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AR uptake enabled by mobile networks

Extract from the Ericsson Mobility Report

June 2023

AR uptake enabled by mobile networks

Video, messaging and multimedia services currently dominate mobile broadband network traffic, with most of this coming from video streaming. However, as AR traffic grows, questions about network coverage, capacity and performance will need to be addressed.

Key insights

- Growth in devices and applications using AR in wide-area use cases is expected to accelerate in the latter part of this decade.
- Mobile networks will need to be re-dimensioned to handle the traffic and performance requirements of these new real-time services.
- The solution will be a combination of additional spectrum and new functionality offering greater efficiencies, complemented with increased Radio Access Network (RAN) density.

AR enables users to experience information or digital objects overlaid onto views of the physical world. The level of augmentation can vary from a simple display of information to fully realized digital objects that adapt to the dynamic environment, moving as if they were physically present in it, with multiple users simultaneously interacting with them. These new services hold the promise of a leap forward in the digitalization of industrial and business processes as well as offering new ways to communicate. Consumers will also benefit, as these technologies are applied to entertainment, gaming and social media.

The AR ecosystem is moving toward a tipping point when all the key elements are sufficiently developed to support services at scale, and this is expected in the latter part of this decade. Critical elements in the ecosystem include attractive devices and applications, enabled by computation offload to the edge cloud, which will need high-quality mobile connectivity.

Consequently, parameters have been defined to model a scenario which enables radio network capacity to be compared with expected traffic demand, and explores alternatives for increasing radio network capacity sufficiently to support the growth of AR services.

Methodology

Data from Los Angeles, a city dominated by a dense urban low-rise landscape, was used to simulate the network impact of combined mobile broadband and AR traffic. This was done under a range of assumptions around AR uptake through 2030. The aim was to explore the operating conditions under which mobile networks need to be prepared for increased requirements, and the additional radio network capacity that will be needed to handle the projected demand.

Mobile data traffic forecasts were taken into account to define growth rates, along with the AR traffic scenario. The forecasts project average monthly mobile data traffic per device in GB, as well as total mobile traffic in EB per month.

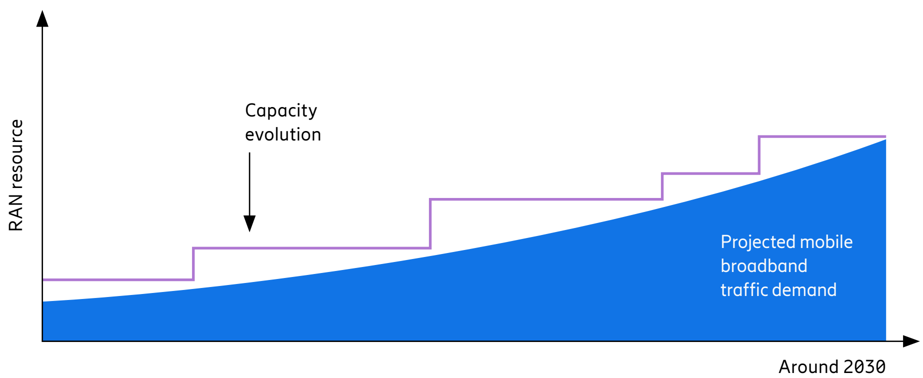
Ericsson simulations show that radio network capacity in areas like Los Angeles will narrowly meet mobile broadband traffic requirements around 2030.

This assumes all currently available spectrum is deployed, and takes industry projected 5G performance evolution into consideration. In particular, uplink will face challenges in meeting the projected traffic demand. Already, there is a need for additional capacity, for example through added mid-band spectrum.

Spectrum used in simulation:
- 2x20 MHz low-band FDD
- 2x40 MHz mid-band FDD
- 1x120 MHz mid-band TDD
- + mmWave

Mobile broadband traffic and simulation parameters for 2030:
- subscriber density: ~10,000/km2
- number of subscribers constant over time
- average macro layer inter-site distance: 700 m
- total traffic demand (uplink and downlink): 63 GB per month
- uplink share of total traffic demand: 15 percent
- share of traffic during a busy hour: 10 percent
- busy hour uplink throughput per subscriber: 69 kbps

Figure 28: Mobile broadband traffic and capacity evolution



Given the development of the AR market, AR users are likely to demand radio network capacity in the same timeframe. Several scenarios could play out, each with different capacity requirements, above projected mobile broadband traffic demand. Projections of AR glasses' unit volume growth through 2030 show a ramp-up of sales to 20–35 million glasses by 2030 in North America. Assuming a renewal rate of around 30 percent, this could indicate an installed base of 30–50 million AR headsets by 2030 – equal to 10–15 percent smartphone subscription penetration.

Mobile broadband and AR applications differ in the type of traffic they generate. AR uptake will drive significant capacity requirements in the radio network, depending on the level of cloud computation offload and usage. Relative to (best-effort) mobile broadband, an AR user will consume more bits due to continuous high-resolution video streams as well as edge cloud computation offload.

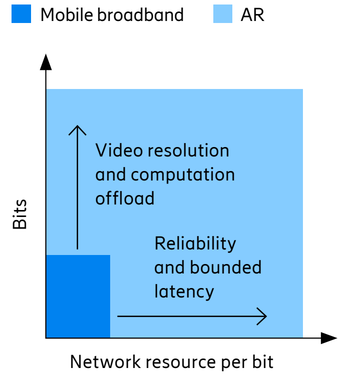
In addition, AR drives higher radio network resource consumption per bit due to its stringent margins for the bounded latency and high reliability necessary to realize a good user experience. The difference between mobile broadband and AR traffic is especially significant for uplink traffic. Figure 29 illustrates the impact of an AR user, relative to a mobile broadband user, on mobile radio networks during the busy hours.

Traffic profiles were simulated in a computation offload scenario for AR (peak traffic speeds of 50 Mbps downlink and 10 Mbps uplink) with a traffic profile of heavy use for 2 hours per day. Bounded latency was set to 20 ms round trip time and reliability to 99 percent. The results were then compared with traffic projected for a mobile broadband user by 2030. Capacity requirements in this scenario increase significantly for both uplink and downlink, however as uplink is predicted to be the bottleneck, the results presented will focus on uplink.

In this scenario, the simulation indicated AR users would consume (in uplink) around three times the bits during the busy hour relative to a mobile broadband user. Each bit would require on average four times more radio network capacity relative to mobile broadband best-effort. This totals 12 times (3x4) more uplink radio network capacity requirements than a mobile broadband user in this timeframe.

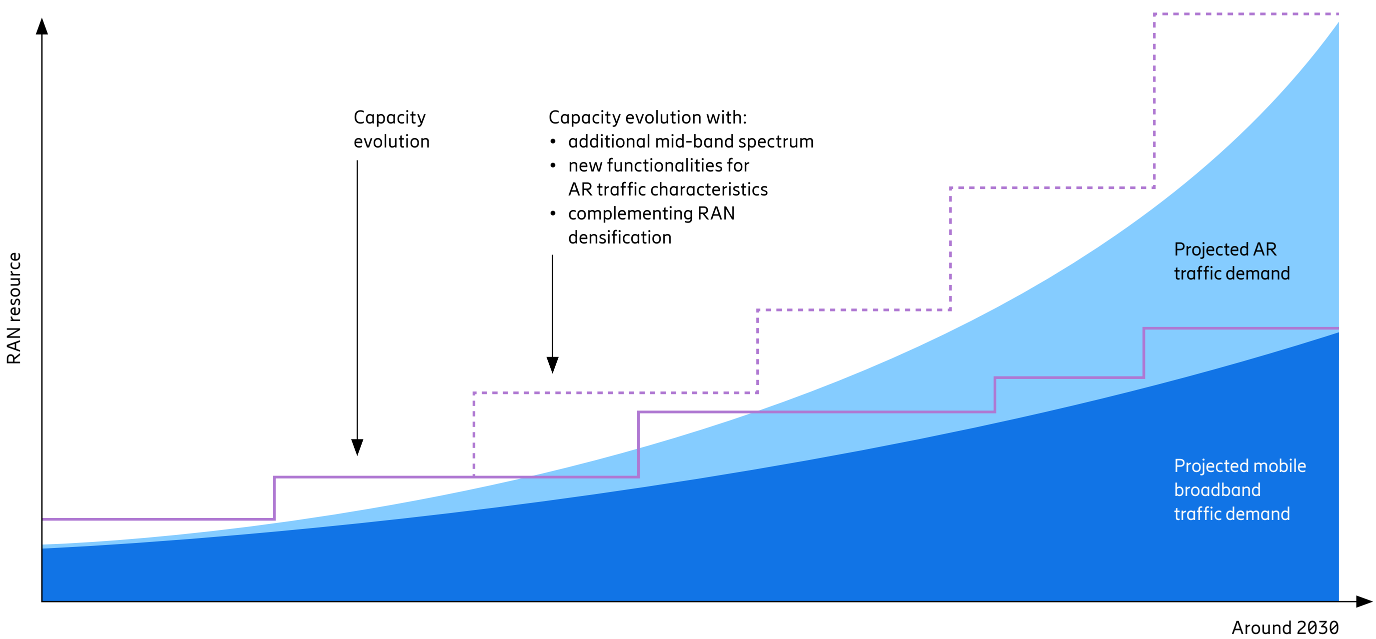
Consuming 12 times the capacity of mobile broadband users over a busy hour will put significant requirements on the network for a relatively low user penetration. With the 10–15 percent penetration range (taken from the estimated installed base of AR glasses above), we see a relative increase of more than double (2.1–2.7 times) the uplink traffic load compared to a network with only mobile broadband traffic. The increased traffic load puts additional requirements on network performance to be able to supply the extra capacity.

Figure 29: Radio network resource consumption (busy hour)



Stringent delay requirements (bounded latency) and limited packet loss (high reliability) are needed for emerging real-time applications such as AR. This can be achieved by adopting more conservative operating parameters in the RAN, in essence, using more network resource to deliver a given amount of traffic. Additionally, an AR user will consume more bits.

Figure 30: AR and mobile broadband traffic and capacity evolution



There are several solutions to address this:

- Additional mid-band spectrum will be needed for increased capacity. Depending on the country, additional mid bands may be within the 3.3–4.2 GHz, 4.4–5 GHz and 6.425–7.125 GHz frequency ranges. Some of the 3.3–4.2 GHz and 4.4–5 GHz bands have already been licensed in parts of the world and there is a device ecosystem with support for those bands. The 6.425–7.125 GHz band is currently under discussion for IMT identification at this year's ITU World Radiocommunication Conference 2023 (WRC-23) and an ecosystem is under development, noting that the band is already included in 3GPP standards (3GPP n104). The 6.425–7.125 GHz band is a key opportunity for large-scale harmonization of wide-area licensed use and, in many cases, the last available mid-band resource.
- New functions to increase capacity and improve coverage are needed. One example is intelligent steering of traffic to spectrum bands based on both throughput and latency requirements. Another example is optimized scheduling to reduce latency and increase reliability by allowing additional retransmissions within a given latency budget.
- RAN densification will help – however, it is associated with high costs and long lead times.

None of these solutions will be sufficient on their own to address the capacity gap toward 2030 in the studied AR scenarios; a combination of all three will be needed to satisfy future network demands. Mobile broadband traffic, plus a scenario of AR traffic uptake, combined with an assumed level of cloud computation offload indicates significant network load demand.

Toward 2030, this demand will not feasibly be met by the available spectrum and 5G performance evolution on an existing site grid. Adding spectrum and functionality on existing sites would be the first steps, with network densification as a complement where and when needed. In the long term (2030 and beyond), the centimetric range 7–15 GHz will be essential to support AR uptake and more advanced use cases.

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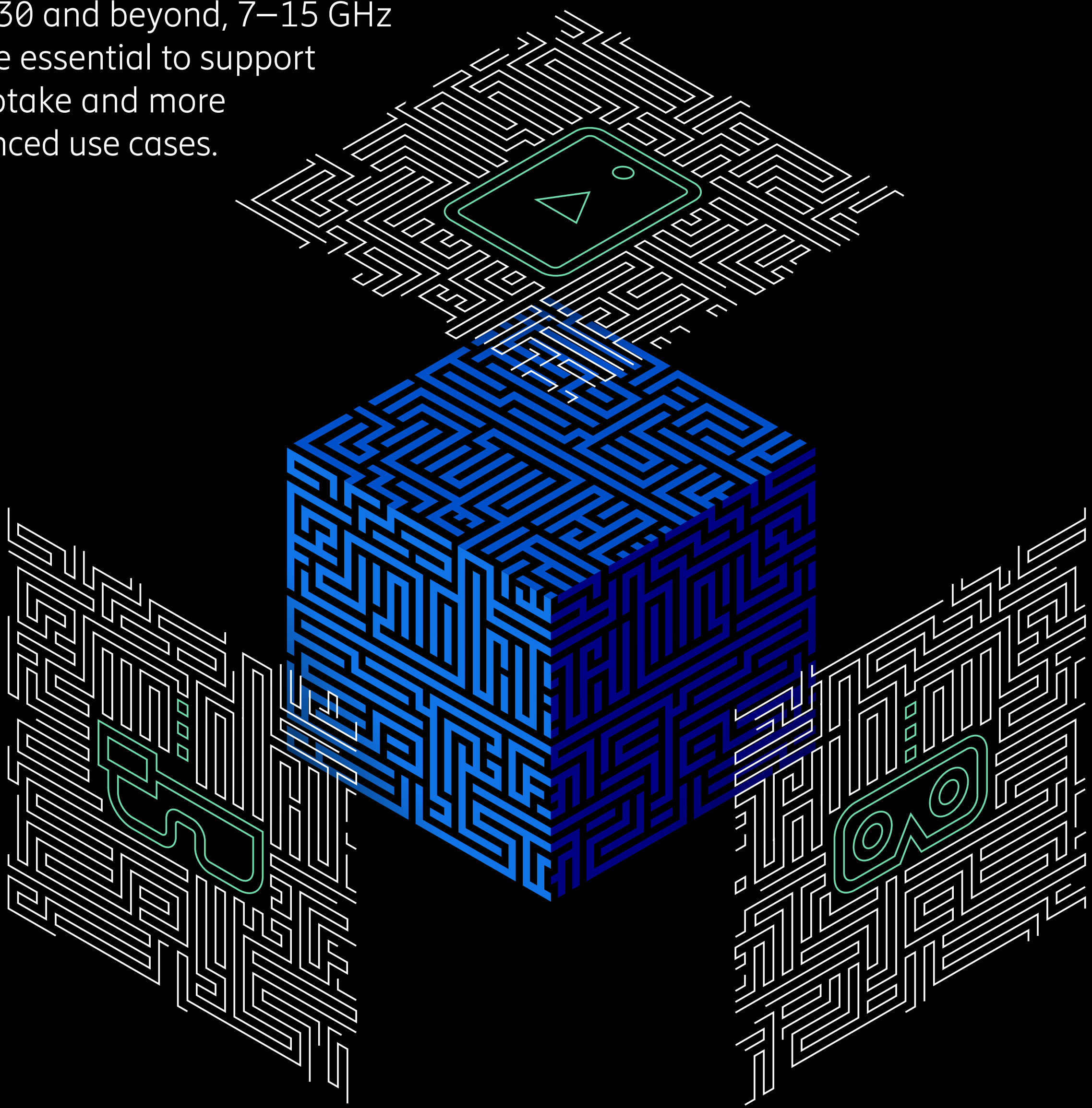

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