UPLINK AND SLOW TIME-TO-CONTENT

EXTRACT FROM THE
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Time-to-content is important to mobile broadband subscribers. A limited uplink can be a critical factor in causing slow time-to-content on many popular websites. With an efficient way to identify cells with low uplink coverage, focused improvements can be made to enhance overall user experience

Providing good network performance is an important differentiator for mobile operators, and has a significant impact on both subscriber loyalty and Net Promoter Score (NPS). Nonetheless, many mobile broadband networks do not consistently provide the performance required for a responsive experience. Often it is the speed of the downlink (from the network to the device) that determines a good time-to-content, as many popular apps receive more data in downlink than they send in uplink. However, once uplink speed drops below a certain threshold, it becomes the bottleneck, limiting the speed at which content can be transferred in downlink.

App coverage can be measured in terms of time-to-content, defined as the time from when a user requests online content until it is rendered on a smart device's display. Benchmarking some of the most popular global and local websites – including e-commerce, e-banking, news and entertainment – it was found that many pages require an uplink speed of at least 300 kbps to meet a target time-to-content of 4 seconds or less. Ultimately, it is up to each mobile operator to define app coverage targets depending on subscriber expectations.
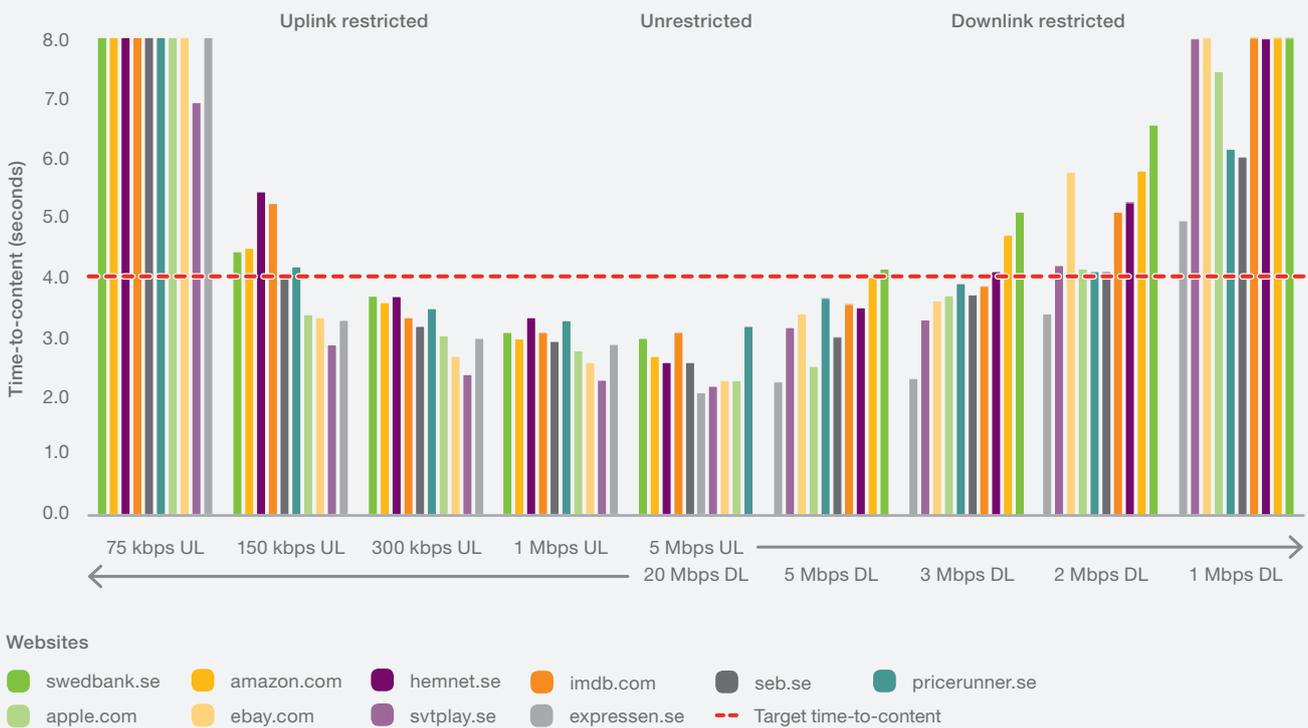
Downlink and uplink between a device and the network
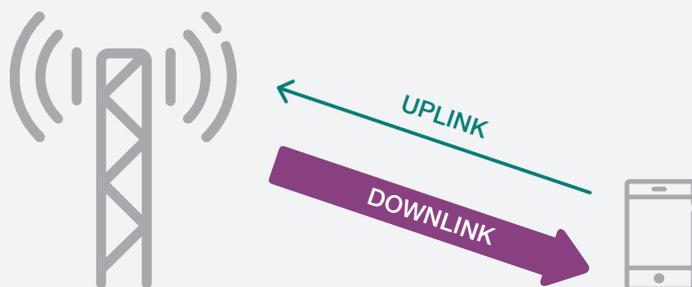
UPLINK

DOWNLINK

Many popular apps receive more data in downlink than they send in uplink. However, the uplink can have a significant impact on time-to-content

Impact of uplink and downlink on time-to-content

Source: Ericsson Smartphone Lab measurements

Websites: swedbank.se, apple.com, amazon.com, ebay.com, hemnet.se, svtplay.se, imdb.com, expressen.se, seb.se, pricerunner.se, Target time-to-content

Determining minimum uplink and downlink speeds

Time-to-content for popular websites is – in many instances – determined by the performance of the mobile network. This is because providers of popular content tend to ensure that the design and size of the content is optimized for smart devices connecting via mobile broadband, and that the content is served from a nearby cache server. A sample of popular web pages was benchmarked by repeatedly loading them on high-end smartphones while logging time-to-content. The smartphones were connected to the internet via an LTE lab network, where the uplink and downlink speeds of each device's connection were controlled.

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Two sets of measurements were performed. For the first set, the downlink speed was unrestricted while the uplink was set to a range of speeds by blocking LTE radio resources.

In the second set, the uplink speed was unrestricted, while the downlink was controlled in the same way.

A minimum uplink speed of about 300 kbps is required for a good time-to-content

The measurements showed that, with an unrestricted downlink (20 Mbps provided by the LTE lab network), an uplink of at least 300 kbps was required to consistently meet a target time-to-content of 4 seconds or less. On the other hand, with an unrestricted uplink (5 Mbps provided by the LTE lab network), there was a wide variation in how much downlink speed was required to render the content within the same 4 second target. In most cases, 1 Mbps was clearly insufficient, while time-to-content was reduced by 1 second or more as measurements were made at 3, 5 and even 20 Mbps in the downlink, depending on the website.

Mobile operators can address the lack of uplink coverage by densifying their network of radio base stations

Target time-to-content not being met in live LTE networks

LTE network performance statistics from metropolitan areas around the world were analyzed. It was found that the probability of a smart device not getting an uplink speed of at least 300 kbps can be as high as 20 percent during peak hours. Given that good time-to-content requires a minimum uplink speed and a minimum downlink speed, the probability of not meeting a target time-to-content of four seconds is even higher.

In some metropolitan areas, there is up to a 20% chance of not getting a sufficient uplink speed during peak hours

Analyzing the network performance statistics also revealed the root causes for limited app coverage. When the uplink was the limiting factor, it was typically coverage-limited, and when the downlink was the bottleneck, it was typically capacity-limited.

A lack of capacity essentially means that the amount of information that can be transmitted per unit of time is limited, and a companion article[1] addresses downlink capacity bottlenecks.

A lack of uplink coverage indicates that a device is too far away to reach the serving radio base station with a sufficiently strong radio signal. The radio transmitter in a smart device can only transmit with a maximum power which is a fraction of the power available to the radio transmitter in a radio base station. Uplink coverage is a challenge both in rural areas and densely populated urban areas with high buildings. Mobile operators can address the lack of uplink coverage by densifying their network of radio base stations.

Network performance statistics can be used to monitor and manage app coverage. This is leading to more efficient ways of identifying bottlenecks and their root causes, enabling operators to target improvements where they matter the most to their subscribers. It is important that network performance statistics are continuously monitored for each radio network cell, as averaging across many cells or for long periods of time may hide where and when a mobile operator's app coverage target is not being met.

Uplink speed has been identified as a cause of slow time-to-content when rendering popular web pages. As web pages continue to grow richer and new apps such as live streaming become more popular, the demands on uplink are ever increasing.

[1] Ericsson Mobility Report, Managing User Experience (June 2016), pp. 26-27

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