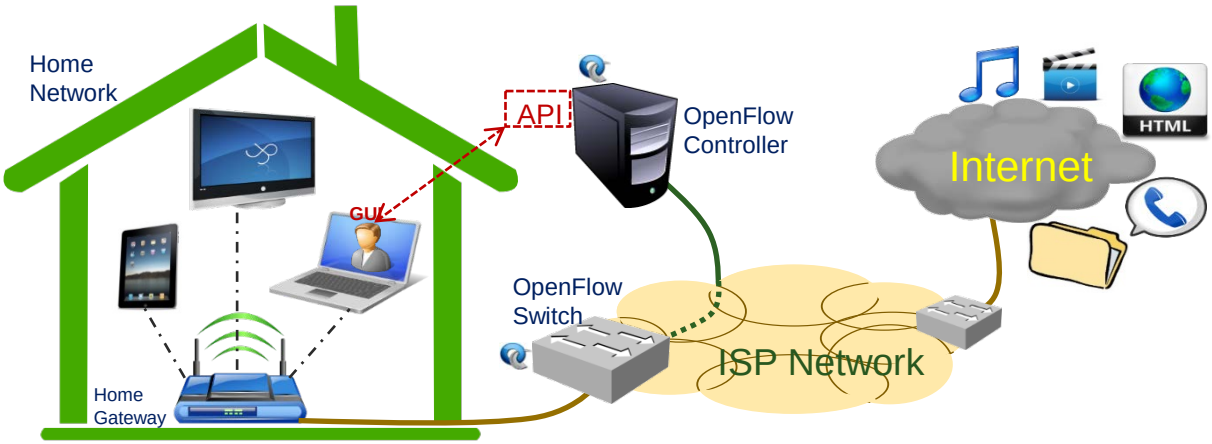
Our proposal: SDN-driven virtualization

- Service quality control exposed via “APIs”
- Create dynamic on-demand “slices” in the network
  - Bandwidth Slicing
  - Separate queue per device / application
- Selective (per flow) control over quality
- APIs open for (any) end-user

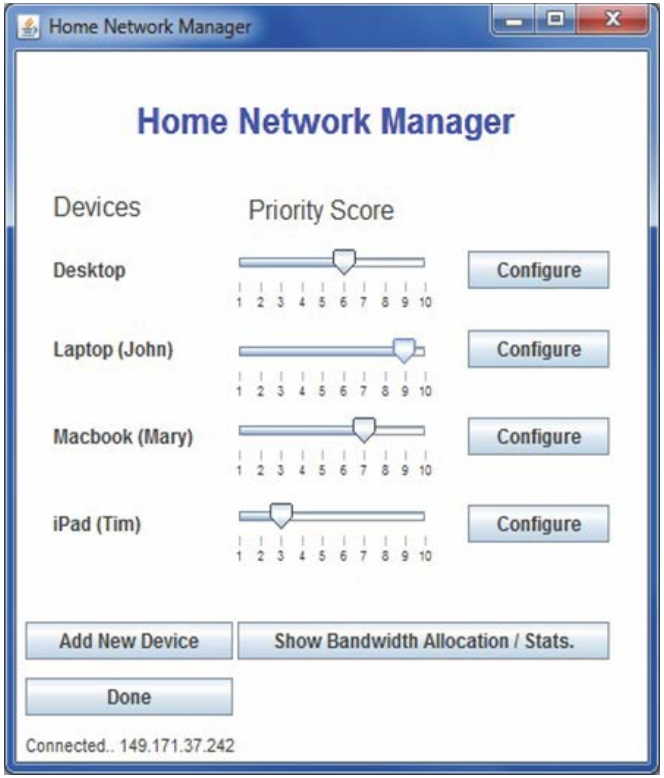


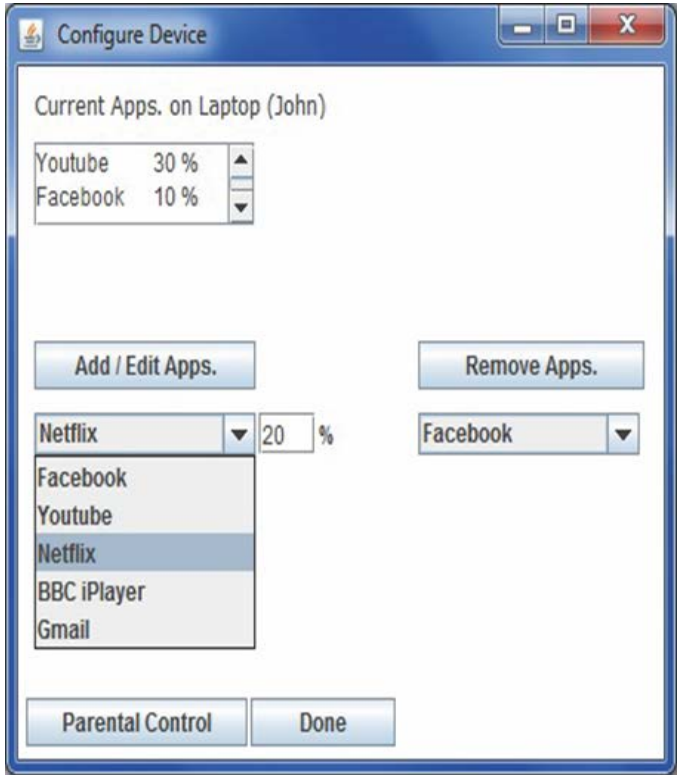
Use-cases

- QoE for streaming video (e.g. YouTube, NetFlix):
- Elastic bulk transfer (e.g. Software upgrades, P2P)
- Low-volume web-browsing

Interface: GUI

- Weighted mean to calculate bandwidth
- John's bandwidth=9/(6+9+7+3)





The APIs

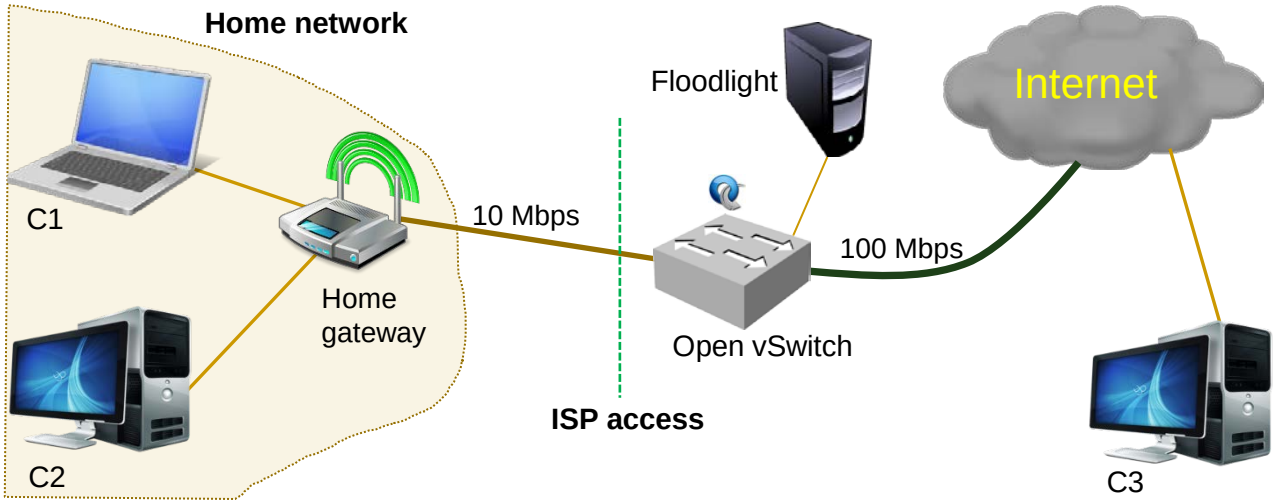
- Caller ID : Id of the entity requesting the service
- Call Type : Service being requested
- Flow tuple : IP src , dst addresses and ports
- Bandwidth :Bandwidth requested by flows (in Kbps)

- JSON API : {hello: juke- box, type: minbw, numQueue: 2, qid:1, nwsrc: 203.5.76.0/24, nwdst: 149.171.37.162/32, bw:5500, qid:2, nwsrc:0.0.0.0/24, nwdst:149.171.37.115 /32 ,bw:4000}

- For Parental control: {……. Actions:drop }

Test-bed @ UNSW

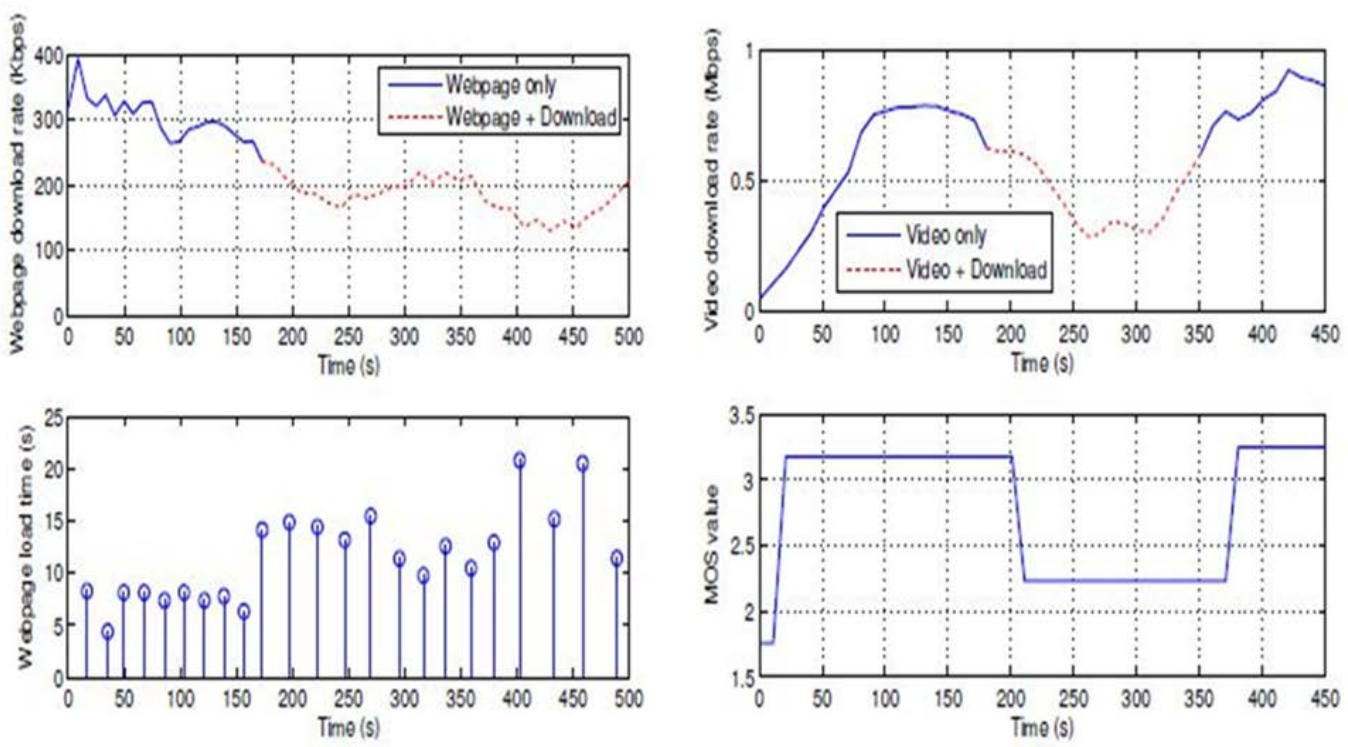
- OpenvSwitch over Dell server
  - Flow queue per API call, HTB slicing
- Floodlight (Java) controller
  - Restful API
- AP: TP-LINK
- Clients: PowerShell scripted
  - C1: HD video or browsing; C3: large download
- Video : YouTube / Web-page: facebook



Experimental Results

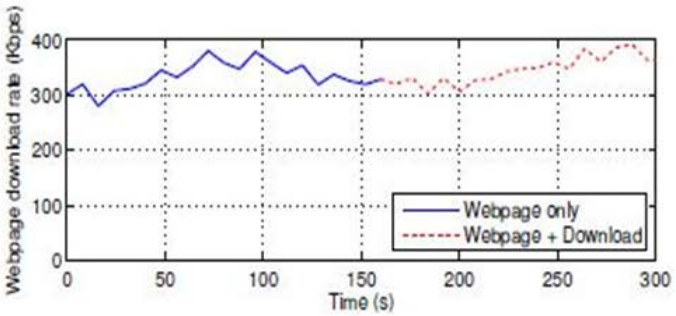
Best effort performance

- C1: Browsing , Video C2:Download

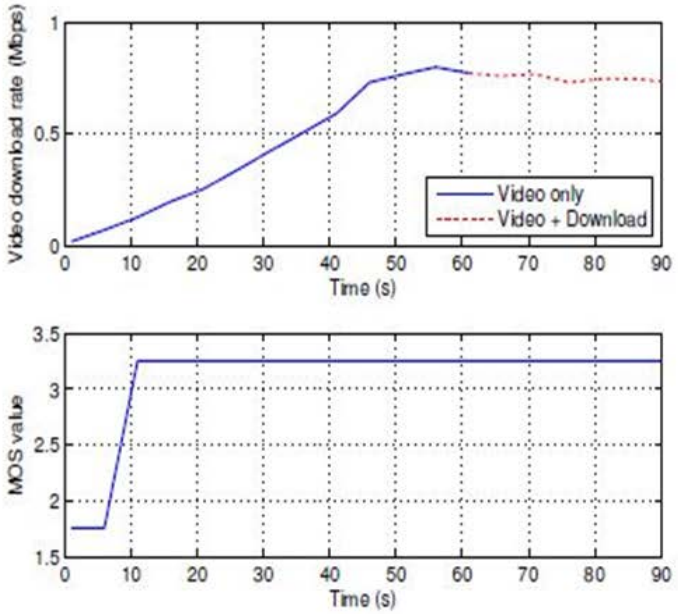


Device level slicing

- C1:Browsing , Video C2:Download
- Perfect video MOS of 3.25
- Page load times unaffected



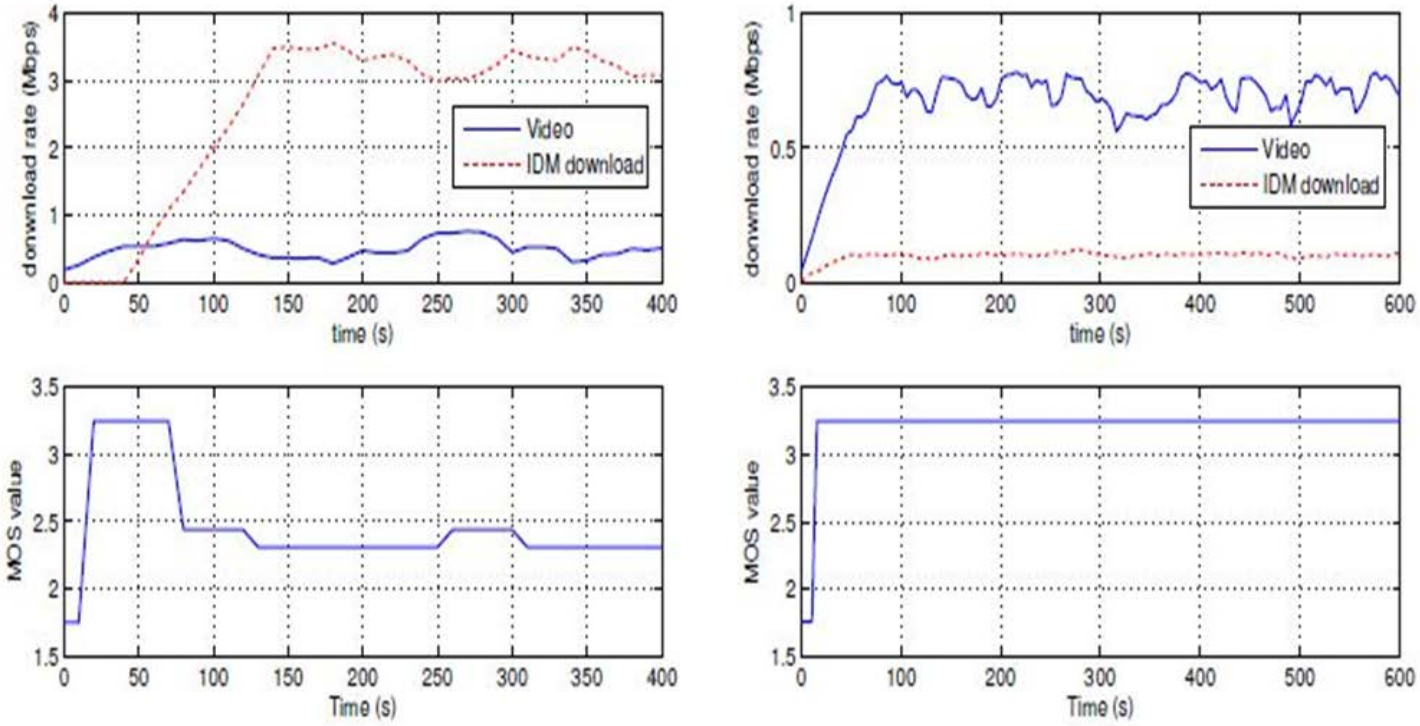
(a) Web browsing



(b) Video stream

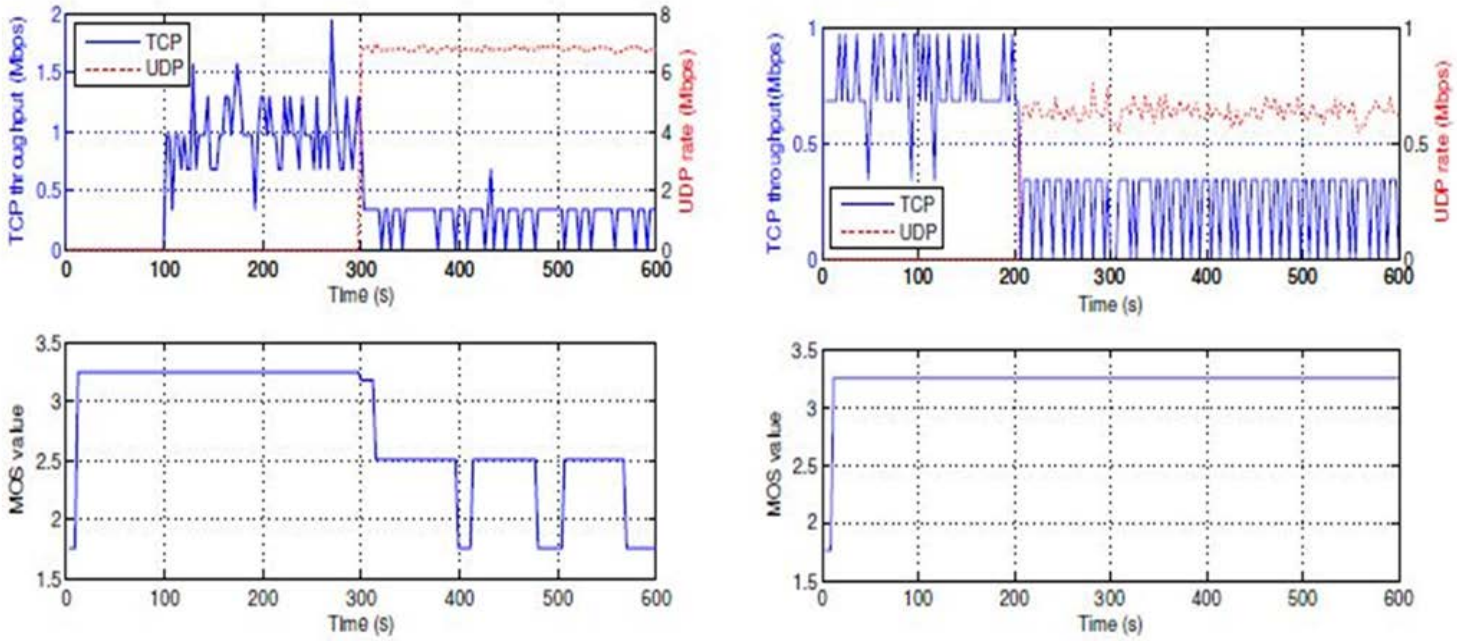
Application level slicing

- C1: IDM + Browsing ; IDM + Video
- Individual applications on C1 using independent minimum BW queues



Iperf measurement

- Effect of TCP,UDP cross traffic



Conclusions

- Access network remains a bottleneck
- Ultimate-goal:
  - make network dynamic so it can be exposed programmatically to outside entities
- Future work:
  - Richer and more programmable home network
    - Security feature
    - More application aware

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