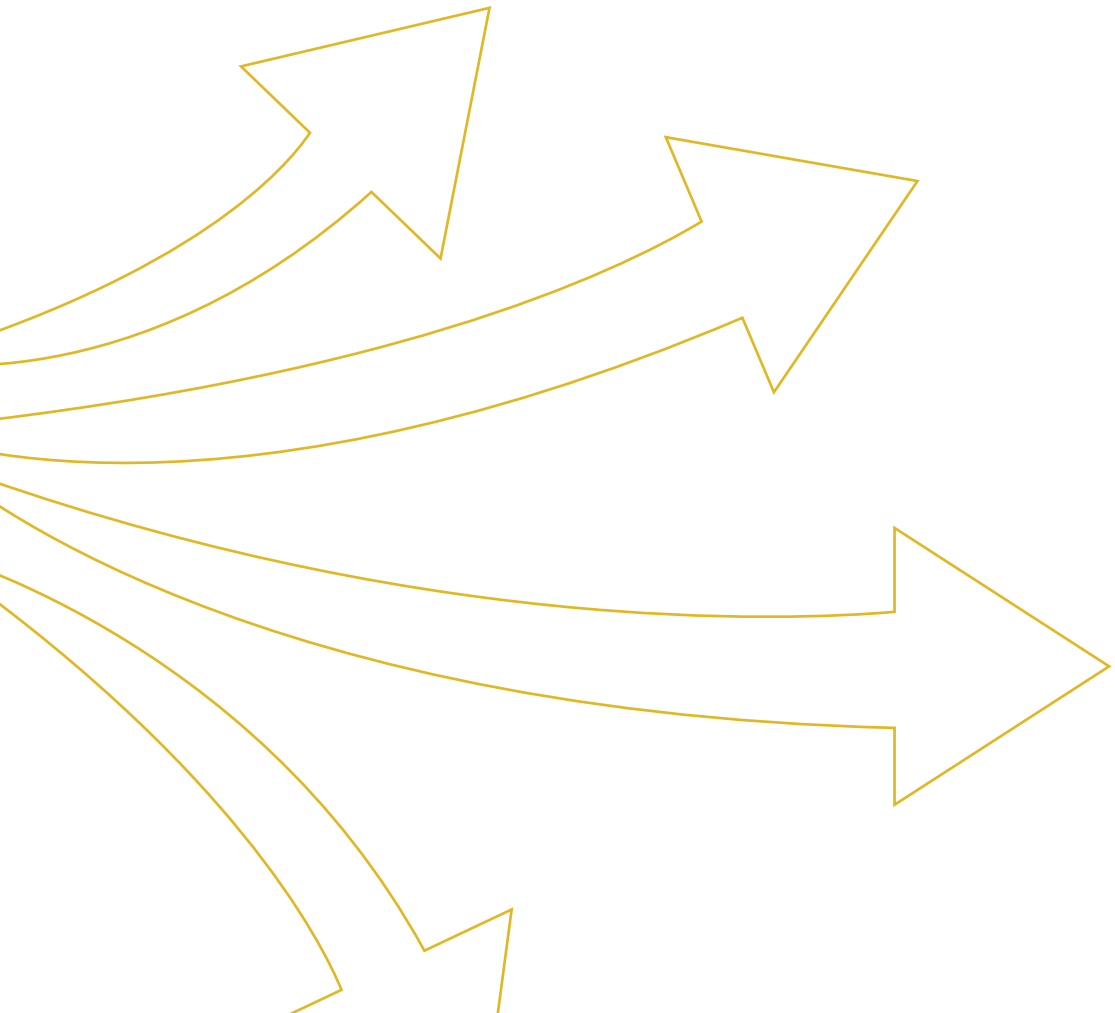
TERACOM

Teracom White Paper:

Can the cellular networks cope with linear radio broadcasting?



Contents

Teracom is part of the Teracom Group. It is a fully integrated pay-TV operator, and it owns and operates terrestrial broadcasting networks for DTT, FM and DAB/DAB+ in Sweden and Denmark.

Background

In Sweden, the radio industry, commercial and public service broadcasters and the government are in agreement concerning the need for a switchover from analogue FM radio to DAB+ digital radio.

Digitisation has many advantages. The listeners gain access to more channels, a wider selection and the opportunity to access new services. As far as the industry is concerned, this means lower distribution costs in the long term and better competition as commercial radio can be broadcasted nationwide and reach more listeners.

The government's premise is that the switchover to digital radio must be fully implemented by 2022. According to the government's strategy, DAB+ or compatible technology should be used for terrestrial digital audio broadcasting.

A change in technology is always a difficult and almost traumatic decision to make; there is a lot at stake and such a decision is easy to criticize. One of the major criticism is that "there is no need for terrestrial radio" since "the cellular networks will handle the small traffic generated from radio listening".

But what would happen if the analogue FM network were switched off in 2022 and not replaced with a digital terrestrial network (DAB+ or compatible technology), and instead the MNOs' (mobile network operators) cellular networks were used for distributing radio to consumers? Teracom commissioned A-focus to analyse this scenario from an objective and technology-neutral perspective.

The purpose of this White Paper, based on A-focus' analysis, is to show the economic, functional and technical conditions for such a scenario. The report directs the key issues decision makers need to understand concerning such a scenario. A-focus has engaged the services of the technology consulting company ÅF for technical calculations and consultations. A-focus has based estimates regarding radio listening on data from Nordicom's surveys and official statistics on radio listening in Sweden[1].

a-focus

goran.hedstrom@a-focus.se
08-679 99 00

The A-focus original report can be ordered free of charge through Lotta Darlin, Teracom. lotta.darlin@teracom.se

[1] Nordicom-Sveriges Mediebarometer 2012.

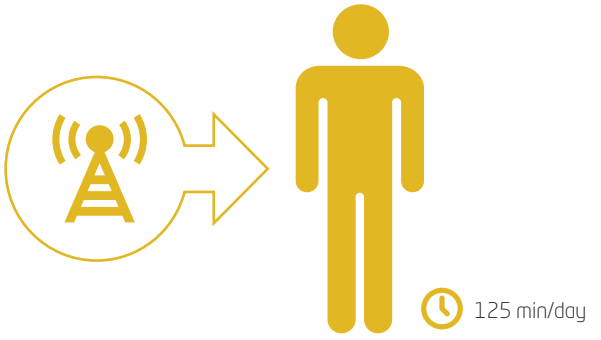
Companies and organisations contacted in the study: BBC, Ericsson, Huawei, The Swedish Ministry of Culture, The Swedish Broadcasting Authority, The Swedish Civil Contingencies Agency, The Swedish Post and Telecom Authority (PTS), SBS Radio, SR, Tele2, The IRM Institute for Advertising & Media Statistics and Teracom.

The radio today

Radio listening in Sweden

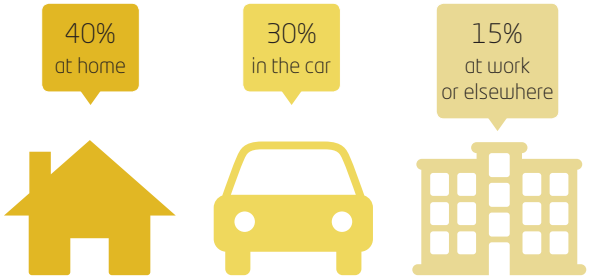
On an average day, 5.9 million Swedes listen to the radio for an average of 125 minutes per person. That corresponds to 270 billion listening minutes per year. What is more, a large proportion of this listening takes place in the car; 6 out of 10 car drivers listen to the radio each day for an average of 50 minutes each[2].

On an average day, 5.9 million Swedes listen to the radio for125 minutes per person.

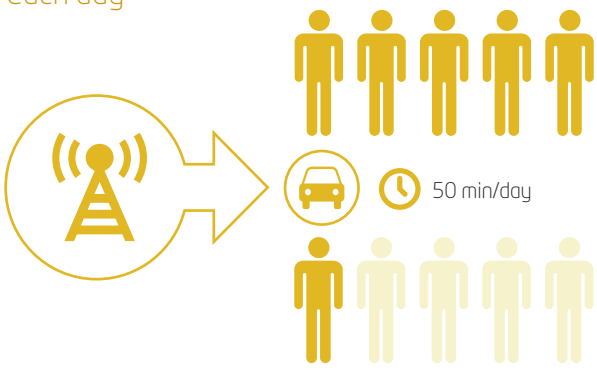


= 270,000,000,000 min/year

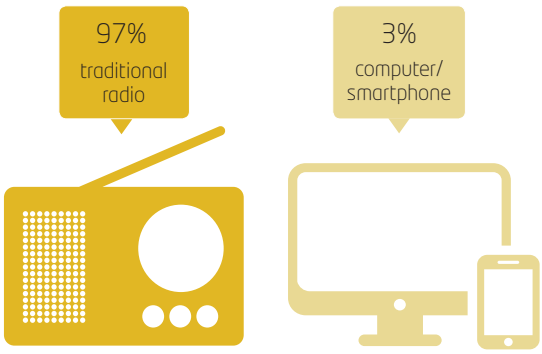
Where do we listen to the radio?



6 out of 10 drivers listen to the radio each day



How do we listen to the radio?

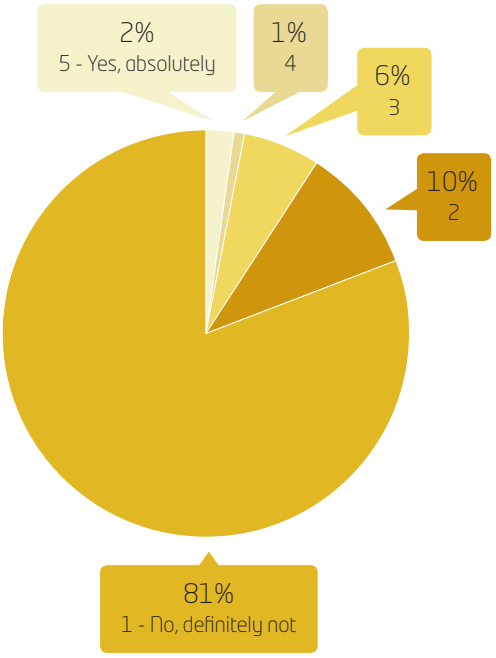


[2] Nordicom-Sveriges Mediebarometer 2012. TNS-SIFO, A-Focus.

Willingness to pay

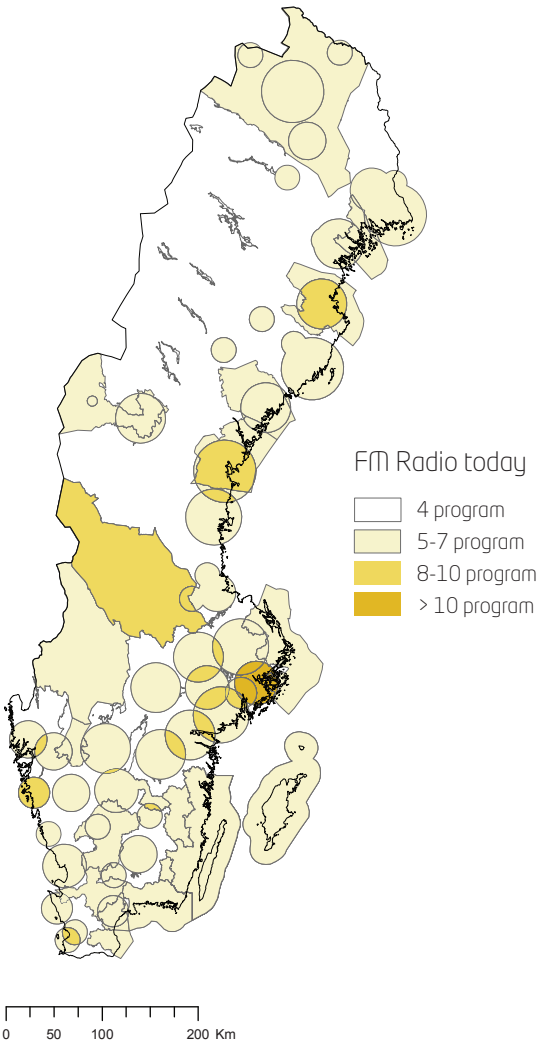
The broadcasters are convinced that radio must be free for the consumers, mainly because they assume there is no willingness among consumers to pay for radio. This view is confirmed by market research performed by A-focus, in which a random sample of 400 radio listeners were asked whether they were prepared to pay a monthly sum to listen to the radio to gain access to more channels. The respondents were asked to grade their answers on a scale from 1-5, where 1 was 'No, definitely not' and 5 was 'Yes, absolutely'. The study shows that an alternative business model to the one used today, where radio broadcasters pay for distribution and radio is free for the listeners, is not possible, irrespective of the technology that is used.

Would you be prepared to pay SEK 50 a month to listen to the radio if you then gained access to more radio channels?



Radio channels in Sweden today

Today, the majority of Swedes, in addition to very local community radio, only have access to an average of six FM channels – four channels from public service broadcaster (Swedish Radio, SR) and two channels from commercial broadcasters (SBS radio and/or MTG radio). Digitisation will provide a wider range of channels (up to the constraints established by the frequency allocations), but it has not yet been determined how many digital radio channels will be licensed and broadcasted. In this study, a reasonable assumption is made that, on average, the listeners will be able to access 25 radio channels in each geographical location. This means that each base station in each of the MNOs' cellular networks must consequently allocate capacity for the broadcasting of at least 25 radio channels at the same time.



Challenges

A network for radio broadcasts must be able to cope with big challenges; the broadcasts must be able to reach practically all listeners across the entire country at any time.

Large amounts of data

The distribution of radio programmes (the entire audio production from the broadcasters) requires a very high transmission capacity. On an average day, approximately 5.9 million Swedes listen to the radio for 125 minutes per person. That means that the total radio listening amounts to 270 billion minutes per year. This figure is ten times more than all the outgoing voice calls in the cellular networks of all MNOs in Sweden throughout the entire year of 2012.

However, radio in cellular networks will, of course, not be distributed as voice, but rather as data. To convert 270 billion minutes per year into data, we use a transmission rate of 96 kbps/channel and determine the equivalent to be 190,000 Terabytes of data per year. This amount of data is more than all the incoming and outgoing data that was transferred in all cellular networks in Sweden in 2012.

The bit rate of 96 kbps corresponds to an acceptable level of audio quality; it is the lowest quality available on Spotify today and a quality that public service broadcasters describe as “medium” in their online offerings. Furthermore, radio listening is predicted to increase from the current 125 minutes per day to about 150 minutes per day as we move into digital broadcasting and a subsequent increase in the number of radio channels. However, at the same time, there are trends that point in the opposite direction. Spotify and other online audio services may take a small proportion of listening time from linear radio.

The total radio listening over one year corresponds to 193,000 Terabytes. That is more than all the incoming and outgoing data that was transferred in all the cellular networks in Sweden in 2012.

All in all, this means that the total listening of linear radio broadcasts in Sweden represents an enormous volume of data that will need to be transferred. Even if the amount of listening does not increase, the infrastructure and the network that are to carry the digital radio of the future require a very high capacity.

High demands on coverage

The coverage for broadcasted radio in Sweden must reach 99.8 per cent of all residential households. This requirement is imposed on public service broadcaster (SR) by the Swedish Parliament. No requirements on area or surface coverage exist today. Nevertheless, it is implied by the licensing terms that broadcasted radio must reach far beyond simply covering residential households. Coverage along trafficked roads is especially important, as a large proportion of listening takes place in cars. Population coverage of 99.8 per cent of households automatically gives area coverage of about 90 per cent using the terrestrial network. This area coverage is today achieved with Teracom’s network, which consists of about 54 major sites (high masts) and about 130 smaller sites (low masts). There is no reason to believe that the requirements on coverage will decrease in the future. The digital radio broadcasts of the future must have at least the same coverage as a person would experience with FM today. For this to happen in the cellular networks, there is a need to densify the current number of sites considerably.

The cellular networks in Sweden are gradually expanding their geographical coverage. The MNOs report that the LTE networks already, or will soon, cover 99 per cent of the population. However, according to the Swedish NRA (National Regulatory Authority), sample field measurements show that there

are inadequacies in these statements. The coverage maps used by the MNOs to confirm their statement are, in many cases, exaggerated. True enough, the MNOs are gradually expanding their cellular networks, but they have a long way to go until they achieve complete coverage, particularly in rural areas. MNOs will probably never reach 99.8 per cent of all households, which is the requirement imposed on broadcasted radio. NRA's measurements show similar or worse results for data services in the cellular networks.

Is new technology the solution?

Distribution of radio in cellular networks presents many technical challenges.

• The cellular network must be able to deliver linear radio to everyone, at all times, even under extraordinary circumstances. There will be situations when it is necessary to reach many people via an EPW (Emergency Population Warning).

• The requirements on coverage that are placed upon public service radio also include a requirement on audio quality. In practical terms, this means that technical solutions for the distribution of radio must deliver high audio quality over a stable, non-interrupted transmission medium. This is something that is also important for the commercial radio channels.

• A large proportion of radio listening takes place in the car. When the listener is moving away from the area covered by one cell and entering the area covered by another cell, the data connection is transferred to the second cell in order to avoid interruptions or a dropped connection. In order to be considered a realistic alternative to DAB (or FM), a cellular network must also be able to handle traffic peaks and spikes as well as seamlessly hand over radio listeners between base stations.

• New technology also imposes new demands on consumers. Today, approximately 1.2 million Swedes (14% of adults) have pretty much never been on the Internet because they have no access, they cannot afford it, or they are not interested. Many people would quite simply not be able to manage to listen to radio on e.g. a smart-phone. If public service radio is meant to reach everyone, which is the requirement from Parliament, then this “digital divide” will be a problem.

What is required?

Can new technology overcome the challenges? New standards and technologies such as UMTS/HSPA and LTE mean that the cellular networks can deliver the data speeds (bps) that are required for audio radio.

The eMBMS (evolved Multimedia Broadcast Multicast Service) or LTE-broadcast technologies must be consistently used if the cellular networks are to be able to deliver radio to many simultaneous listeners within a limited area as well as to sufficiently cope with radio listeners who are on the move, e.g. in cars.

• The MNOs would need to invest in software licences in order to upgrade all the radio base stations (eNodeB) in their LTE networks so as to be able to handle eMBMS functionality as well as invest in hardware and software for new entities in LTE networks, such as BM-SC (Broadcast MulticastService Center), eMBMS gateway and MCE (Multi-cell/ Multicast Coordination Entity) for example.

• The use of eMBMS in a cellular network also affects the distance allowed between the base stations. In order for it to work, the distance between LTE radio base station sites must be a maximum of approximately 5 kilometres. A concentration of radio base station sites along country roads and in rural areas would probably be required.

• eMBMS is a completely unproven technology on a larger commercial scale. There is still no cellular network anywhere in the world that uses eMBMS for commercial services. Thus, today, there is no market for the manufacturers of cellular network equipment. The prices are probably in accordance with this.

• eMBMS makes it possible to handle many simultaneous radio listeners within a limited area and, under certain conditions, also streamline the radio communication efficiency in the cellular network. With eMBMS, capacity in LTE networks

can be allocated constantly or during a limited time period. This guarantees that audio streams can also be delivered when the networks are experiencing high traffic and spikes. However, this occurs at the expense of the capacity for other services in the networks.

Today, no MNO in the world offers services based on eMBMS (other than in very limited tests). It will be costly to introduce eMBMS, and the preferred effects in reality will not occur as often as needed for the MNOS to bear these costs. So the question must be asked if this is a feasible change of technology. Radio is already currently distributed throughout the entire country to all listeners, at all times, using the terrestrial network's 54 large broadcasting masts and additional smaller masts. To achieve equivalent coverage in the cellular networks, MNOs would have to be broadcasted over estimated 20,000 sites, in addition to introducing eMBMS consistently in all sites.

Costs

The cost of broadcasting digital radio via the terrestrial network is estimated to be EUR 15-20 million per year. The calculations are based on all listeners having up to thirty radio channels with national coverage at their disposal. The yearly cost includes everything that must be in place to build and operate a digital radio network, including interest and depreciation for initial and yearly investments.

If radio is to be distributed in cellular networks, the major issue is the cost of the data capacity required to serve all listeners.

A-focus and ÅF have estimated the cost of data capacity in the cellular networks to be about EUR 860 million per year. This cost calculation applies to both a unicast (LTE) and a multicast (LTE/eMBMS) scenario. It is clear that the broadcasters would get some discounts on pre-booked capacity of such a volume. A-focus has estimated that the broadcasters might get discounts of up to 30 per cent. Even with a possible discount, the cost is at a level that is completely unrealistic for the broadcasters to bear.

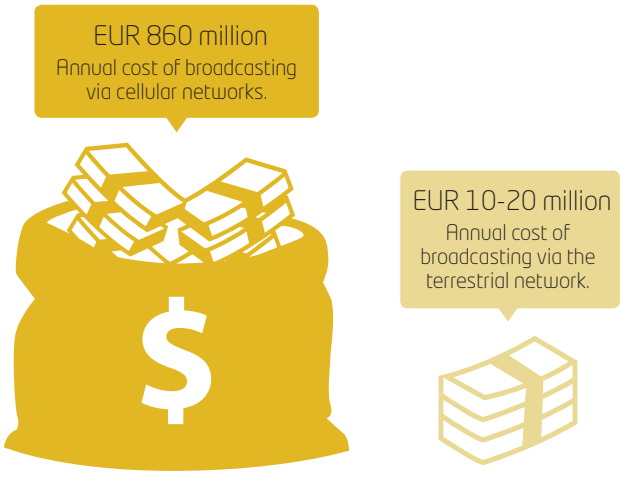
We have also seen in A-Focus consumer survey that only 3 per cent of consumers would be willing to pay for radio. The MNOs would be obliged to give price reductions per byte in the magnitude of 96 per cent in order to come down to the same levels as today´s traditional broadcasting (via FM or DAB+).

Also, if radio, when distributed in the cellular networks, were to meet the same requirements on coverage and contingency as terrestrial broadcasting does today, the MNOs would face huge additional costs. First, the cellular network must be expanded geographically in order to increase coverage from 99 to 99.8 per cent. A-Focus has estimated this additional investment to be in the order of EUR 420 million, provided the MNOs share infrastructure. Second, availability and up-time must be increased to meet the high demands on contingency that radio imposes on any network. A-Focus has estimated this additional investment to be in the order of an additional EUR 450 million, provided that only one of the MNOs reinforces its cellular network.

Examples of reinforcements and expansions necessary at each cellular site in order to improve availability:

- Redundancy. For example, dual transmitters at each base station or site and dual transmission lines.
- Back-up power. In the event of a power failure, back-up power must exist for at least three-twelve hours.
- Physical security. The site infrastructure (building, masts) would need to be upgraded. Locks, card readers and other security measures need to be improved.

All in all, we are talking about huge costs in the order of EUR 860 million per year, plus additional investments of about EUR 930 million, if cellular networks were to replace terrestrial networks. The alternative, of course, is to remain on FM (EUR 18 million/year[1]) or make a switchover into DAB+ (EUR 10 million/year[2]).



1. Today's annual distribution cost in FM for SR, four nationwide channels, i.e. EUR 4.5 million per year per FM channel.
2. Estimated annual distribution cost in DAB+ for SR, 10-12 nationwide channels, i.e. EUR 1million per year per DAB+ channel.

Conclusions

A-focus, as commissioned by Teracom, has studied whether it is possible to completely replace the terrestrial network and instead use MNOs' cellular networks for the distribution of radio (linear audio streaming). The conclusion is that this is not a realistic alternative. The main reason for this is the very high costs, but there are also several other strong reasons that each represent a powerful argument against such a solution.

Large data volumes – high costs

Large data volumes in the order of 190,000 Terabytes would be required, which corresponds to more than all the incoming and outgoing data that was transferred in all the cellular networks in Sweden in 2012

This, naturally, also means that very large costs are involved. According to the calculations by A-Focus, the MNOs must be able to charge for costs of around EUR 860 million per year, plus additional investments of about EUR 930 million, if cellular networks were to replace terrestrial networks. This sum, even with a discount, is more than the turnover of the entire radio industry in Sweden. The cost imposed on the cellular networks in this scenario can be compared to the EUR 10-20 million per year for nationwide DAB+ networks with enough capacity to deliver about 30 radio channels.

In order to be considered a realistic alternative, MNOs' prices for mobile data in Sweden must be reduced by 96 per cent. On top of that, the almost EUR 450 million in additional investments for security and robustness has still not been included in the calculation, which also necessitates the development of the LTE standard as well as new legislation. The investment of EUR 420 million in additional investments in extra base stations has also not been included, which is needed in order to reach 99.8 per cent of households.

New technology – untried with unclear benefits

New technology in cellular networks should, at least in theory, be able to improve the cellular networks' suitability for radio broadcasting. The technology is referred to as eMBMS in the LTE standard (4G) and is intended to be used for broadcasting. So far, there is no operator in the world that offers commercial services based on eMBMS, but, in theory, it could provide better conditions for the cellular networks to be able to handle handovers and traffic spikes. The eMBMS technology would not, however, be more efficient from a capacity point of view. The cost of broadcasting linear radio in cellular networks using eMBMS is just about as high as delivering the traffic to the listeners using unicast (streaming). The efficiency improvements with eMBMS are almost completely lost as the number of broadcasting sites is increased from about 7,000 to 20,000.

Higher demands on the listeners

Another reason for not using cellular networks for radio broadcasting is that it would mean substantial disadvantages for the listeners. It would place high demands on listeners with regard to their habits and ability to handle technology, since they are assumed to have a cellular subscription and smartphone or similar. Approximately 1.2 million Swedes have pretty much never even been on the Internet, and among Swedes who have a cellular phone, less than half have used it for accessing the Internet. Many people would quite simply not be able to manage listening to the radio if it were digital.

More pressure on the broadcasters

The broadcasters would also be negatively affected. In order to distribute radio channels via cellular networks, the broadcaster needs to enter into agreements with four different MNOs, none of which are obligated by the NRA to sell this service. Consequently, the broadcasters would be in a weak negotiating position with concerns about uncertain and unfavourable terms and conditions for the service over time. What is more, the cost of broadcasting radio in the cellular networks would exceed the broadcasters' total revenue many times over. With the listeners' unwillingness to pay for radio, financing becomes an impossible equation.