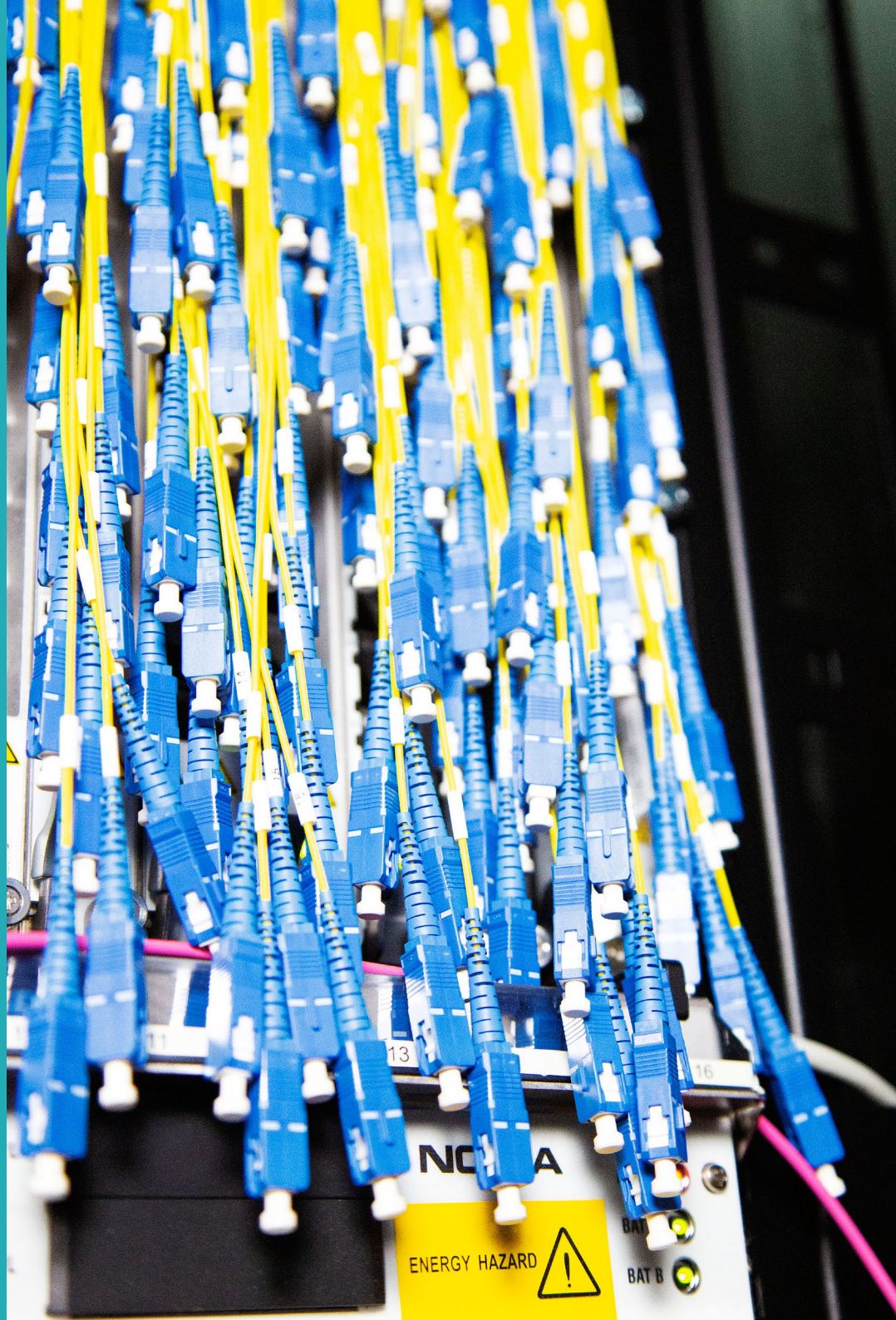
The art of forecasting broadband demand

Introduction

Forecasting bandwidth demand is one of the most important concerns of broadband operators. It affects business-critical decisions such as go-to-market strategy, network planning, and technology investment.

Under-predicting demand results in frequent network upgrades or an increased threat from competitors; over-predicting increases cost-per-user and creates a long return on investment.

In a residential broadband environment, demand is a factor of so many variables: the number of users per home; the number and type of connected devices; advances in video technology; the apps and services being used; changes in consumer behavior; and so on. And, of course, demand sees daily and seasonal variations as well as sudden shifts caused by long-term incidents such as COVID or short-term viewing spike for a major sporting event.



What drives bandwidth demand?

The access network traffic consists of sustained traffic and bursty traffic.

Bursty traffic is for example browsing or speed test.

Sustained traffic primarily consists of video streams including cloud gaming and VR.

Video traffic is by far the biggest component of sustained bandwidth demand. And will continue to be so as the bits per video stream is increasing.

Video delivery is transitioning from being primarily multicast to being primarily unicast. Fixed broadband forecast should be modeled for all unicast video delivery.

The advances in video compression continue to slow down the growth in video bit rate. The long-time trend gives 50% fewer bits/second every 10 years continues.

Speed testing is important for regulatory compliance and competitive reasons.

The results of speed test should achieve the advertised broadband service rate even during times of peak sustained traffic.

At a minimum, the access network must be dimensioned to support the modelled future sustained traffic plus sufficient headroom for speed testing and other bursty traffic.

The many dimensions of video

Video is the biggest driver for bandwidth growth. However, not all video is the same. Live TV services, premium video on demand (VoD), and over-the-top (OTT) internet video services, as well as cloud gaming and VR apps all have varying characteristics. For each year we must consider:

The number of simultaneous streams per home in peak hour.

How many of those streams are cloud gaming or virtual reality (VR).

The video resolutions of each of those streams.

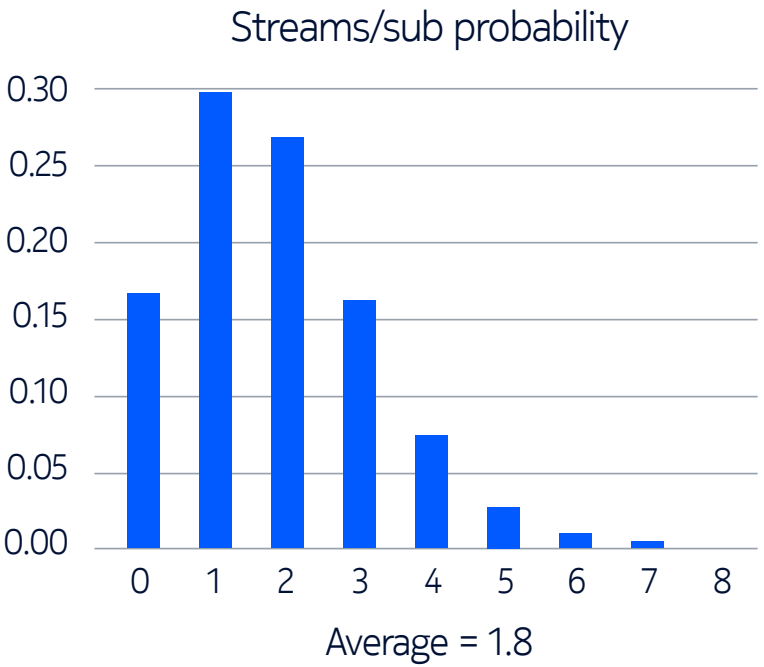
For each resolution, the required bit rate.

These factors vary from user to user, so we assume moderate and heavy usage scenario. A statistical modelling method—the Monte Carlo probability model—then looks at all these elements and can then determine the volume of sustained video traffic demanded for a desired percentile of simulations. And as we must plan our networks to cope with maximum expected usage, we must consider demand during peak hours.

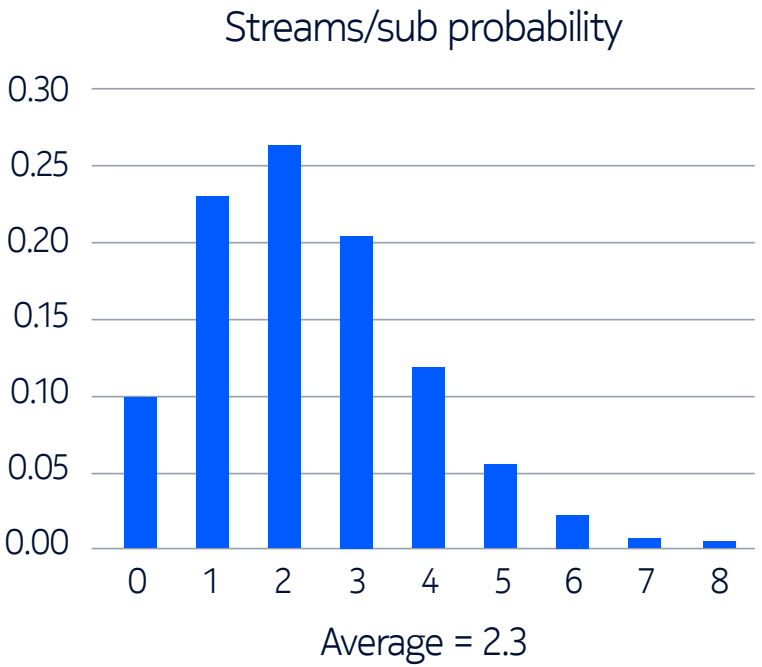
Simultaneous streaming

We first need to look at the average number of streams per home at any one time (all types of video combined). In any type of modelling, we should consider different scenarios. Here, we have chosen two: a moderate usage and a heavy usage scenario. The reality is expected to fall somewhere between the two. A moderate scenario uses an average of 1.8 simultaneous video streams per subscriber and a heavy scenario uses an average of 2.3 simultaneous video streams—perhaps the parents watching Netflix while the kids are on YouTube.

Moderate scenario

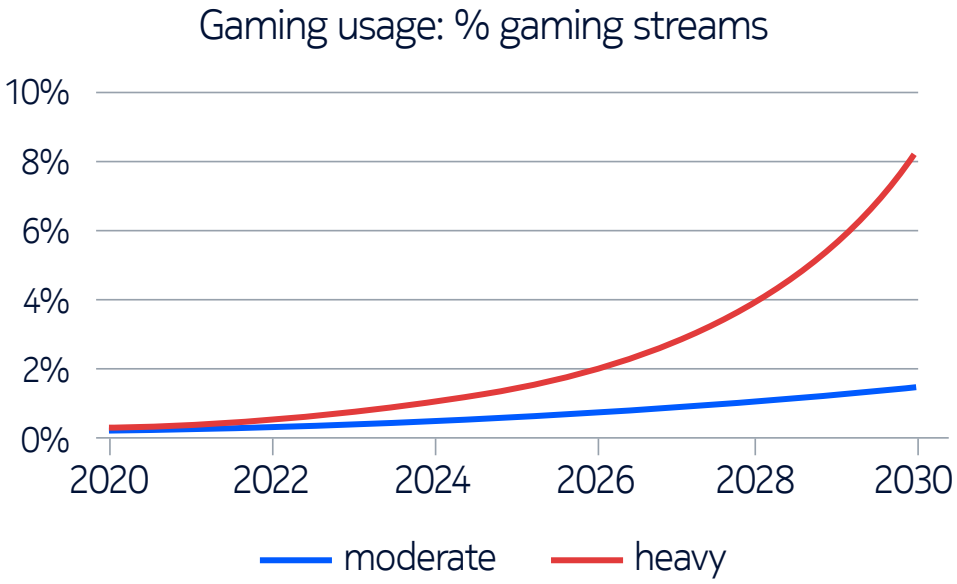


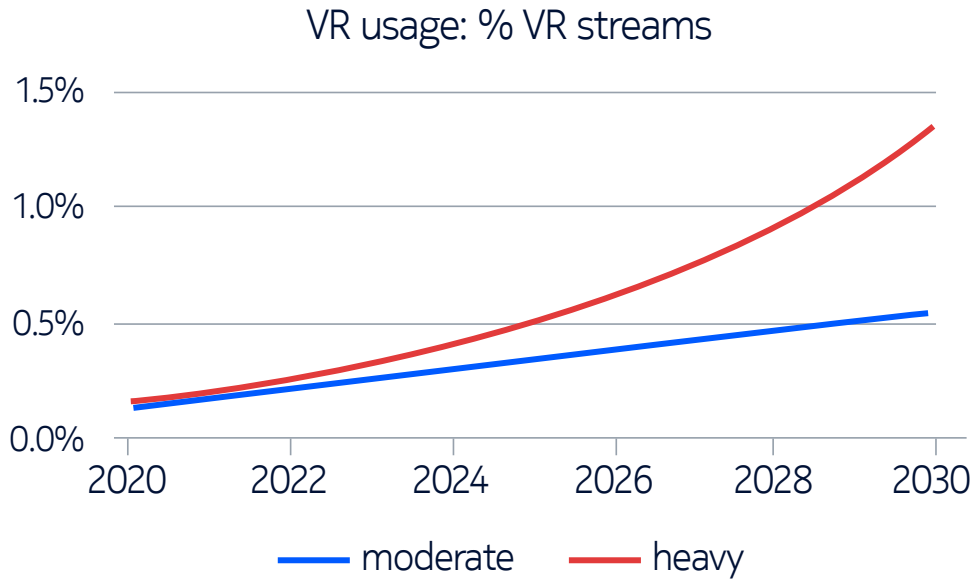
Heavy scenario



Percentage of video streams that are cloud gaming and VR

Cloud gaming and VR are emerging ways of consuming video and are being adopted at different rates in different markets. In comparison to streamed live and on demand video, they demand a higher bitrate per stream and, hence, consume a greater share of a broadband network's capacity than the share of streams. We need to consider the percentage of all simultaneous streams that are either cloud gaming or VR as they place greater demand on our networks. We can again devise moderate and heavy forecast patterns and their growth over time.

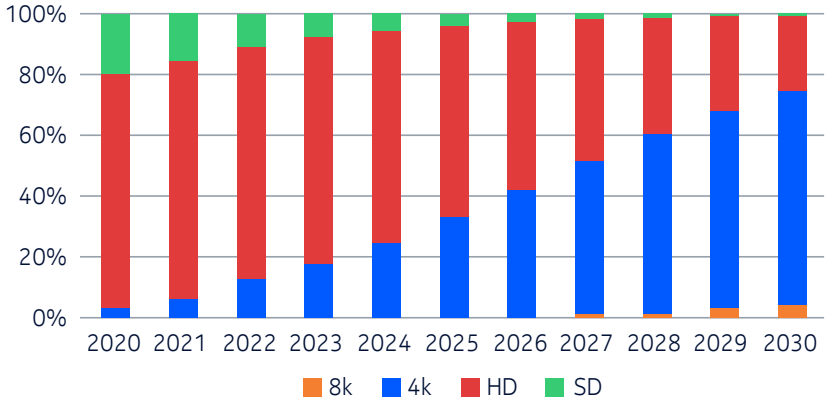




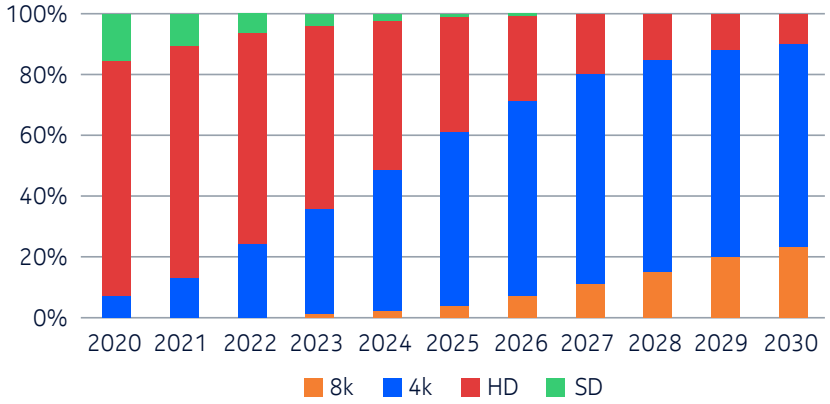
Video resolution

Another factor that varies by market is the adoption of higher resolution TV and device screens. We can forecast the evolution of the probability distribution of SD, HD, 4K (UHD), and the latest 8K formats, using a typical S-curve for the adoption of new formats. A heavy scenario assumes a faster adoption of 4K and 8K devices.

Video resolution forecast, moderate scenario

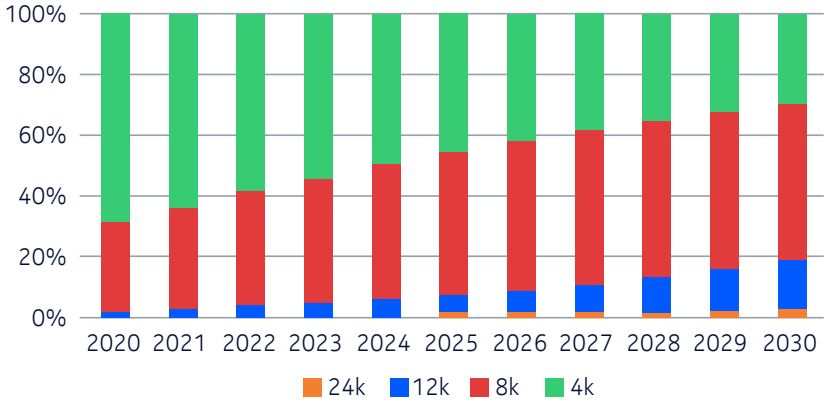


Video resolution forecast, heavy scenario

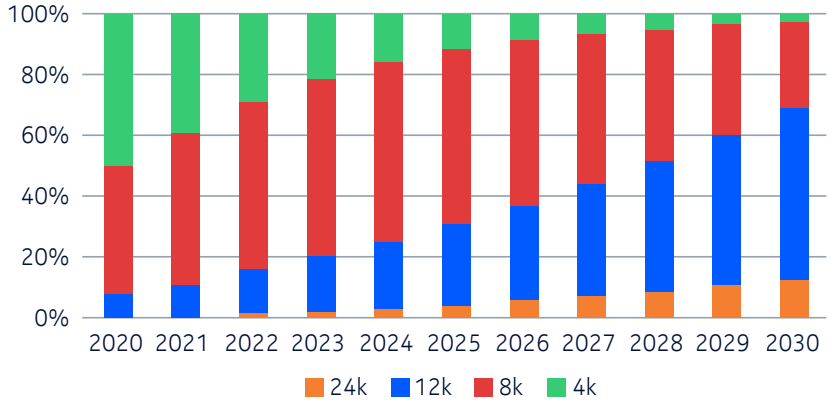


The same resolution acceleration is occurring in VR as well.

VR resolution forecast, moderate

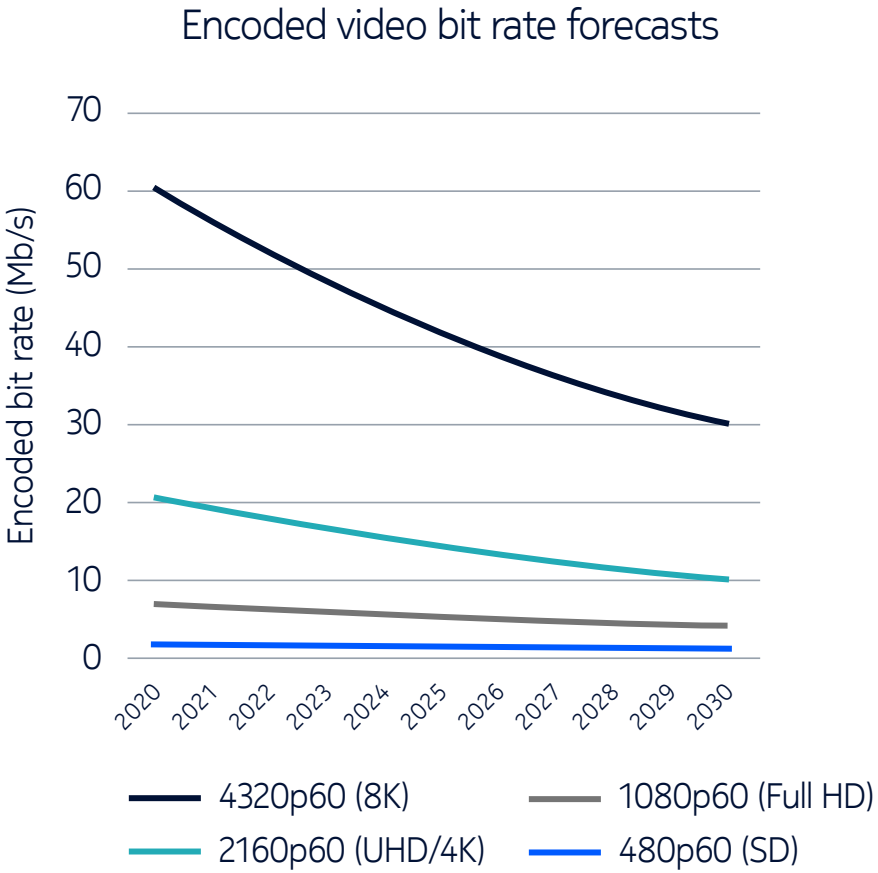


VR resolution forecast, heavy



Video bit rates

While all the trends covered so far push bandwidth demand in one direction—up—there is one trend working in the opposite direction. Video compression technologies improve over time and mitigate, to some extent, the increased information rate of higher resolution video. Other techniques also exist, such as transmitting the area surrounding the field of view for VR, reduces the load on networks but requires very low latency.



Don't forget the bursts

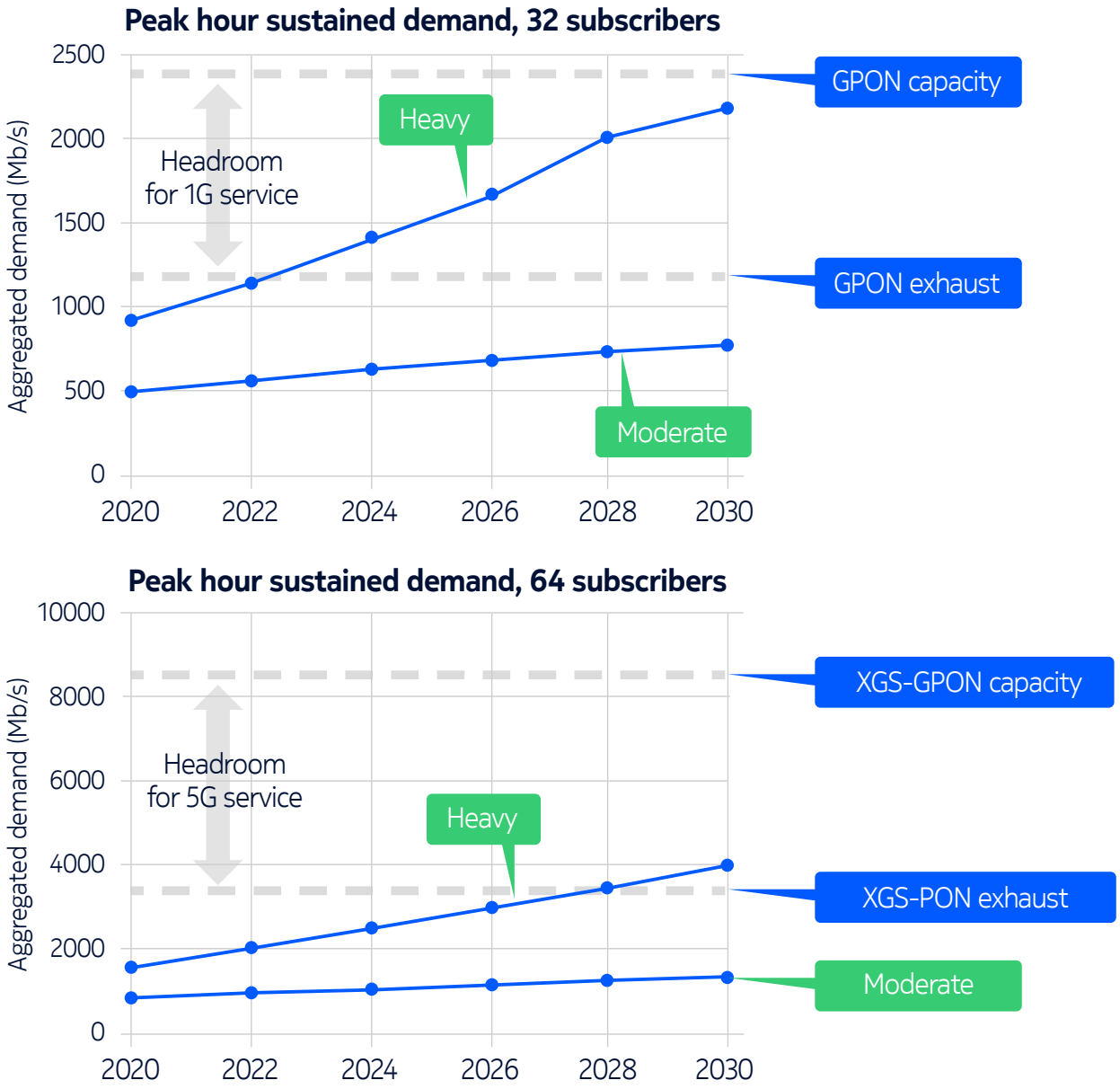
The thing about customers is that, if they're paying for a service level, they expect that service level at any time. So, if a customer on a premium Gigabit service decides to run a speed test, they don't care that it's a busy time for video traffic: they want to see their Gigabit.

Therefore, broadband operators must leave headroom—an additional amount of capacity equal to or higher than the top service level above the forecasted sustained traffic—to deal with these bursts in traffic, including speed tests.

Symmetrical or asymmetrical?

Is broadband demand becoming symmetrical? Most consumers download far more data from the network than they upload to the network. In any 24-hour period, therefore, network traffic can be considered asymmetrical (total downstream and upstream traffic are not the same). However, most consumers regularly generate occasional bursts of high-bandwidth upstream traffic, for example for video calls or cloud services. Therefore, networks today must be configured to accommodate high-upstream or symmetrical bandwidth. Symmetrical services are also a powerful marketing tool, especially when competing against cable operators.

Broadband demand forecast 2020-2030



New digital behavior, increased usage of video services and the all-important headroom factor are the basics for forecasting bandwidth demand to 2030. This is where the limitations of a technology become apparent. Offering a Gigabit premium service on a GPON network carries a risk, as bandwidth start to eat into the headroom needed to support a sudden Gigabit burst over sustained traffic. In a heavy usage scenario, the headroom could already be gone. In contrast, XGS-PON has the capacity to deal with both sustained and bursty traffic and multi-gigabit speed tests for years to come.

Conclusion

To cope with relentless traffic growth, broadband operators need to make wise decisions about network upgrades. Video continues to be the biggest driver of downstream bandwidth demand and deservedly gets the most attention when planning for the future. Fortunately, it is reasonably predictable. The adoption of VR or 8K TVs have, by and large, settled into forecastable patterns.

Unpredictability comes from those sudden burst traffic. That's why headroom is so important for protecting service levels and keep customers satisfied.

Time is running out for GPON. It has been with us since 2007 and, while it is used around the world to successfully deliver Gigabit services, the forecasts we've explored suggest that GPON's capacity will be exhausted by the end of the decade.

So, the time to start planning for XGS-PON and 25G PON is now!

For more information about Nokia's broadband solutions, click here.

Nokia OYJ
Karakaari 7
02610 Espoo
Finland

Tel. +358 (0) 10 44 88 000

CID:212551

At Nokia, we create technology that helps the world act together.

As a B2B technology innovation leader, we are pioneering the future where networks meet cloud to realize the full potential of digital in every industry.

Through networks that sense, think and act, we work with our customers and partners to create the digital services and applications of the future.