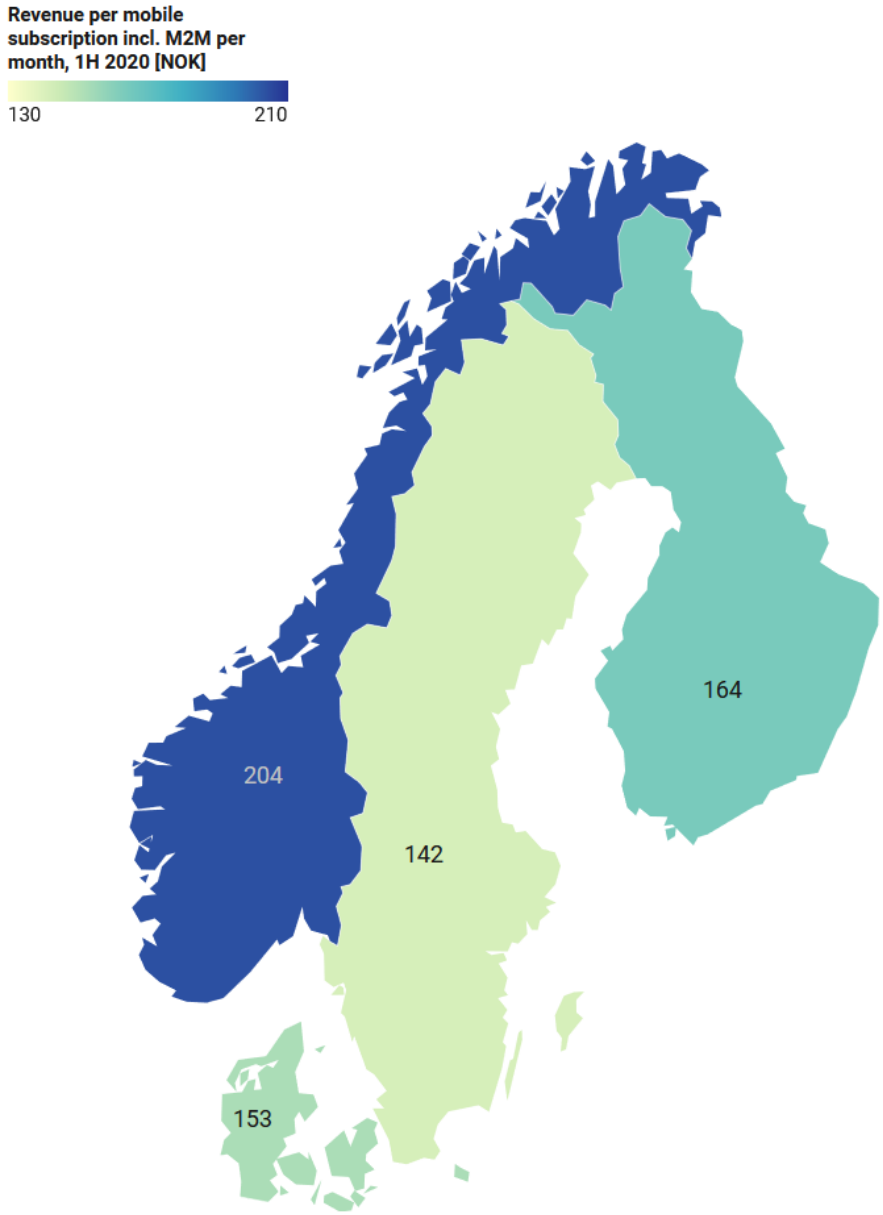
tefficient

Analysis prepared for Kommunal- og moderniseringsdepartementet

Assessment of Norwegian mobile revenues in a Nordic context



Contents

1. Executive summary

This analysis is commissioned by Kommunal- og moderniseringsdepartementet (KMD). It investigates whether Norwegian mobile prices should be considered high or moderate given certain specific Norwegian conditions.

A multitude of metrics are used – always compared between the same four markets: Norway, Denmark, Sweden and Finland. The analysis shows why these markets form a near-perfect peer group.

Regulator data shows that Norwegian revenue per mobile subscription is higher than in the other three countries. When adjusting the revenue of the other countries with purchase power parity GDP, we can see that the Finnish revenue per subscription roughly matches that of Norway – and that Swedish and Danish revenues come closer. The average data usage is however higher in Denmark, Sweden and, especially, Finland.

To give a sense of the current pricing of data-rich plans, the analysis compares 70 plans with unlimited data or a bucket of at least 30 GB per month. Norway generally has higher prices, but when adjusting for purchase power parity GDP, Swedish pricing comes quite close to Norwegian for the data-rich bucket plans. Norwegian unlimited plans are still more expensive and more restricted in policy.

Norway's lower population density doesn't result in a higher number of sites if compared to Sweden and Finland – that narrative is true only when comparing to Denmark. Norway has a lower number of mobile sites compared to Sweden and Finland per MNO, per network and per network if excluding the last entrant.

The analysis shows why network costs and network size – in a Nordic perspective – no longer define the total costs (OPEX and CAPEX) for an established operator. A network with many mobile sites represents a revenue opportunity for operators and is regarded an asset by infrastructure companies.

Telenor and Telia Norway have the highest EBITDA margins in the Nordics, so high OPEX isn't behind the higher mobile revenue in their case. Ice's situation is different in part because of high national roaming OPEX.

Norwegian operators use more CAPEX than what is typical in the Nordics. This is particularly true for Ice which invests the most in relation to its revenue. Since the EBITDA-CAPEX (~cash flow) margins of Telenor and Telia Norway are higher than average, the companies can well afford its current level of CAPEX. Ice's situation is again different with the highest OPEX and the highest CAPEX in relation to revenue.

Norway is not only having the lowest mobile data usage in the Nordics, it is also growing slower than in Denmark, Sweden and Finland. This gives Norway the unfavourable (from a consumer point of view) combination of higher revenue and lower usage per subscription. The revenue per mobile gigabyte (GB) is much higher in Norway – also after purchasing power adjustment.

Norwegian fixed broadband networks are excellent in availability and speed. But it is not explaining the low mobile data usage since the other countries have as excellent fixed broadband networks.

The speeds when using mobile data in Norway is higher than in the other three countries, though. As mobile speed depends on the traffic load, Norway's low mobile data usage helps on speed. It is also an indication of that Norwegian operators have invested in capacity not fully utilised. With a wider take on mobile network

quality – not just speed – Norway's mobile networks are still world-class, but so are the mobile networks of Denmark, Sweden and Finland.

The analysis shows that the Norwegian mobile market is uniquely concentrated. It is not just explained by the number of MNOs.

In its conclusion, the analysis ranks the analysed potential root causes based on how likely it is that they cause Norway's high revenue per mobile GB. Tefficient concludes that the most likely root cause is the market concentration but that the stronger Norwegian purchase power also plays a role. Other factors are unlikely to have any major impact – or unlikely to have any impact at all.

2. Background

This analysis is commissioned by Kommunal- og moderniseringsdepartementet (KMD). KMD has provided this background to the analysis (translated from Norwegian):

Norwegian mobile networks are well developed and score high in international comparisons of capacity and quality. The prices for mobile data in Norway may, however, appear to be high compared with other countries, e.g. in the Nordic region, and the use of mobile data is correspondingly lower. A possible explanation for this may be weak competition as a result of Norway being one of the few countries in Europe with only two full-fledged nationwide mobile networks, and one under development; Ice.

Kommunal- og moderniseringsdepartementet (KMD) is working on a white paper to Stortinget covering electronic communications. One of several topics that will be discussed in the white paper is the competition in the mobile markets and the prices for mobile services/mobile data. In the work on the white paper, KMD received input from Norwegian telecom providers. There are different opinions about whether Norwegian mobile prices can actually be considered high. Several have argued that Norwegian mobile prices are moderate if special Norwegian conditions are taken into account, including that Norway has scattered settlements, a challenging topography and a generally high level of income, price and cost compared with other countries in the Nordic region.

KMD wants assistance from an external investigator to shed light on and assess whether Norwegian mobile prices are moderate or can be said to be too high as a result of a lack of competition. An important part of the assignment will be to assess the various arguments that have emerged in this context.

3. Peer group

In the input that KMD received from Norwegian telecom providers, different peer groups have been used to compare different metrics:

- Nordic countries – Norway, Denmark, Sweden, Finland, Iceland
- Nordic countries except Iceland – Norway, Denmark, Sweden, Finland
- Norway and Sweden
- Selected European countries – Norway, the Netherlands, Denmark, Belgium, Finland, Sweden, France, the UK, Germany
- Selected global countries – Norway, Denmark, the Netherlands, Germany, Sweden, Finland, France, China, the UK, USA, Canada
- Selected global countries – Norway, Ireland, Austria, Denmark, Germany, the Netherlands, Sweden, Italy, Belgium, Australia, Finland, France, Switzerland, the UK, New Zealand, Spain, Taiwan, USA, Greece, Portugal, South Korea, Canada, Japan

As a telecom analyst, Tefficient well understands how difficult it can be to find comparable market data for comparable markets. There is however a risk in mixing the comparison peer group between different parts of an analysis and as Tefficient we favour an approach where **the same markets are compared on all metrics**.

For the past eight years, 2013-2020, Tefficient has annually, as a commercial service, benchmarked a varying group of telecom operators in Norway, Denmark, Sweden and Finland against a common peer group solely consisting of the participating operators from these four countries. The identities of the participating operators aren't public. Designing a common peer group for these four countries was a deliberate decision as operators in these countries show **a high level of comparability** in the business environment and in how telecom operators are operating. We also sense that Nordic operators generally have a stronger urge to excel and improve than telecom operators in other mature markets. This means that a peer group solely consisting of Nordic operators will not only be highly comparable, but also more challenging. The Nordics is very well served with high quality telecommunications in spite of low population. Nordic operators are also generally quite profitable.

During on our eight years of conducting a very detailed benchmark in the region we have noted that the differences between operators in one and the same market could be more significant than the differences between markets as a whole. This can be seen when comparing the reported margins in Section 9.

On the next page are some high level indicators of why operators in Norway, Denmark, Sweden and Finland are comparable.

For the reasons stated above, Tefficient has for this analysis decided to use the four countries **Norway, Denmark, Sweden and Finland** as the peer group. All metrics will always[1] be compared between these four countries to allow the reader to understand how one metric may affect another metric.

[1] On a few occasions, regulatory data with sufficient break-down isn't available, leaving out that metric for the country in question

	Norway	Denmark	Sweden	Finland
Mobile				
High smartphone penetration	>90%	>90%	>90%	>90%
High data-only (mbb) penetration	5%	14%	10%	23%
High mobile data traffic [GB per SIM per month]	5,6	9,9	9,1	26,4
High contract share of mobile subscriber base	90%	98%	78%	94%
Low/medium mobile churn [per year]	25-30%	20-30%	15-30%	15-25%
Subsidy/instalment model in mobile equipment sales	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes
World-class mobile network quality	Yes	Yes	Yes	Yes
High 4G population coverage	>99% Except Ice 91% if excl. national roaming	>99%	>99% Except '3' 91% June 2020	>99%
Commercial 5G	2 of 3 operators Limited rollout mainly on lower spectrum bands as 3.5 GHz not yet fully auctioned	4 of 4 operators Limited rollout mainly on lower spectrum bands as 3.5 GHz not yet auctioned	4 of 4 operators Limited rollout mainly on lower spectrum bands as 3.5 GHz not yet fully auctioned	3 of 3 operators Large rollout on 3.5 GHz from all three
Mobile active network sharing	No	Yes TT-Netværket between Telenor & Telia for 2G, 3G, 4G & 5G	Yes SUNAB between Tele2 & Telia for 3G; 3GIS between Telenor & '3' for 3G; Net4Mobility between Tele2 & Telenor for 2G, 4G &5G	Yes Suomen Yhteisverkko between Telia & DNA for 2G, 3G, 4G & 5G (Northeast half of Finland)
Fixed				
Medium cable TV homepass	~40%	~65%	~50%	~60%
High fiber share of fixed broadband base	57%	39%	73%	55%
High average Netflix speed [Mbit/s]	4,4	4,2	4,3	4,2
Fixed-mobile convergent offers	Light =combine, get more	Light =combine, get more	Light =combine, get more	No

Figure 1. Comparison of some high-level business drivers in Norway, Denmark, Sweden and Finland[2] [source: Tefficient]

[2] Subscriber and usage figures for Norway, Sweden and Finland are for June 2020, for Denmark for December 2019 as the regulator there has not yet reported 1H 2020 data

4. Are Norwegian mobile revenues higher?

To answer the question, we have used regulator data from the four national regulatory agencies NKOM, Energistyrelsen, PTS and Traficom to calculate the average service revenue per mobile subscription[3] per month – normally referred to as **ARPU** within the industry. Figure 2 below shows the ARPU including *all* mobile subscriptions – regular, data-only (mbb) and M2M/IoT subscriptions. The ARPUs of the other three countries have been recalculated into NOK[4] for easier comparison.

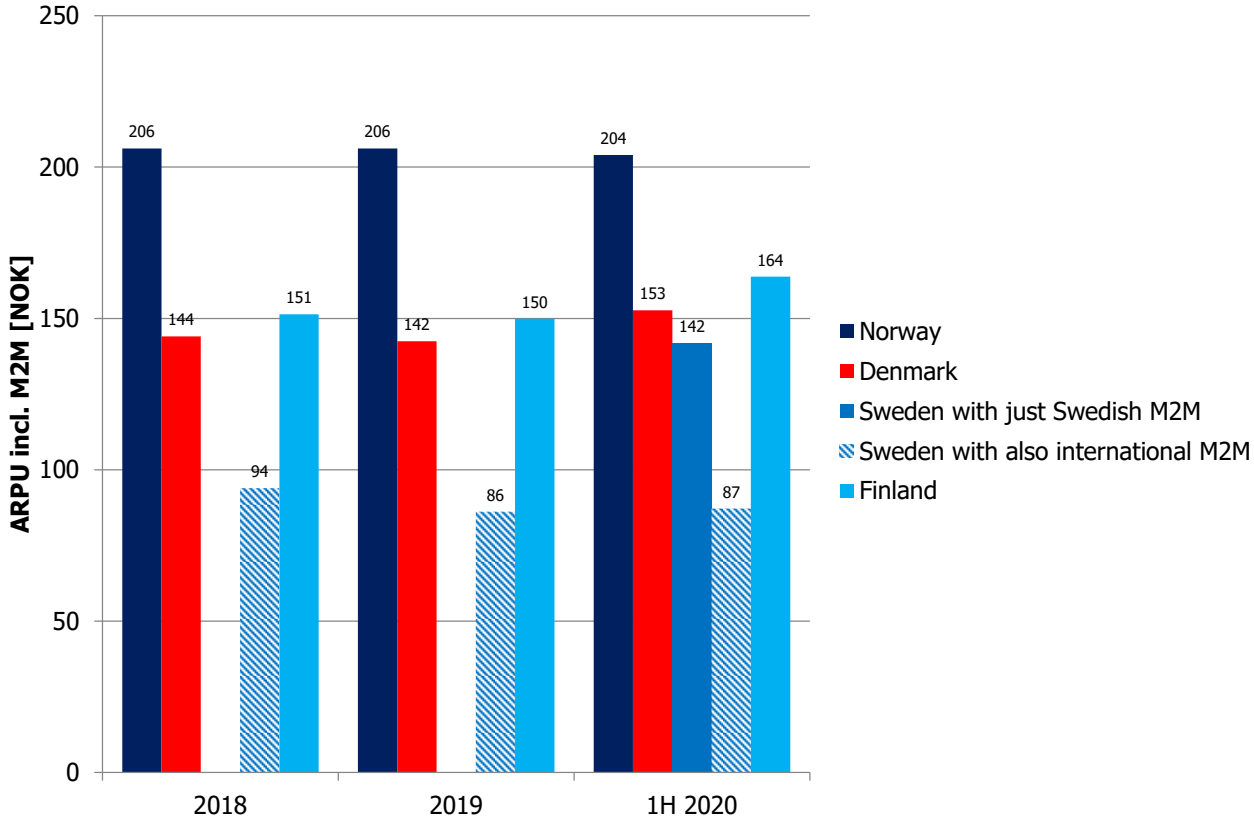


Figure 2. Comparison of mobile ARPU incl. M2M in Norway, Denmark, Sweden and Finland 2018, 2019 and 1H 2020 [source: NKOM, Energistyrelsen, PTS, Traficom, operator reports for 1H 2020 for Denmark and Finland as Energistyrelsen and Traficom do not report revenue half-yearly]

Norway's mobile ARPU is significantly higher, 204 NOK in 1H 2020, than the mobile ARPU in the other three Nordic countries. The ARPU levels are generally quite stable in the Nordics and Norway is no exception.

It might appear as if the ARPU is growing in 1H 2020 in Denmark, Sweden and Finland. This is a consequence of the weakening of the NOK as Figure 2 compares the ARPU in NOK.

[3] Average number of subscriptions in the period calculated as Average(number of subscriptions at the start of the period; number of subscriptions at the end of the period)

[4] Using the average of the daily currency rates for the period in question as reported by ECB

Sweden's ARPU is significantly lower than the other markets when including all M2M SIMs, also the international. This is explained by a very large number, 15.9 million, of M2M subscriptions being homebased in Sweden, mainly Telenor Connexion subscriptions. The Swedish regulator has only recently stated to break out how many of these are actually in Sweden – 3.8 million in June 2020. As that data isn't available historically, we can't calculate the Swedish ARPU for 2018 and 2019, but in 1H 2020 it's 142 NOK.

Figure 3 *excludes* the M2M subscriptions and the M2M revenue thus avoiding the Swedish M2M reporting problem. The Danish and Finnish regulators are, however, not breaking out M2M revenues in its reporting, making it impossible to calculate the ARPU excluding M2M for these two countries. Denmark and Finland are therefore in the graph below with the values including M2M.

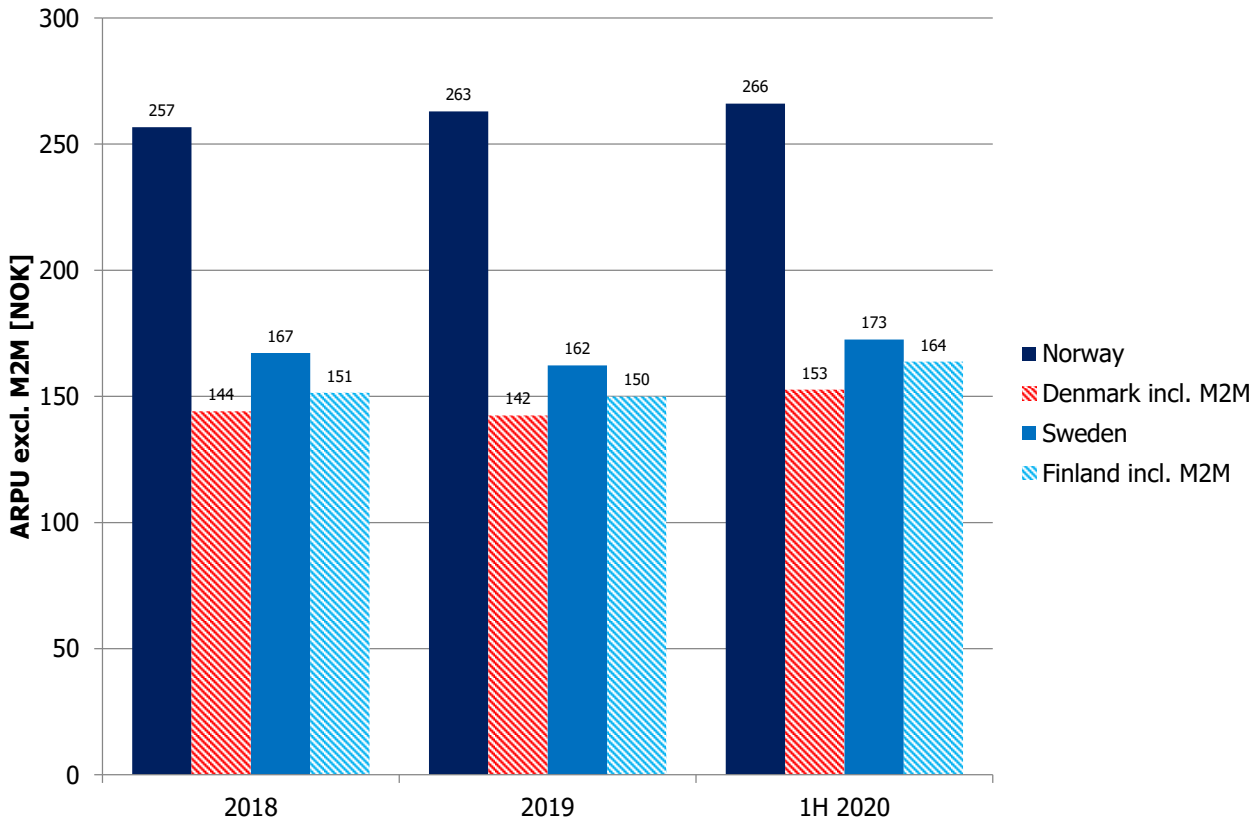


Figure 3. Comparison of mobile ARPU excl. M2M in Norway and Sweden 2018, 2019 and 1H 2020. The Danish and Finnish regulators do not break out M2M revenues so ARPU excl. M2M can't be calculated for Denmark and Finland [source: NKOM, Energistyrelsen, PTS, Traficom, operator reports for 1H 2020 for Denmark and Finland as Energistyrelsen and Traficom do not report revenue half-yearly]

The only like for like comparison when excluding M2M is therefore with Sweden. Norway's ARPU was 93 NOK (54%) higher than the Swedish ARPU in 1H 2020; 266 NOK vs. Sweden's 173 NOK.

Norwegian revenue per mobile subscription is higher than in Denmark, Sweden and Finland.

Let's now see if differences in purchasing power can explain this.

5. Is higher purchasing power explaining Norway's higher ARPU?

Norway has a higher GDP per capita than the other three Nordic countries[5]. A higher GDP per capita is most often also an indication of a higher purchasing power, but using the *nominal* GDP[6] per capita differences as adjustment doesn't take the differences in price levels into account.

A common way to deal with this is **purchasing power parity** (PPP) conversion. An introduction to PPP is given in the box below[7].

Measuring economic activity in a country is difficult, since 'the economy' is a complex system with lots of moving parts. A common way to deal with this is to focus on aggregate indicators, such as total national output: "the monetary value of all goods and services produced within a country (or region) in a specific time period". That's what economists call the Gross Domestic Product (GDP).

GDP is measured using prevailing national prices to estimate the value of output. In other words, GDP is calculated using local currency units. This means that in order to make meaningful cross-country comparisons, it is necessary to translate figures into a common currency – i.e. use a consistent 'unit of measure'.

One option is to simply translate all national figures into one common currency (for instance, US dollars) using exchange rates from currency markets. But because market exchange rates do not always reflect the different price levels between countries, economists often opt for a different alternative. They create a hypothetical currency, called 'international dollars', and use this as a common unit of measure. **The idea is that a given amount of international dollars should buy roughly the same amount – and quality – of goods and services in any country**.

The exchange rates used to translate monetary values in local currencies into 'international dollars' (int-$) are the 'purchasing power parity conversion rates' (also called PPP conversion factors).

In this analysis we are using the quotas between **purchasing power parity (PPP)** GDP per capita as adjustment when striving to make revenue and prices comparable between countries. Figure 4 shows the differences between the nominal GDP per capita (left) and the PPP GDP per capita (right). When compensating for the purchasing power, Norway's GDP per capita leadership is still there, but a bit narrower.

[5] We are using the official GDP of Norway in this analysis, not "BNP Fastlands-Norge"

[6] In this analysis we have refrained from using e.g. electronic communications spend as share of nominal GDP since it does not take differences in price levels into account. Another reason is that electronic communication (ekom) is wider than just *mobile* communications. For the same reason we have not used price comparison indices including e.g. postal services.

[7] From Our World in Data: https://ourworldindata.org/what-are-ppps

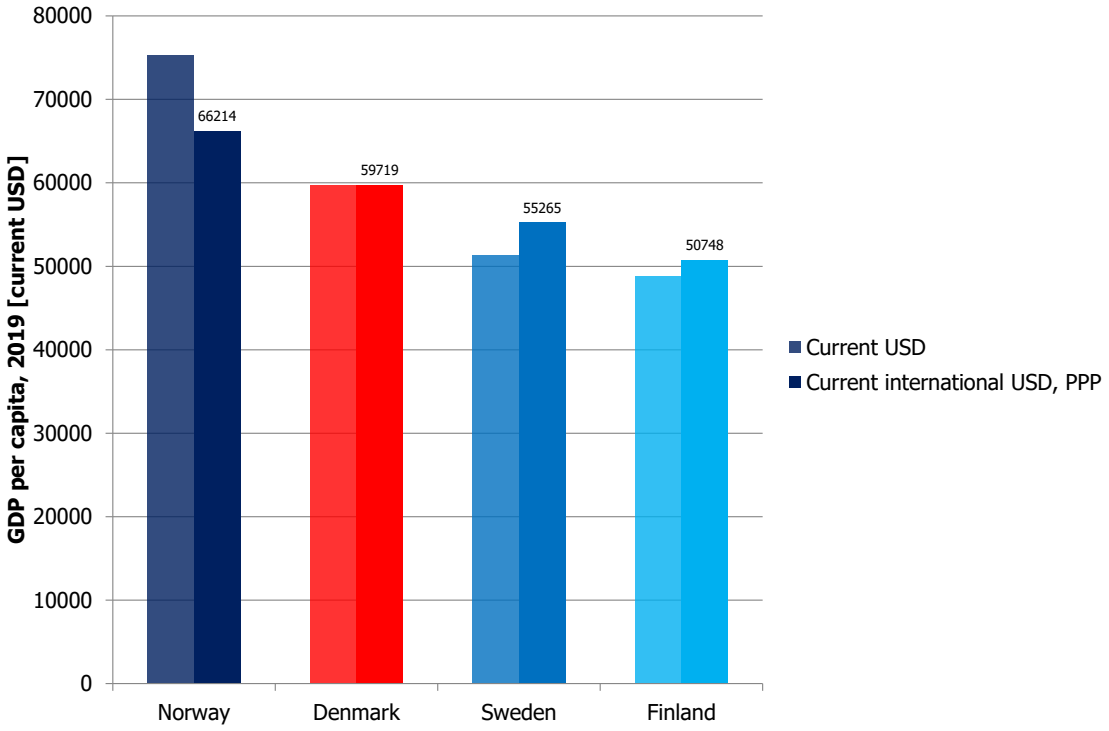


Figure 4. Comparison of GDP per capita (left) and purchase parity adjusted GDP per capita (right) in Norway, Denmark, Sweden and Finland 2019 [source: IMF]

Applying PPP on the mobile revenue and pricing is a modelling attempt to make the levels more comparable between the countries. Since PPP is calculated on a *generic* basket of goods and services, it isn't developed specifically for mobile revenue and pricing, though. The outcome after PPP adjustments should therefore be regarded as *indicative*. You could say that the logic of applying PPP on mobile revenue and pricing is "with higher general purchasing power, buyers are expected to pay as much more for mobile services as they pay for goods and services in general".

With this disclaimer, let's now apply the differences in PPP on the previously calculated mobile ARPU values. First including M2M:

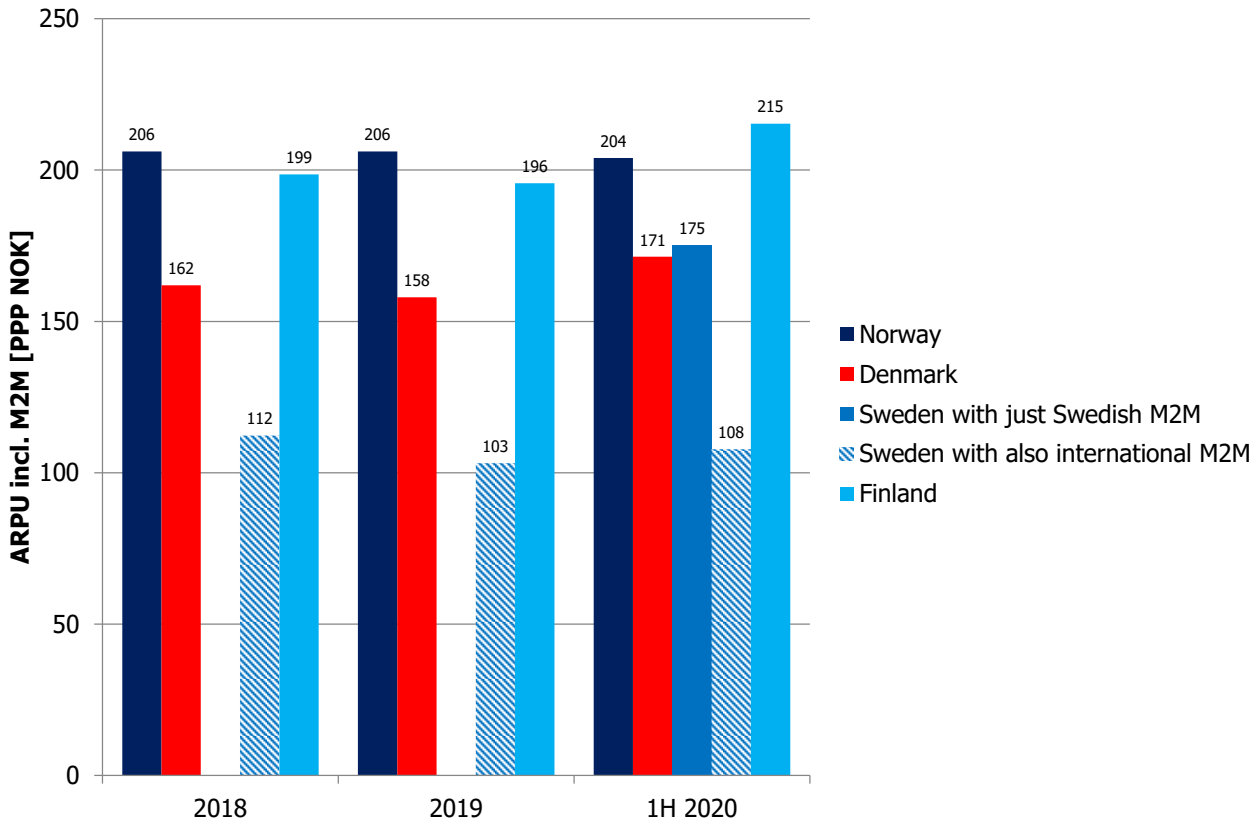


Figure 5. Comparison of PPP mobile ARPU incl. M2M in Norway, Denmark, Sweden and Finland 2018, 2019 and 1H 2020. The PPP values for 2020 are preliminary [source: NKOM, Energistyrelsen, PTS, Traficom, IMF, operator reports for 1H 2020 for Denmark and Finland as Energistyrelsen and Traficom do not report revenue half-yearly]

Norway's ARPU levels are the same as in Figure 2 since we adjust the ARPU of the other three markets upwards to emulate what the ARPU levels in these markets might have been if these markets would have the same high purchasing power as Norway. The differences in ARPU are now smaller. If Finland would have had the same purchasing power as Norway, the mobile ARPU might actually be higher than Norway's[8]. Finnish mobile users are however getting much data more for their ARPU; we will compare that in section 10.

In comparison to Denmark and Sweden, Norway's mobile ARPU is still high – even after having compensated for differences in purchasing power.

Now to the comparison if excluding M2M, see Figure 6. As before, we can only compare Norway to Sweden here, but it's clear that Norway's mobile ARPU is still much higher than that of Sweden – 53 PPP NOK (25%) higher.

[8] True for 1H 2020. IMF's PPP values for 2020 are still preliminary (as the year has not yet ended). In 2018 and 2019 Finnish PPP ARPU was still lower than Norwegian.

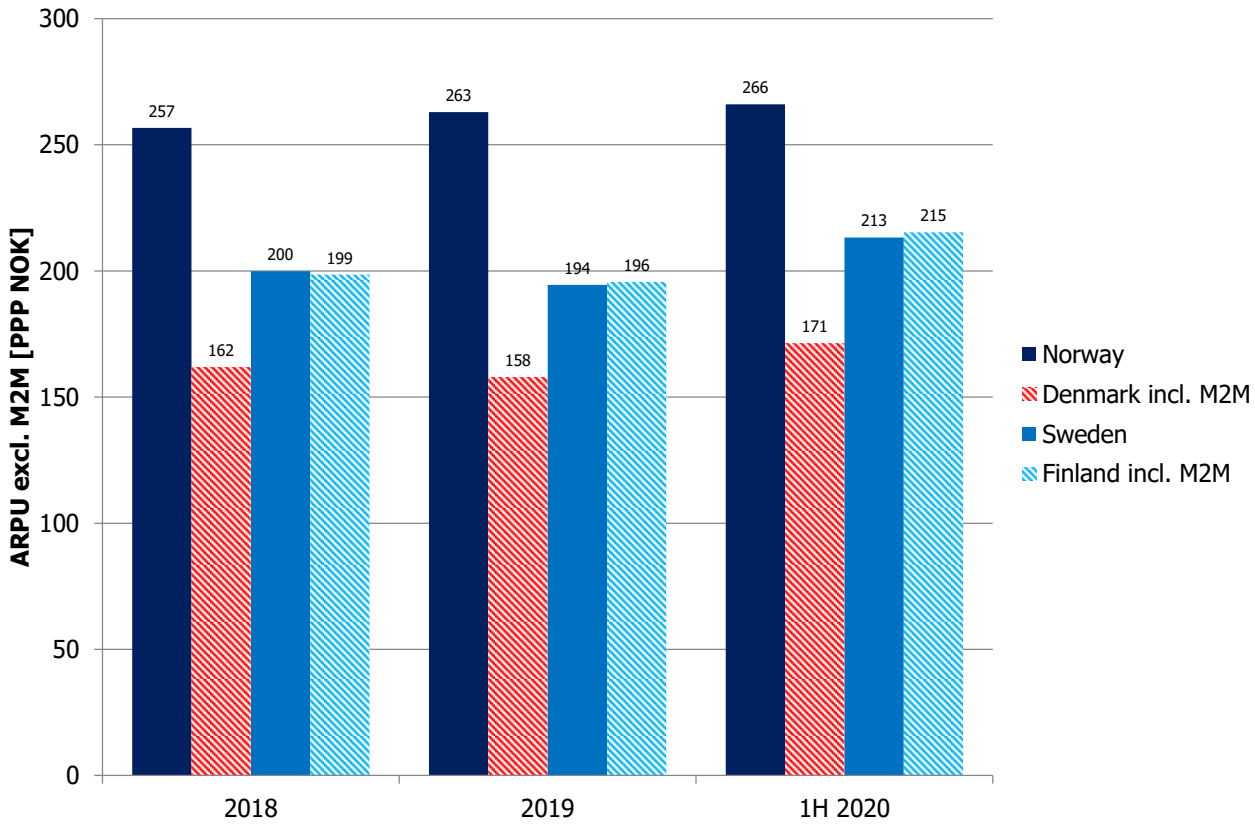


Figure 6. Comparison of PPP mobile ARPU excl. M2M in Norway and Sweden 2018, 2019 and 1H 2020. The Danish and Finnish regulators do not break out M2M revenues so ARPU excl. M2M can't be calculated for Denmark and Finland. The PPP values for 2020 are preliminary [source: NKOM, Energistyrelsen, PTS, Traficom, IMF, operator reports for 1H 2020 for Denmark and Finland as Energistyrelsen and Traficom do not report revenue half-yearly]

Higher purchasing power is likely contributing to Norway's higher ARPU, but the differences to Denmark and Sweden are there still. Our analysis suggests that the Finnish ARPU could have been as high as the Norwegian would Finland have the same purchasing power, but then we have not yet taken into account the large differences in mobile data usage.

6. Are Norwegian data-rich mobile plans more expensive?

It is relatively straight-forward to compare advertised prices on mobile plans between operators and between markets, but we would like to warn against concluding solely based on such analysis as it's not representative for what mobile customers actually *pay*. It shows how much mobile customers *could pay*.

In the Nordics, only about 15-30% of mobile customers actually switch mobile provider during a year. 70-85% of mobile customers are not. Many of these are subscribing to mobile plans that are different compared to those that presently are marketed and sold. As there is ongoing price erosion and data bucket inflation in the Nordics, most customers that are on old plans **pay more for their usage than they could have** would they have been on a new plan.

Hence, we favour comparing the revenues derived from mobile users – as we just did when comparing ARPU – as opposed to comparing price points. But to balance this analysis, we have done an almost complete[9] market scan of the pricing of *data-rich* (30 GB or more) mobile plans in our four countries.

To differentiate, operators use e.g. different policies, service bundling tactics, inclusive services, family discounts, youth discounts and fixed-mobile bundling discounts. To make this comparison as like-for-like as possible, we have applied the following criteria:

- Only *consumer* prices considered – including VAT
- Only plans with *unlimited* voice and messaging and EU roaming considered
- Time limited discounts – like first three months for half price – *not* considered
- Age based discounts *not* considered
- Fixed-mobile bundling discounts *not* considered
- Energy-mobile bundling discounts *not* considered
- Family discounts *not* considered
- Binding contracts – for example 24 months – *not* considered
- Premium plans that include content – for example with several streaming services for an additional fee – *not* considered

Figure 7 compares a total of **70 data-rich plans** across our four markets. The vertical axis shows the monthly price – recalculated into NOK[10]. The horisontal axis shows the size of the *full speed data bucket*. Plans with an unlimited[11] full-speed mobile data allowance are shown at the ∞ symbol.

[9] All MNOs are covered if full. The most prominent sub-brands (if any) of each MNO are covered too. Also larger MVNOs that are strong in data-rich plans are covered.
[10] Using the actual exchange rate for the same day, 24 November 2020
[11] Unlimited means 1000 GB with most Danish operators and with Ice's Data Frihet. With most Swedish operators, the user will have to answer an SMS after having used a certain amount of data in a day (in Telenor's case e.g. 20 GB) to continue to use data.

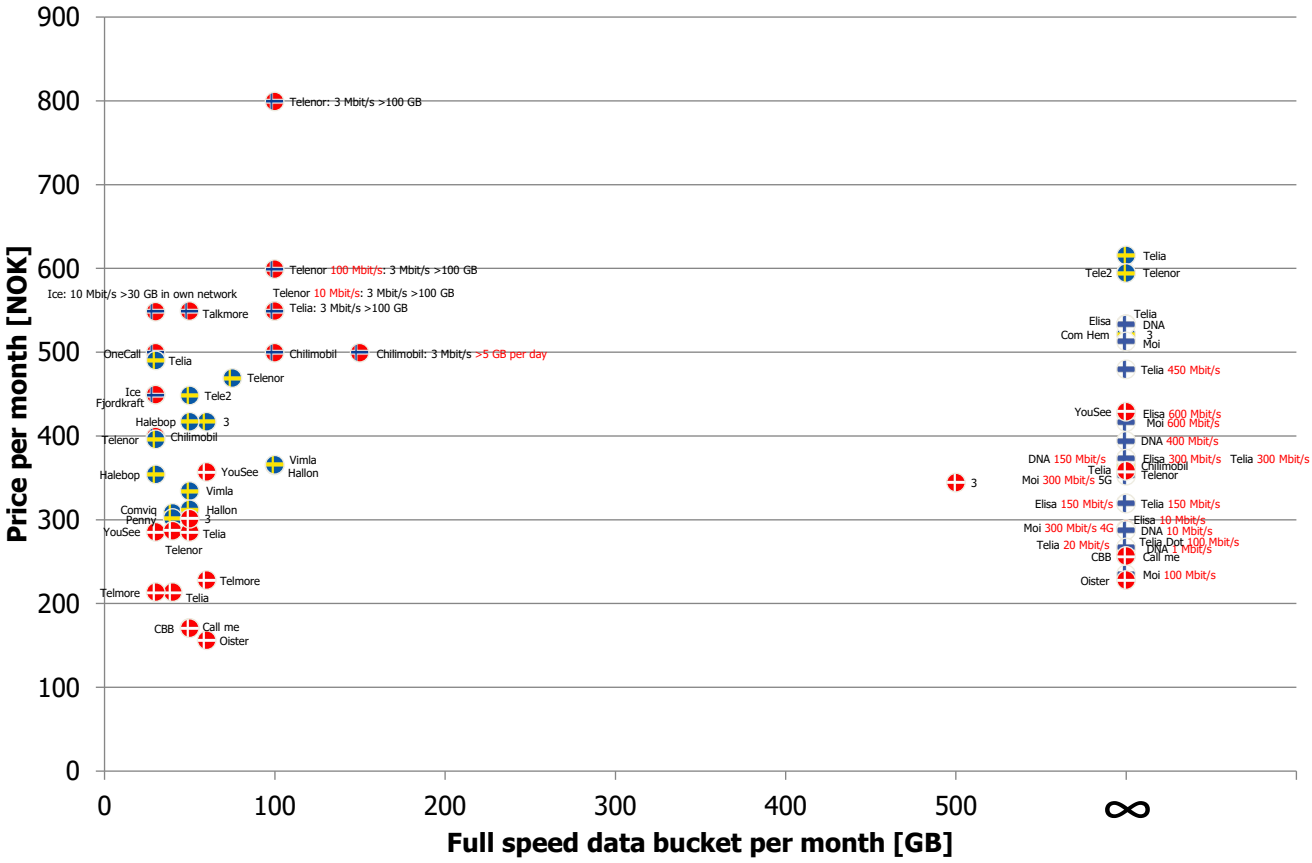


Figure 7. Comparison of the pricing of data-rich (>30 GB) mobile plans with unlimited voice & messaging across main MNO brands, most secondary MNO brands and a few selected MVNO brands in Norway, Denmark, Sweden and Finland 24 November 2020 [source: Individual webpages of the mobile brands, compiled by Tefficient]

There is yet no mobile plan in Norway which grants the customer an unlimited amount of *full-speed* data. At present, most plans marketed as unlimited in Norway will throttle the speed to **3 Mbit/s** when 100 GB of mobile data has been consumed in a month[12].

This throttling-beyond-a-bucket policy for unlimited is unique for Norway – in the other three Nordic markets there is no speed degradation after a certain bucket.

Norwegian plans are positioned in the upper left part of Figure 7. This means that the Norwegian plans are more expensive than almost all of the Danish, Swedish and Finnish plans. As mentioned, Norwegian unlimited plans are also more restrictive in policy as they throttle speeds when a certain bucket has been consumed.

[12] Chilimobil, the MVNO that was first with unlimited in Norway, alternatively offers a plan – for the same price – that throttles the speed to 3 Mbit/s once 5 GB has been consumed in a *day*. If the customer uses that to its maximum extent every day, the full speed data bucket per month could in theory be 150 GB for a month with 30 days. Ice, the third MNO in Norway, offers an add-on (Data Frihet) to most of its bucket plans allowing 1000 GB of extra data in a month, but throttled to 10 Mbit/s, as long as that extra data is consumed in Ice's own network and not through national roaming on Telia's network. In the graphs we have plotted the price for the 30 GB full-speed plan *without* Data Frihet and the price for the 30 GB full-speed plan *with* Data Frihet.

Telenor Norway is offering unlimited (throttled to 3 Mbit/s after 100 GB) with three speed tiers: 10 Mbit/s, 100 Mbit/s and full speed. The latter plan is 799 NOK per month – 183 NOK more expensive than the second most expensive plan in these four countries (Telia Sweden). The plan from Telia Sweden isn't throttled after 100 GB.

Denmark is generally providing the most affordable data-rich plans in the Nordics – cluttered in the lower left part of the chart. The cheapest unlimited plan is also Danish – from 3's Oister brand: 228 NOK.

The chart is also showing that there are no other plans than unlimited in **Finland**. Finnish mobile customers always get unlimited data, what they pay for is how *fast* they want the access to be (at best). A majority of the unlimited plans with speeds up to 600 Mbit/s are cheaper than all Norwegian plans with 30 GB.

Sweden generally has more expensive plans than Denmark and Finland. This is particularly true for unlimited plans. There is one exception though – hardly visible in Figure 7 – and that's **Chilimobil** Sweden. Chilimobil is an MVNO on 3's network in Sweden and offers unlimited for just 349 SEK (365 NOK). Chilimobil offers unlimited[13] in Norway as MVNO on Telia's network for 499 NOK. Although that is the cheapest unlimited proposition in Norway, it is still **37% more expensive** than in Sweden. This could be an indication of the differences in mobile wholesale rates between Sweden (where four MNOs are hosting MVNOs) and Norway (where two MNOs presently are hosting MVNO).

Based on the pricing of current offers – without purchase power adjustment – it is not possible to conclude that Norwegian data-rich mobile plans are moderately priced. Without adjustment, Norway's data-rich plans are more expensive and also, in the case of unlimited, more restricted in policy.

In a similar way as we adjusted the mobile ARPUs for differences in purchasing power, we have redrawn the pricing comparison in PPP NOK in Figure 8 below. As in the ARPU section, this makes Denmark, Sweden and Finland close in on Norway.

[13] 3 Mbit/s after 100 GB per month – or after 5 GB per day (two plan options)

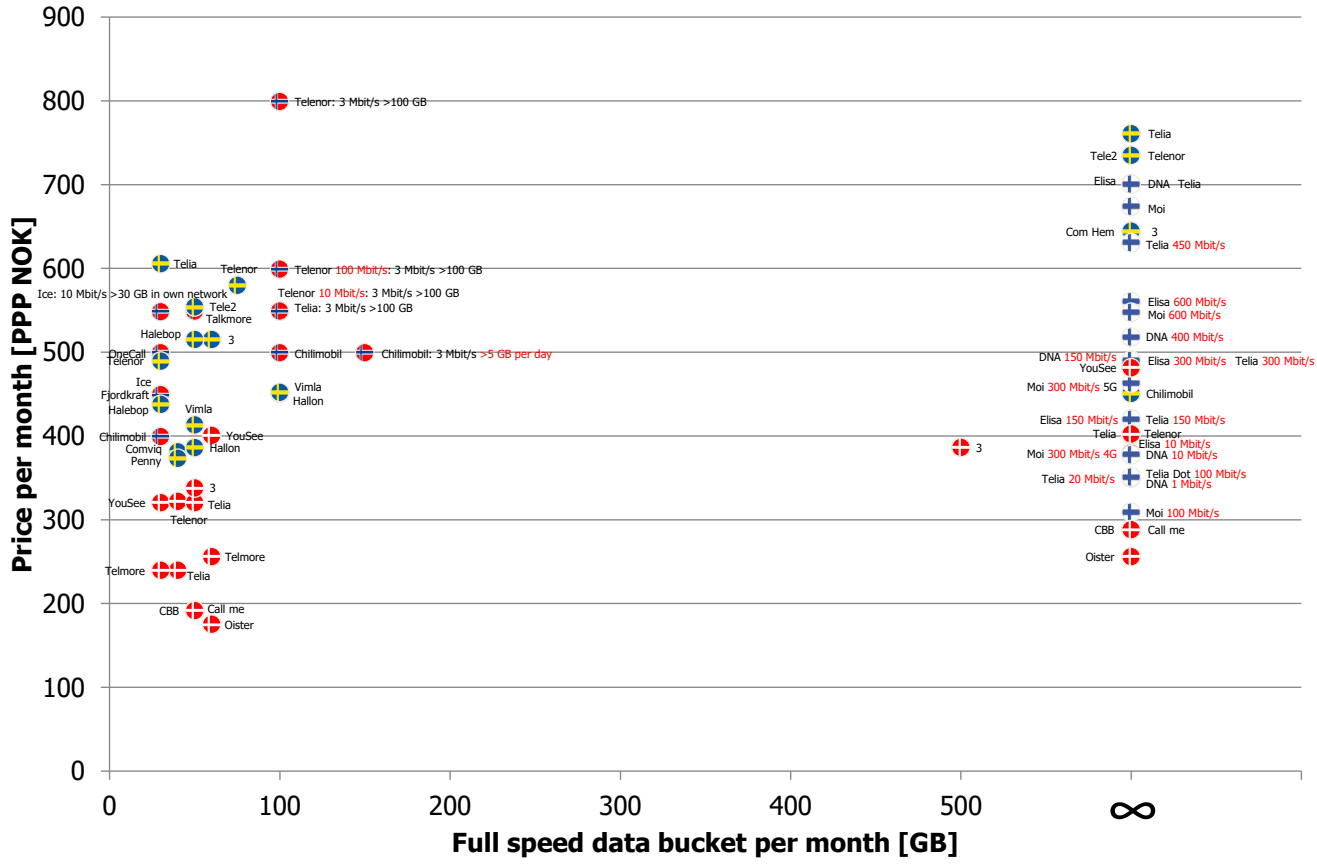


Figure 8. Comparison of the purchase parity pricing of data-rich (>30 GB) mobile plans with unlimited voice & messaging across main MNO brands, most secondary MNO brands and a few selected MVNO brands in Norway, Denmark, Sweden and Finland 24 November 2020 [source: Individual webpages of the mobile brands, IMF, compiled by Tefficient]

Swedish plans are now mixing with the Norwegian plans in the upper left corner. Finnish unlimited plans are also touching Norwegian price points when we compensate for the differences in purchasing power. Danish plans are still visibly the cheapest among our countries.

To help interpret Figure 8, a few country categorisations have been added to Figure 9. The graph is otherwise the same.

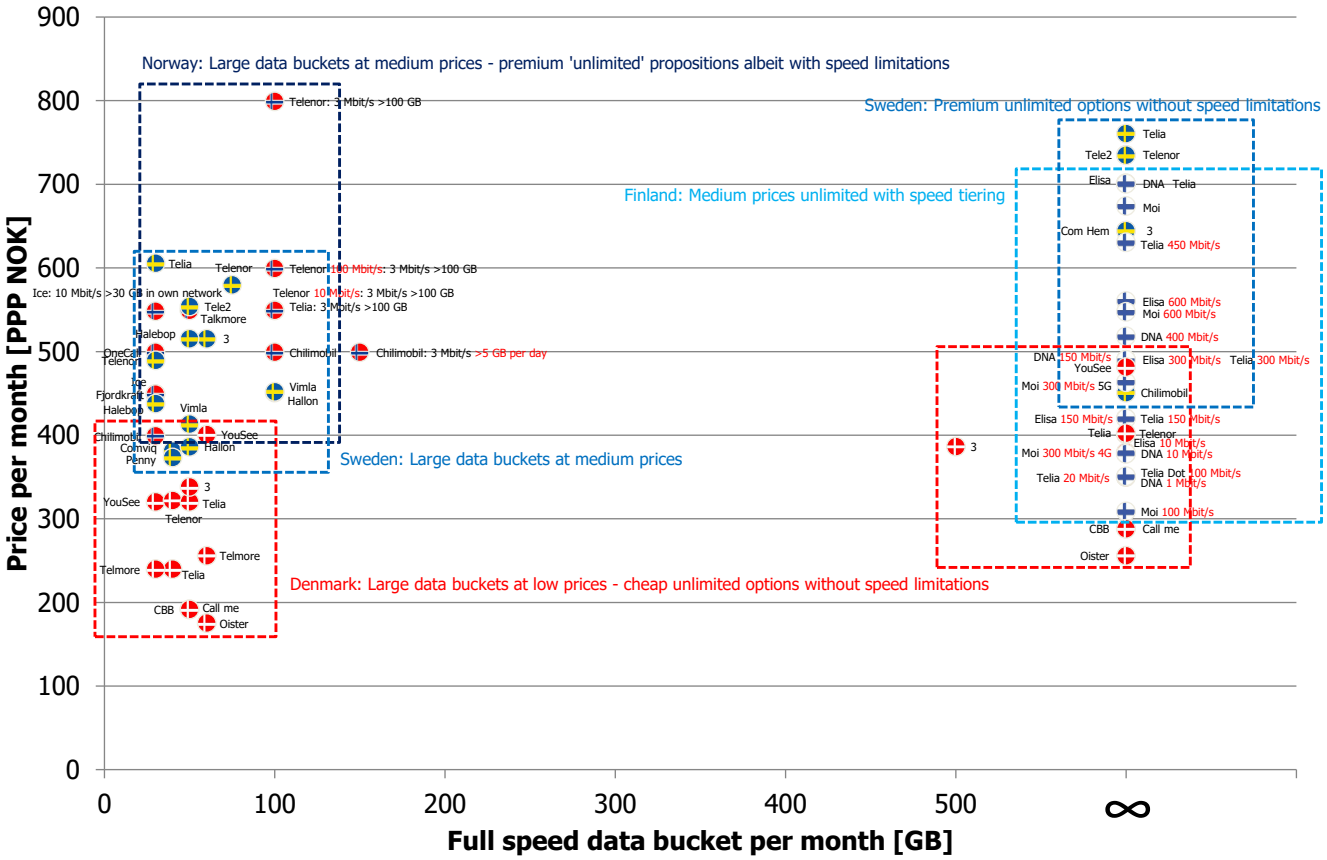


Figure 9. Comparison of the purchase parity pricing of data-rich (>30 GB) mobile plans with unlimited voice & messaging across main MNO brands, most secondary MNO brands and a few selected MVNO brands in Norway, Denmark, Sweden and Finland 24 November 2020 [source: Individual webpages of the mobile brands, IMF, compiled by Tefficient]. Same graph as Figure 8, just with comments.

Based on the pricing of current offers in the markets – without purchase power adjustment (Figure 7) – it was not possible to conclude that Norwegian data-rich mobile plans are moderately priced.

As with ARPU, an adjustment for purchase power improves the relative position of Norway.

Based on the pricing of current offers – with purchase power adjustment (Figure 8) – it is possible to conclude that Norwegian 30 GB mobile plans are moderately priced driven by the prices of Chilimobil, Fjordkraft and Ice which would compete well on price in a Swedish purchase power adjusted context. The unlimited plans are still to be considered expensive, though, as more restricted in policy.

We however started this section warning against concluding solely based on current pricing. Few customers are today on the plans currently offered. The ARPU is representative of what mobile customers actually *pay* and should be given more weight in a balanced conclusion, see section 13.

7. Are topology and population density affecting the number of sites in mobile networks?

It's a frequently narrative in Norway that the country's topology – with mountains and fjords – and demography with low population density require larger mobile networks. This would, in turn, drive the total costs – OPEX and CAPEX – of an operator. And in order to be profitable and to compensate for these extra network costs, mobile revenues need to be higher.

We will strive to test each element in that chain of logic:

a) Norway has more mountains & fjords and lower population density than the other Nordic countries – but are the mobile networks larger? (tested in this section)
b) Are larger networks driving an operator's total costs? (tested in section 8)
c) Are higher mobile revenues needed to compensate for these network costs? (tested in section 9)

Starting with a), the number of TETRA (Nødnett in Norway) base stations has been used to exemplify that topology and population density drive the number of base stations. Tefficient believes that the TETRA example isn't representative for mobile networks – of several reasons. TETRA networks are primarily dimensioned for coverage since the number of users and traffic are low. Mobile networks are carrying much more traffic. *Capacity*, not coverage, is therefore since long the primary driver for the inter-site distance of mobile networks in populated areas. TETRA is also operating on one, low frequency, band whereas mobile networks operate on many, higher frequency, bands. The use cases and dimensioning criteria are also totally different between a mission critical emergency network and a public mobile network. The number of mobile base stations is defined by a **multitude of factors where coverage is one** – but definitely not the only one.

Tefficient has combined information from multiple sources – public registers, operator reporting and Tefficient's own insight – to calculate the number of mobile network sites[14] in Norway, Denmark, Sweden and Finland respectively. The numbers are rounded to the closest 1000, see Figure 10.

[14] A site represents one physical address – typically a mast or a rooftop – and can host one or several base stations depending on the capacity need, systems used (2G, 3G, 4G, 5G) and an operator's chosen configuration and vendor mix

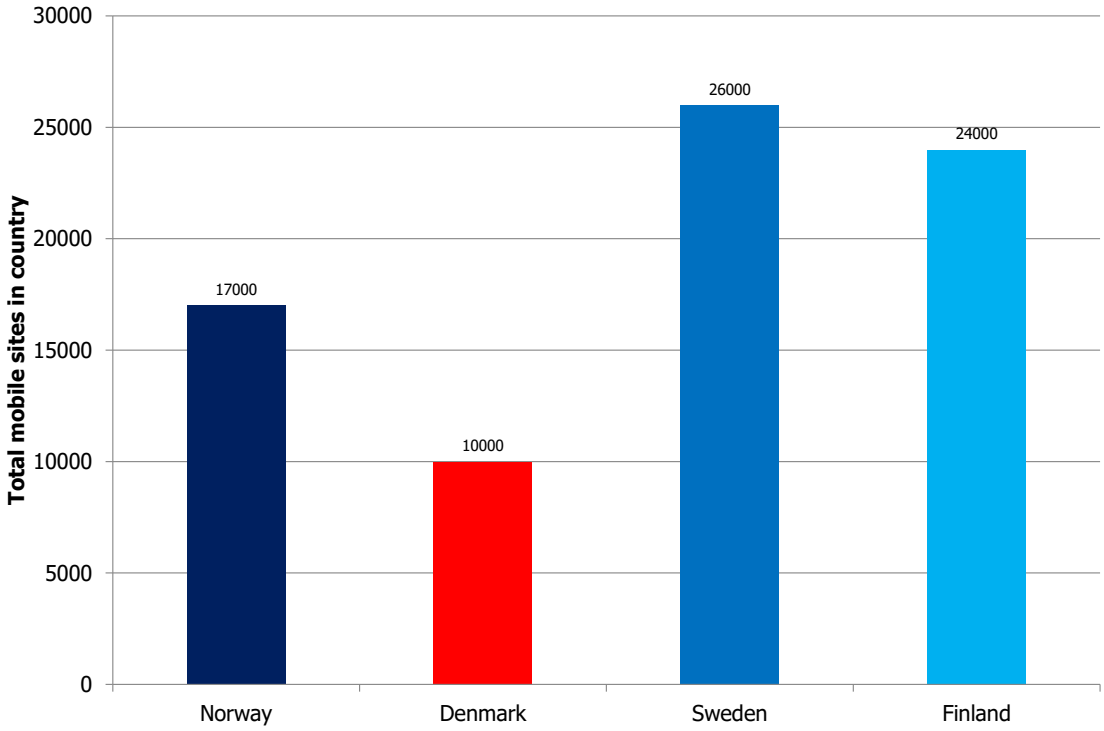


Figure 10. Comparison of the total number of mobile sites in Norway, Denmark, Sweden and Finland [source: Public registers, operator reporting, Tefficient insight, compiled by Tefficient]

7.1. Site numbers vs. population density

Let's first test these site numbers against the population density – measured as population per km^2 – of the countries to see if low population density explains high site numbers.

Sweden and Finland are having a higher number of mobile sites than Norway and Denmark, but as the number of mobile network operators (MNOs) varies in between the countries, we first need to calculate the average number of mobile sites *per MNO* to get a more correct comparison.

- Norway has 3 MNOs – Telenor, Telia and Ice
- Denmark has 4 MNOs – TDC, Telenor, Telia and 3
- Sweden has 4 MNOs – Telia, Tele2, Telenor and 3
- Finland has 3 MNOs – Elisa, Telia and DNA

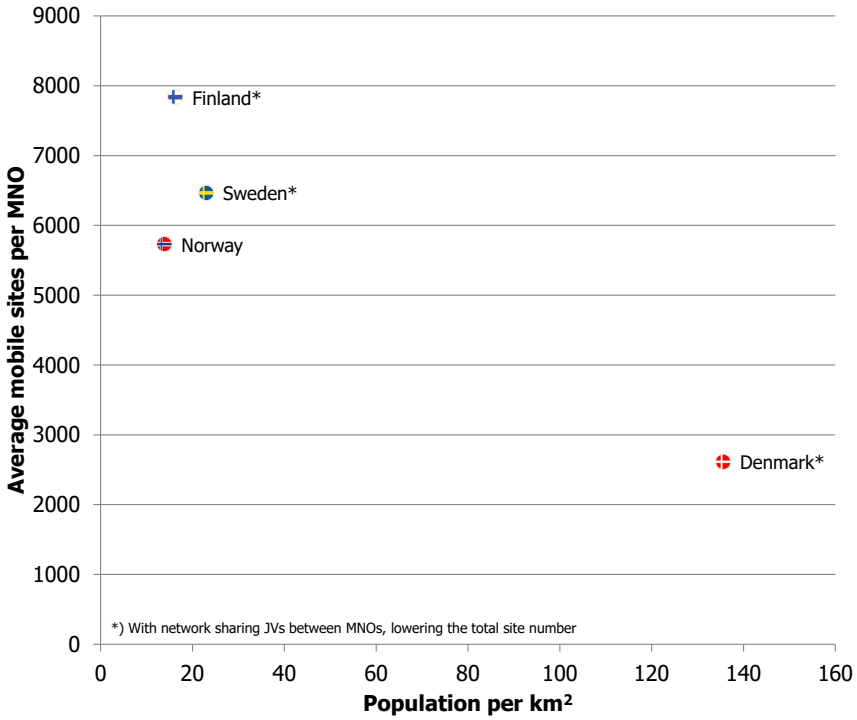


Figure 11. Comparison of the average number of mobile sites per MNO in Norway, Denmark, Sweden and Finland [source: Public registers, operator reporting, Tefficient insight, compiled by Tefficient] with the population per km^2 [source: Kartverket, World Bank]

It's obvious from Figure 11 that Denmark's MNOs can have a low number of sites due to the relative compact size of the country which results in a high population density. The differences between Norway, Finland and Sweden are much smaller. Let's zoom into from Figure 11 so that we only look at these three, geographically larger, countries.

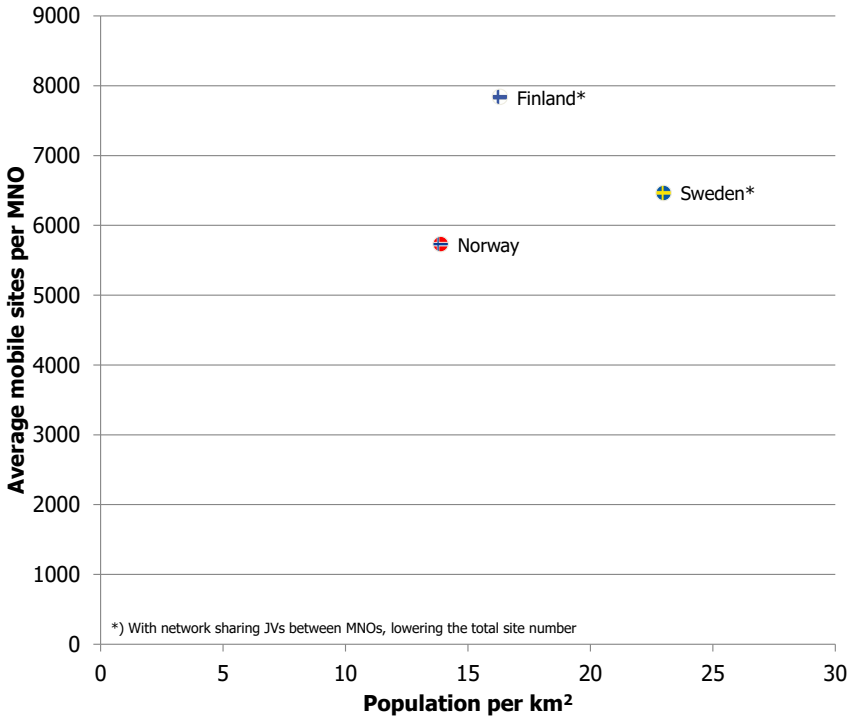


Figure 12. Comparison of the average number of mobile sites per MNO in Norway, Sweden and Finland [source: Public registers, operator reporting, Tefficient insight, compiled by Tefficient] with the population per km^2 [source: Kartverket, World Bank]

In our sample of three countries, Norway has the lowest number of average mobile sites per MNO even though the population density is the smallest. If the Norwegian narrative – Norway's low population density would drive the number of mobile sites – Norway should have a *larger* number of sites than Finland and Sweden, not a smaller.

To add to this, Norway is the only of the countries *without* active network sharing. The point of network sharing joint ventures is to save sites by avoiding duplication. So network sharing lowers the number of mobile sites per MNO. This means that without network sharing, to compare with Norway, the number of sites in Sweden and Finland per MNO in Figure 12 should be even higher.

To take the effect of network sharing into account, let's calculate the average number of sites *per network* instead of per MNO. We have here made the following assumptions:

- Norway: 3 networks = Telenor, Telia, Ice
- Denmark: 3 networks = TDC, TT-Netværket (Telenor/Telia nationwide 2G/3G/4G/5G JV), 3
- Sweden: 3 networks = Telia[15], Net4Mobility (Tele2/Telenor nationwide 2G/4G/5G JV), 3[16]
- Finland: 2,5 networks = Elisa, Telia (counted as 0,5), DNA (counted as 0,5), Suomen Yhteisverkko (Telia/DNA 50% of country 2G/3G/4G/5G JV)

The result is shown in Figure 13 below.

[15] Telia is also in a nationwide 3G JV with Tele2 (SUNAB)
[16] 3 is also in an almost nationwide (all but three largest cities) 3G JV with Telenor (3GIS)

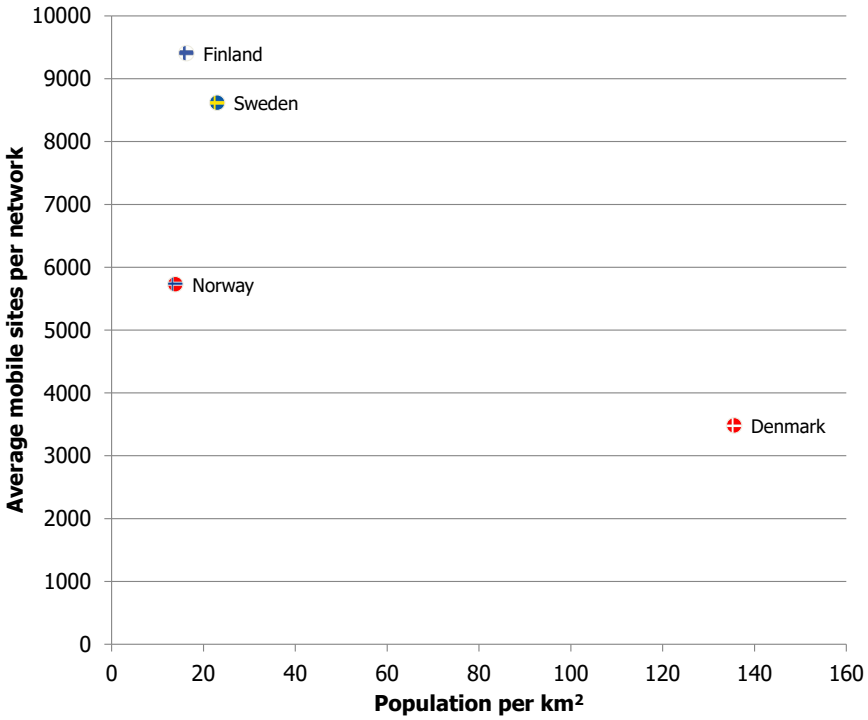


Figure 13. Comparison of the average number of mobile sites per network in Norway, Denmark, Sweden and Finland [source: Public registers, operator reporting, Tefficient insight, compiled by Tefficient] with the population per km^2 [source: Kartverket, World Bank]

Calculating the average number of sites per network as in Figure 13 makes the differences larger; it does not look as if Norway's lower population density has had any negative effect on the average number of sites per network.

But Norway's three networks aren't equal in size – Telenor is reporting 8500 sites[17] in Norway whereas Ice reported 2696 mobile sites[18] for September 2020. As Ice is expanding its network, its final number of mobile sites will grow. Maybe the average number of sites per network provides an incorrect comparison given that the third network in Norway isn't ready yet?

To compensate for this, we have in Figure 14 *excluded the last entrant* from the site count and average. For Norway, Ice has been excluded. For Denmark, 3. For Sweden, 3 (including 50% of the 3GIS JV). For Finland, DNA (including 50% of the Suomen Yhteisverkko JV).

[17] https://www.mynewsdesk.com/no/telenor/pressreleases/her-kommer-5g-i-2020-og-2021-3045353
[18] https://icegroup.com/investor/operational-kpis

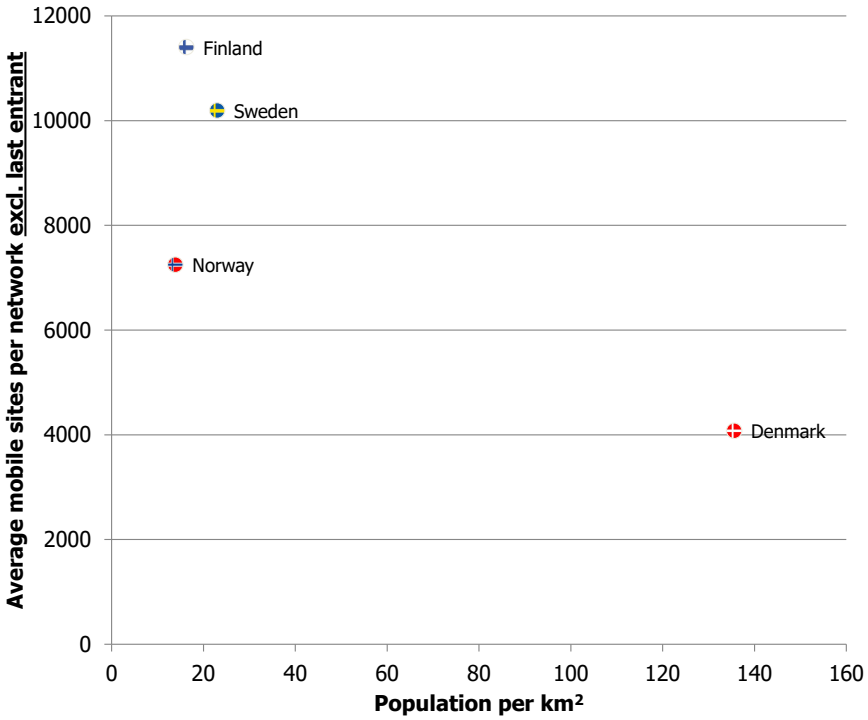


Figure 14. Comparison of the average number of mobile sites per network – excluding last entrant – in Norway, Denmark, Sweden and Finland [source: Public registers, operator reporting, Tefficient insight, compiled by Tefficient] with the population per km^2 [source: Kartverket, World Bank]

With this change, Norway comes a bit closer to Finland and Sweden, but even after having eliminated the last entrant networks, there is no support for the narrative that Norway's low population density resulted in a need to build more mobile sites. In spite of a higher population density in Finland and Sweden, the average number of mobile sites per 'incumbent network' is significantly higher than in Norway. The narrative that low population density should increase the site number has no support when comparing Norway to Sweden and Finland. It is only true when comparing Denmark with Norway/Sweden/Finland as a collective.

It can't be concluded that Norway's lower population density would result in a higher number of mobile sites – except if comparing with Denmark. In comparison to Sweden and Finland, Norway has a lower number of mobile sites per MNO, per network and per network if excluding the last entrant. If anything, Norway's lower population density seems to have lowered the number of mobile sites. Any negative effect from Norway's topology can also be disputed – unless if comparing with Denmark.

In the start of this section, we highlighted that *capacity* is one of the more important factors behind the number of sites in a mobile network. The capacity requirements on the Swedish networks are roughly 2x that of Norway, driven mainly by differences in population. The capacity requirements on the Finnish networks aren't driven by more population than in Norway, but a mobile data usage that is 4.7 times higher than in Norway, see section 10.

7.2. Site numbers vs. population

If we disregard the differences in country size and just compare the mobile site numbers to the population, we can see that the horisontal axis outlier no longer is Denmark (due to its small geography) but Sweden (due to its higher population).

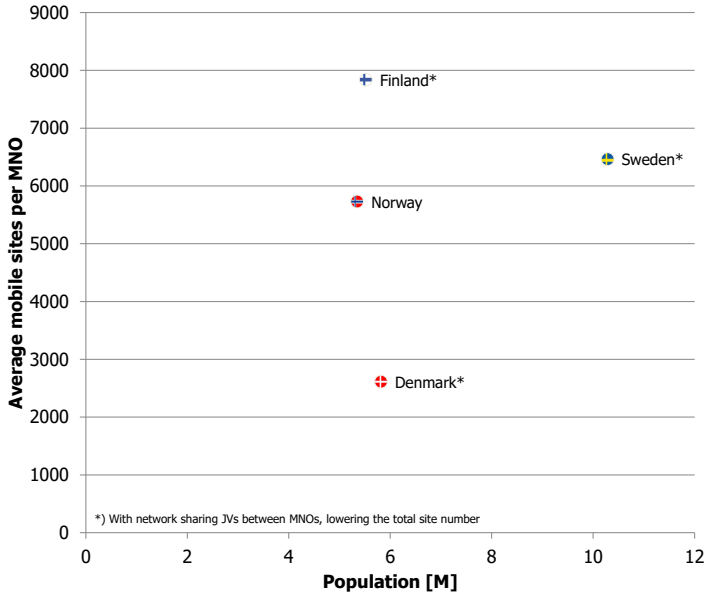


Figure 15. Comparison of the average number of mobile sites per MNO in Norway, Denmark, Sweden and Finland [source: Public registers, operator reporting, Tefficient insight, compiled by Tefficient] with the population [source: World Bank]

The average Norwegian MNO – that has to serve roughly the same population as a Danish or Finnish MNO – has built fewer sites than the average Finnish MNO but more sites than the average Danish MNO.

Per *network* – calculated in the same way as earlier – Denmark, Sweden and Finland lift in the graph, making the difference between the average Finnish network and the average Norwegian network larger.

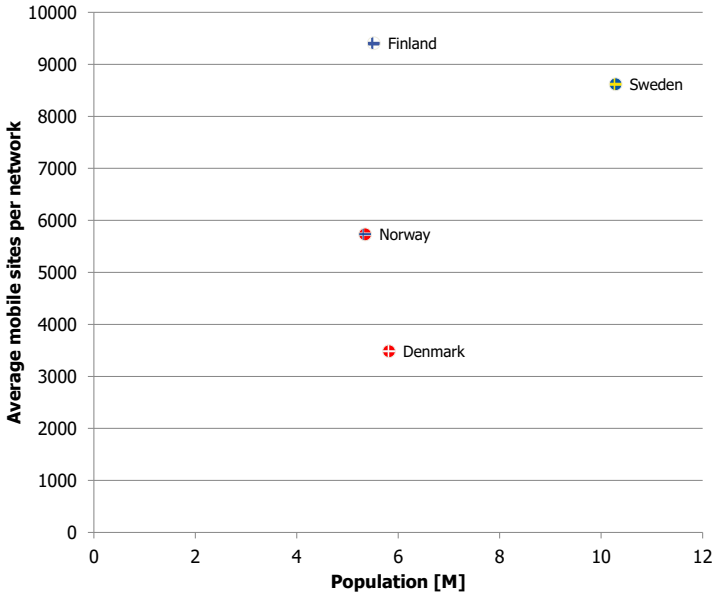


Figure 16. Comparison of the average number of mobile sites per network in Norway, Denmark, Sweden and Finland [source: Public registers, operator reporting, Tefficient insight, compiled by Tefficient] with the population [source: World Bank]

Finally the graph per network *excluding the last entrant* in which Norway moves upwards a bit.

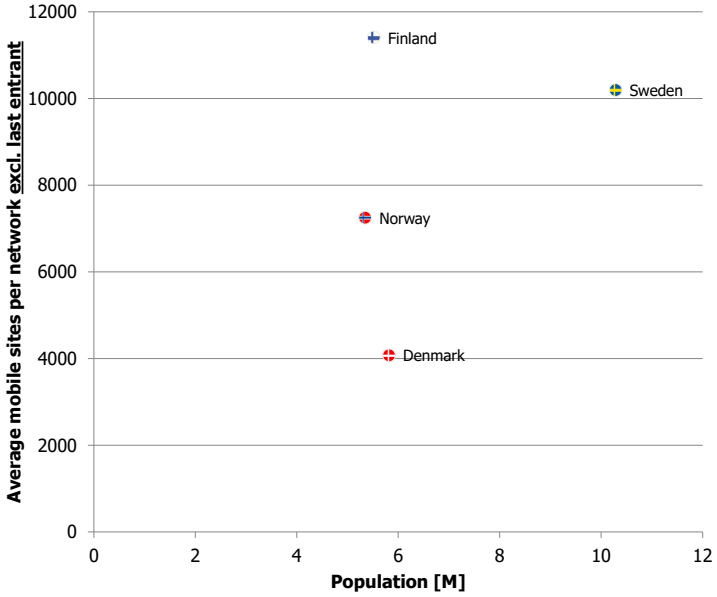


Figure 17. Comparison of the average number of mobile sites per network – excluding last entrant – in Norway, Denmark, Sweden and Finland [source: Public registers, operator reporting, Tefficient insight, compiled by Tefficient] with the population [source: World Bank]

Sweden's higher population might well explain that the number of mobile sites per MNO or network in Sweden is higher than in Norway. For Denmark, we could previously explain the difference to Norway with Denmark's smaller geography. But for Finland, this analysis does not provide any explanation other than that the average Finnish network is unusually large given its geography and population.

7.3. Site numbers vs. population in 'tettsteder'

Norway has a lower population density than the other Nordic countries. An explanation to this is that a lower share of Norway's population lives in 'tettsteder', i.e. cities, towns or villages with more than 200 inhabitants. The Nordic countries have a common definition of 'tettsteder' which allows a direct comparison.

	Share of population in 'tettsteder'
Norway	82.3%
Denmark	88.1%
Sweden	87.4%
Finland	85.3%

Figure 18. Comparison of the share of population living in 'tettsteder' (cities, towns & villages with more than 200 inhabitants) in Norway, Denmark, Sweden and Finland, 1 January 2020 [source: SSB, SCB, Danmark Statistik, Tilastokeskus]

Let's finally compare the site numbers with the share of population in 'tettsteder' to see if that percentage could explain a higher site number.

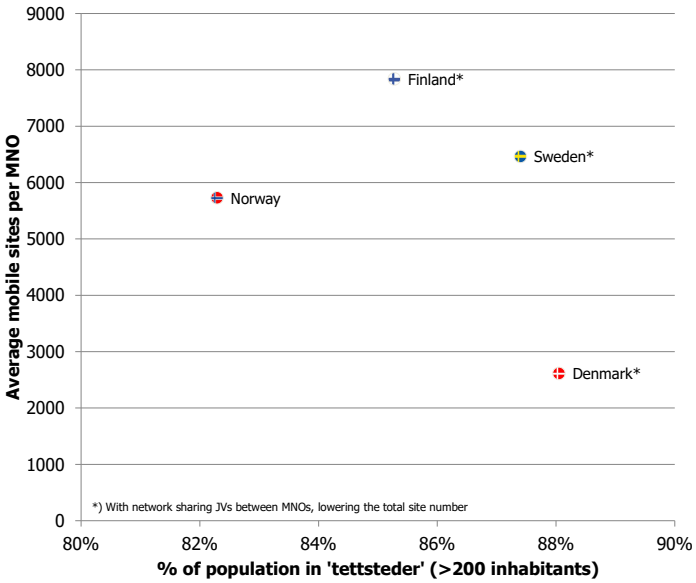


Figure 19. Comparison of the average number of mobile sites per MNO in Norway, Denmark, Sweden and Finland [source: Public registers, operator reporting, Tefficient insight, compiled by Tefficient] with the share of population in 'tettsteder' [source: source: SSB, SCB, Danmark Statistik, Tilastokeskus]

The average Norwegian MNO has built more sites than the average Danish MNO but less sites than the average Finnish and Swedish MNO.

Per *network* – calculated in the same way as earlier – Denmark, Sweden and Finland lift in the graph, making Norway a bit more isolated in the graph. The low share of population in 'tettsteder' in Norway seems to have had lowered the Norwegian site number per network vs. that of Finland and Sweden. The higher capacity requirements in Sweden and Finland might be behind.

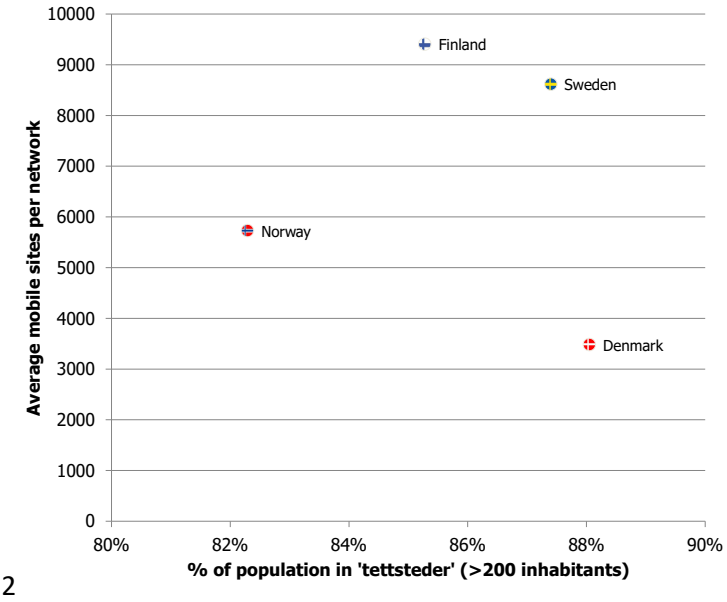


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Figure 20. Comparison of the average number of mobile sites per network in Norway, Denmark, Sweden and Finland [source: Public registers, operator reporting, Tefficient insight, compiled by Tefficient] with the share of population in 'tettsteder' [source: source: SSB, SCB, Danmark Statistik, Tilastokeskus]

Finally the graph per network *excluding the last entrant* in which Norway moves upwards a bit.

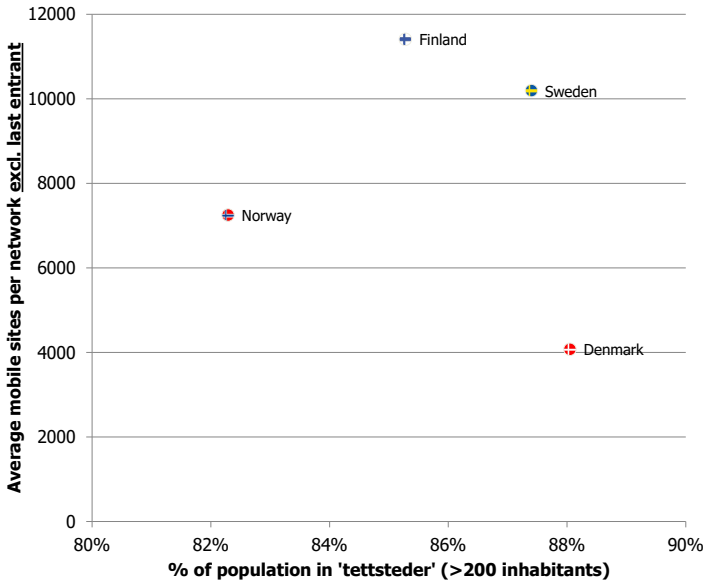

Figure 21. Comparison of the average number of mobile sites per network – excluding last entrant – in Norway, Denmark, Sweden and Finland [source: Public registers, operator reporting, Tefficient insight, compiled by Tefficient] with the share of population in 'tettsteder' [source: source: SSB, SCB, Danmark Statistik, Tilastokeskus]

Sweden's higher population – to a higher extent living in 'tettsteder' – might well explain that the number of mobile sites per MNO or network in Sweden is higher than in Norway. For Denmark, we could previously explain the difference to Norway with Denmark's smaller geography. But for Finland, this analysis does not provide any explanation other than that the average Finnish network is unusually large given its geography, population and share of population living in 'tettsteder'.

8. Are larger networks driving an operator's total costs?

By comparing the total mobile site numbers between Norway, Sweden and Finland we have not been able to prove that Norway's mobile networks are larger than Swedish or Finnish networks.

Referring to our point b) from the previous section, Tefficient would anyhow like to test the notion that network size should have a significant impact on an operator's total costs. For a representative sample of *established* Nordic operators, see Figure 22, the average mobile operator used 15% of its revenue on Networks OPEX and 7% of its revenue on Networks CAPEX. In total, **22% of revenues were used on network costs**.

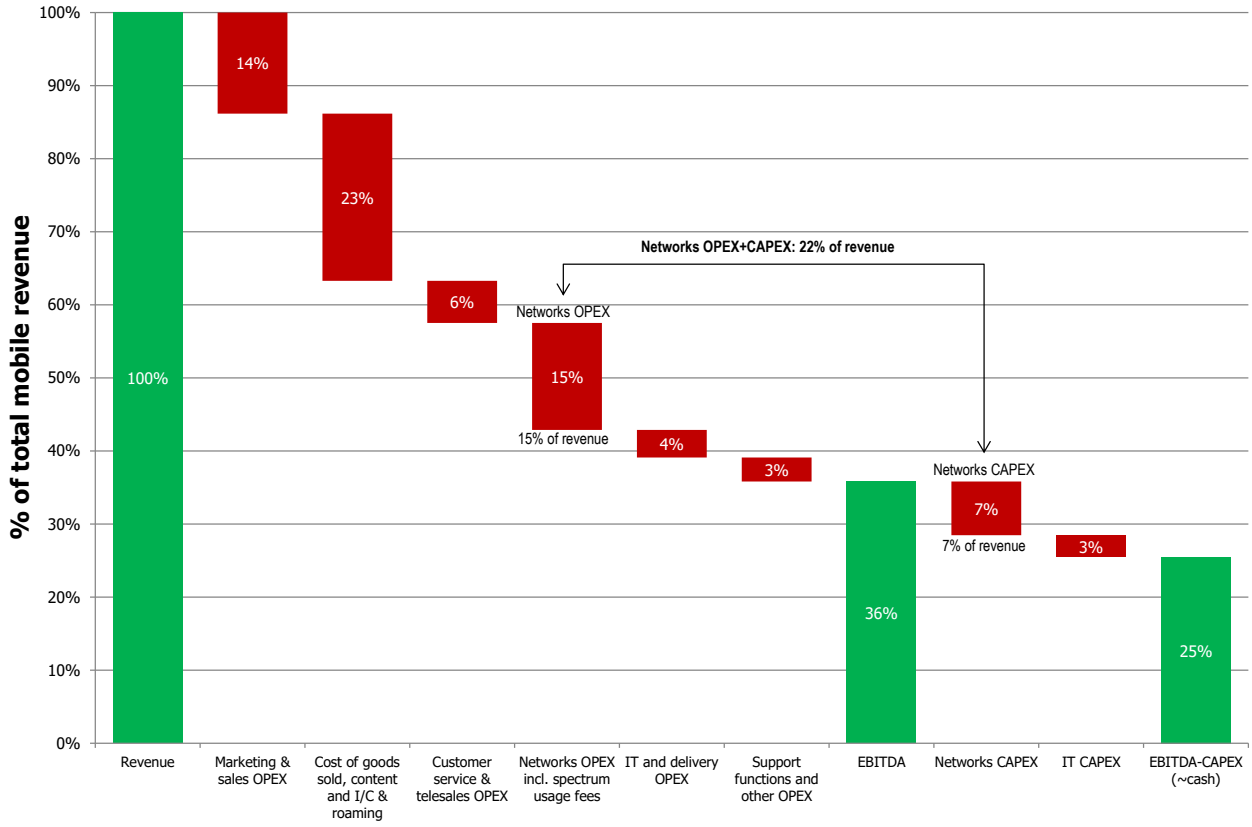

Figure 22. Breakdown of mobile revenue into different OPEX, CAPEX and profit items – average for a number of established operators in Norway, Denmark, Sweden and Finland [source: Tefficient insight, compiled by Tefficient]

Although 22% of revenues isn't a small cost item, established operators have other cost items – most importantly Marketing & sales OPEX (14% of revenue) and Cost of goods sold etc (23% of revenue) – that are large too. Since established operators averagely use 64% of revenues on OPEX, they averagely had an EBITDA margin of 36% after OPEX. And while they use 10% of revenues on CAPEX[19], they averagely had an EBITDA-CAPEX (an approximation of cash flow) margin of 25%.

[19] Frequency auction fees (if any) not included

Whether or not a mobile operator has a few hundred mobile sites more or less doesn't make any visible difference to their cost distribution. Most of the revenues aren't going to the networks; they go to other costs (and to profit).

But what if Norwegian mobile sites are much more expensive to build? Sometimes Norwegian operators have to pull cables for tens of kilometres to serve one rural base station with power and transmission. They might have to build a dedicated road to it – or lift in the equipment with a helicopter and use snowmobiles when servicing it. These anecdotes are impressive and operators deserve to be praised for walking the extra mile, but it's important to know that every operator in every rural Nordic country have similar rural sites where costs to build and serve are truly over the top. But in the full picture, these sites are **exceptions**. An absolute majority of sites in all mobile networks are totally uncomplicated standard type of masts and roof tops. Although a Nordic operator might have a few tens truly unique and difficult rural sites, they drown in the uncomplicated mass deployment of thousands of sites.

In Tefficient's experience, the *average* mobile site is not more complicated to build and maintain in Norway than in Sweden and Finland. Denmark, lacking the sizeable rural areas of Norway, Sweden and Finland, has a slight benefit, but as a vast majority of mobile sites are totally uncomplicated in all countries, the differences shouldn't be exaggerated.

The notion that network size should have a significant impact on an established operator's total costs is exaggerating reality. A representative sample of established Nordic operators averagely used 22% of revenues on Networks OPEX and CAPEX. 78% of revenues were used on other cost items and on profit. Adding a few hundred sites to a mobile network doesn't change these cost fundamentals.

To add to it, a site is not only a cost item for a mobile operator – it is **also a source of revenue**. Tefficient's insight from established Nordic operators is that the site rental income per owned site averagely is about 120,000 NOK per year. This revenue comes from the rent competitors or other networks pay for being granted a right to install and operate base station equipment and antennas on the site and in the mast. Operators that are first to establish a site in a previously uncovered area can often expect to have one or several tenants.

The Spanish infrastructure company Cellnex Telecom recently (12 November 2020) acquired all the mobile sites of CK Hutchison in Europe[20]. The operator of the '3' brand, CK Hutchison, sold a total of 24,600 sites in Italy, the UK, Ireland, Austria, Sweden and Denmark. 4,050 of these sites are today in Sweden and Denmark – two of our four Nordic peer group markets.

The total acquisition price for the 24,600 sites was 10 billion EUR, meaning that the average European site – among them Swedish and Danish sites – was acquired for 407,000 EUR or **4.2 million NOK**. This transaction is an example of how highly valued mobile sites actually are by investors. Cellnex's business model is to rent the acquired assets, the mobile sites, back to CK Hutchison – but also to find other tenants. The expectation is of course that the company will be profitable in doing so. The business model is well tested in e.g. the US, Latin American and APAC markets where companies such as American Tower Corporation operate more than 170,000 sites with good profit[21].

[20] https://www.cellnextelecom.com/en/cellnex-to-add-c-30000-telecommunication-european-sites-from-ck-hutchison-to-its-portfolio/
[21] https://www.americantower.com/investor-relations/earnings-materials/

Another indication of the asset values associated with mobile sites is that some operators in Europe are in the process of spinning off their site assets in separate companies – like Vodafone did with Vantage Towers in June 2020[22]. Telenor has recently gathered its infrastructure in a separate company, Telenor Infra. Some have speculated in that this is a preparation for a later spin-off[23].

A mobile network with many owned sites represents a revenue opportunity for the operator. The mobile sites are seen as assets by infrastructure companies and some operators in Europe are currently in the process of selling their site assets – or spinning off their sites in a separate company.

[22] https://www.vodafone.com/news-and-media/vodafone-group-releases/news/vantage-towers
[23] https://e24.no/teknologi/i/XqB84m/telenor-norge-splittes-opp-flytter-mobilmastene-over-i-nytt-selskap

9. Are higher mobile revenues needed to compensate for these network costs?

Now to the final c) element in the chain of logic: Are higher mobile revenues needed to compensate for these network costs?

The conclusion of the previous section might have given you an idea of this already, but let's use the operator reported EBITDA and CAPEX figures to compare the EBITDA margins and EBITDA-CAPEX margins between operators in Norway, Denmark, Sweden and Finland.

The adjusted EBITDA margins (what remains of revenue after having paid recurring OPEX) of all mobile operators in Norway, Denmark, Sweden and Finland are shown in Figure 23.

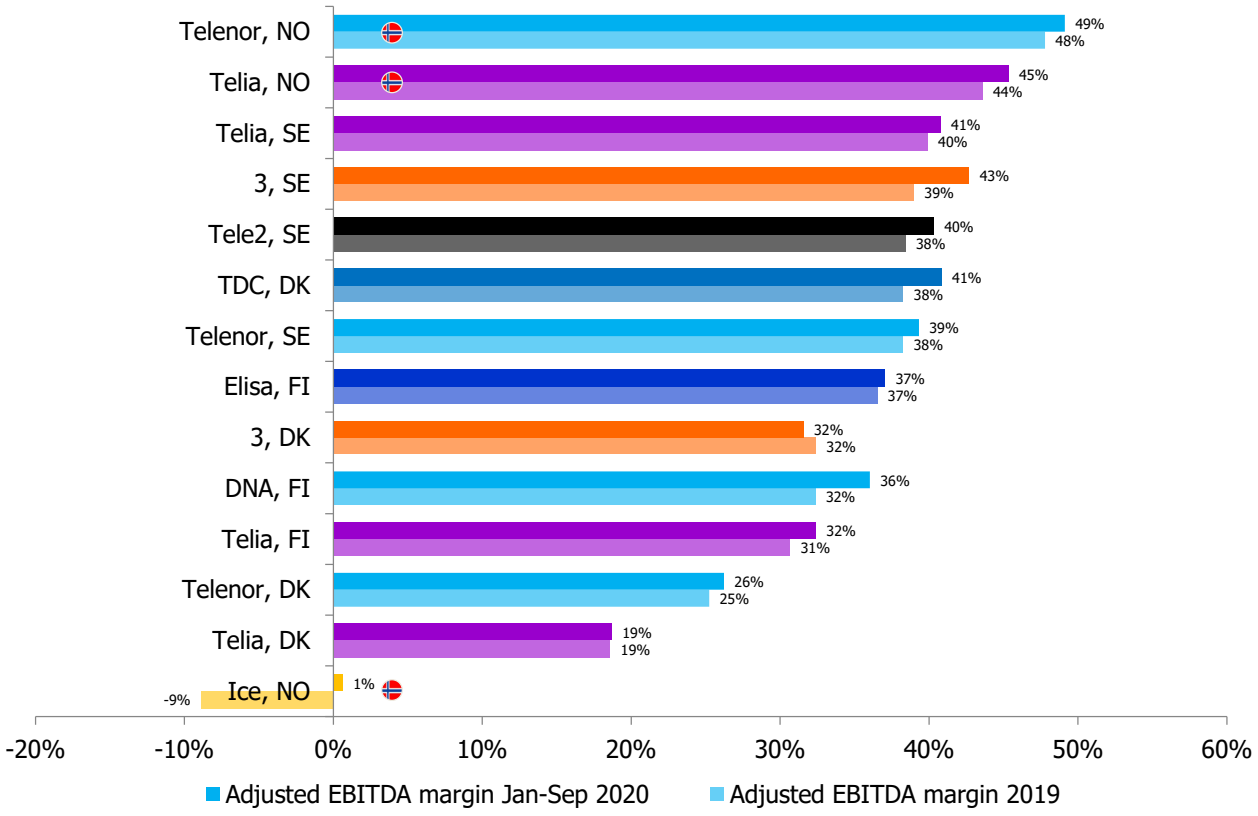

Figure 23. Adjusted EBITDA margin for all mobile operators in Norway, Denmark, Sweden and Finland. Note that operators report their EBITDA for their complete business which most often is wider than just mobile; three operators are pure mobile: 3 Sweden, 3 Denmark and Ice [source: operator reports, compiled by Tefficient]

The two established Norwegian operators, **Telenor** and **Telia**, have the highest adjusted EBITDA margins in these four countries. This is true both for the full year of 2019 as for the first nine months of 2020. In contrast, the third Norwegian operator, **Ice**, has the lowest adjusted EBITDA margin. In 2019 it was still negative, but Ice has turned to positive adjusted EBITDA in 2020.

That Telenor and Telia Norway have the strongest adjusted EBITDA margins is an indication of 1) that their revenue is unusually high, or, 2) that their OPEX is unusually low, or, 3) both. Ice's position is a result of weaker revenue per customer (ARPU) and higher OPEX. In the first nine months of 2020, Ice's national roaming costs[24] represented 23% of Ice's total revenue[25]. The new national roaming agreement Ice made with Telia following the new Market-15 regulation from NKOM will lower that costs item significantly for Ice starting January 2021.

Concluding on Figure 23, it is very unlikely that Telenor or Telia could have a Networks OPEX issue of a magnitude that would dominate their total OPEX – if they had, their adjusted EBITDA margins wouldn't be best in class.

The comparison of adjusted EBITDA margins makes it very probable that neither Telenor Norway nor Telia Norway have a Networks OPEX issue. In the case of Ice, national roaming costs consumed 23% of Ice's total revenues in the first nine month of 2020.

But there are other costs than OPEX – we also need to take CAPEX into account. Figure 24 compares the CAPEX to revenue ratios for our operators. **Ice** is by far the operator in the Nordics that invests the most given the revenues at hand – 44% in the first nine months of 2020. TDC in Denmark is currently, under new ownership, rolling out fibre networks at a very high speed and used a very high 33% of its revenues on CAPEX in the first months of 2020. **Telenor** Norway invested a high 21% of its revenues in 2019 and in the first nine months of 2020. **Telia** Norway is also investing a bit more than what is common in the Nordics; 16% of revenues in the first nine months of 2020. There is merit in the claim that **Norwegian operators invest more**.

We have in Figure 24 marked the operators that are in joint ventures for active mobile network sharing in 4G/5G with an asterisk (*). It could be a coincidence, but likely not, that the operators with the lowest CAPEX to revenue ratios tend to have network sharing joint ventures.

[24] Ice uses Telia's network outside of its own network's coverage area
[25] Source: Ice's financial reporting, calculated by Tefficient

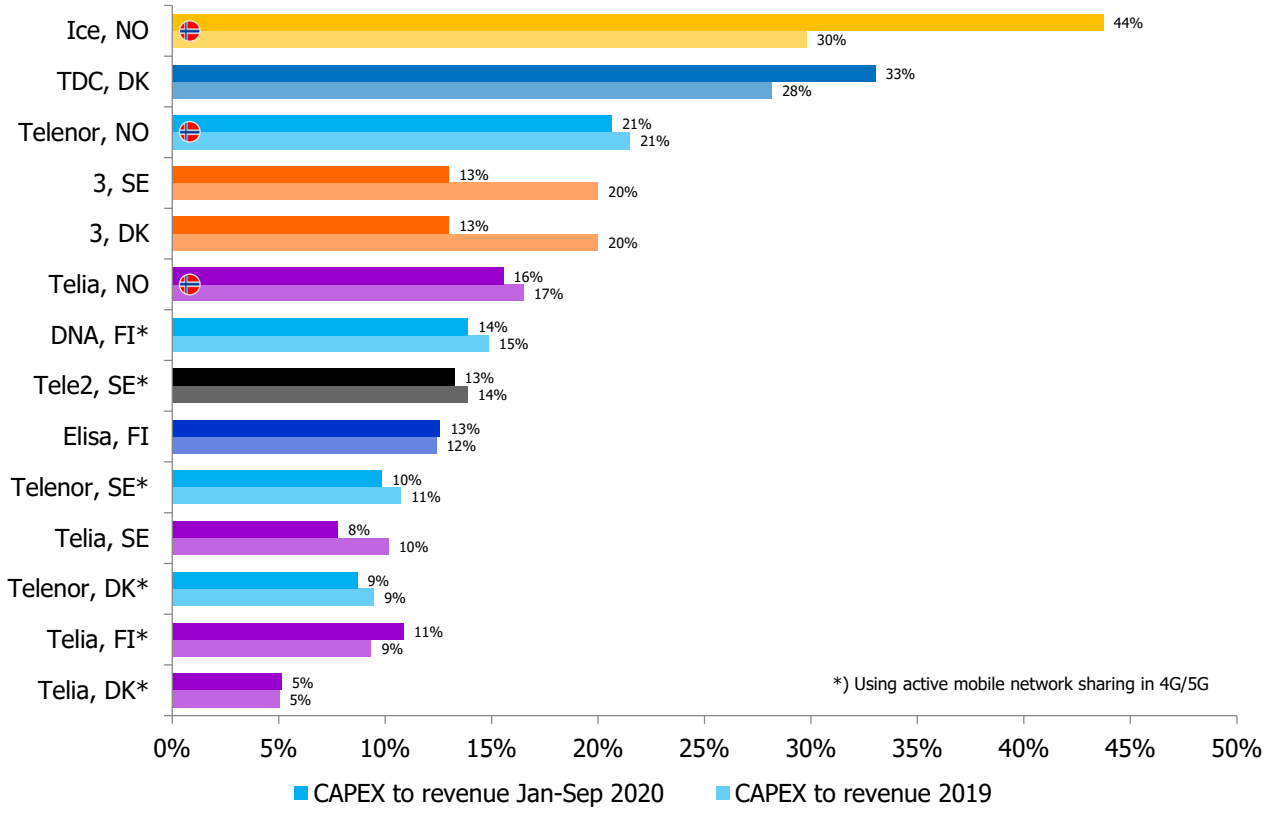

Figure 24. CAPEX to revenue for all mobile operators in Norway, Denmark, Sweden and Finland. Note that operators report their CAPEX for their complete business which most often is wider than just mobile; three operators are pure mobile: 3 Sweden, 3 Denmark and Ice. 3 doesn't separate its CAPEX reporting between Sweden and Denmark, hence the same percentage [source: operator reports, compiled by Tefficient]

Now to the question of this section – are higher mobile revenues needed to compensate for higher network costs? Are e.g. the Norwegian operators producing less cash because they use more on CAPEX?

Figure 25 shows the EBITDA-CAPEX margin (what remains of revenue after having paid recurring OPEX and CAPEX) of the same operators.

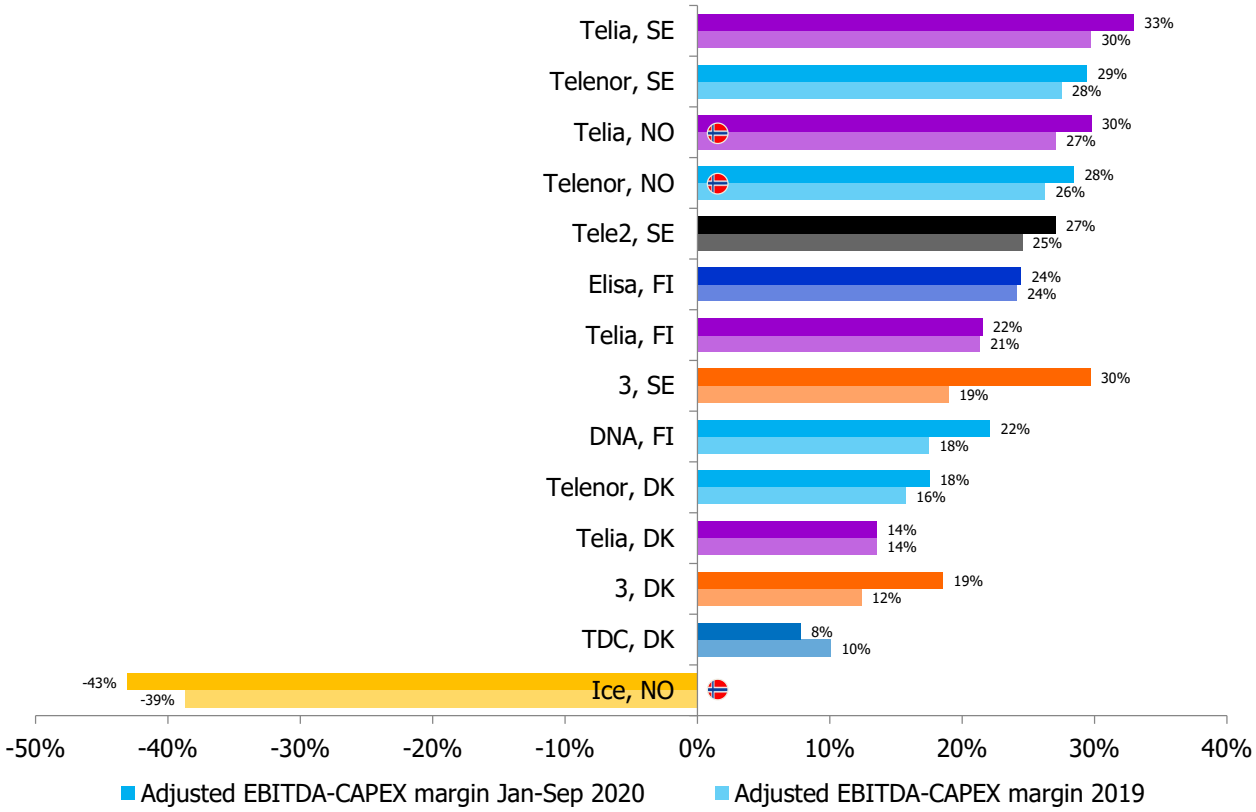

Figure 25. Adjusted EBITDA margin for all mobile operators in Norway, Denmark, Sweden and Finland. Note that operators report their EBITDA and CAPEX for their complete business which most often is wider than just mobile; three operators are pure mobile: 3 Sweden, 3 Denmark and Ice [source: operator reports, compiled by Tefficient]

Since **Telenor** Norway's and **Telia** Norway's CAPEX levels are higher than the average of the four markets, Telenor and Telia are no longer holding the number 1 and 2 positions after having deducted also CAPEX. They are still well positioned as number 3 and 4, though. **Ice** is the only operator in these markets with a negative EBITDA-CAPEX margin. There are two reasons to it: 1) A much lower EBITDA margin as shown in Figure 23, 2) A very high CAPEX to revenue ratio as shown in Figure 24.

If an operator would have higher network costs and would compensate for that with higher revenue – *just enough* to cover those extra network costs – we could expect that operator to report an *average* EBITDA margin and an *average* EBITDA-CAPEX margin. If those margins are higher than average, it suggests that the operator in question has *overcompensated* for such extra costs (or there weren't any).

The comparison of the EBITDA-CAPEX margins shows that Telenor Norway and Telia Norway can very well afford its current level of Networks CAPEX. After having paid OPEX and CAPEX, their margins are still higher than Nordic average. The situation for Ice is very different – at present Ice's revenues cover its OPEX but none of its CAPEX making Ice the only operator in our markets with negative EBITDA-CAPEX margin.

10. Comparison of mobile data usage and revenue

Figure 26 compares the mobile data usage per subscription (incl. M2M) between our four countries. Finland is the world leader[26] in average mobile data usage and totally dominates over the other Nordic countries with an average of 22.4 GB used per subscription per month in 1H 2020.

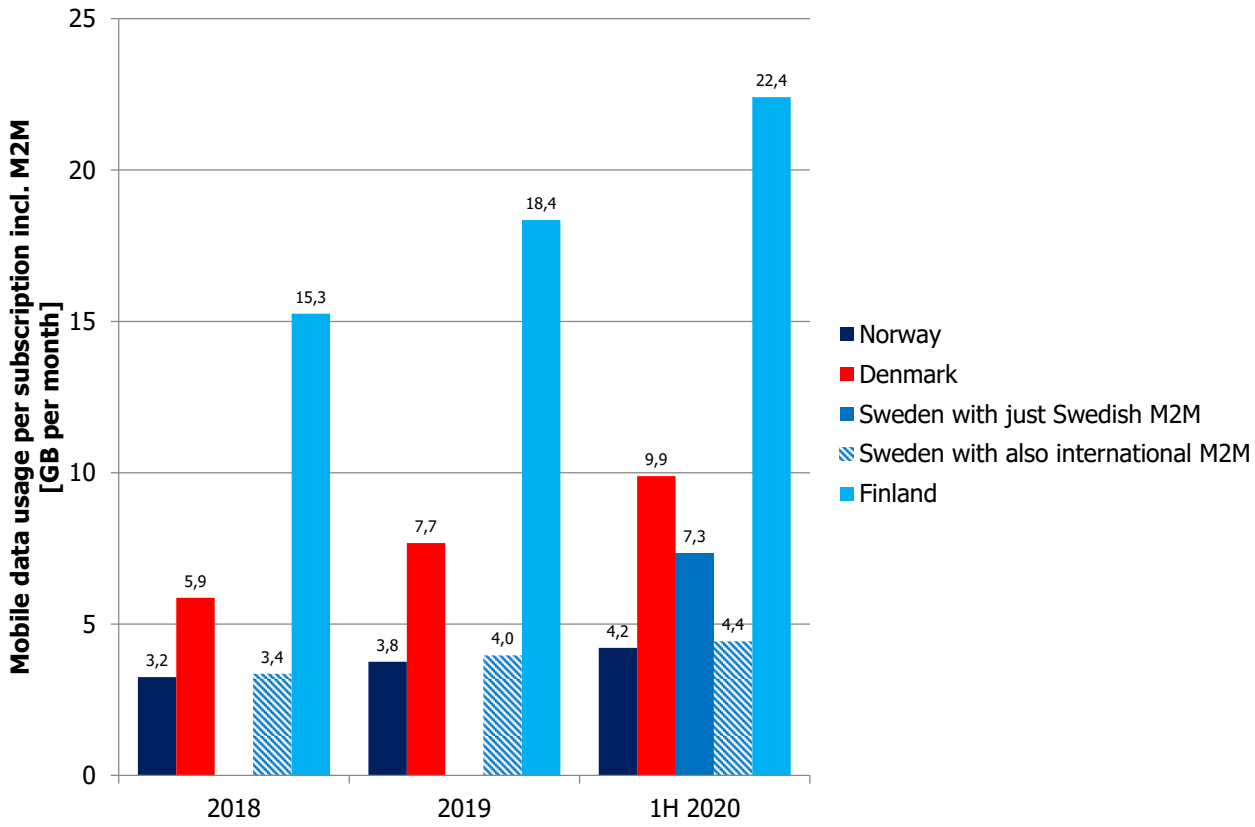

Figure 26. Average mobile data usage per mobile subscription including M2M for Norway, Denmark, Sweden and Finland 2018, 2019 and 1H 2020 [source: NKOM, Energistyrelsen, PTS, Traficom, compiled by Tefficient]

The average mobile data usage of Norway was 4.2 GB per subscription per month in 1H 2020 – significantly lower than Finland obviously, but also much lower than Denmark and Sweden.

To avoid M2M and the difficulties with the Swedish reporting, let's now exclude M2M[27], see Figure 27. Also here, Finland totally dominates over the other Nordic countries with an average of 26.4 GB used per subscription (excl. M2M) per month in 1H 2020.

[26] https://tefficient.com/the-growth-in-mobile-data-wasnt-stopped-by-a-pandemic/

[27] Denmark and Finland aren't separating out the M2M data traffic (Norway and Sweden do) but from the Norwegian and Swedish data it's clear that the M2M data traffic is very small compared to the overall data traffic – 0.4% in Norway and 0.5% in Sweden in 1H 2020. We have therefore assumed that the M2M traffic in Denmark and Finland is zero rather than excluding the countries from this metric.

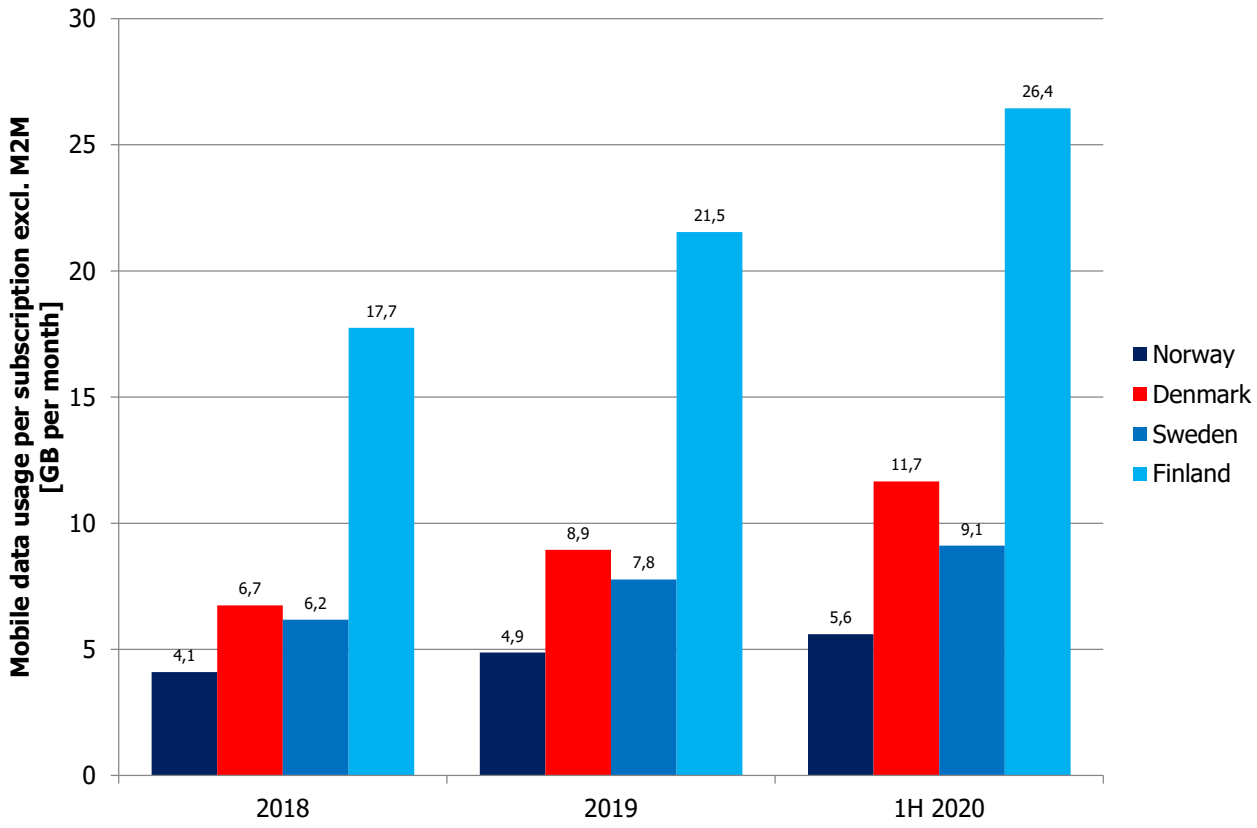

Figure 27. Average mobile data usage per mobile subscription excluding M2M for Norway, Denmark, Sweden and Finland 2018, 2019 and 1H 2020 [source: NKOM, Energistyrelsen, PTS, Traficom, compiled by Tefficient]

The average mobile data usage of Norway was 5.6 GB per subscription per month in 1H 2020 – significantly lower than Finland obviously, but also much lower than Denmark and Sweden.

Norway is *not* closing the gap vs. the other countries as the growth in mobile data usage actually is the slowest amongst our four markets:

Y-o-y development in mobile data usage excl. M2M	2018	2019	1H 2020
Norway	27% slowest	19% slowest	23% slowest
Denmark	32% fastest	32% fastest	35% fastest
Sweden	30%	26%	29%
Finland	31%	21%	31%

Figure 28. Y-o-y development in mobile data usage per mobile subscription excluding M2M for Norway, Denmark, Sweden and Finland 2018, 2019 and 1H 2020 [source: NKOM, Energistyrelsen, PTS, Traficom, compiled by Tefficient]

We saw in section 6 that Norway's current data-rich offers are more expensive than in the other countries – if not adjusting for purchasing power. Could Norway's low mobile data usage and slow growth have something to do with the cost of mobile data? To assess this, we have calculated the **total mobile service revenue per consumed GB**[28].

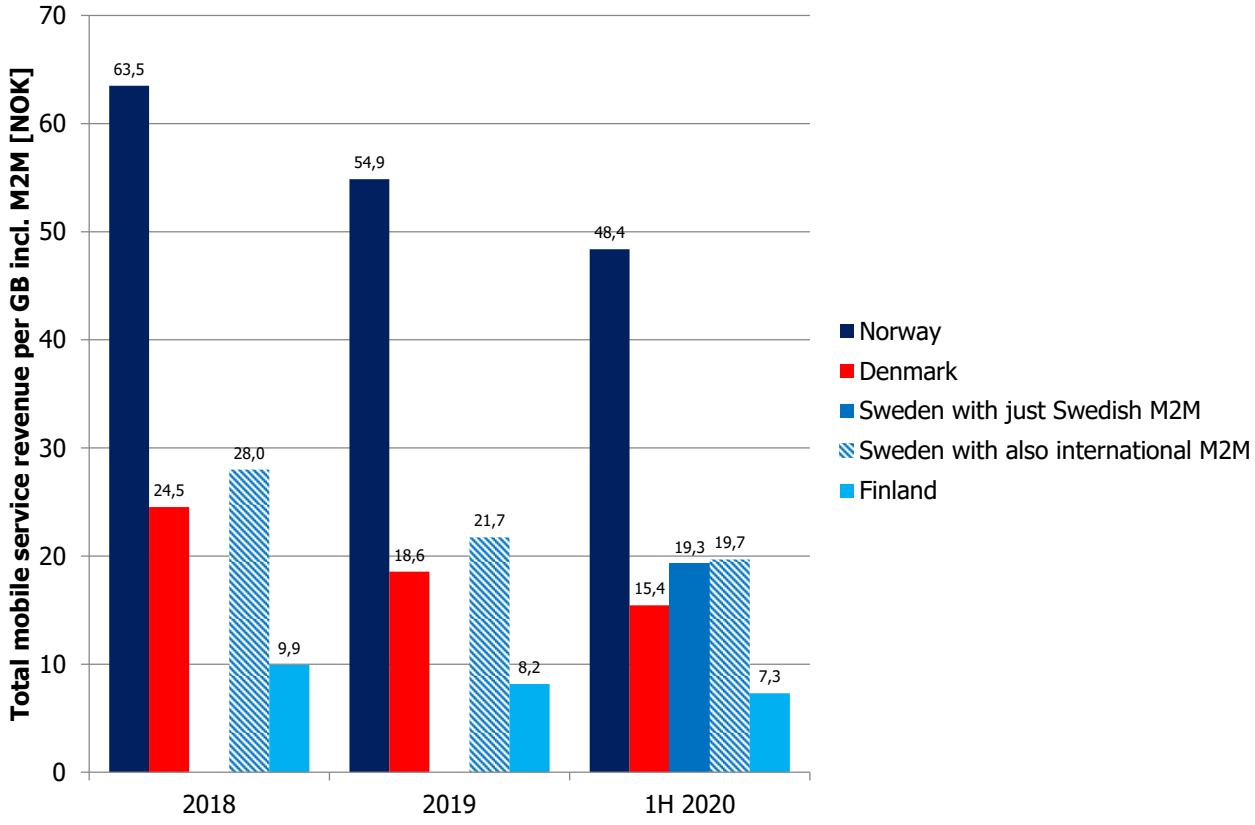

Figure 29. Total mobile service revenue per consumed GB including M2M for Norway, Denmark, Sweden and Finland 2018, 2019 and 1H 2020 [source: NKOM, Energistyrelsen, PTS, Traficom, IMF, operator reports for 1H 2020 for Denmark and Finland as Energistyrelsen and Traficom do not report revenue half-yearly, compiled by Tefficient]

Figure 29 shows the figures if including M2M. The revenue per GB in Norway was 3.1 times higher than in Denmark in 1H 2020, 2.5 times higher than in Sweden and 6.6 times higher than in Finland. Two factors are behind this: 1) The higher ARPU in Norway, see section 4, 2) The lower mobile data usage in Norway, see this section.

Excluding the M2M SIMs from the calculation doesn't change the graph much.

[28] The reason why we use the total mobile service revenue, not just the mobile service revenue associated with mobile data, is the way mobile plans are packaged today – with a typically unlimited amount of minutes and text messages and a limited or unlimited number of GBs. With this, there is no way to separate the total service revenue into voice, messaging and data.

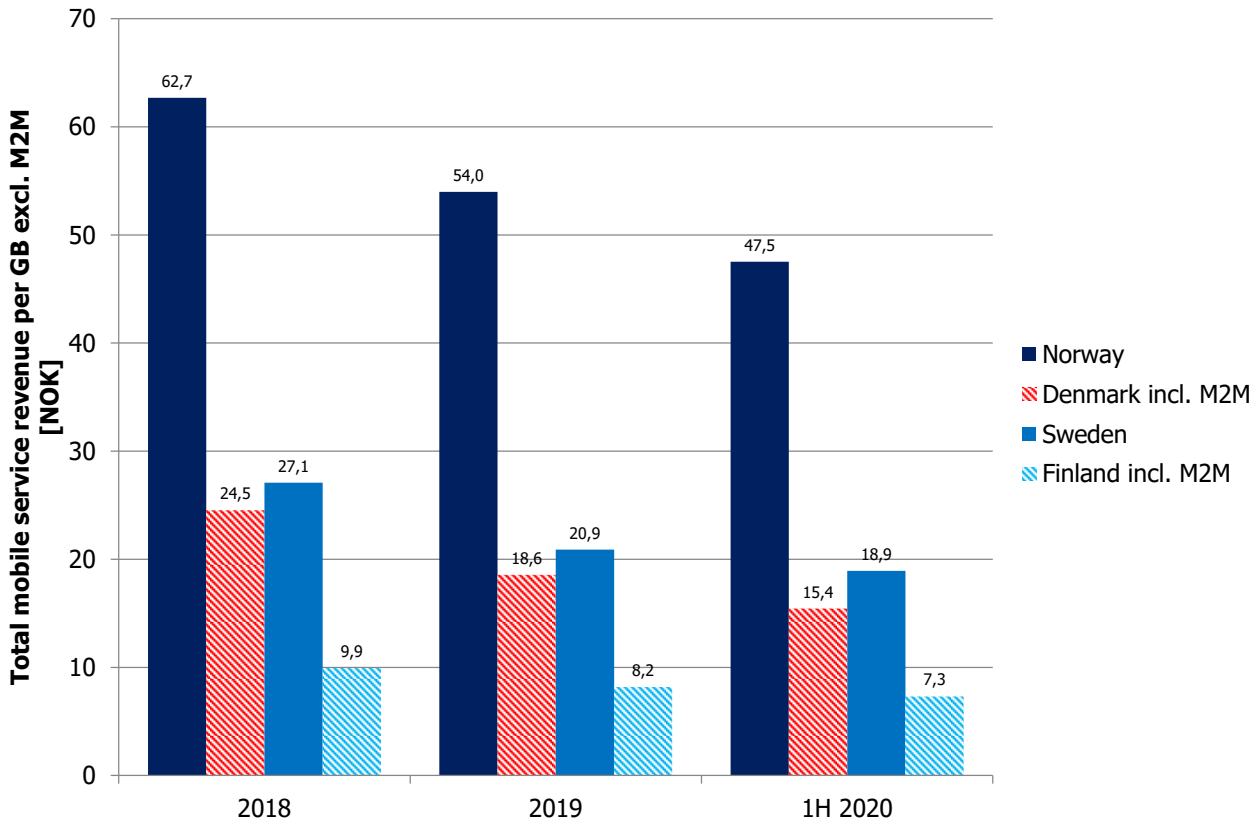

Figure 30. Total mobile service revenue per consumed GB excluding M2M for Norway, Denmark, Sweden and Finland 2018, 2019 and 1H 2020. The Danish and Finnish regulators do not break out M2M revenues so revenue excl. M2M can't be calculated for Denmark and Finland [source: NKOM, Energistyrelsen, PTS, Traficom, IMF, operator reports for 1H 2020 for Denmark and Finland as Energistyrelsen and Traficom do not report revenue half-yearly, compiled by Tefficient]

The revenue per GB in Norway was still 2.5 times higher than in Sweden in 1H 2020.

Now let us apply the purchasing power adjustments to these two graphs.

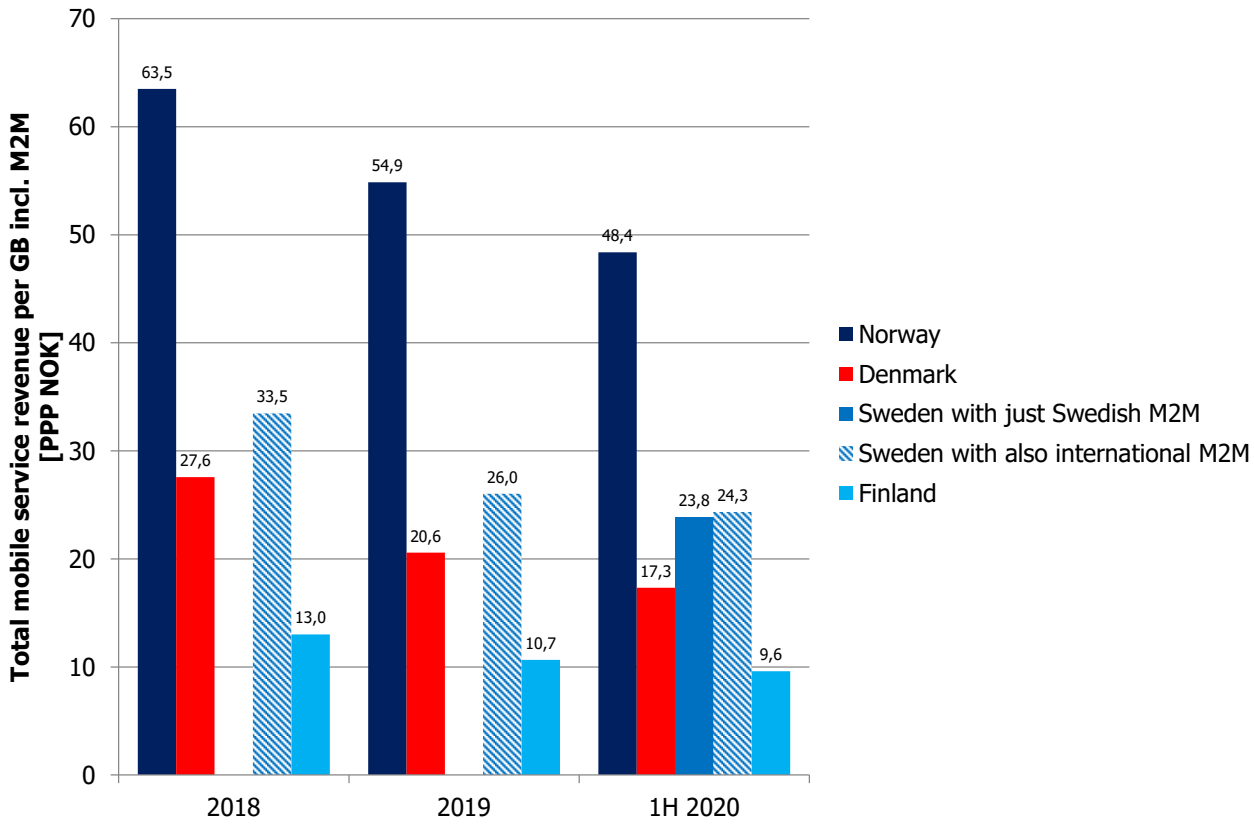

Figure 31. Total mobile service revenue in PPP NOK per consumed GB including M2M for Norway, Denmark, Sweden and Finland 2018, 2019 and 1H 2020. The PPP values for 2020 are preliminary [source: NKOM, Energistyrelsen, PTS, Traficom, IMF, operator reports for 1H 2020 for Denmark and Finland as Energistyrelsen and Traficom do not report revenue half-yearly, compiled by Tefficient]

Figure 29 shows the PPP figures if including M2M. The PPP adjusted revenue per GB in Norway was 2.8 times higher than in Denmark in 1H 2020, 2.0 times higher than in Sweden and 5.0 times higher than in Finland.

Excluding the M2M SIMs from the calculation doesn't change the graph much.

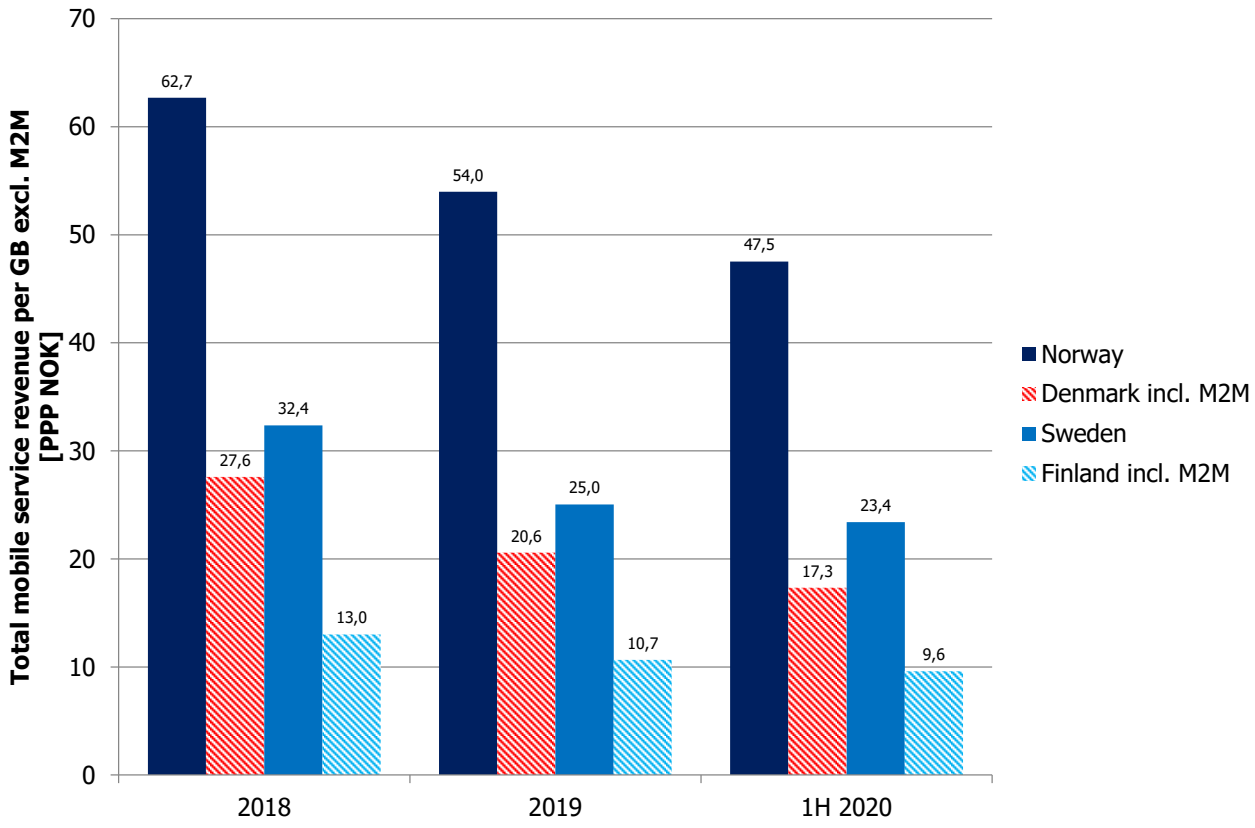

Figure 32. Total mobile service revenue in PPP NOK per consumed GB excluding M2M for Norway, Denmark, Sweden and Finland 2018, 2019 and 1H 2020. The Danish and Finnish regulators do not break out M2M revenues so revenue excl. M2M can't be calculated for Denmark and Finland [source: NKOM, Energistyrelsen, PTS, Traficom, IMF, operator reports for 1H 2020 for Denmark and Finland as Energistyrelsen and Traficom do not report revenue half-yearly, compiled by Tefficient]

The PPP adjusted revenue per GB in Norway is still 2.0 times higher than in Sweden in 1H 2020.

The total mobile service revenue per consumed GB in 1H 2020 was 2.5-6.6 times higher in Norway than in the other Nordic countries. If adjusting for purchasing power, 2.0-5.0 times. It's likely that the high revenue hampers the Norwegian usage.

The following graphs compare how much mobile subscribers **get for what they pay**. We are simply comparing the ARPU from section 4 with the average mobile data usage from this section. First a graph where M2M is included and no adjustment for purchase parity has been made:

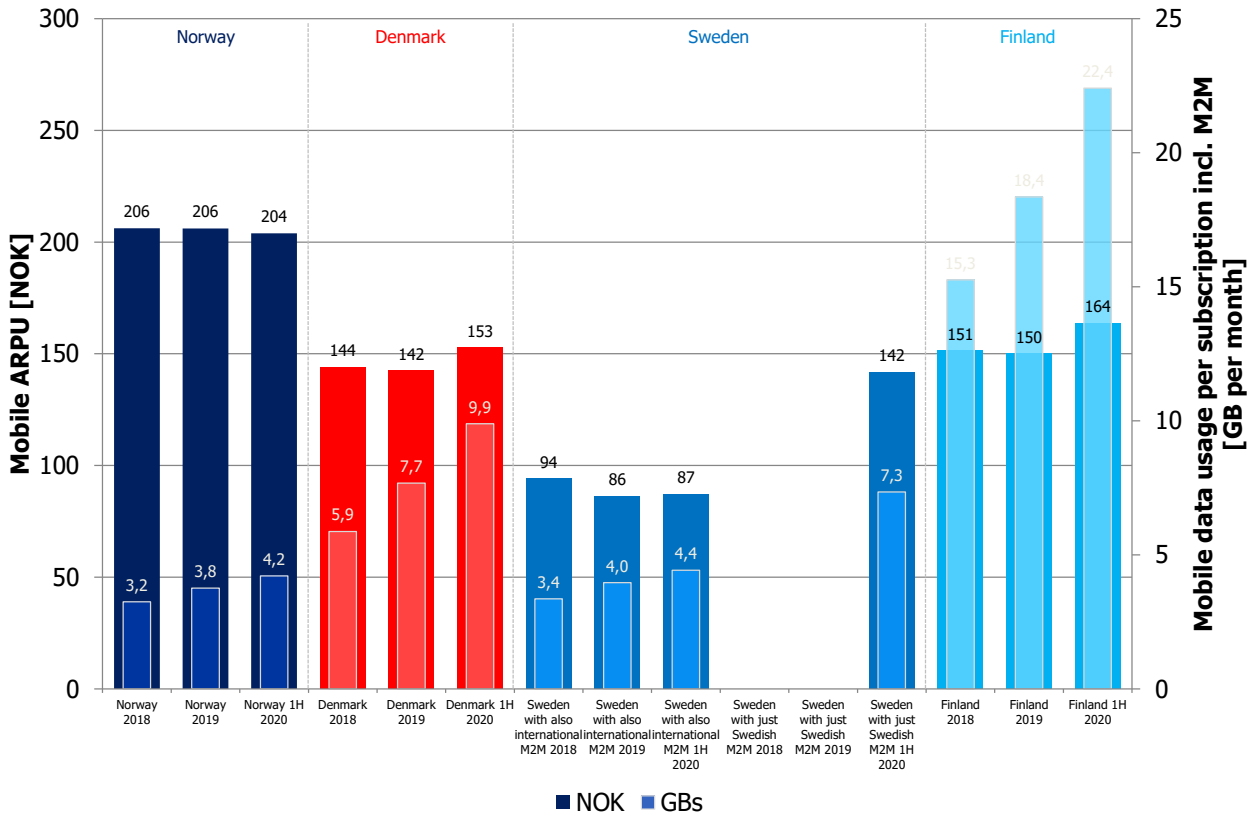

Figure 33. ARPU per mobile subscription including M2M vs. the average mobile data usage per subscription including M2M for Norway, Denmark, Sweden and Finland 2018, 2019 and 1H 2020 [source: NKOM, Energistyrelsen, PTS, Traficom, operator reports for 1H 2020 for Denmark and Finland as Energistyrelsen and Traficom do not report revenue half-yearly, compiled by Tefficient]

Norway's ARPU is the highest, but the average mobile data usage is still the lowest.

Excluding M2M from Figure 33 simplifies the comparison as the Swedish M2M reporting problem is avoided. On the other hand, as before, Denmark and Finland can't be shown as the M2M revenues aren't separated out.

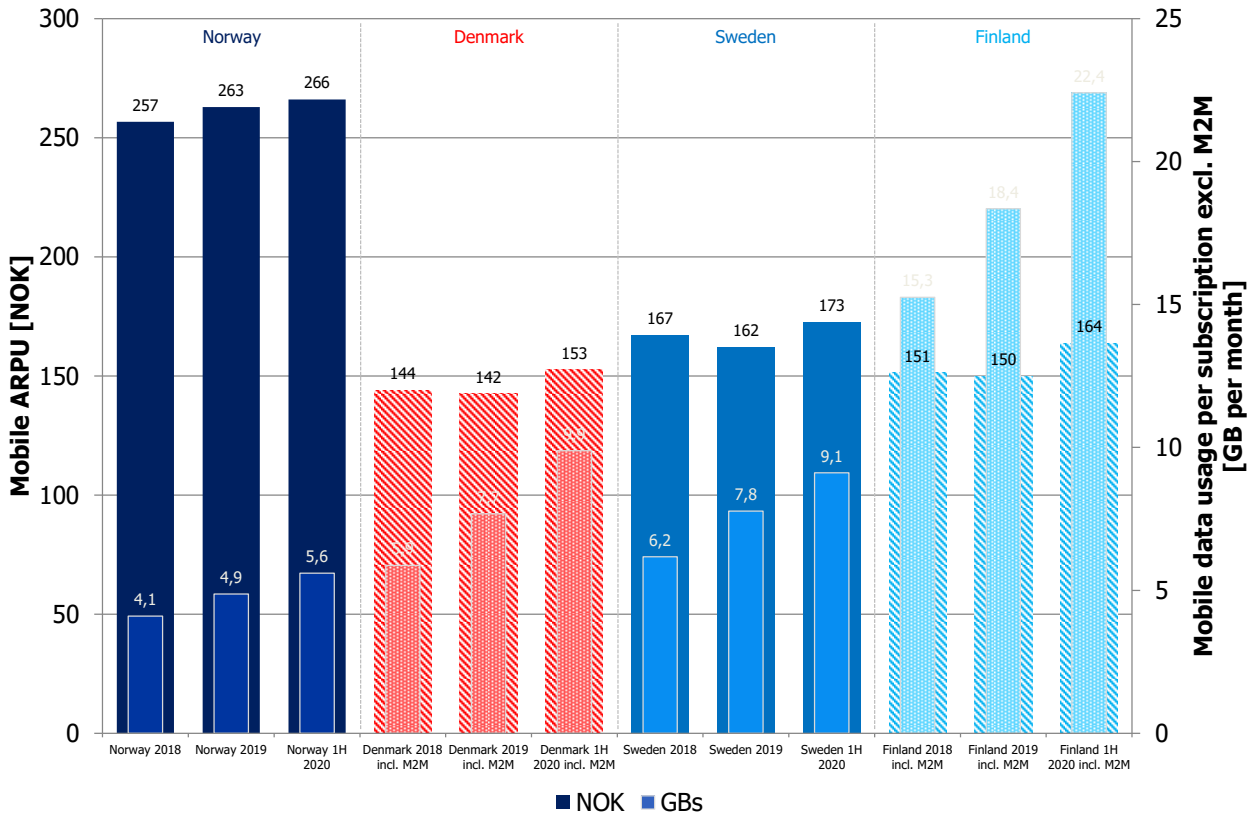

Figure 34. ARPU per mobile subscription excluding M2M vs. the average mobile data usage per subscription excluding M2M for Norway and Sweden 2018, 2019 and 1H 2020. The Danish and Finnish regulators do not break out M2M revenues so ARPU excl. M2M can't be calculated for Denmark and Finland [source: NKOM, Energistyrelsen, PTS, Traficom, operator reports for 1H 2020 for Denmark and Finland as Energistyrelsen and Traficom do not report revenue half-yearly, compiled by Tefficient]

In comparison to Sweden, Norway's ARPU is higher, but the average mobile data usage is still much lower.

As in all most other sections in this analysis, we have also prepared graphs in which differences in purchase power have been taken into account.

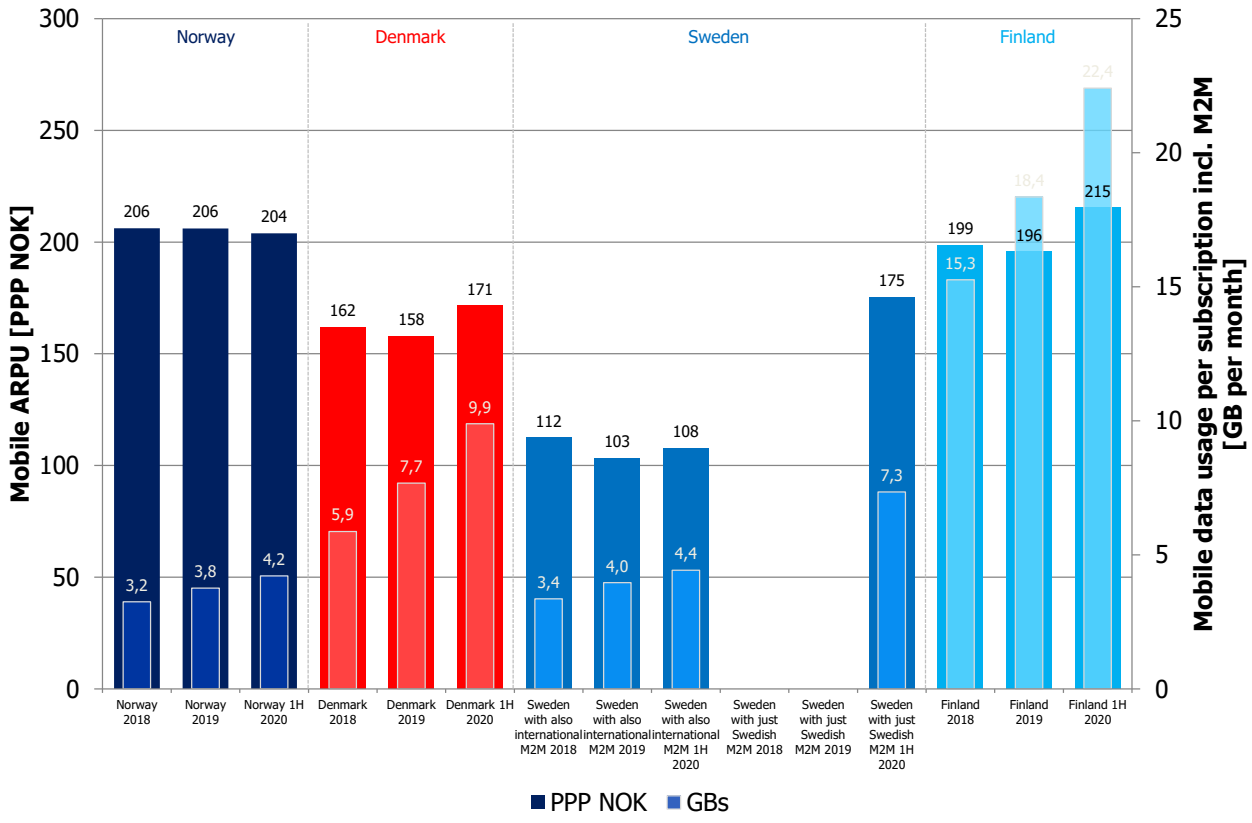

Figure 35. PPP ARPU per mobile subscription including M2M vs. the average mobile data usage per subscription including M2M for Norway, Denmark, Sweden and Finland 2018, 2019 and 1H 2020. The PPP values for 2020 are preliminary [source: NKOM, Energistyrelsen, PTS, Traficom, IMF, operator reports for 1H 2020 for Denmark and Finland as Energistyrelsen and Traficom do not report revenue half-yearly, compiled by Tefficient]

Applying PPP raises the ARPU bars for Denmark, Sweden and Finland. Finnish ARPU is now on par with – or in 1H 2020 even higher – than the Norwegian ARPU. But the difference in how much mobile data is consumed with that ARPU is still very significant. Versus Sweden and Denmark, the Norwegian ARPU is still high, but the mobile data usage in Norway is lower.

Finally the PPP graph excluding M2M.

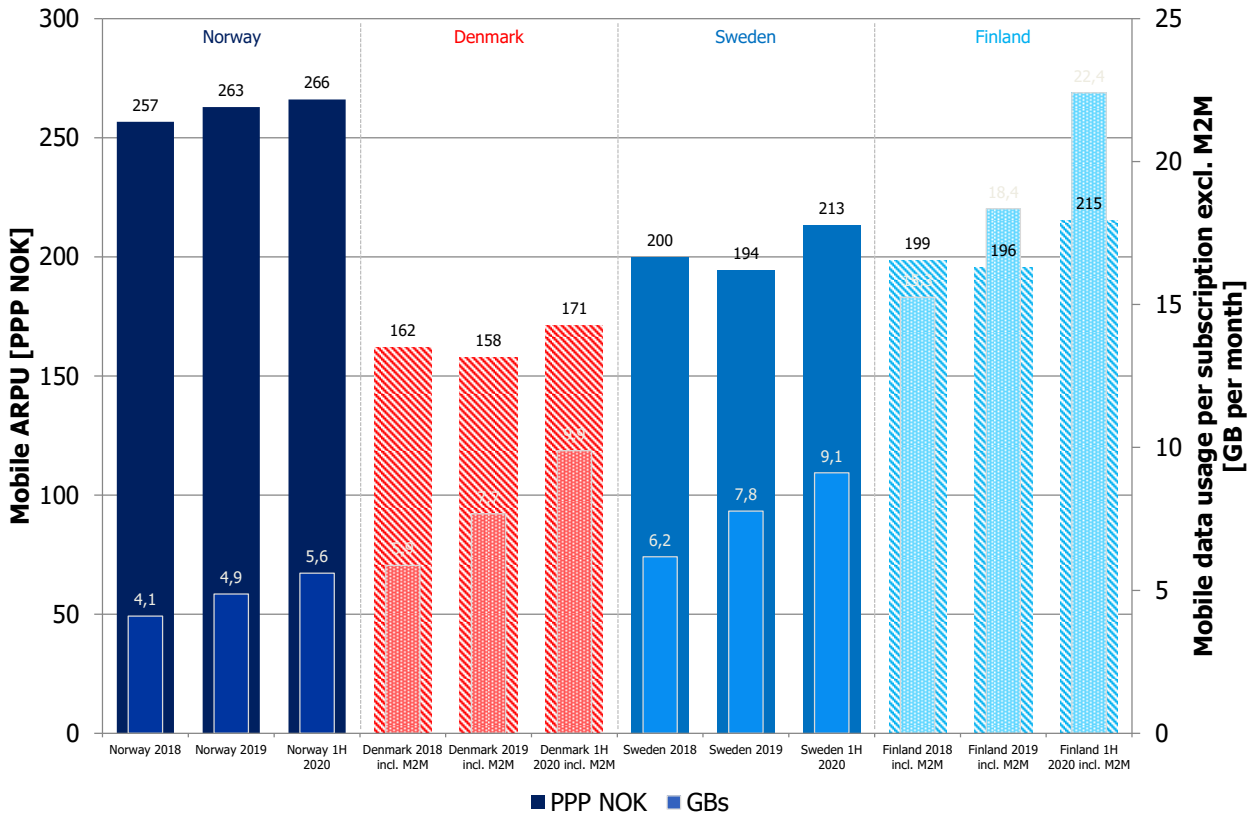

Figure 36. PPP ARPU per mobile subscription excluding M2M vs. the average mobile data usage per subscription excluding M2M for Norway and Sweden 2018, 2019 and 1H 2020. The Danish and Finnish regulators do not break out M2M revenues so ARPU excl. M2M can't be calculated for Denmark and Finland. The PPP values for 2020 are preliminary [source: NKOM, Energistyrelsen, PTS, Traficom, IMF, operator reports for 1H 2020 for Denmark and Finland as Energistyrelsen and Traficom do not report revenue half-yearly, compiled by Tefficient]

In comparison to Sweden, Norway's PPP ARPU is higher, but the average mobile data usage is still much lower.

Without adjustment for purchasing power, the average Norwegian mobile subscription generates the highest ARPU in our four markets although the mobile data usage is the lowest. With adjustment, Finnish ARPU becomes as high as Norwegian ARPU but the Finnish data usage is 6.6 times higher. Even after adjustment, Norwegian ARPU is higher than Danish and Swedish ARPU although Norwegian data usage is lower. If data volume is what defines value, then Norwegian mobile subscribers have made the worst deal in these Nordic markets.

11. Is high quality fixed broadband behind lower mobile data usage?

Could it be so that the mobile data usage in Norway is low because of the excellent shape of Norwegian fixed broadband networks? With high quality ubiquitous fixed broadband providing excellent Wi-Fi connectivity in key locations as homes, offices, schools and in public spaces, mobile users might actually prefer Wi-Fi over mobile data. Regardless of this, smartphones are generally prioritising Wi-Fi over mobile data based on the idea that Wi-Fi is free, but mobile data not.

The high mobile data usage in **Finland** is partly driven by **fixed-line substitution**: Whereas only 5% of the Norwegian mobile subscriptions are data-only, that figure for Finland is 23% (Denmark is at 14% and Sweden at 10%). The total dominance of unlimited mobile data contracts in Finland allowed for some Finnish households and businesses to not have fixed broadband.

If we calculate the fixed broadband subscriptions per capita, we are also getting a sense of this: Finland only has 0.33 fixed broadband subscriptions per capita. Norway has 0.42.

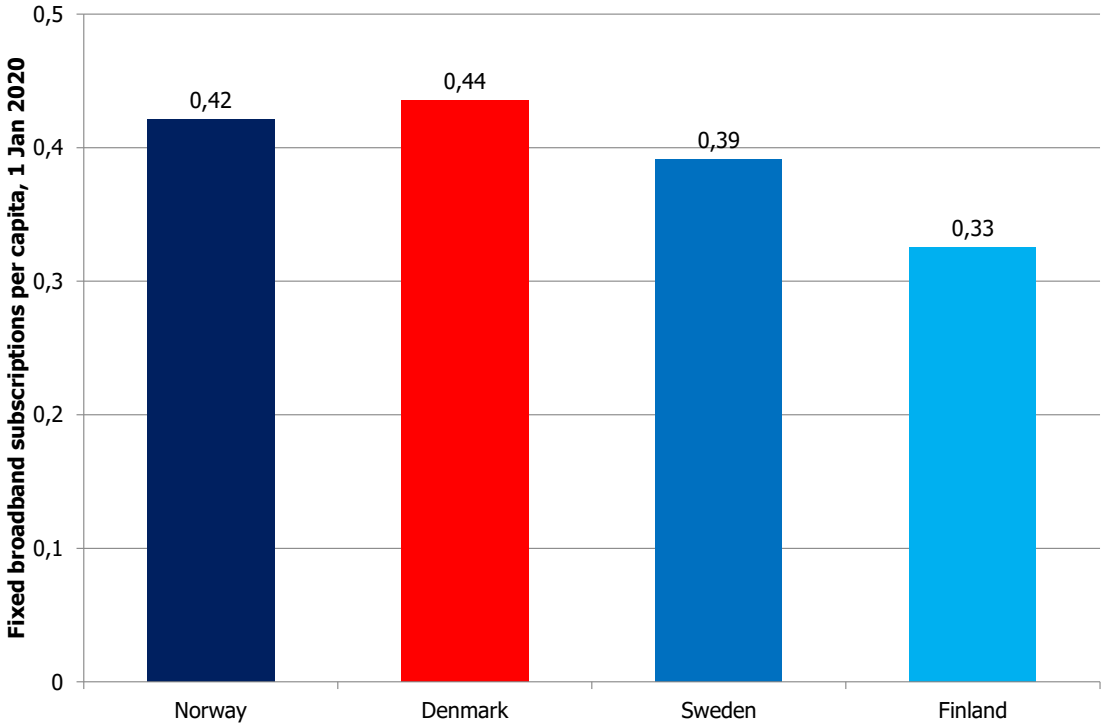

Figure 37. Fixed broadband subscriptions per capita for Norway, Denmark, Sweden and Finland 1 January 2020 [source: NKOM, Energistyrelsen, PTS, Traficom, SSB, Eurostat, compiled by Tefficient]

Denmark and Sweden – with higher mobile data usage than Norway – are however at a similar level; Denmark 0.44 and Sweden 0.39 fixed broadband subscriptions per capita.

But not all fixed broadband is created equal. The quality of a Wi-Fi connection will be much higher if the fixed broadband connection is fast and stable. Fibre networks are generally regarded as the best technology for fixed broadband today, although modern cable TV networks can compete well. Copper-based xDSL

networks are generally regarded inferior. So let's compare the technology distribution in the fixed broadband base in our four markets.

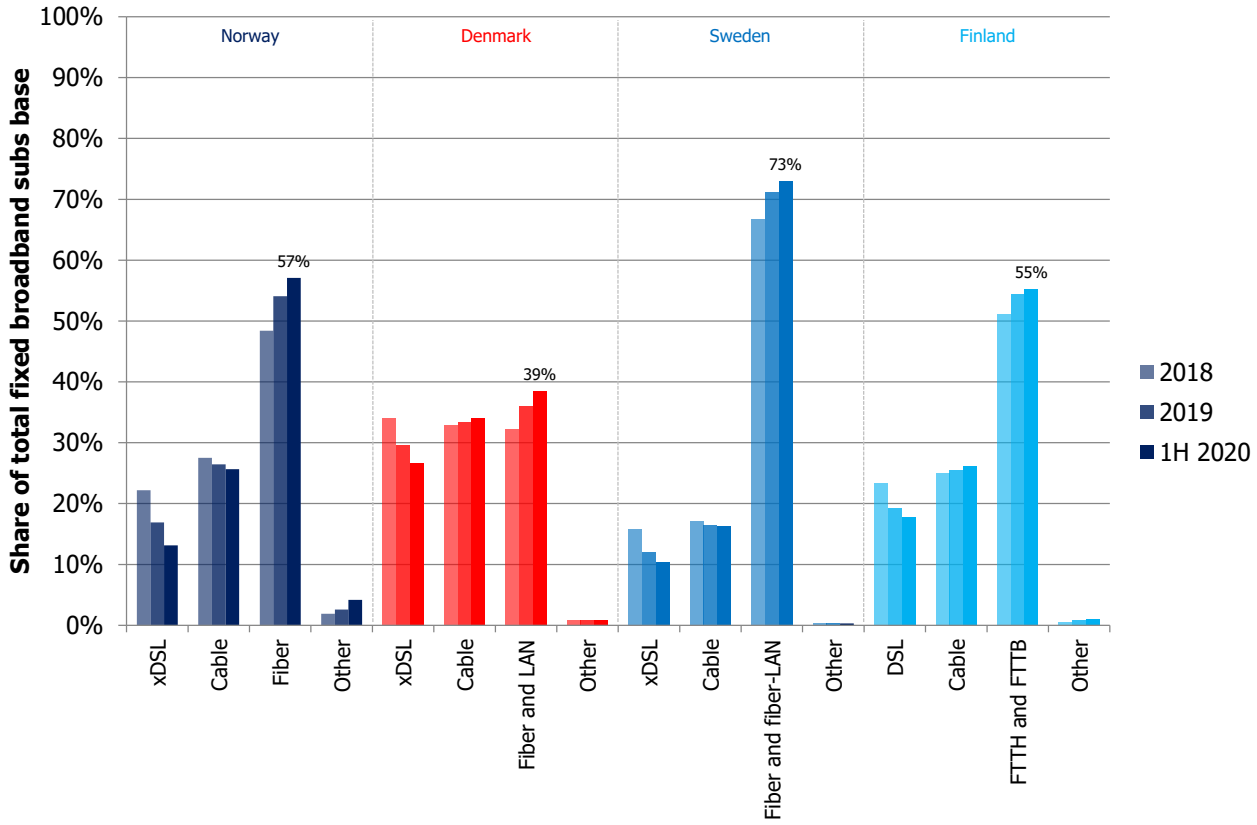

Figure 38. Distribution of fixed broadband subscriptions between technologies for Norway, Denmark, Sweden and Finland 2018, 2019 and 1H 2020 [source: NKOM, Energistyrelsen, PTS, Traficom]

In June 2020, 57% of the Norwegian fixed broadband subscriptions were fibre subscriptions. That is indeed a higher share than in Denmark which depends more on both cable TV and xDSL. But Finland's fibre share of base is very similar to Norway – 55%. And in Sweden, with higher mobile data usage than Norway, 73% of all fixed broadband subscriptions were over fibre. If the fibre penetration would define the mobile data usage, then Sweden should have the lowest mobile data usage in the Nordics.

But not even all *fibre* broadband is equal. The subscriber has to be willing to pay for a faster connection; maybe there is a difference in fixed broadband *speeds* that could explain the difference in mobile data usage?

Since NKOM doesn't report the speed distribution between fixed broadband subscriptions[29], we turn to Ookla Speedtest data which is crowdsourced based on tests actively done by broadband users.

[29] PTS, Energistyrelsen and Traficom do for Sweden, Denmark and Finland respectively

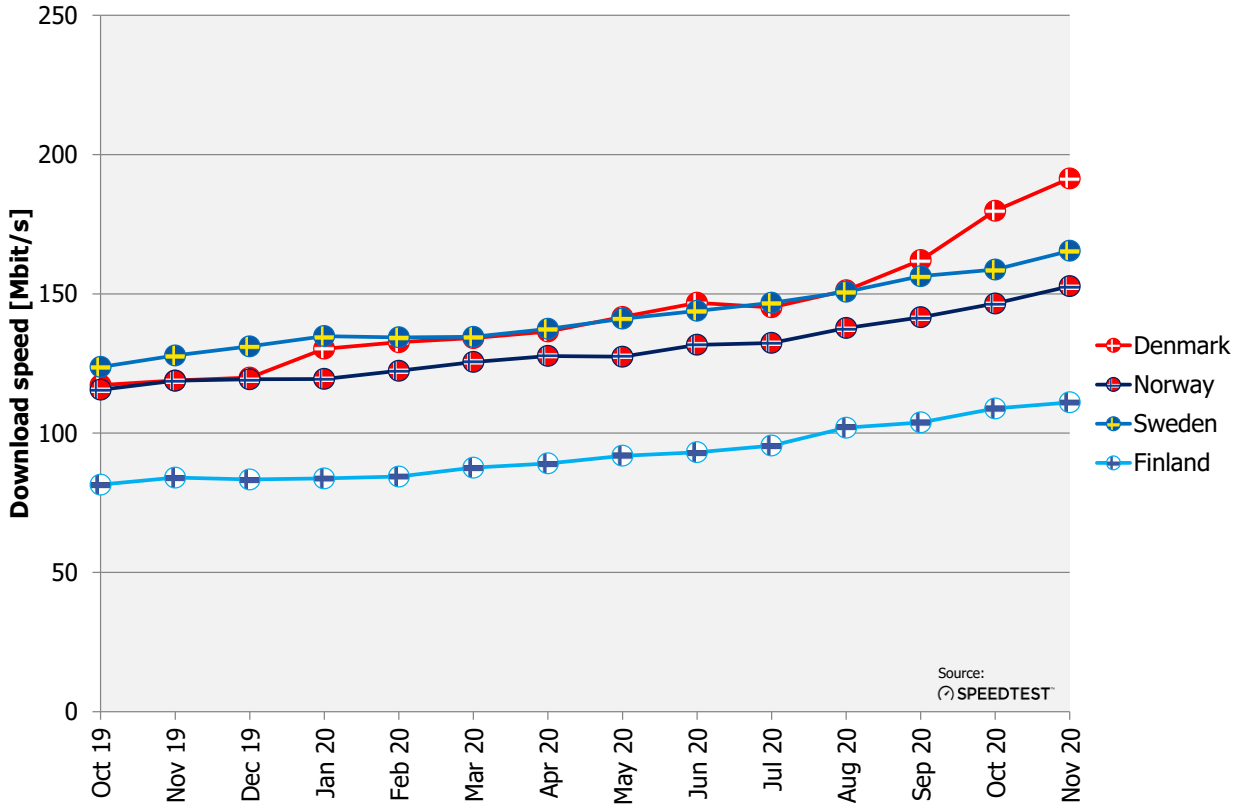

Figure 39. Average fixed broadband download speed for Norway, Denmark, Sweden and Finland per month Oct 2019-Nov 2020 [source: Ookla Speedtest]

Figure 39 shows the development of the average measured fixed broadband download speed month by month. The fastest fixed broadband is actually in **Denmark** today – although that is the country with the lowest share of fibre connections. A key reason to it is that the Danish cable TV networks are well distributed and generally deliver high fixed broadband speeds. The level of competition in Denmark has increased in 2019 and 2020 with new players (and TDC) aggressively rolling out fibre while TDC's YouSee has promised all existing customers at least a doubling of their cable internet speeds[30].

Finland is having the slowest fixed broadband – although the fibre penetration is almost as high as in Norway. A likely explanation is that with unlimited mobile data totally dominating mobile subscriptions in Finland (**78%** of non-M2M subscriptions were unlimited in June 2020), the willingness to pay for higher fixed broadband speed tiers is not really present in Finland.

Norwegian fixed broadband connections are fast – averagely 153 Mbit/s in November 2020 – but Danish and Swedish fixed broadband connections are faster still. Yet the mobile data usage is higher than in Norway.

Norway has excellent fixed broadband networks, but so have the other Nordic markets. The reason to the low mobile data usage in Norway is not to be found in the availability or quality of fixed broadband.

[30] https://www.berlingske.dk/virksomheder/yousee-slaar-aggressivt-tilbage-i-bredbaandskamp-stoerste-loeft-af

12. Comparison of the mobile network experience

The viewpoint that Norwegian mobile customers rate **high mobile network quality** much higher than low price has been expressed by some Norwegian operators[31]. The claim that the mobile network quality is high in Norway is not without merit.

If we continue with Ookla Speedtest, we can see that the Norwegian networks continuously deliver download speeds that are about 20 Mbit/s faster than the other three markets.

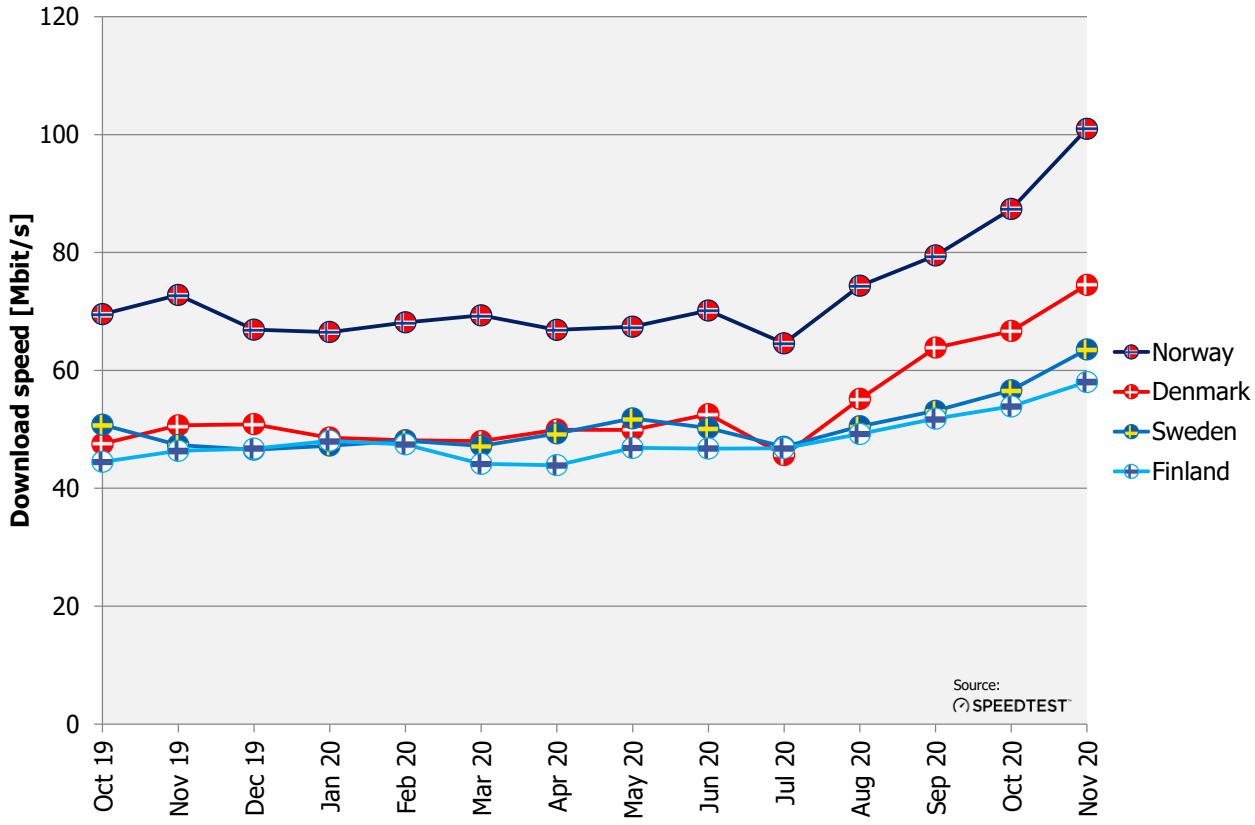

Figure 40. Average mobile broadband download speed for Norway, Denmark, Sweden and Finland per month Oct 2019-Nov 2020 [source: Ookla Speedtest]

When interpreting Figure 40, it's important to remember that 78% of non-M2M subscriptions are **unlimited and charged based on speed tiers**[32] in Finland. The average Finnish mobile speed can therefore be curbed by customers not willing to pay more for speed. Finnish operators have come much further than operators in Norway, Denmark and Sweden with its **5G** rollout – but as 5G speeds cost extra in Finland, customers need to be convinced to pay more – for a new device, but *also* for a new subscription. The 5G introductions in Norway, Denmark and Sweden have generally been done so that existing customers *automatically* get access to 5G; they only thing they need is a new device.

[31] An example: https://www.insidetelecom.no/artikler/nordmenn-vil-ha-kvalitet-ikke-lav-pris/500566

[32] Telenor Norway has recently introduced a similar approach with its new 'Next' plans

Another important point to make is that mobile networks **share the existing capacity** between the users of a cell. If there is much demand for data, the speed per user will be slower. If there is little demand, the speed per user will be higher. Operators can improve the user experience by adding more capacity.

Since Norway has the lowest mobile data usage in the Nordics, the average speeds will be higher – if the capacity is the same – than in the other three markets. On top of this, Norwegian operators could of course have deployed more capacity[33] – but that can't be assessed based on crowdsourced network performance test.

But play with this idea: What if Finland and Norway exchanged population (roughly as large) overnight so that the average subscription in Norway now used 22 GB, not 4 GB per month? The measured average speed of the Norwegian networks would then fall as the capacity no longer would be sufficient for the load. It is relatively simpler for Norway to win a speed award because of the lower mobile data usage.

Other crowdsourced tests take other factors than just speed into account. The Canadian company Tutela has defined what they call *consistent quality* metrics that are measured in common coverage areas – where a majority of operators provide coverage.

The chart below shows *excellent* consistent quality.

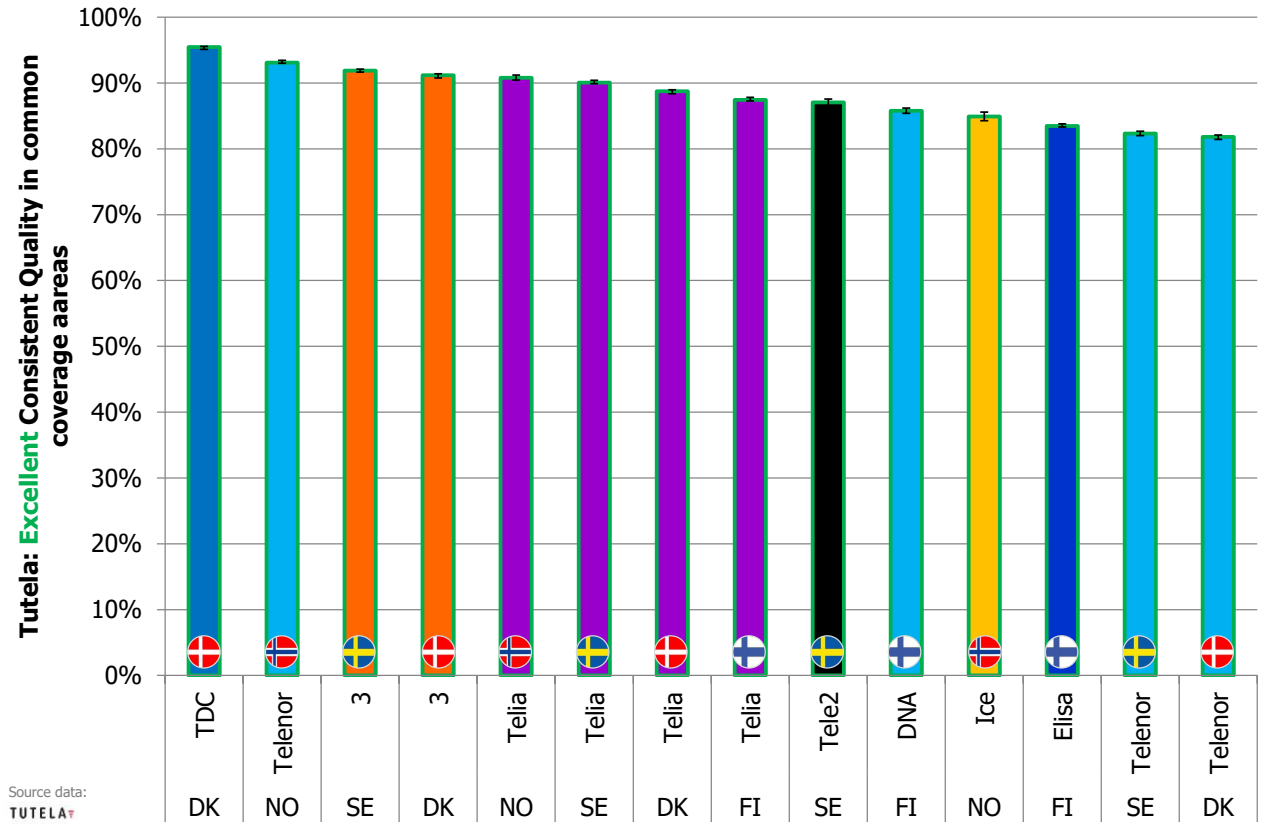

Figure 41. Excellent consistent quality percentage for mobile operators in Norway, Denmark, Sweden and Finland June-October 2020 [source: Tutela, compiled by Tefficient]

[33] The higher CAPEX of Norwegian operators could suggest that

Excellent consistent quality is defined as:

- >5 Mbit/s download throughput
- >1.5 Mbit/s upload throughput
- <50 ms latency
- <30 ms jitter
- <1% packet loss

TDC provides the highest percentage of samples categorised as excellent consistent quality by Tutela: 95.5%. **Telenor** Norway is number 2 with 93.1%, **Telia** Norway number 5 with 90.8% and **Ice** number 11 with 84.9%.

In Tutela's more multifaceted methodology, highest speed is not necessarily making a network a winner. Unlike Ookla Speedtest's results, there is no 'country factor' in the outcome – all countries have a spread between the operators. It worthwhile mentioning that the Nordic results overall – on an international scale – are very good. In a global report[34] based on older data (from August 2019 to August 2020) for hundreds of countries, Norway was ranked as #1 globally in excellent consistent quality, Denmark as #5, Finland as #15 and Sweden as #19.

There is also a lower quality tier called *core* consistent quality:

- >1.5 Mbit/s download throughput
- >0.5 Mbit/s upload throughput
- <100 ms latency
- <50 ms jitter
- <5% packet loss

[34] https://www.tutela.com/blog/global-mobile-experience-2020?utm_content=140867057

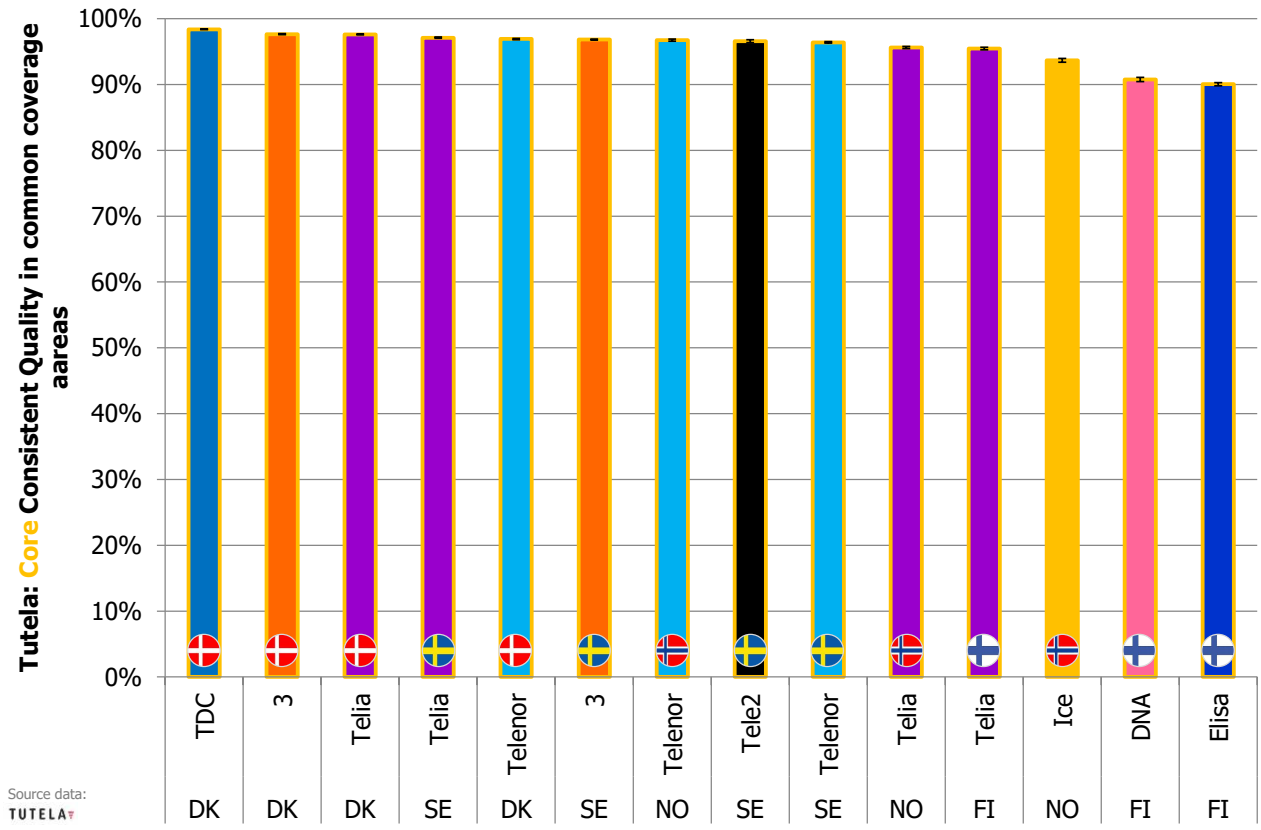

Figure 42. Core consistent quality percentage for mobile operators in Norway, Denmark, Sweden and Finland June-October 2020 [source: Tutela, compiled by Tefficient]

As the requirements are lower, the percentages are now higher. In contrast to excellent consistent quality, there is a 'country factor' in core consistent quality: **Danish** networks are generally rated the highest, Finnish networks the lowest. **Telenor** Norway is number 7, **Telia** Norway number 10 and **Ice** number 12.

In the global report mentioned, Denmark was ranked as #1 globally in core consistent quality, Sweden as #2, Norway as #4 and Finland as #34.

Norwegian mobile networks are generally providing a faster download speed than other Nordic networks. Low mobile data usage contributes to this. It is also likely that Norwegian operators have invested in capacity currently not fully utilised. With regards to consistent quality, Norwegian networks are world-class – but so are the networks in Denmark, Sweden and Finland.

We spoke about low load contributing to the high average download speed of Norwegian networks. Another factor that helps on speed is a **modern smartphone base**.

Norway has an unusually high share of Apple **iPhone** in its smartphone base. The sales top list of Telia Norway in October[35] and November[36] show just how iPhone-centric Norway is: Apple iPhones are on positions 1, 2, 3, 4, 5 and 6 (and in November also positions 8 and 9) on Telia's top 10 list.

Without being able to prove it, Tefficient believes that the average age of the Norwegian smartphone base is lower than in the other Nordic countries. This is likely an effect of the higher purchasing power in Norway. If so, this is **good news for the average speed of mobile networks**; more modern iPhones[37] are providing significantly faster speeds than older iPhones. This is shown by Opensignal in a blog post[38] – from which the following graph is fetched:

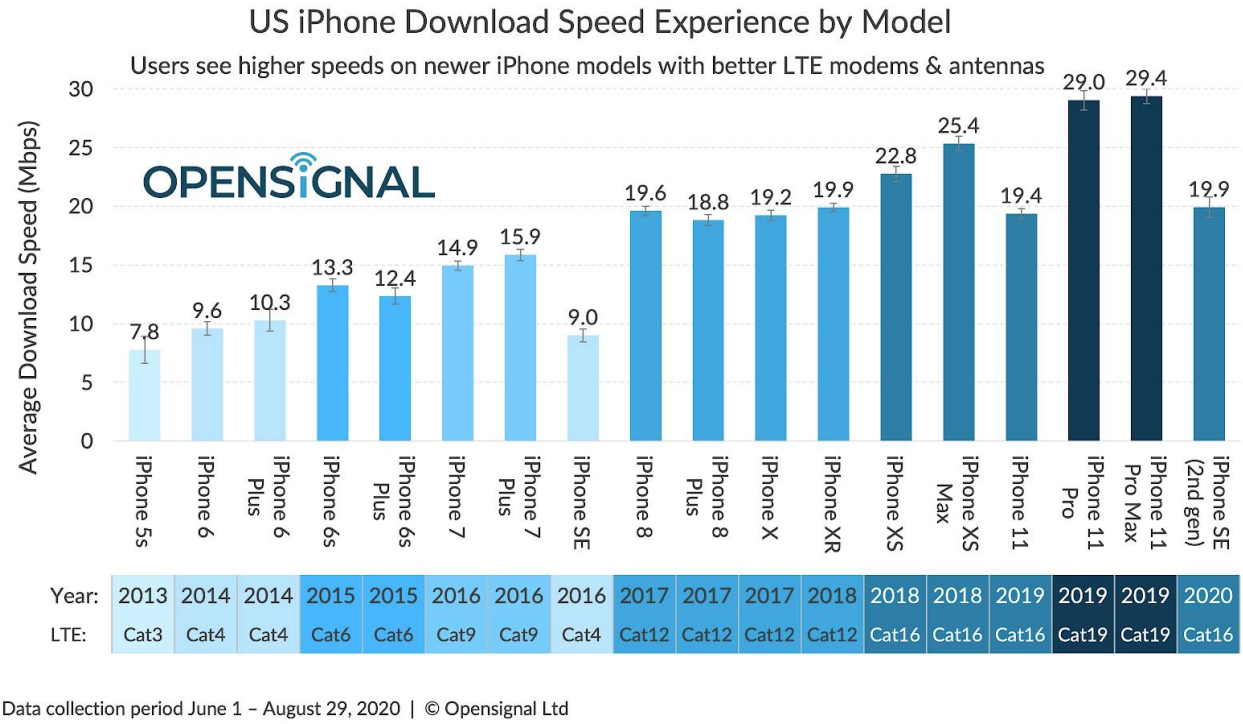

Figure 43. How the age of an iPhone correlates with the average download speed [source: Opensignal]

[35] https://presse.telia.no/pressreleases/telias-topp-10-oktober-apples-5g-telefoner-rett-inn-paa-pallen-3048045
[36] https://presse.telia.no/pressreleases/telias-topp-10-november-apple-befester-sin-posisjon-3055471
[37] This is likely true for any smartphone manufacturer as it is mainly an effect of performance improvements in chipsets and design
[38] https://www.opensignal.com/2020/09/23/the-5g-iphone-lessons-from-existing-5g-smartphones

13. Conclusions

13.1. Summary of findings so far

This analysis shows that Norwegian revenue per mobile subscription is higher than in Denmark, Sweden and Finland. The **revenue per mobile GB** is – after purchasing power adjustment – 2 to 5 times higher in Norway. This is relatively undisputed. What historically has been discussed is what the *root causes* to this are.

When adjusting the revenue of the other countries according to purchase power parity GDP, we can see that Finnish revenue per subscription roughly matches that of Norway – and that Swedish and Danish revenues come closer to Norway's. We therefore find it likely that **higher purchasing power is one likely root cause** – but it's also clear that it is *not the only* explanation as revenue gaps aren't entirely closed.

The analysis contains a comparison of current pricing of data-rich plans. When adjusting these for purchase power parity GDP, Swedish pricing is actually quite similar to Norwegian for data-rich bucket plans (e.g. 30 GB). The Norwegian unlimited plans are still more expensive and more restricted in policy. It nevertheless supports the conclusion that higher purchasing power contributes to (but doesn't fully explain) Norway's higher mobile revenue.

The narrative that Norway's lower population density would result in a higher number of sites is not correct when comparing with Sweden and Finland – only when comparing with Denmark. Norway actually has a *lower* number of mobile sites per MNO, per network and per network (if excluding the last entrant) when comparing with Sweden and Finland. We therefore find it **unlikely that Norway's lower population density is a root cause** to the higher mobile revenue.

In general, we find the notion that the mobile network size should have a major impact on the total costs of an established operator misconceived. Even if including CAPEX, network costs are merely consuming 22% of the revenue of the average established Nordic operator. 78% of revenues were used on other cost items and on profit. Hence we find it **unlikely that larger mobile networks are a root cause** to Norway's higher mobile revenue. (Norway's mobile networks aren't larger anyhow). Mobile network sites are representing a revenue opportunity for operators and are regarded as assets by infrastructure companies.

In the case of Telenor and Telia Norway, **high OPEX is an unlikely root cause** to Norway's higher mobile revenue as these two companies have the highest EBITDA margins in the Nordics. **Ice** is though having an EBITDA margin just above zero – in part driven by high OPEX for national roaming.

High CAPEX is a more likely root cause as our analysis shows that Norwegian operators invest more of their revenue than most other Nordic operators. The largest investor in relation to revenue is however Ice. When taking both OPEX and CAPEX into account and comparing EBITDA-CAPEX margins, it shows that Telenor and Telia Norway can very well afford its current level of Networks CAPEX as their EBITDA-CAPEX margins are higher than the Nordic average. Ice's situation is again much different.

The **least likely root cause** for Norway's higher mobile revenue is **mobile data usage**. Not only does Norway have the lowest data usage, it is also growing slower than in Denmark, Sweden and Finland. When comparing the revenue per mobile subscription with the average mobile data usage, Norway comes out very

unfavourable – from an end-user perspective – with high-to-highest revenue albeit the lowest usage. It's likely that the high revenue hampers the Norwegian usage.

Just as the other Nordic markets, Norway has excellent **fixed broadband** networks. Since there's no edge in the availability or speeds of Norwegian fixed broadband, the shape of Norway's fixed broadband is an **unlikely root cause for the low mobile data usage** of Norway and hence an unlikely root cause for the higher mobile revenue.

A somewhat likelier root cause to the higher mobile revenue is the **data speeds on Norwegian mobile networks** – because it indicates that Norwegian operators have invested in capacity currently not fully utilised. With a more multifaceted comparison of mobile network quality, taking also factors such as latency, jitter and packet loss into account, we come to a similar conclusion as for the fixed broadband networks; Norway's mobile networks are excellent – but so are the networks in Denmark, Sweden and Finland.

The most likely root cause to Norway's higher mobile revenue is not yet mentioned in our analysis:

13.2. Market concentration

Figure 44 below shows the distribution of mobile service revenue in Norway between the three MNOs Telenor, Telia and Ice – and other (non-MNO) providers.

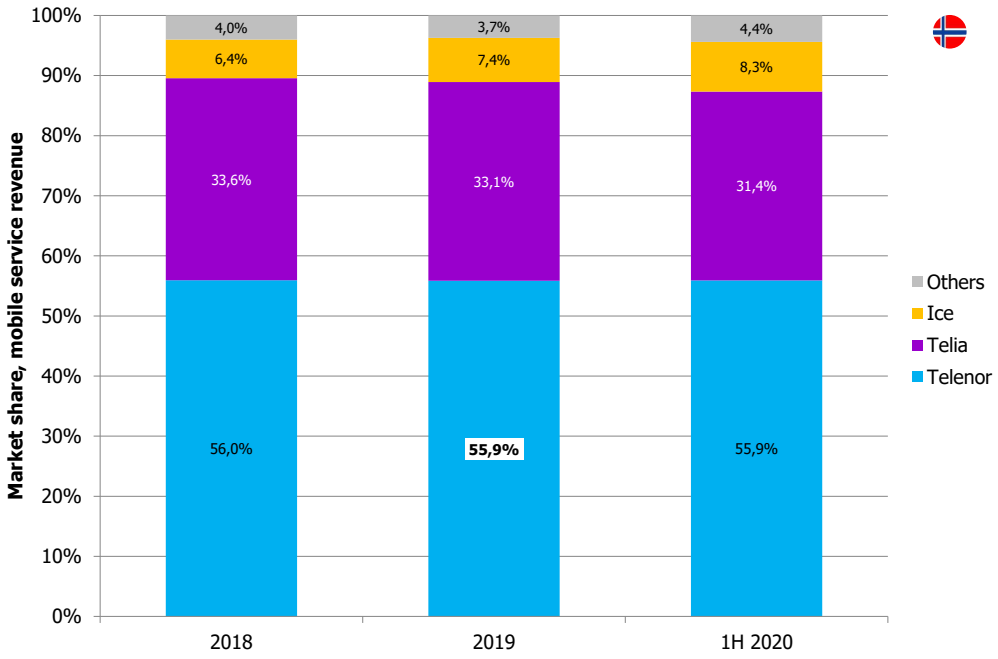

Figure 44. Market share in mobile service revenue, Norway [source: NKOM]

Telenor has a stable revenue market share of around 56% in Norway. We have highlighted the **55.9%** value for the full year of 2019 since we can get an apple-to-apple[39] comparison for that year for all of the other three countries analysed.

Denmark's mobile service revenue distribution is shown below.

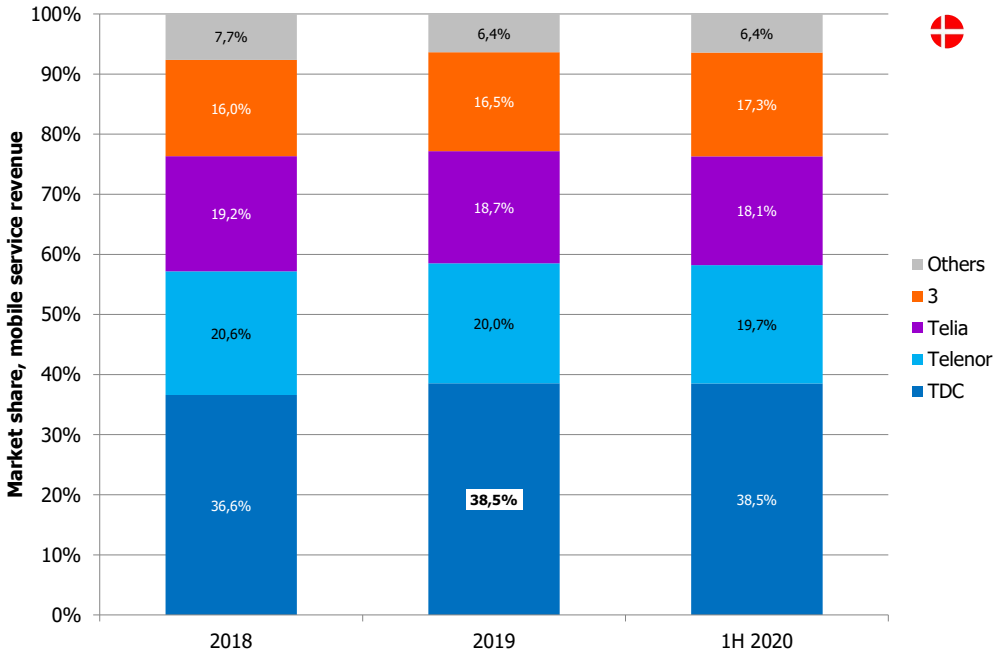

Figure 45. Market share in mobile service revenue, Denmark [source: Energistyrelsen for 2018 and 2019 – for 1H 2020 operator reports as Energistyrelsen only reports revenue annually; 50% of 'others' revenue in 2019 assumed for 1H 2020 as no reporting available]

Denmark has four MNOs and the incumbent operator TDC has a more limited market share than in Norway; **38.5%** in 2019. The graph for Sweden follows below.

[39] Regulator-reported

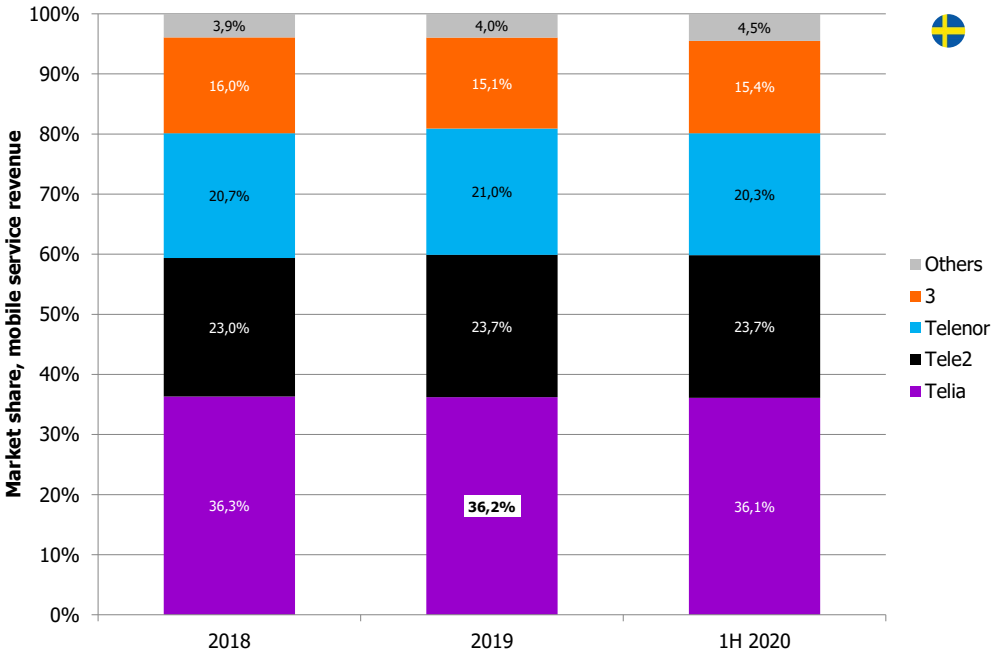

Figure 46. Market share in mobile service revenue, Sweden [source: PTS]

The incumbent in Sweden, Telia, had a **36.2%** revenue market share in 2019.

Finally the graph for Finland:

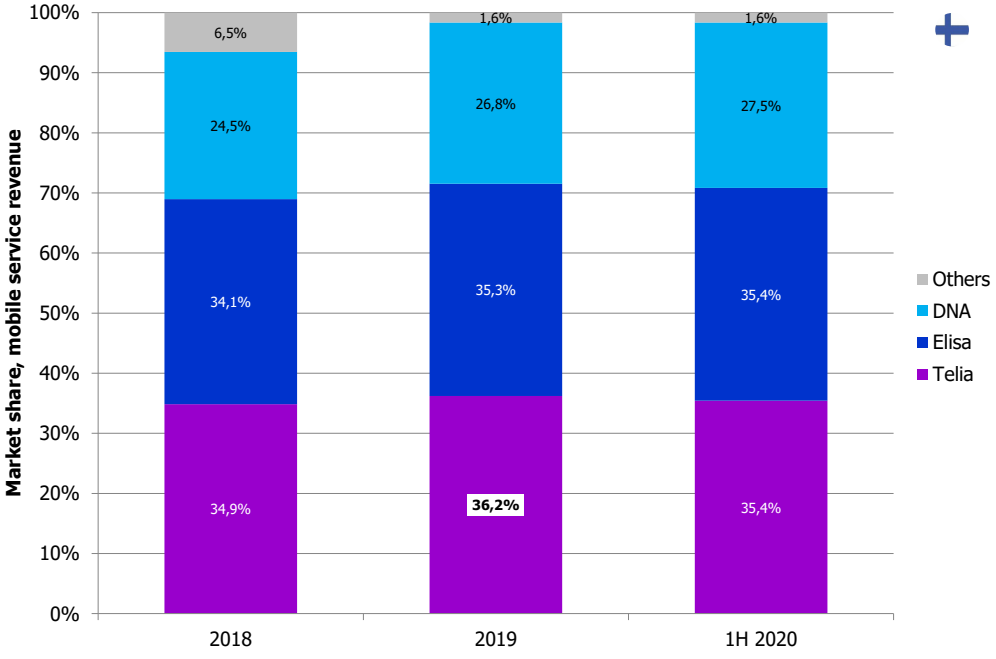

Figure 47. Market share in mobile service revenue, Finland [source: Traficom for 2018 and 2019 – for 1H 2020 operator reports as Traficom only reports revenue annually; 50% of 'others' revenue in 2019 assumed for 1H 2020 as no reporting available]

The largest operator in Finland[40] in 2019, Telia, had a **36.2%** market share in 2019.

The table below summarises the market shares of the incumbent in each other markets – and calculates the concentration index HHI for the individual mobile markets as a whole.

What is HHI?

The Herfindahl-Hirschman Index is a simple and widely applied economic concept that often is used in regulation and antitrust matters. It is defined as the sum of the squares of the market shares of the companies competing in a market. A monopoly would thus get an index of 100^2 = 10000 which is the maximum value and depicts a fully concentrated market.

Where the line should be drawn between a moderately concentrated and a highly concentrated market is obviously debatable but the U.S. Department of Justice has in its merger guidelines that a HHI value above 2500 should be considered highly concentrated.

The mobile business, with its limited number of licences, is often having higher HHI values than 2500, though.

In the table 2019 is used as that is the latest data point for which regulator data is fully available.

	Revenue market share of incumbent MNO 2019	Herfindahl-Hirschman Index (HHI) 2019 [0-10000][41]
Norway (3 MNOs)	55.9%	4281
Denmark (4 MNOs)	38.5%	2544
Sweden (4 MNOs)	36.2%	2559
Finland (3 MNOs)	36.2%	3281

Figure 48. Comparison of incumbent market shares in mobile service revenue, Norway, Denmark, Sweden and Finland – as well as HHI for the whole mobile market, 2019 [source: NKOM, Energistyrelsen, PTS, Traficom]

The Norwegian mobile market is **uniquely concentrated**. This is true both when comparing the revenue market share of the incumbent as well as when comparing the HHI.

The fact that Norway only has three MNOs doesn't explain this; Finland too has three MNOs and although the Finnish HHI is a bit higher than in Denmark and Sweden that is mainly due to 'Others' being very limited in Finland. When looking at the revenue market share of the largest operator, Telia Finland had 36.2% in 2019, a number similar to the incumbents in Denmark and Sweden.

[40] Telia here assumed as the Finnish incumbent as it had the largest revenue market share in 2019. Unlike the other markets, Finland has not had a nationwide incumbent as the fixed networks rather were local monopolies.
[41] 'Others' is treated as one which increases HHI a bit in all markets

Of the HHI for Norway, Telenor's contribution is **73%** (3120 of 4281 HHI points). In comparison TDC's contribution to the Danish HHI is 58%, Telia's 51% to the Swedish HHI and Telia Finland's 40% to the Finnish HHI.

The Norwegian mobile market is uniquely concentrated. It is not just explained by the number of MNOs. Telenor's market share is behind 73% of Norway's HHI.

13.3. Summary and conclusion

The image below summarises the findings of this analysis and ranks the analysed potential root causes after how likely it is that they explain the high mobile revenue in Norway.

A key finding of the analysis is **how high the Norwegian mobile service revenue per consumed GB is** compared to Denmark, Sweden and Finland. The difference is significant also after an adjustment for purchasing power. The price analysis done on plans presently sold across the Nordics shows that data-rich bucket plans (typically 30 GB in Norway's case) can be considered **moderate** in price when adjusting for purchasing power. This should be attributed to the smaller challenger providers such as Chilimobil, Fjordkraft and Ice. The unlimited plans have **high** prices in Norway – even after purchasing power adjustment – particularly as they are more restricted than its Nordic equivalents.

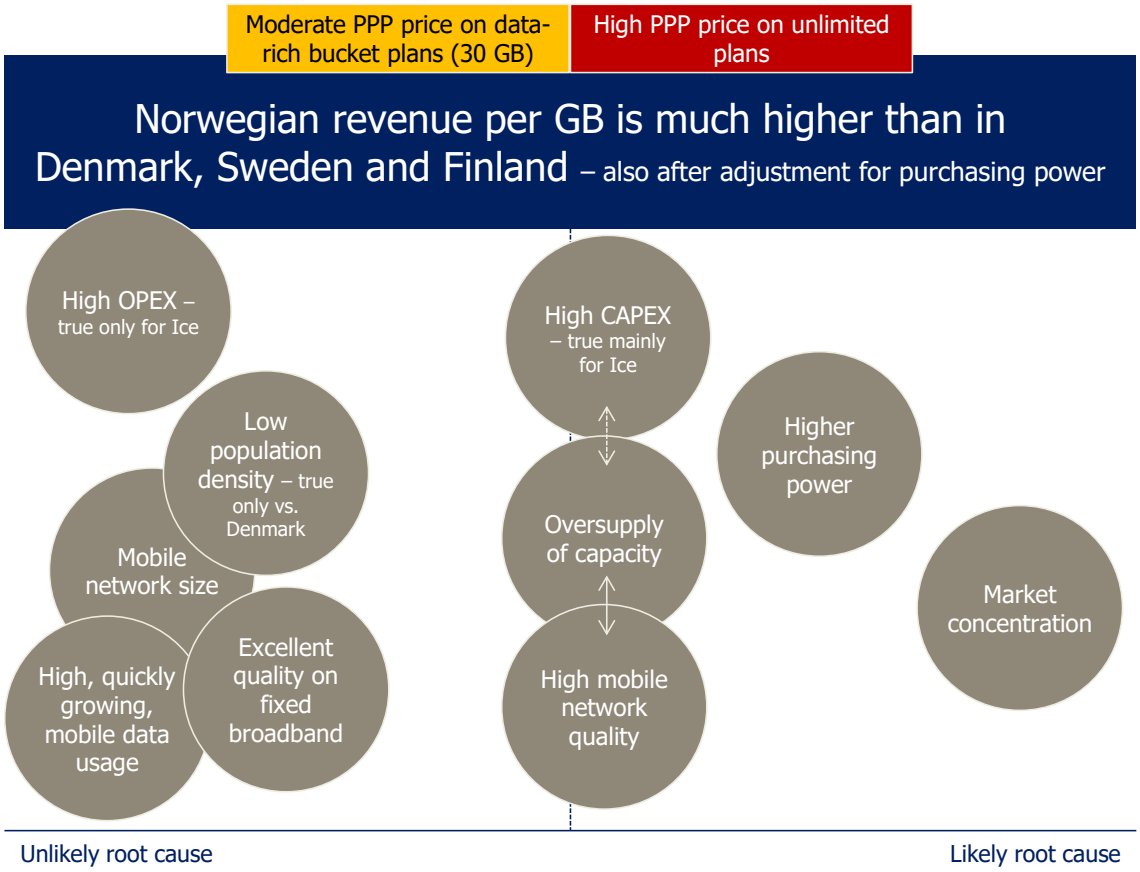

Figure 49. Summary of the analysis including a likelihood ranking of the root causes to Norway's high revenue per mobile subscription [source: Tefficient]

As shown in the grey part of Figure 49, Tefficient concludes that **the most likely root cause is the market concentration** – as it stands out so significantly in comparison to Denmark, Sweden and Finland. The Norwegian incumbent, Telenor, last year earned 55.9% of the mobile service revenues in Norway. The largest operators in the other three countries had a revenue market share of 36.2% to 38.5%.

There are numerous academic studies on price vs. concentration and although science is not always in agreement, market concentration is often seen as a problem; the disagreements have more been around *how to* regulate it. Jean Tirole was in 2014 awarded The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel for his analysis of market power and regulation.

> *"Many industries are dominated by a small number of large firms or a single monopoly. Left unregulated, such markets often produce socially undesirable results – prices higher than those motivated by costs, or unproductive firms that survive by blocking the entry of new and more productive ones.*
>
> *From the mid-1980s and onwards, Jean Tirole has breathed new life into research on such market failures. His analysis of firms with market power provides a unified theory with a strong bearing on central policy questions: how should the government deal with mergers or cartels, and how should it regulate monopolies?"*
>
> Extract from the press release from The Royal Swedish Academy of Science when Jean Triole 2014 was awarded The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel

The scientific background[42] to this prize provides excellent, balanced, reading.

With market concentration as the most likely root cause, the **higher purchasing power in Norway adds to it**. It is however a weaker root cause than the market concentration since an adjustment for purchasing power doesn't fully neutralise the differences in revenue and pricing.

Three factors – **CAPEX level**, **oversupply of capacity** and **high mobile network quality** – are somewhat linked to each other. The high speeds of Norwegian mobile networks suggest an oversupply of capacity at present, something that likely adds a bit to the CAPEX levels in Norway. There's merit in the claim that Norwegian CAPEX levels generally are high, but it's not a very likely root cause for the high revenue per GB.

The analysis shows that the other factors – including low population density – are unlikely root causes to Norway's higher revenue per GB.

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[42] https://www.nobelprize.org/uploads/2018/06/advanced-economicsciences2014.pdf