Introduction to Computer Networks

Quality of Service Overview

(§5.4.1)

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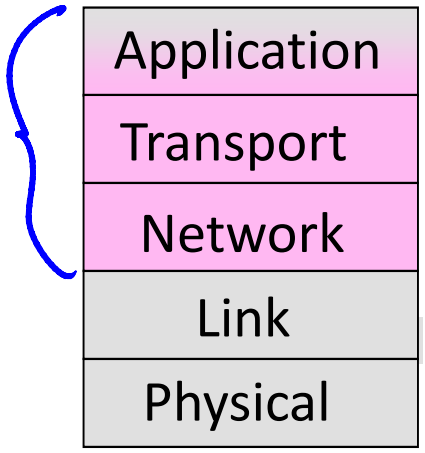
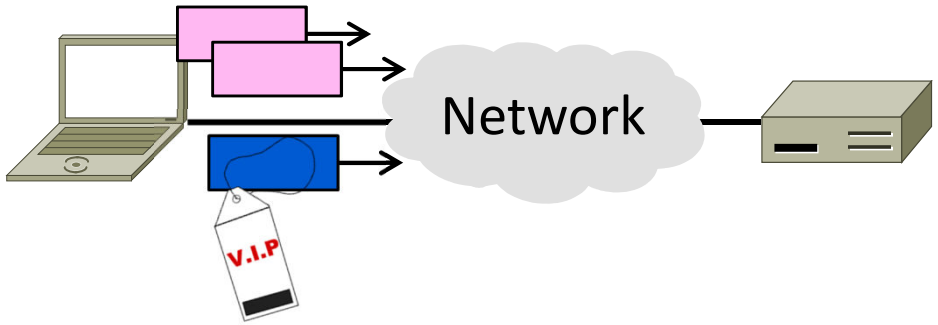
Where we are in the Course

- Revisiting the layers
  - Quality of Service (QOS) involves both the Network and its users/applications



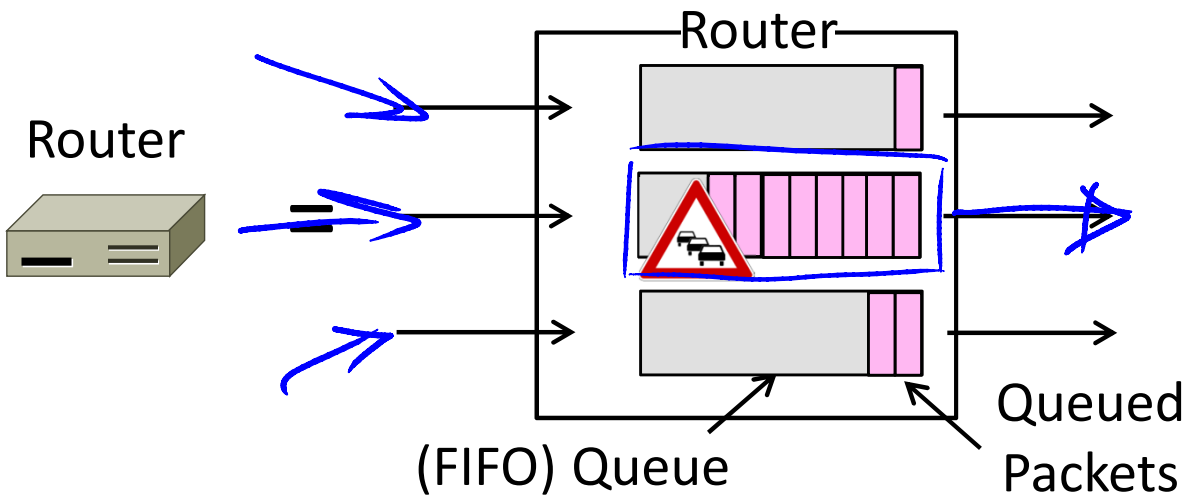
Topic

- QOS relates to the kind of service a user gets from the network
  - E.g., high/low bandwidth, delay, loss
  - Important issue for future Internet



"Best Effort" Service

- What we get in the Internet today with FIFO routers
  - Apps compete for bandwidth; queues add delay and loss
  - Try to deliver with no guarantee of bandwidth, delay, loss

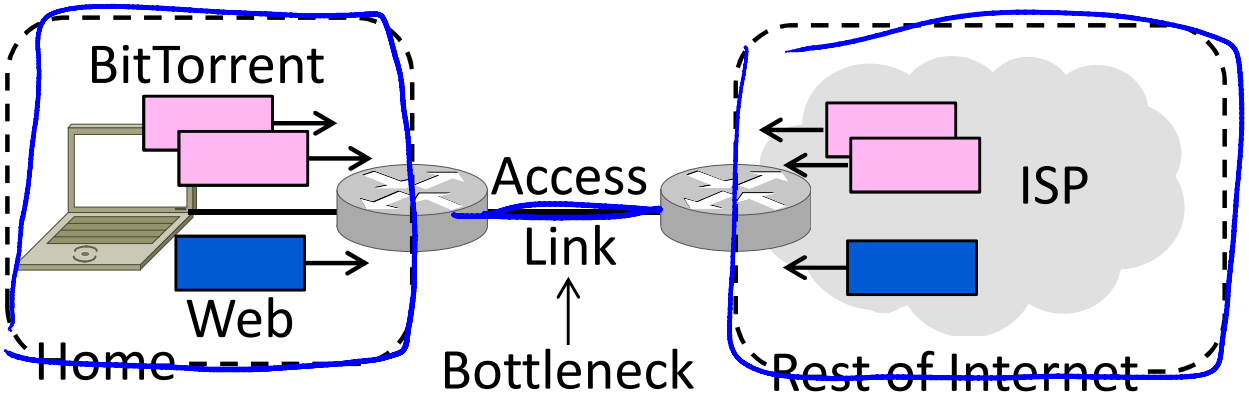


QOS Motivation

- Best effort is not always enough!
  - May want performance guarantees
- What can't be done:
  - Guarantee more bandwidth or lower delay than exists in the network
- What can be done:
  - Control how bandwidth (hence delay/ loss) is allocated to different users

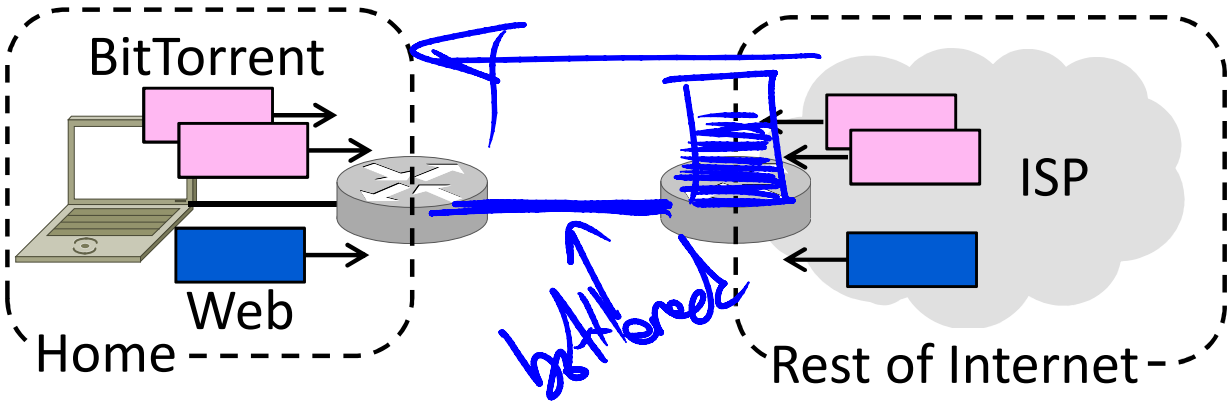
Example – Web and BitTorrent

- Home user browses the Web and runs BitTorrent at the same time
  - Assume access link is the bottleneck
  - What happens? What do we want?



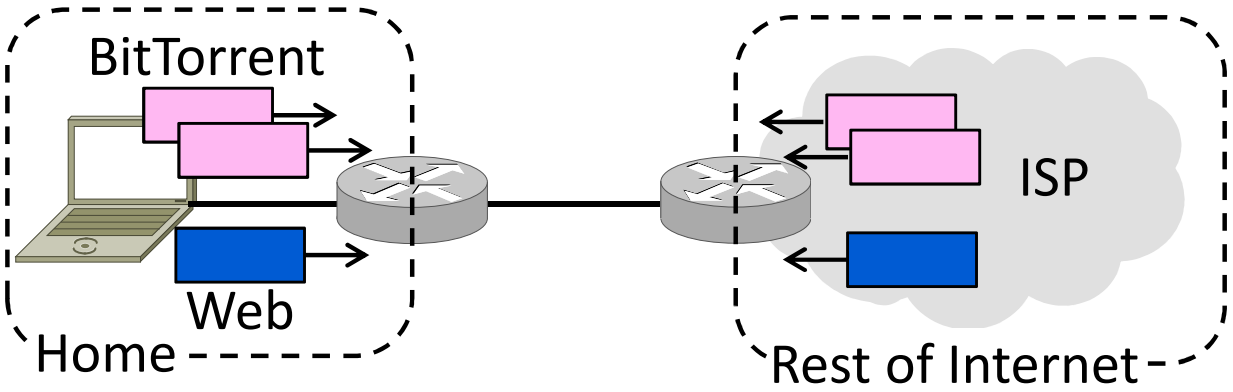
Web and BitTorrent (2)

- What happens?
  - Web and BitTorrent compete for downstream bandwidth using TCP
  - Queues build at ISP end of access …



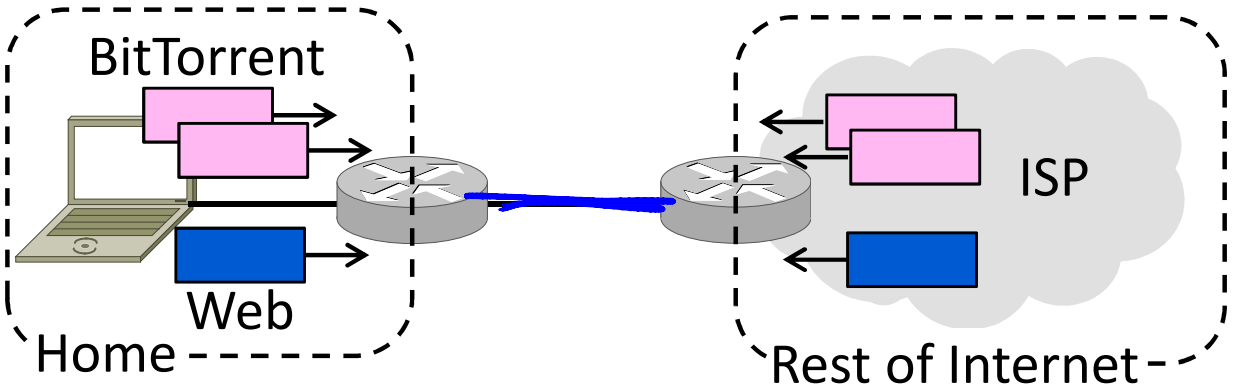
Web and BitTorrent (3)

- What happens?
  - Web PLT rises because of BitTorrent
  - Less web bandwidth, more delay/loss



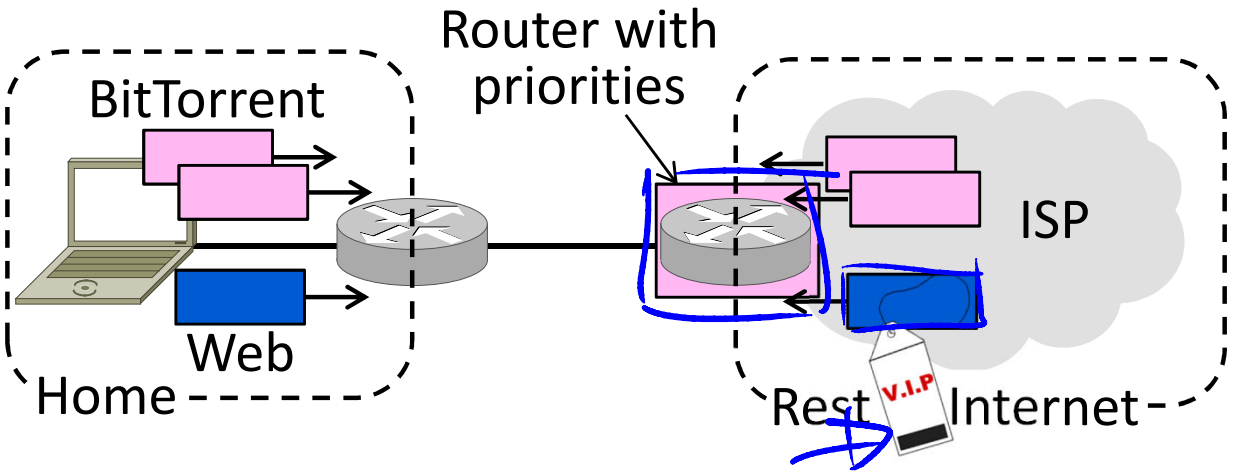
Web and BitTorrent (4)

- What do we want to happen?
  - Web is interactive, while BitTorrent runs in the background
  - Prefer to use bandwidth for Web



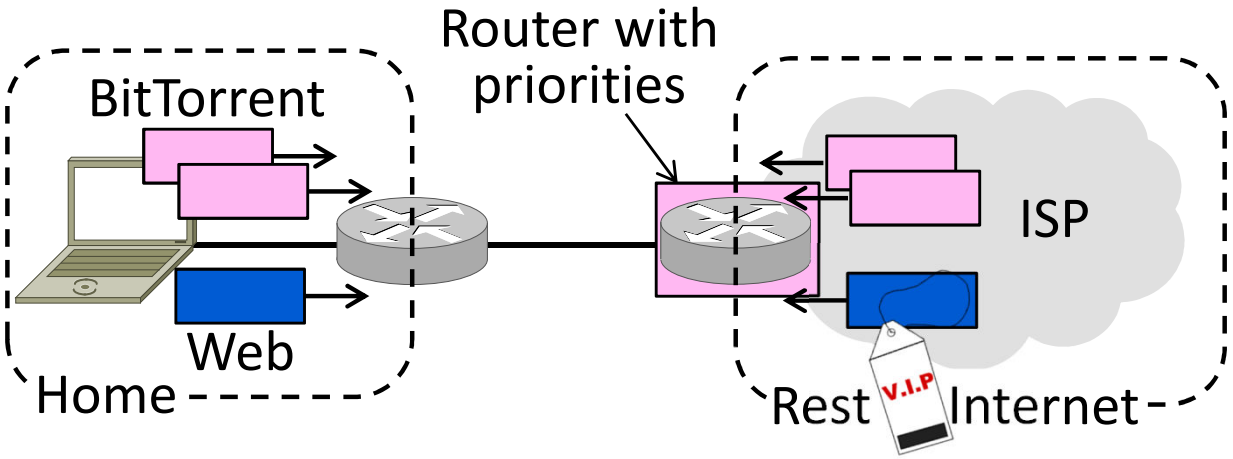
Web and BitTorrent (5)

- What do we want to happen?
  - Suppose we modify ISP router to give priority to Web packets on access link



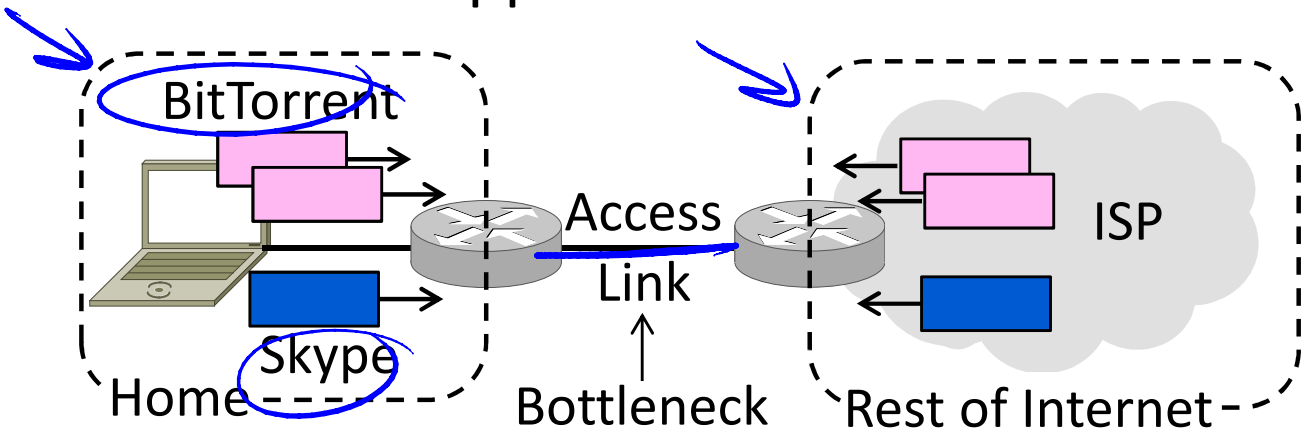
Web and BitTorrent (6)

- What do we want to happen?
  - Would minimize web PLT for user
  - BitTorrent just has less bandwidth



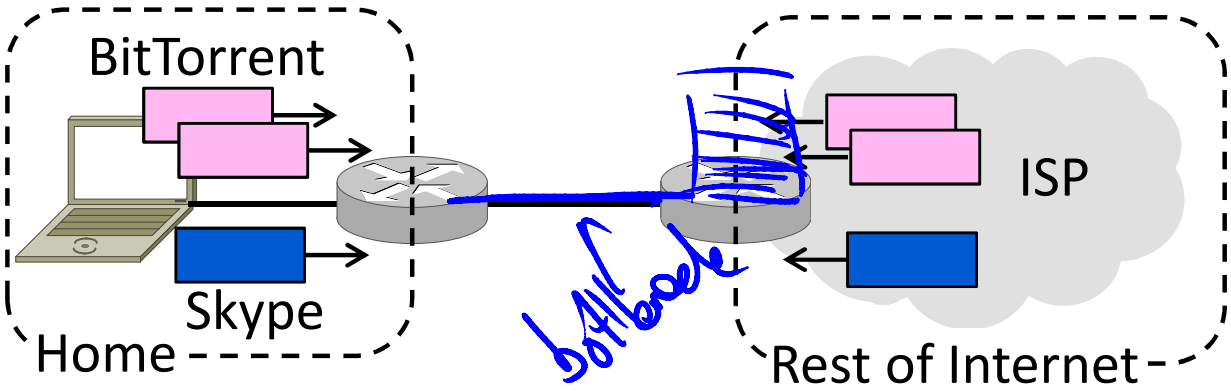
Example – Skype and BitTorrent

- Home user skypes (VoIP only) and runs BitTorrent at the same time
  - Assume access link is the bottleneck
  - What happens? What do we want?



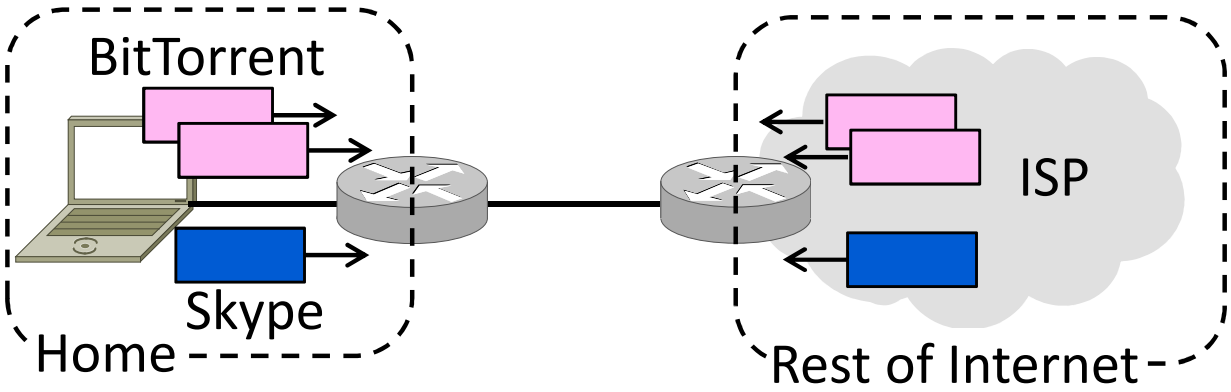
Skype and BitTorrent (2)

- What happens?
  - Skype and BitTorrent compete as before, though not with TCP
  - Queues build at ISP end of access …



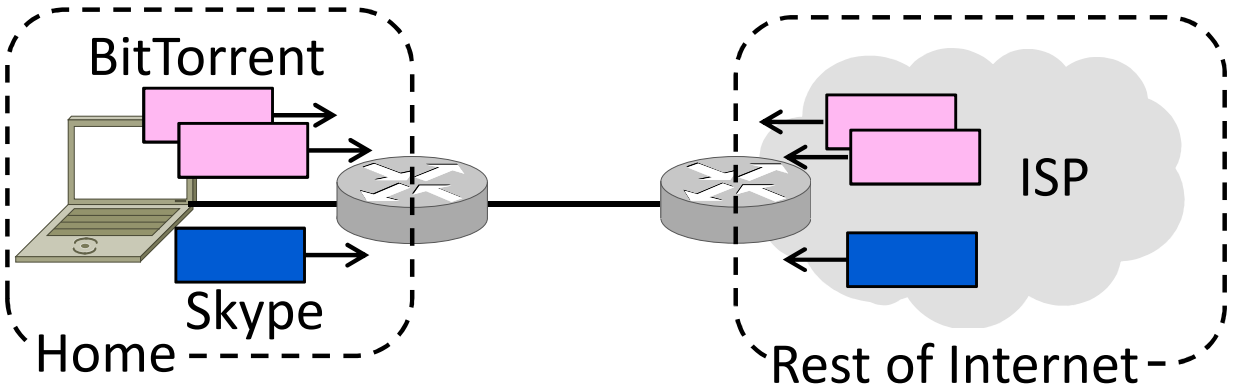
Skype and BitTorrent (3)

- What happens?
  - Skype call quality falls due to BitTorrent
    - More delay/loss; little bandwidth issue



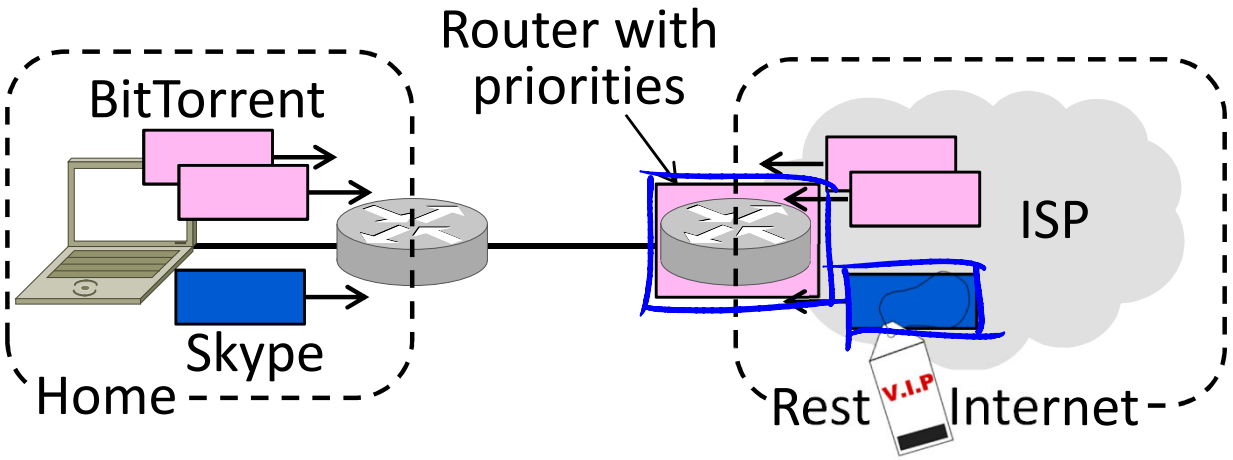
Skype and BitTorrent (4)

- What do we want to happen?
  - Skype real-time, BitTorrent background
  - Prefer low-delay for Skype and high-bandwidth for BitTorrent



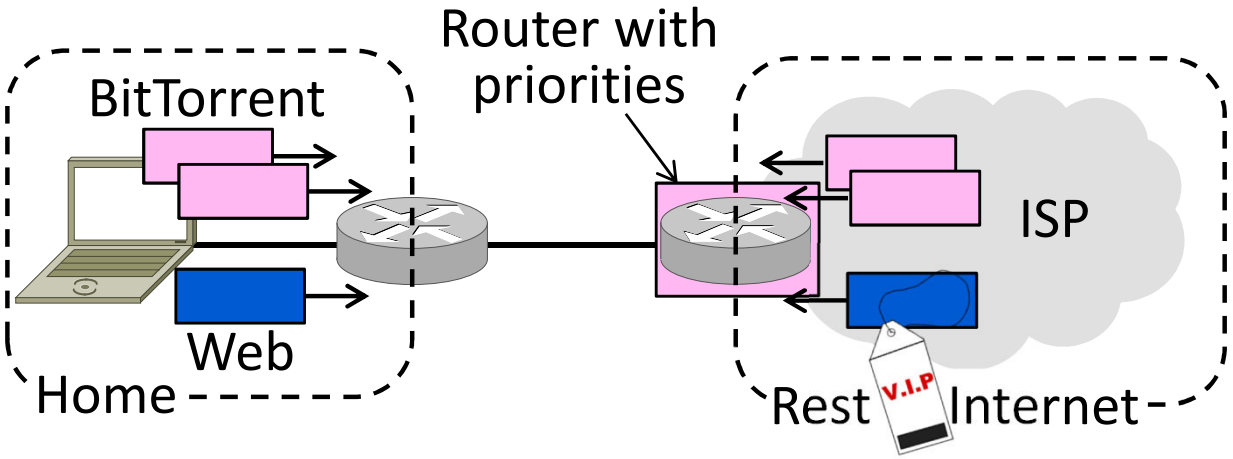
Skype and BitTorrent (5)

- What do we want to happen?
  - Modify ISP router to give priority to Skype packets on access link



Web and BitTorrent (6)

- What do we want to happen?
  - Maximizes skype call quality without slowing BitTorrent – both win!



QOS Motivation (2)

- Opportunity to allocate bandwidth to improve app/user performance
  - Guarantee bandwidth to an app
  - Satisfy multiple apps at once

- To provide QOS, we need to know what apps require of the network
  - Need for bandwidth, delay, loss

QOS Motivation (3)

- Revisit the assumption for a moment …
- QOS matters only when there is a network bottleneck
  - Otherwise no queuing or loss
  - Otherwise no opportunity to improve
- Overprovisioning approach:
  - Build heaps of network capacity!
  - Simple, but not cost-effective

Application Requirements

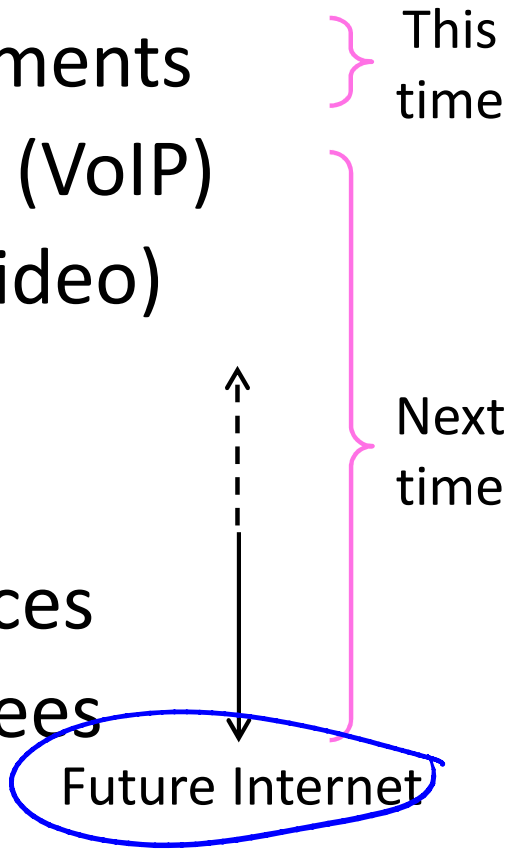
- HIGH stringency means high bandwidth, low delay/loss

Application	Bandwidth	Delay	Jitter	Loss
Email	Low	Low	Low	Medium
File sharing	High	Low	Low	Medium
Web access	Medium	Medium	Low	Medium
Remote login	Low	Medium	Medium	Medium
Audio on demand	Low	Low	High	Low
Video on demand	High	Low	High	Low
Telephony	Low	High	High	Low
Videoconferencing	High	High	High	Low

Variation in delay

Topics

- Application requirements
- Real-time transport (VoIP)
- Streaming media (video)
- Fair Queuing
- Traffic Shaping
- Differentiated services
- Rate/Delay guarantees



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