

Assessment of mobile network experience 28 February – 18 March 2022 in Denmark

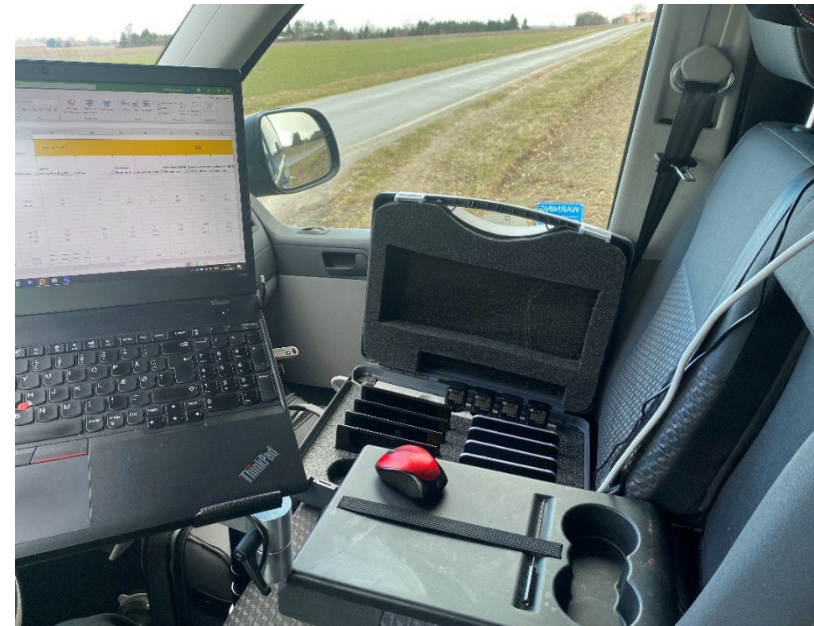


A van from Danish Technological Institute at one of the randomly selected test locations – here at Sattrup north-west of Horsens



Contents

- Extent and test method Pages 3-4
- The 576 randomly selected test point locations Page 5
- Summary of results Pages 6-7
- National results Pages 9-22
- Regional results Pages 24-46





Extent and test method

- TDC NET commissioned and paid for the assignment. It was carried out in the same way as the surveys in 2014, 2015, 2016, 2017, 2018, 2019, and 2021. The assignment had a large geographical spread with stationary measurements of the mobile network experience throughout Denmark with one of the most popular mobile phones:

iPhone 12 - 5G

- TDC NET defines a **good mobile network experience as:**
 - **A 30 sec. error-free mobile phone conversation** (where you can hear the recipient) is defined as approved. In case of error, one redial is made. If the redial is successful, then the phone call is approved.
 - **10 MB download within 8 sec.** TDC NET considers 60 sec. or more as useless mobile coverage.
 - **10 MB upload within 15 sec.** TDC NET considers 60 sec. or more as useless mobile coverage.
 - **60 sec. DR TV news on an app without buffering waiting time.** In previous surveys, the same YouTube video was streamed, but to avoid possible caches from test to test, DR TV was chosen instead. A buffering waiting time of 0.1-10 sec. is categorised as failure. TDC NET compares a buffering waiting time of more than 10 sec. with video streaming not being possible.

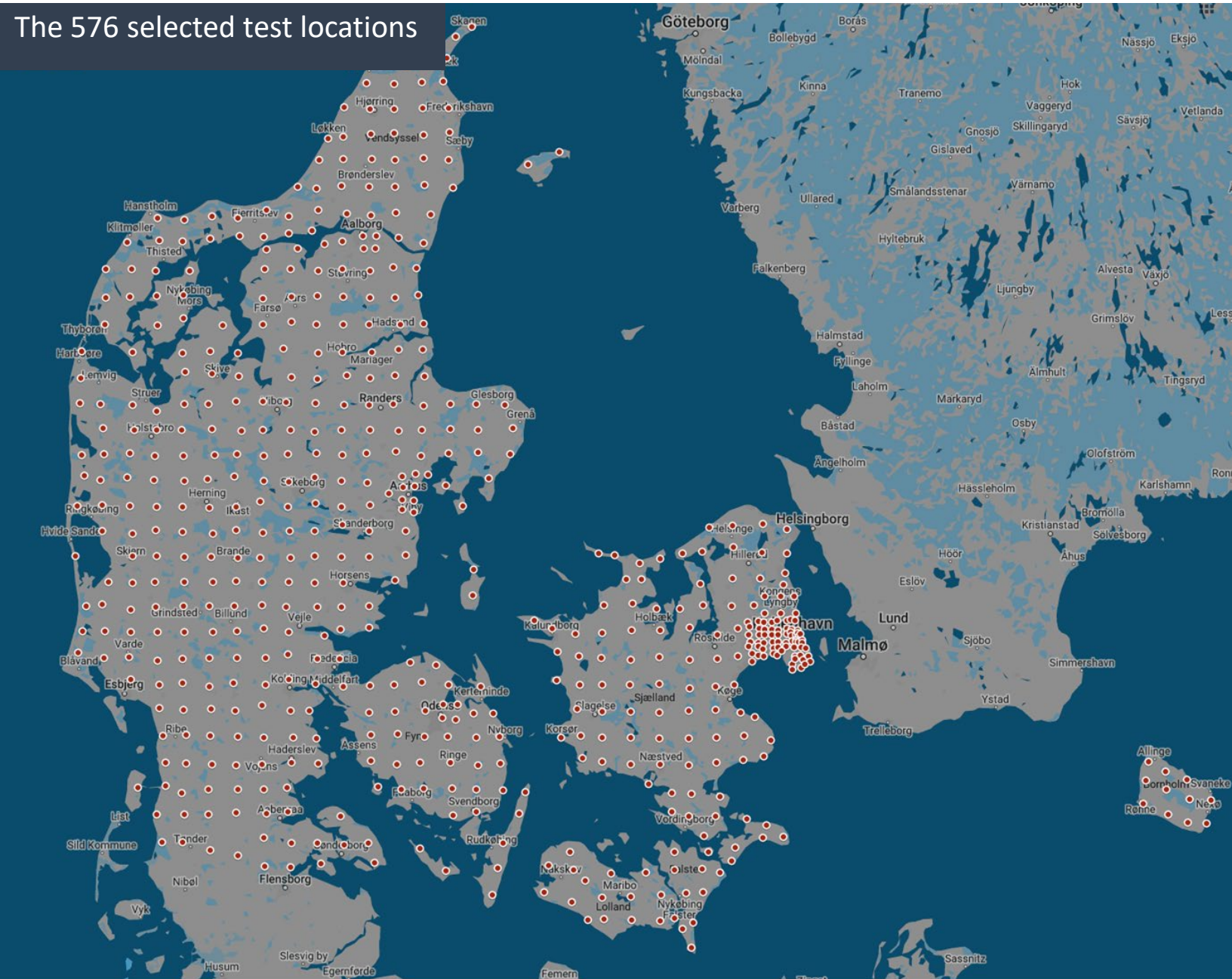


Extent and test method

- The 576 test locations were evenly distributed in 10x10 km squares **throughout** Denmark. They comprised the countryside, towns, islands, forests, and beaches – and always in places where it was possible to park the van. See map on the next page.
- The density of the measurements was doubled in larger towns, as large buildings can affect the coverage locally. The number of measurements was increased in the Capital Region of Denmark, Region Zealand and the North Jutland Region to ensure adequate statistic validity.
- Test locations were selected at random by Danish Technological Institute without knowledge of/consideration for antenna locations – and always in places where it was possible to park the van. The test locations were typically moved 1.5-2.5 km compared to the 2021 survey. TDC NET was informed about the GPS coordinates of the test locations AFTER the measurements.
- The stationary measurements were carried out in a van with the telephone in a holder.
- An iPhone 12 5G was used. TDC NET supplied the cell phones in unopened packaging to Danish Technological Institute. Danish Technological Institute bought SIM cards from the four network providers. The SIM cards were inserted at random in the supplied cell phones.
- Before the test started, Danish Technological Institute informed Telenor, Telia, and 3 that a mobile phone coverage survey would be conducted for an anonymous client; i.e., the four network providers were put on an equal footing.



The 576 selected test locations





Summary of results

- Nationally and regionally, TDC NET has a much better total mobile network experience* than Telenor, 3, and Telia.
- Nationally, TDC NET has a 90% error-free mobile network experience*. Nationally, Telenor and 3 have a 66% error-free mobile network experience, and Telia has a 63% error-free mobile network experience*.
- The 2022 survey showed a clear progress for all network providers compared to the 2021 survey. That is seen in faster download and upload speeds and more error-free download and uploads.
- Nationally and regionally, TDC NET has faster and more error-free download and upload than Telenor, Telia, and 3. Nationally, the TDC NET download is 1.7 seconds faster and 19% more error-free. The upload is 2.9 seconds faster and 11% more error-free.
- Ordinary mobile phone conversations are almost error-free. There are no statistically measurable differences between TDC NET, Telenor, Telia, and 3. Differences compared to previous years can be due to statistical coincidences.
- TDC NET has 99.7% error-free video streaming with a 5G mobile phone. Telenor has 98.3%, Telia has 97.6%, and 3 has 98.3% error-free video streaming. A substantial explanation of the minor spread between the network providers is that the app adjusts the picture quality in relation to the available download speed.
- TDC NET is the only network provider that has a nationwide and fully developed 5G network with 99.3% access. The other network providers are in a transitional phase. 3 has 55%, and Telenor and Telia have 28% access to 5G.



Comments to results

- The results in this report are national and regional results and therefore AVERAGE FIGURES.
- The regional results have considerable statistical uncertainty which appears from the specifications of the statistical confidence interval.
- **Coverage where you currently are using your mobile phone might give a different result than the average figures of the region.**
- No updated figures are available from the Danish Energy Agency's telephone statistics. In the first six months of 2021, the data traffic increased by 14.8% which corresponds to an annual increase in the order of magnitude of 30%. In the previous surveys, the network providers were more challenged with an annual increase of 40%.
- Although Telenor and Telia share masts and frequencies, their results differ. That is due to only in-part joint ownership of the underlying transmission technology.
- During the test period, all network providers were extra busy with 5G and other upgrades. As the busy period with upgrades will continue for many months, the test period is regarded as representative.



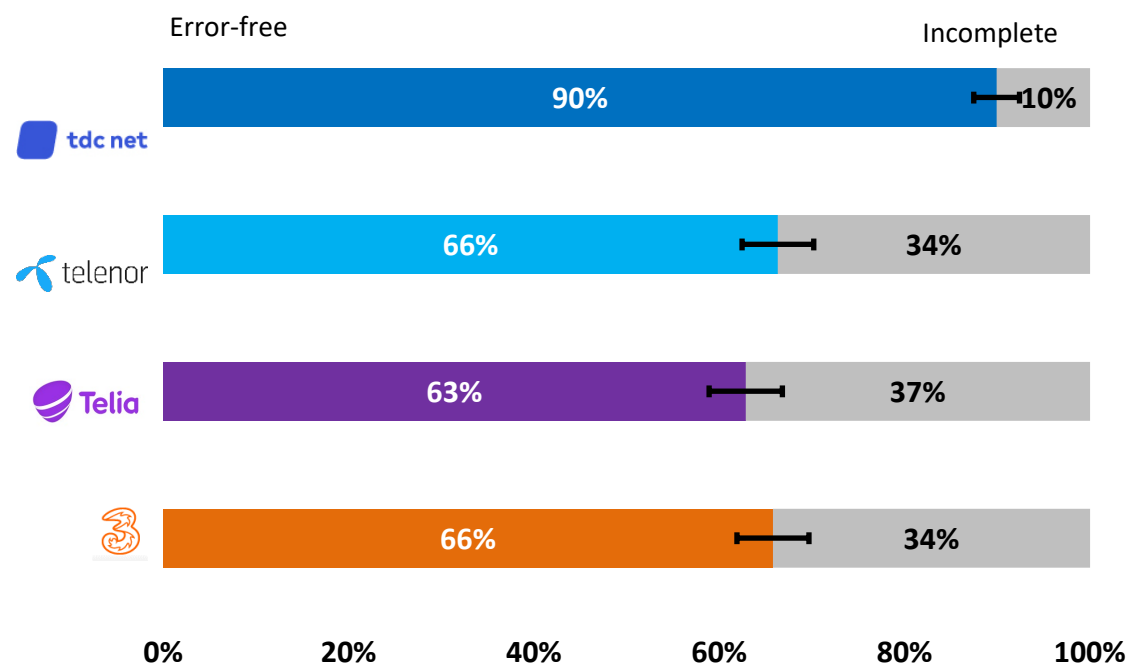
A van from Danish Technological Institute at one of the randomly selected test locations - here west of Grenaa near channel



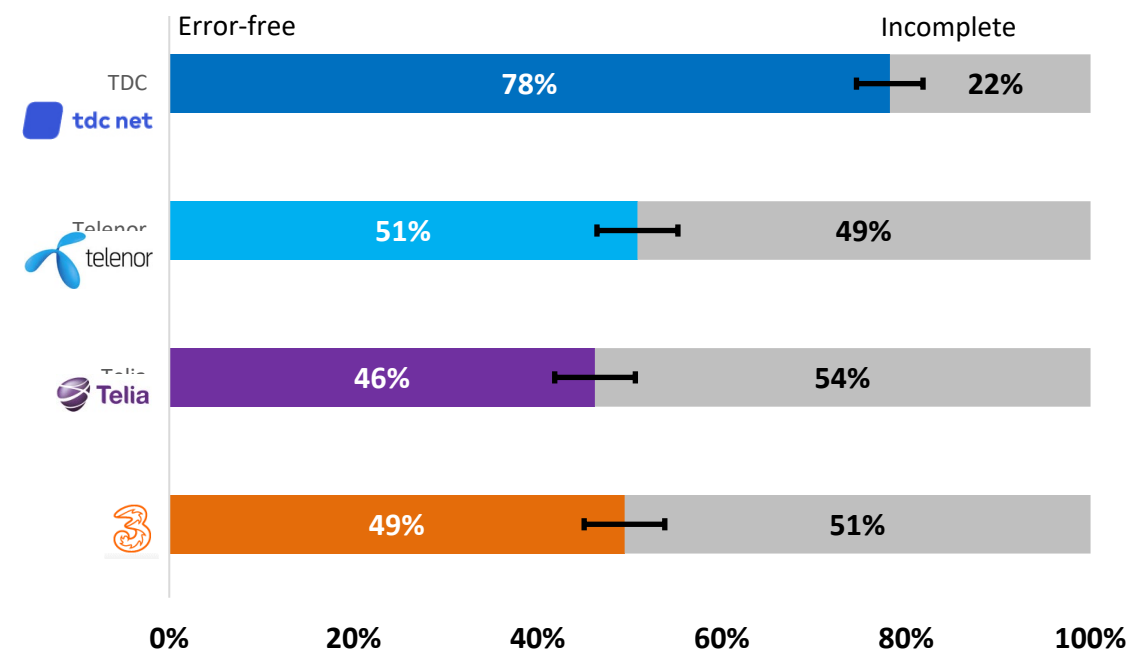
National result of mobile network experience 2022 with a 5G phone

TDC NET has a better total mobile network experience* than Telenor, Telia, and 3

2022 THROUGHOUT DENMARK: 5G PHONE
THE GOOD MOBILE NETWORK EXPERIENCE



2021 THROUGHOUT DENMARK: 5G PHONE
THE GOOD MOBILE NETWORK EXPERIENCE



*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time. **Horizontal black lines indicate a 95% statistical confidence interval.**

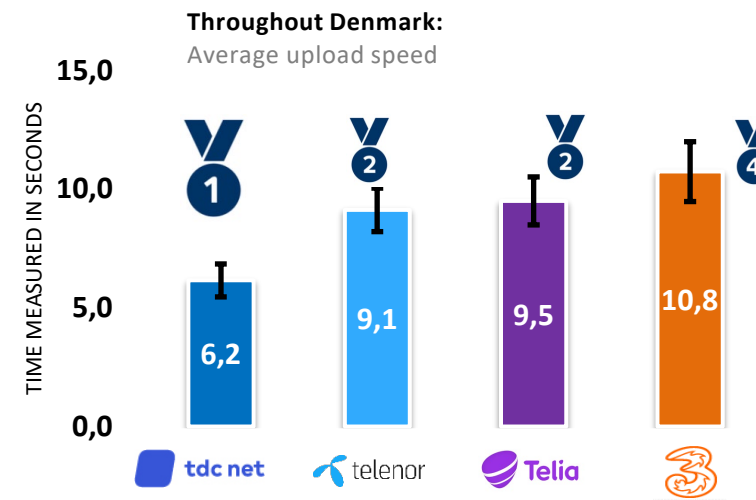
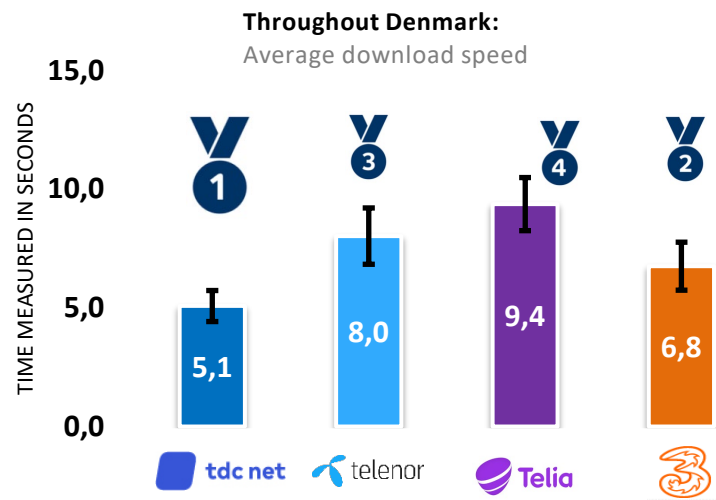


A van from Danish Technological Institute at one of the randomly selected test locations - here at Visborggård Castle near Hadsund

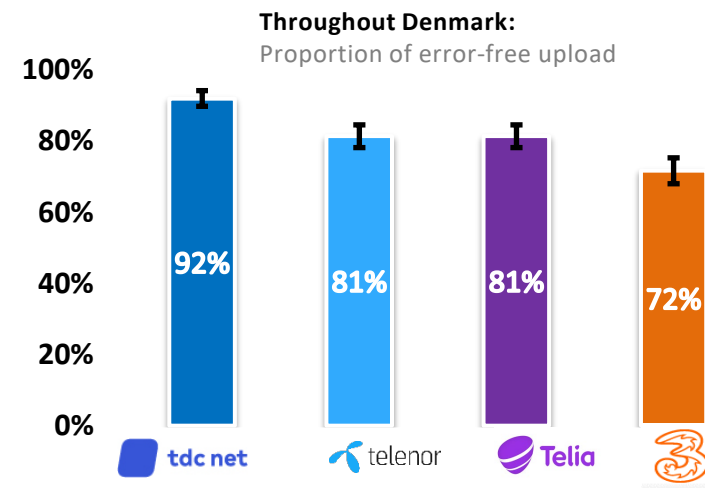
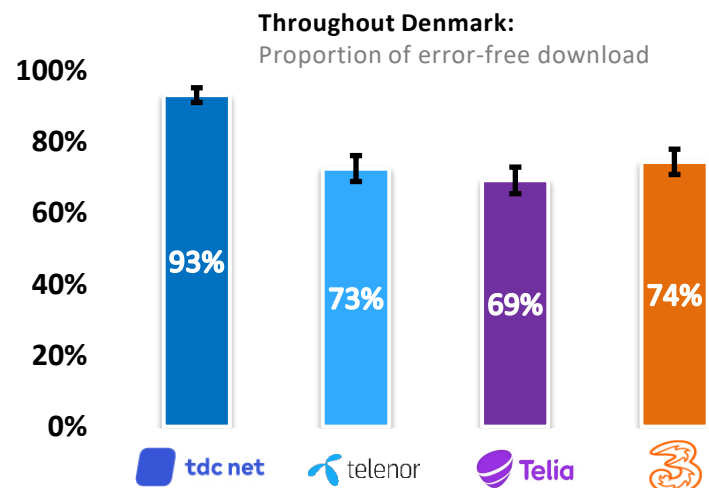


National result of download and upload speeds in 2022 with a 5G phone

TDC NET has much faster and more error-free downloads and uploads than Telenor, Telia, and 3
 The download and upload speeds of all network providers have become faster and more error-free since 2021



Medals for total assessment of average speed and error-free application

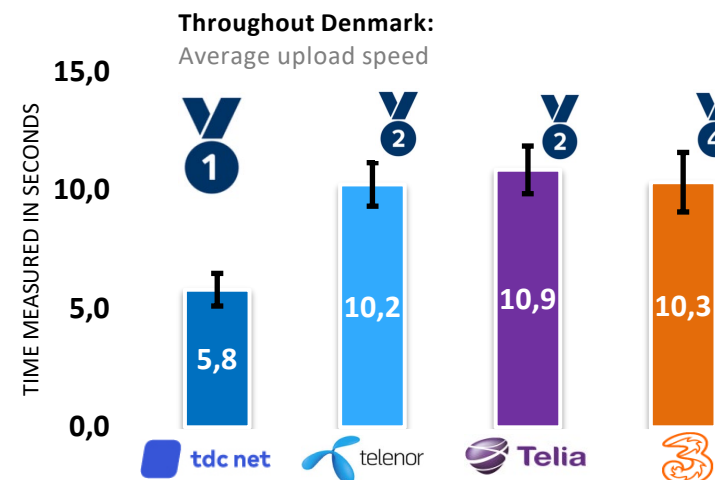
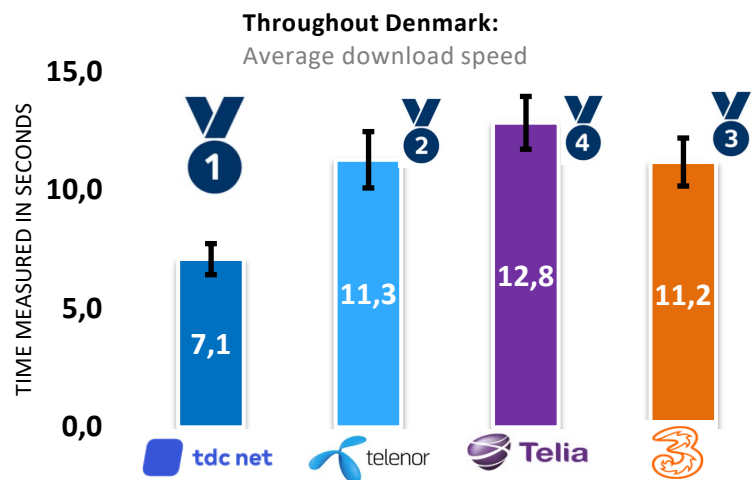


*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time. Vertical black lines indicate a 95% statistical confidence interval.

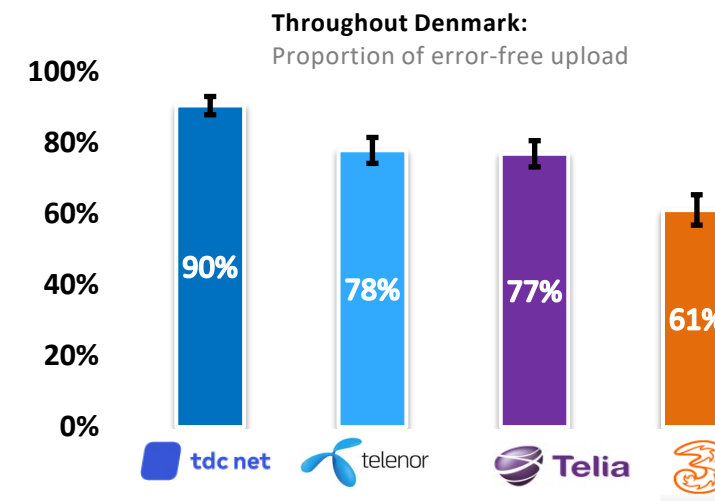
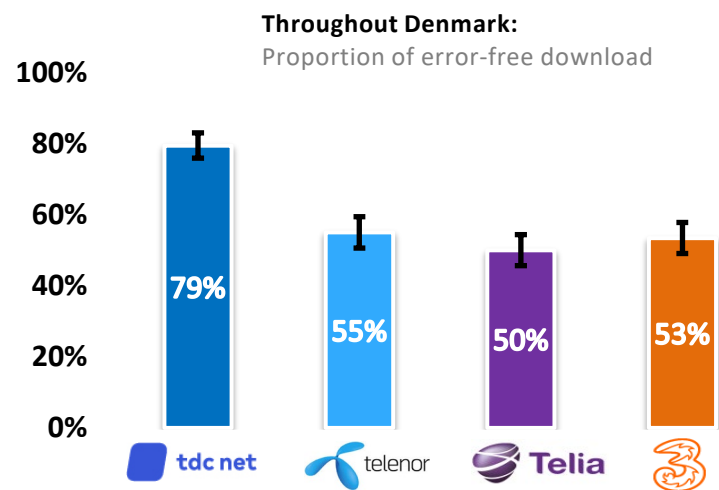


National result of download and upload speeds in 2021 with a 5G phone

TDC NET had much faster and more error-free downloads and uploads than Telenor, Telia, and 3



Medals for total assessment of average speed and error-free application



*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time. Vertical black lines indicate a 95% statistical confidence interval.

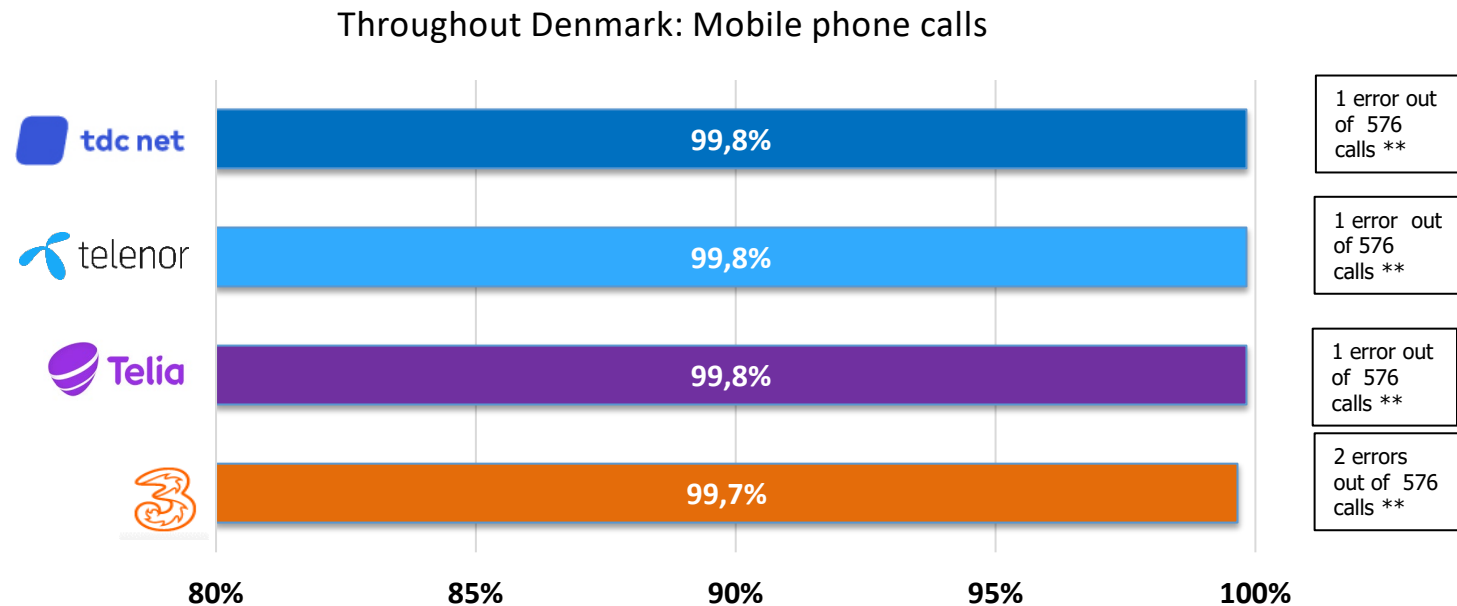


A van from Danish Technological Institute at one of the randomly selected test locations – here at Børglum Kloster in Vrå in North Jutland shrouded in sea fog



National result of ordinary mobile phone conversations in 2022 with a 5G phone

Ordinary mobile conversations* show no significant differences between TDC NET, Telenor, Telia, and 3



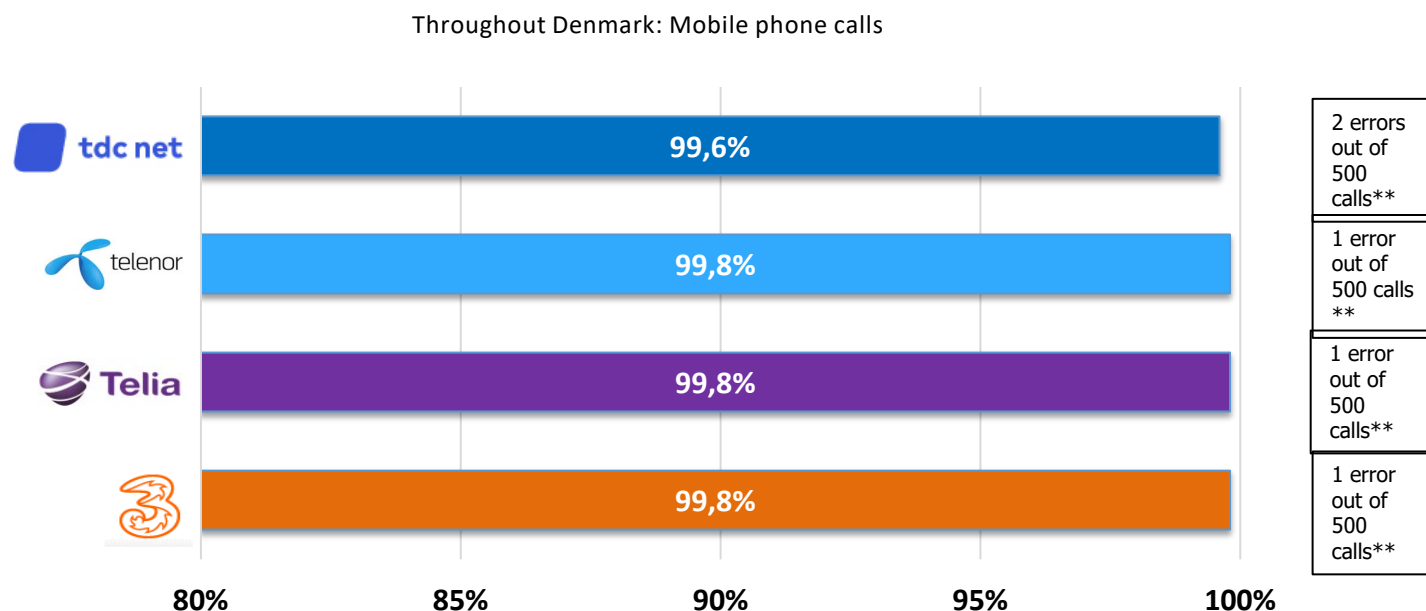
*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time.

** In case of error, one redial is made. If the redial is successful, then the phone call is approved.



National result of ordinary mobile phone conversations in 2021 with a 5G phone

Ordinary mobile phone conversations* show not significant differences between TDC NET, Telenor, Telia, and 3



*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV video without buffering waiting time.

** In case of error, one redial is made. If the redial is successful, then the phone call is approved.

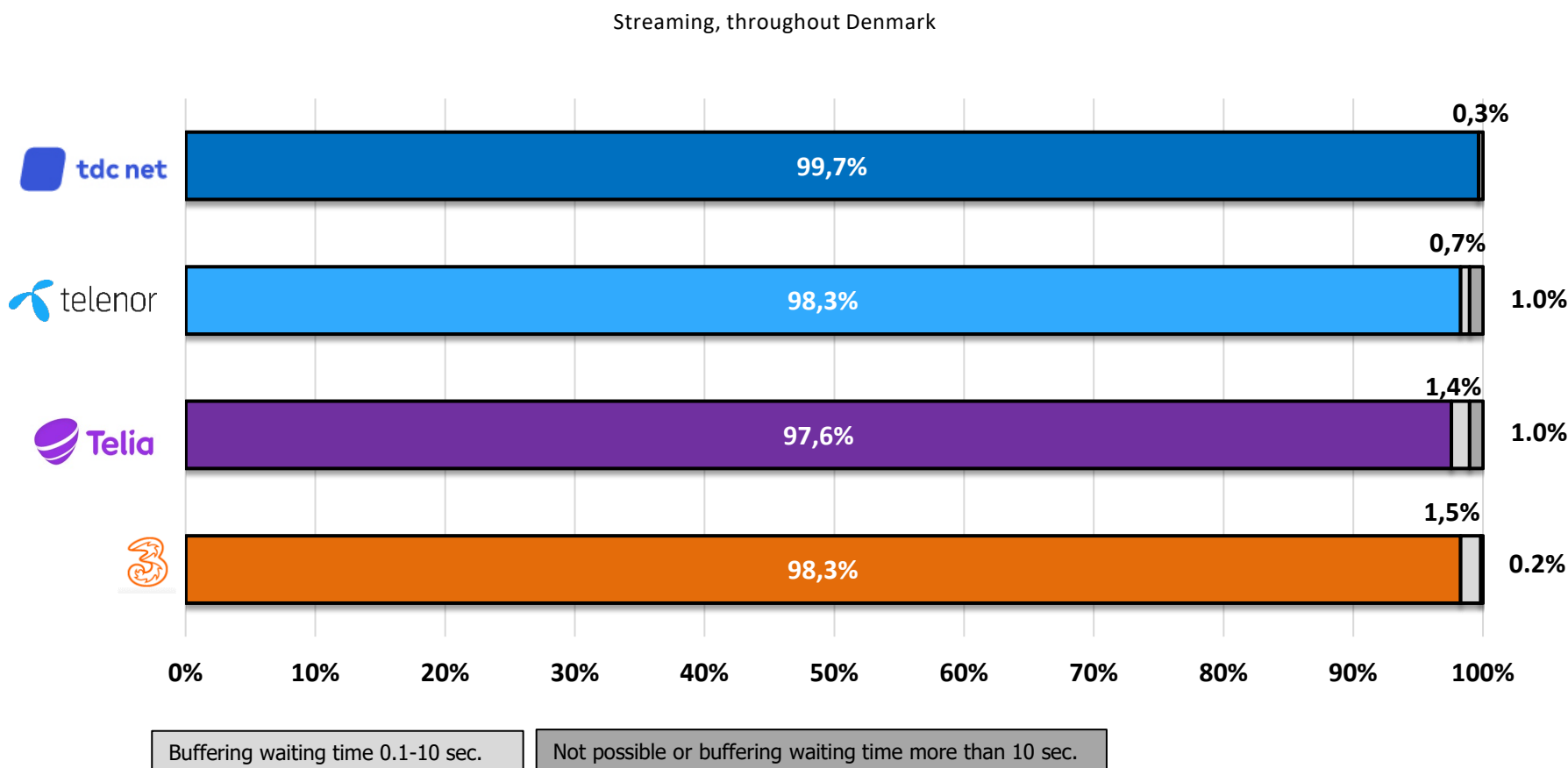


A van from Danish Technological Institute at one of the randomly selected test locations – here at the preserved railway line Bryrup-Vrads. Vrads Station is located between Silkeborg and Brande



National result of video streaming in 2022 with a 5G phone

At national level, video streaming is almost error-free. There are only minor differences between the individual network providers.

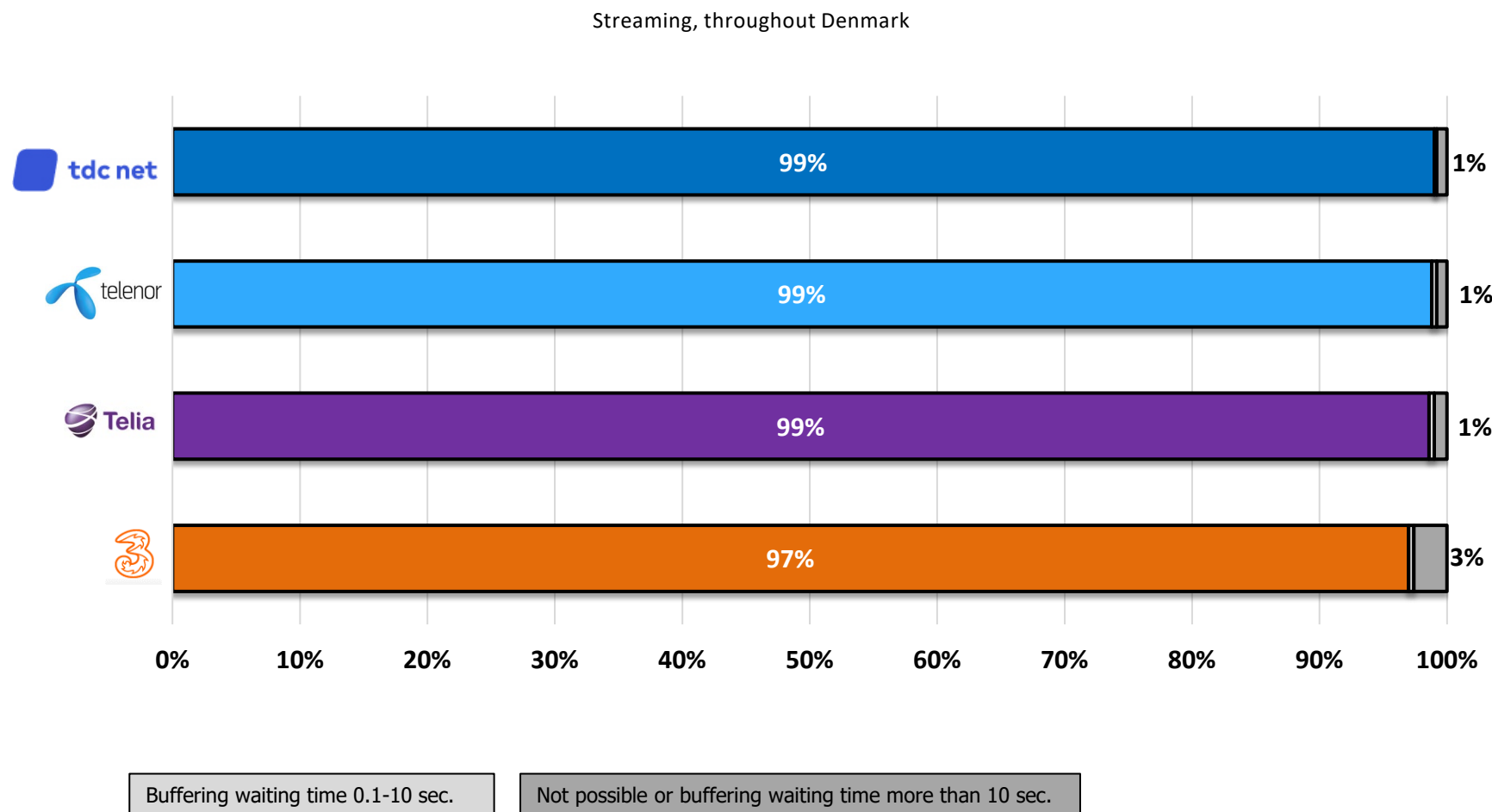


*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time.



National result of video streaming in 2021 with a 5G phone

At national level, video streaming with a 5G phone has the same high level for TDC NET, Telenor, and Telia. 3 is slightly below.

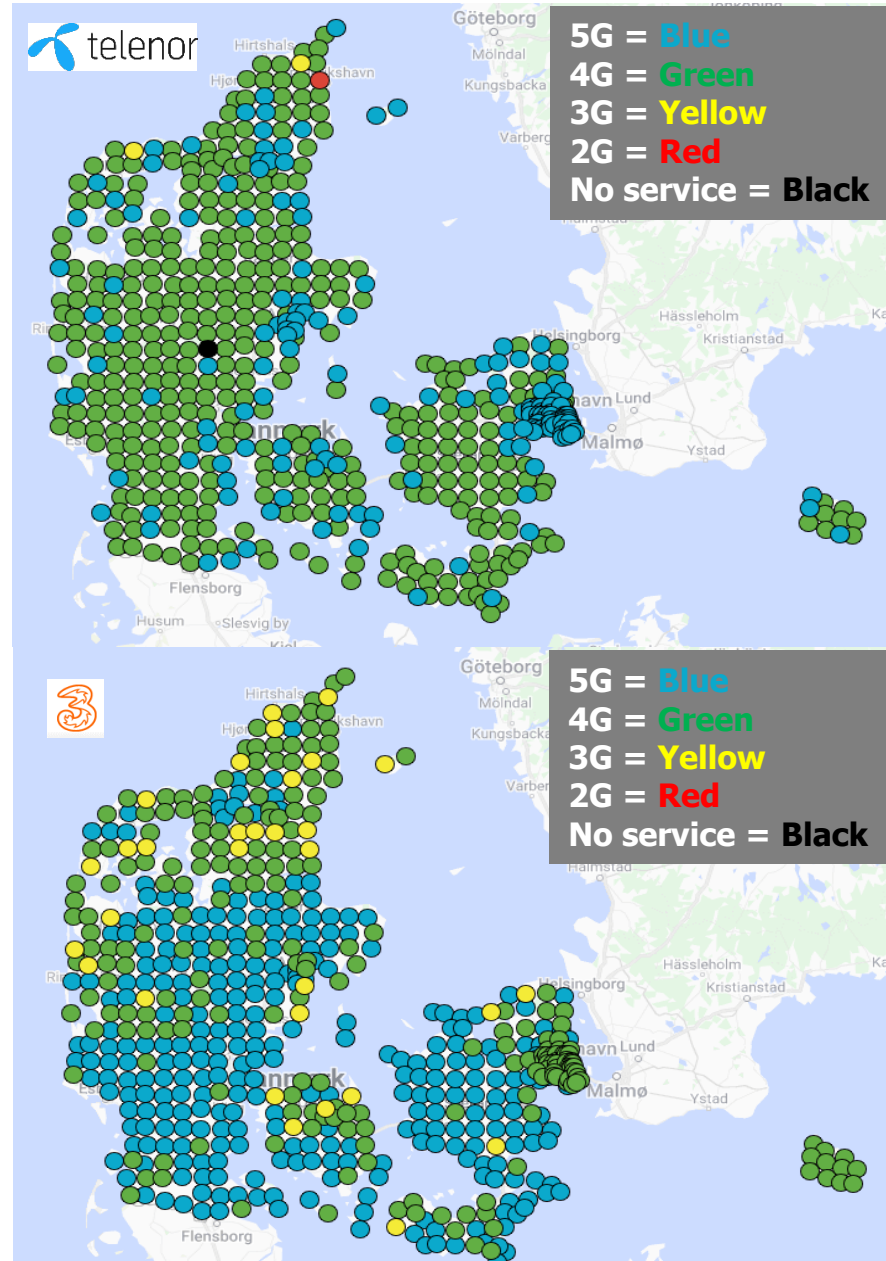
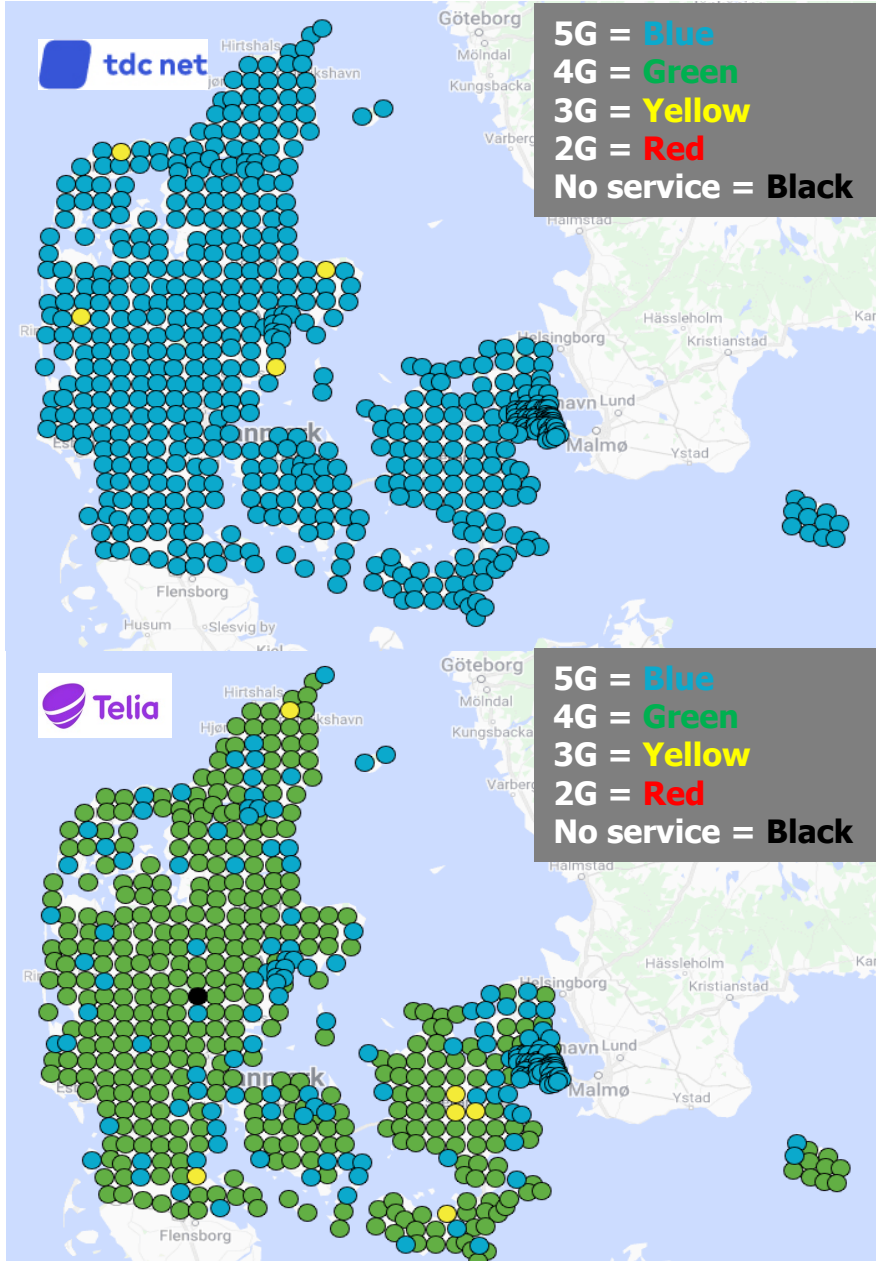


*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time.

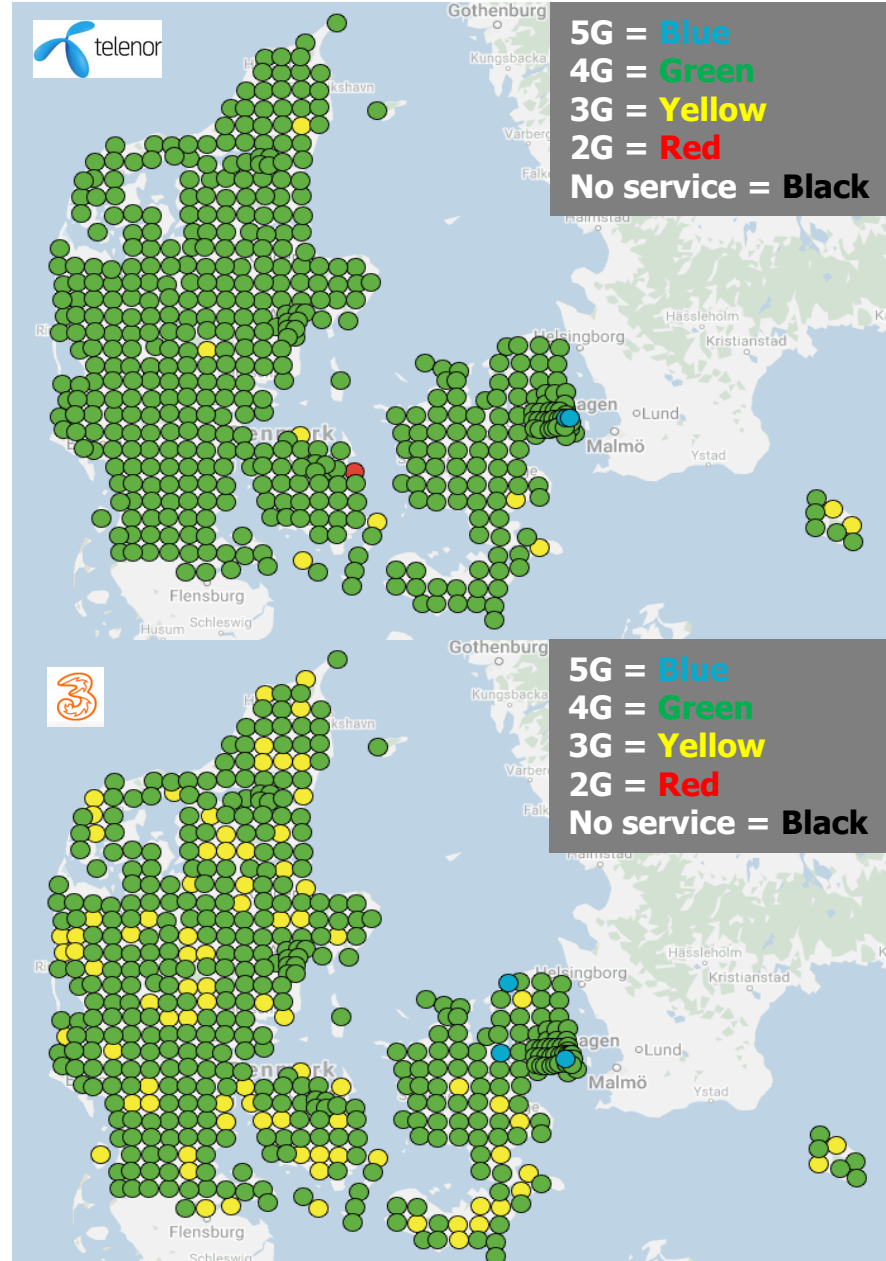
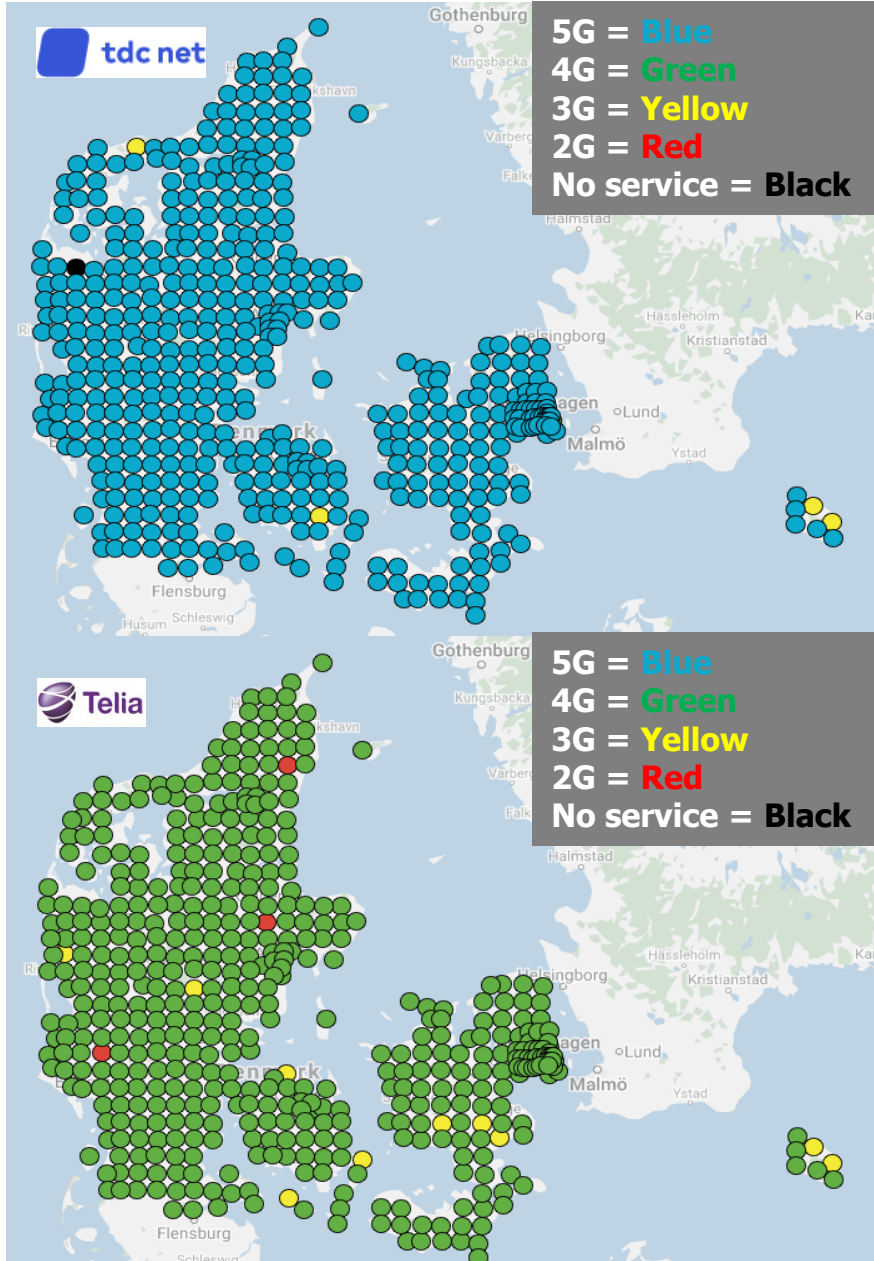


A van from Danish Technological Institute at one of the randomly selected test locations – here east of Varde

2022: Access to 5G, 4G, 3G, and 2G with a 5G phone



2021: Access to 5G, 4G, 3G, and 2G with a 5G phone

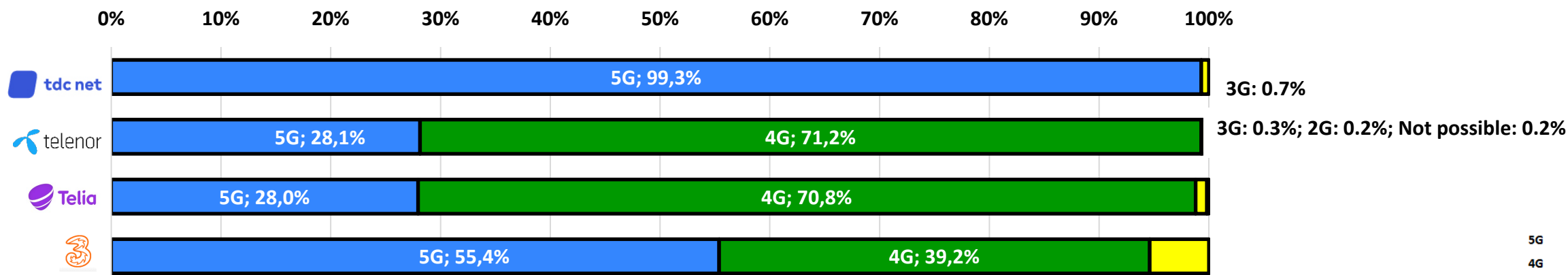




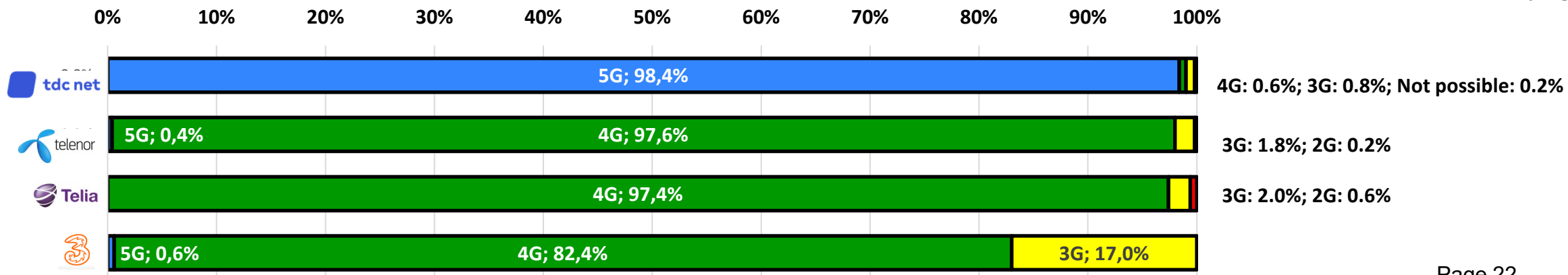
National result of access to 5G and 4G in 2022 and 2021 with a 5G phone

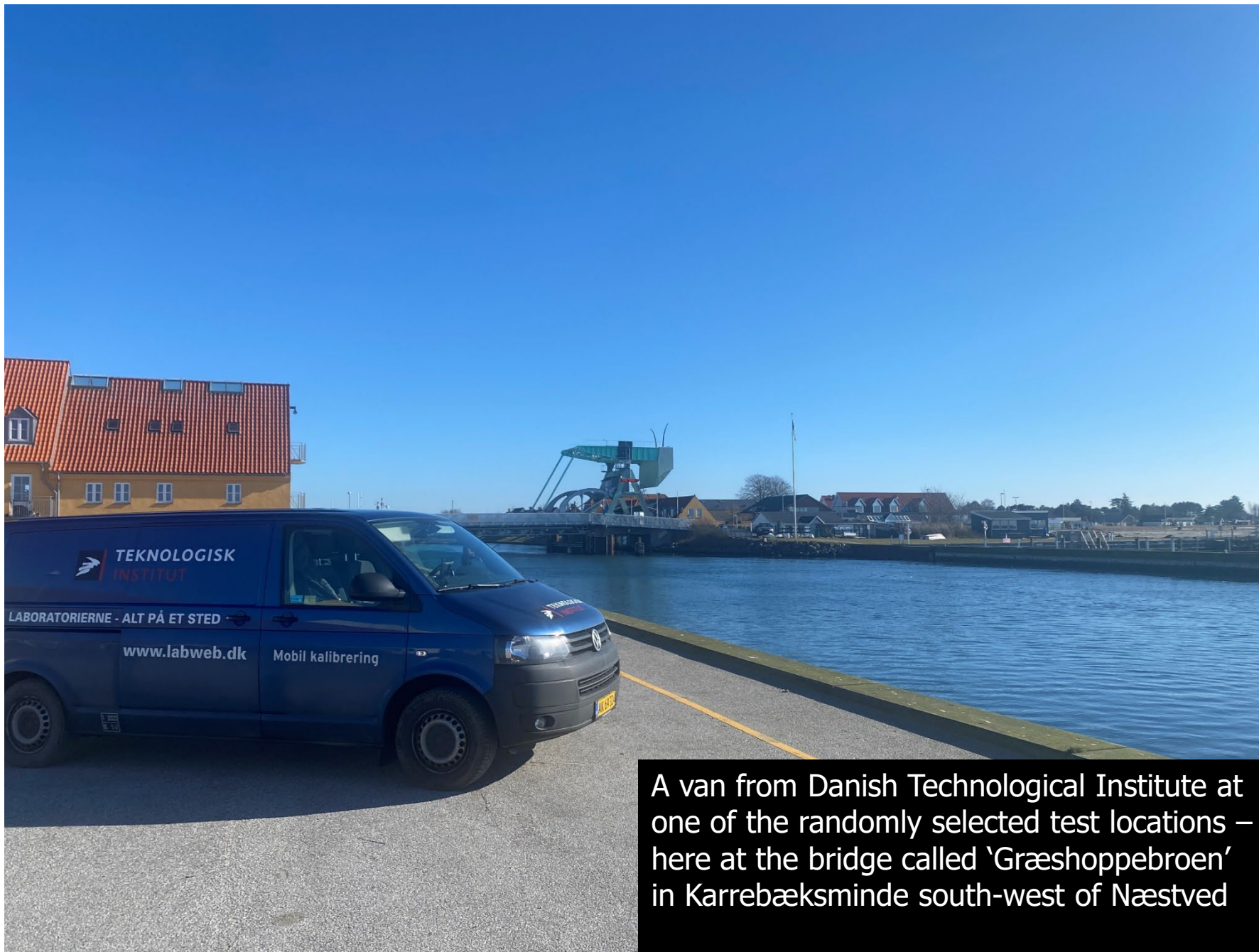
TDC NET has 99.3% access to 5G; 3, Telenor, and Telia have less access to 5G

2022 THROUGHOUT DENMARK: ACCESS TO 5G, 4G, 3G, AND 2G



2021 THROUGHOUT DENMARK: ACCESS TO 5G, 4G, 3G AND 2G





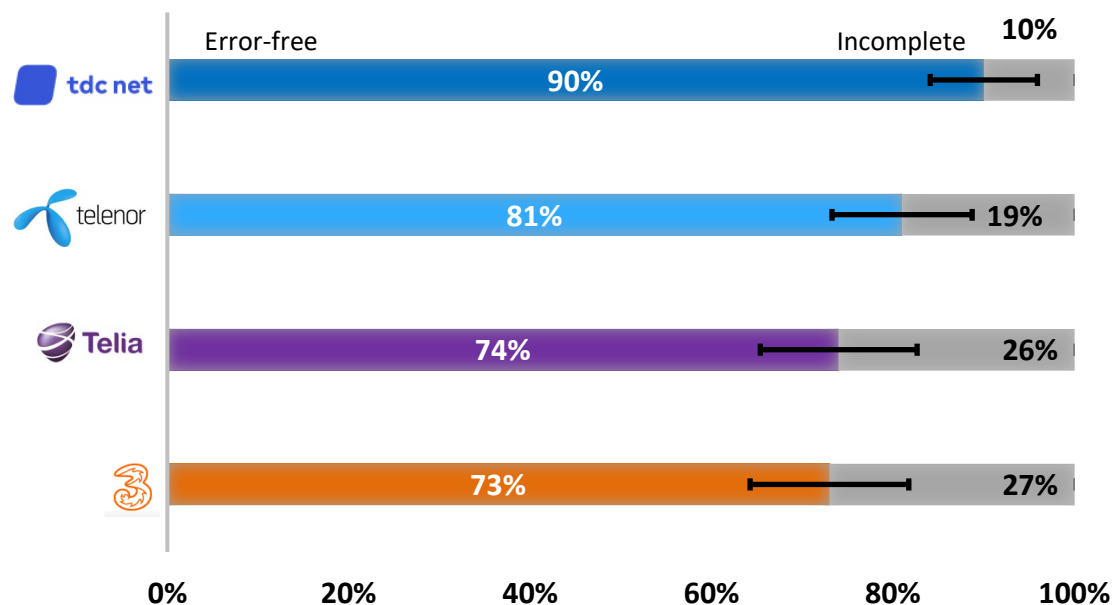


Regional results of mobile network experience in 2022 with a 5G phone

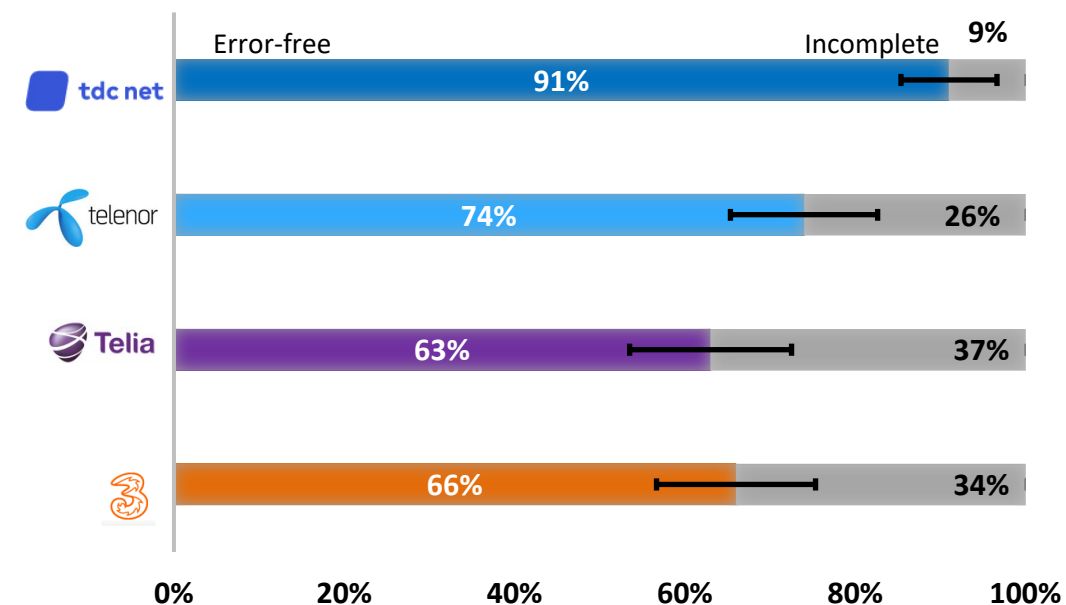
TDC NET has a better total mobile network experience* in the Capital Region of Denmark and a much better total mobile network experience * than Telenor, Telia, and 3 in Region Zealand

Telenor comes in second. Telia and 3 come in third.

**CAPTIAL REGION OF DENMARK:
THE GOOD MOBILE NETWORK EXPERIENCE**



**REGION ZEALAND:
THE GOOD MOBILE NETWORK EXPERIENCE**



*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time. **Horizontal black lines indicate a 95% statistical confidence interval.**

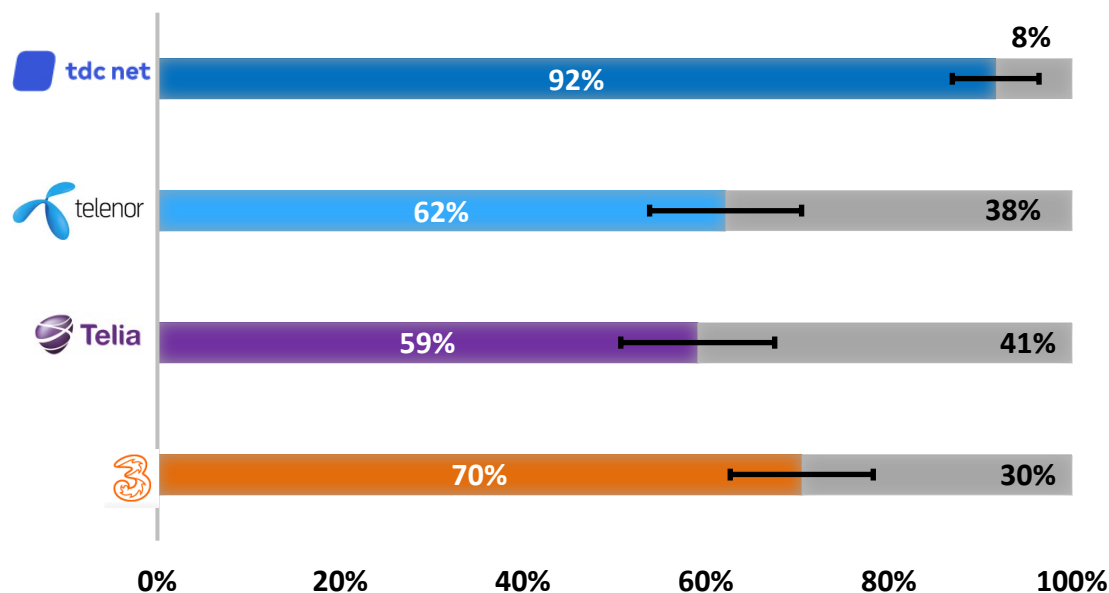


Regional results of mobile network experience in 2022 with a 5G phone

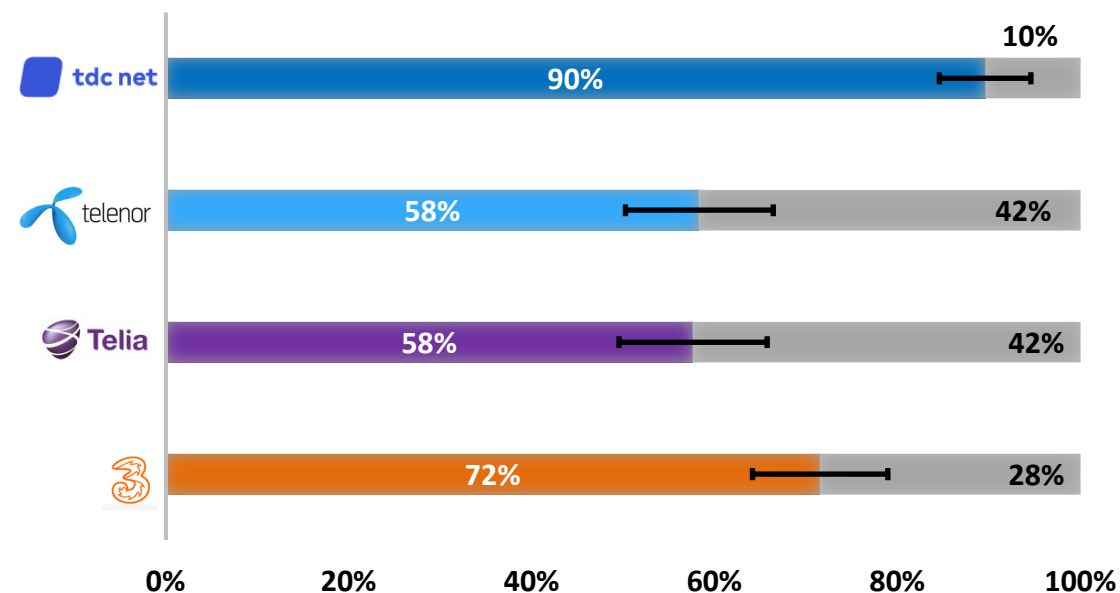
TDC NET has a better total mobile network experience* than Telenor, Telia, and 3 in the Region of Southern Denmark and Central Denmark Region

3 comes in second.

REGION OF SOUTHERN DENMARK:
THE GOOD MOBILE NETWORK EXPERIENCE



CENTRAL DENMARK REGION:
THE GOOD MOBILE NETWORK EXPERIENCE



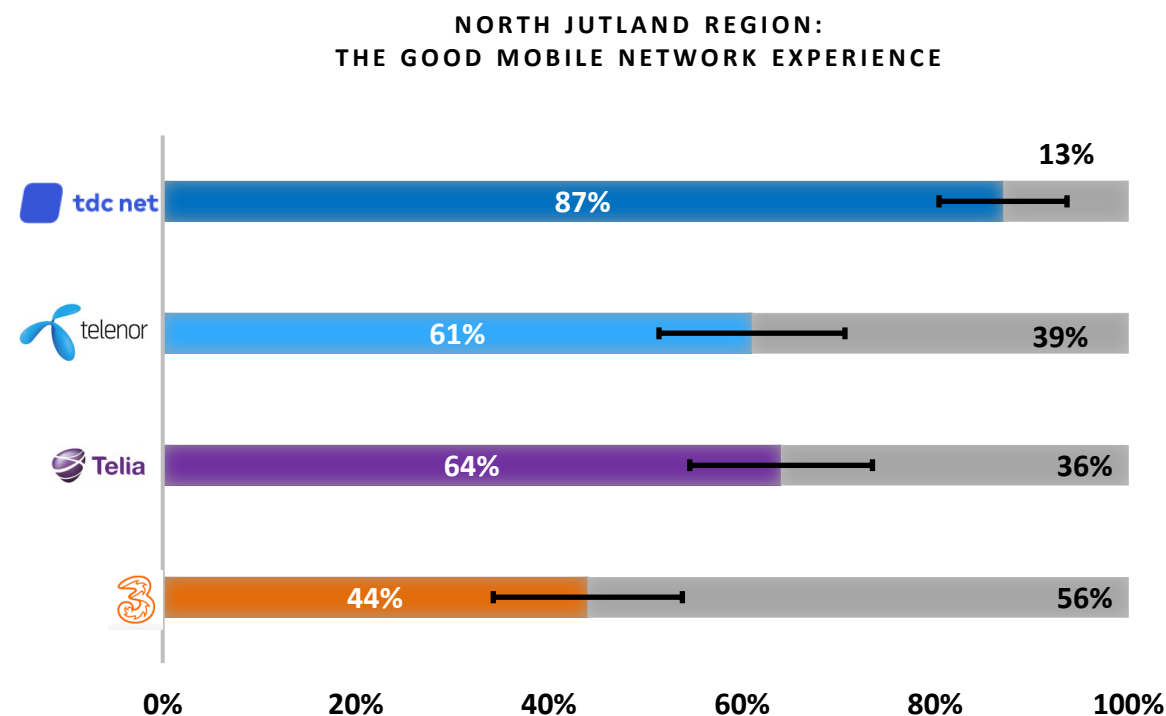
*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time. **Horizontal black lines indicate a 95% statistical confidence interval.**



Regional results of mobile network experience in 2022 with a 5G phone

TDC NET has a much better total mobile network experience* than Telenor, Telia, and 3 in the North Jutland Region

Telenor and Telia come in second.



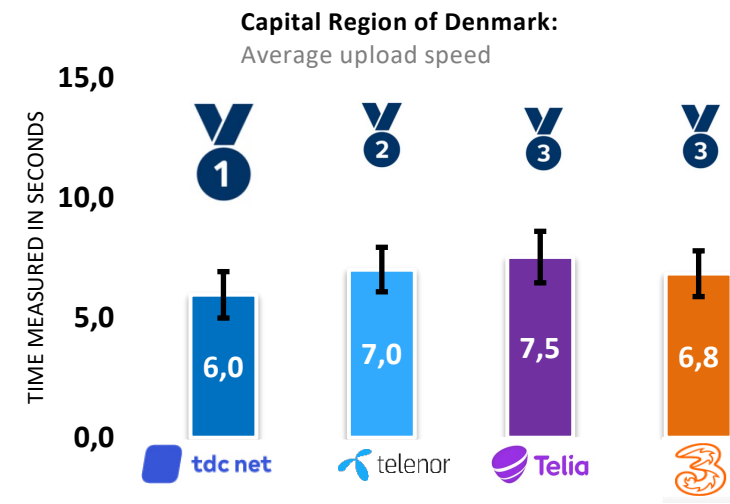
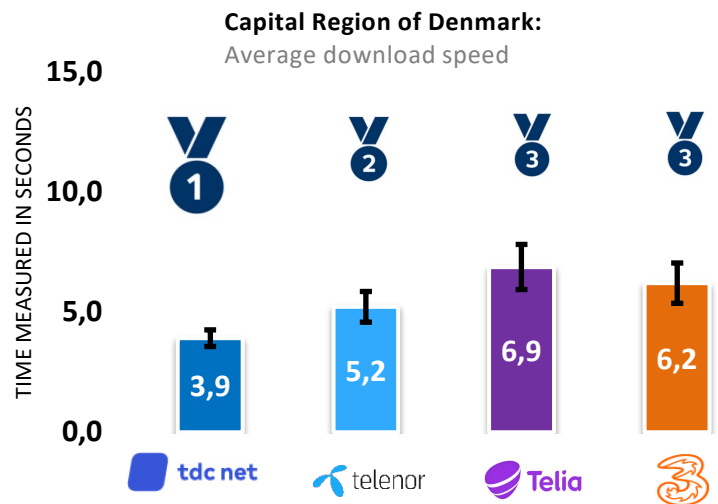
*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time. **Horizontal black lines indicate a 95% statistical confidence interval.**



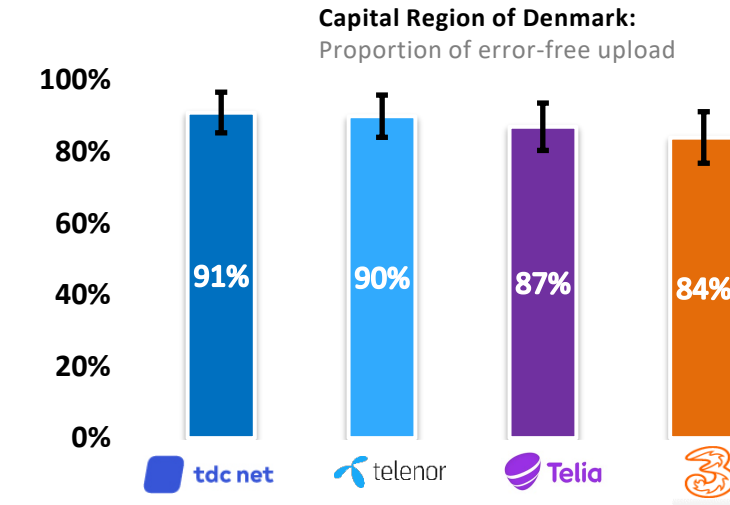
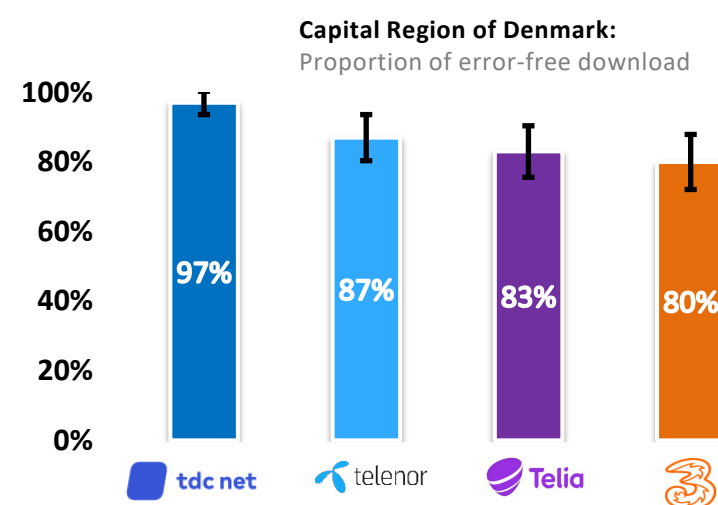


Regional results of download and upload speeds in 2022 with a 5G phone

TDC NET has much faster and more error-free* downloads and somewhat faster upload speeds than Telenor, Telia, and 3 in the Capital Region of Denmark



Medals for total assessment of average speed and error-free application

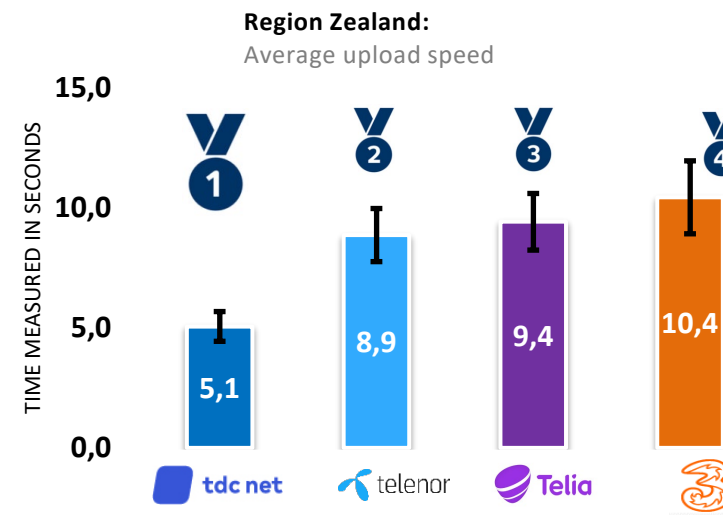
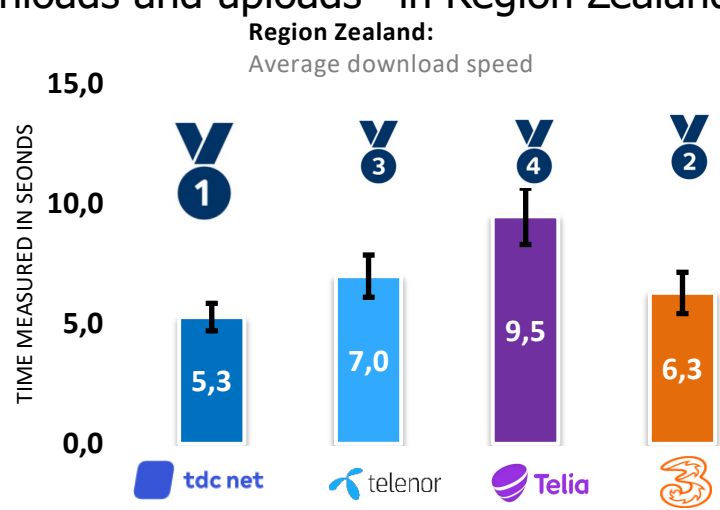


*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time. Vertical black lines indicate a 95% statistical confidence interval.

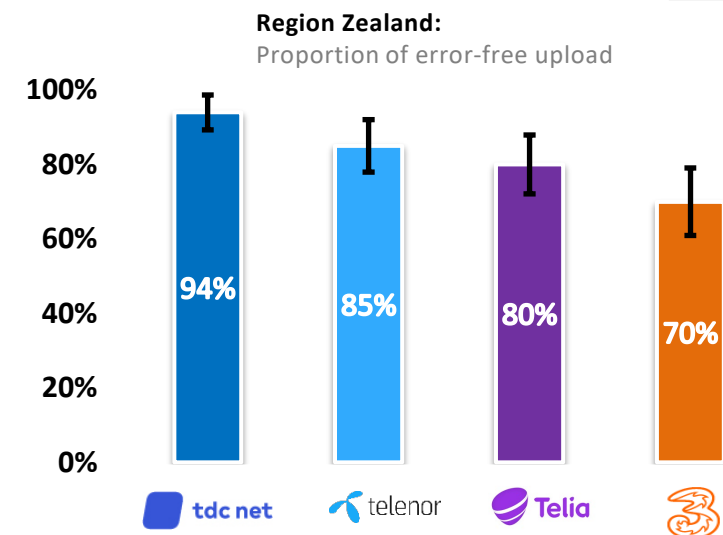
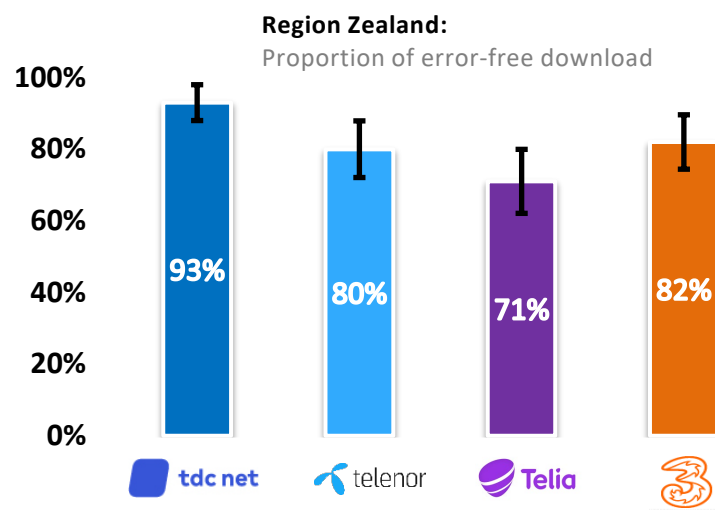


Regional results of download and upload speeds in 2022 with a 5G phone

TDC NET has faster downloads and much faster upload speeds and substantially more error-free downloads and uploads* in Region Zealand



Medals for total assessment of average speed and error-free application



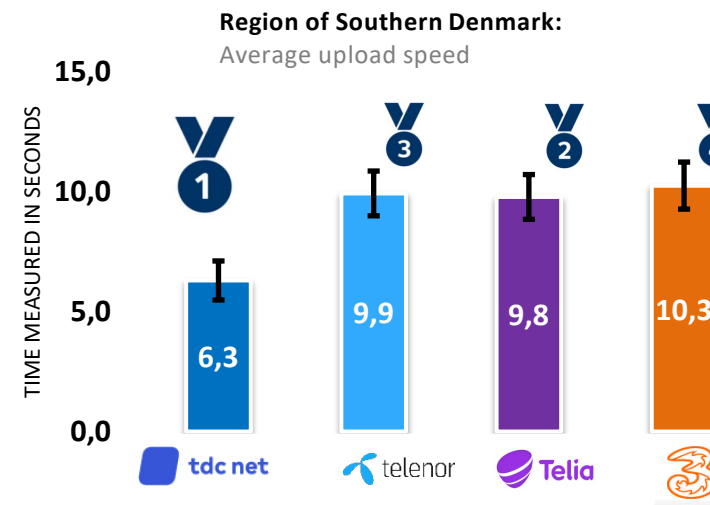
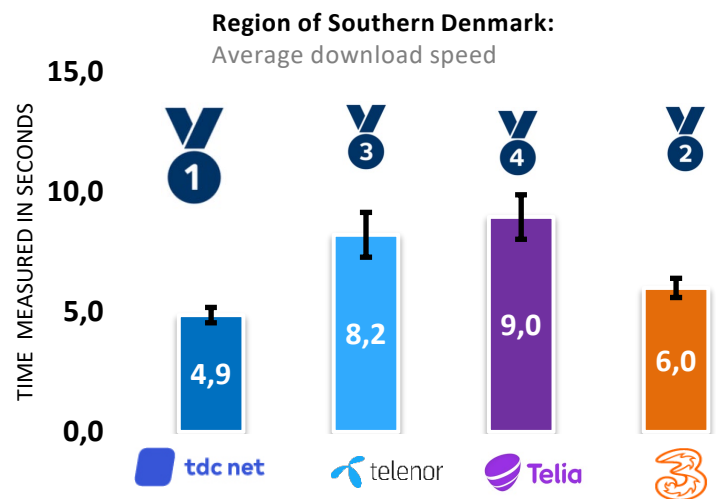
*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time. Vertical black lines indicate a 95% statistical confidence interval.

Regional results of download and upload speeds in 2022 with a 5G phone

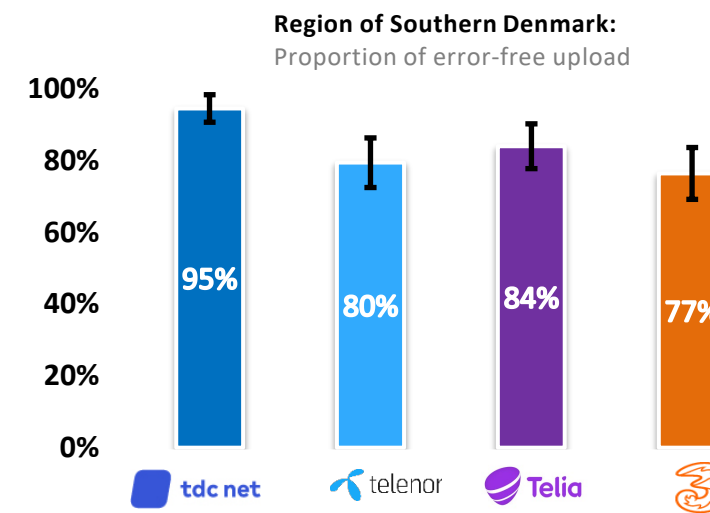
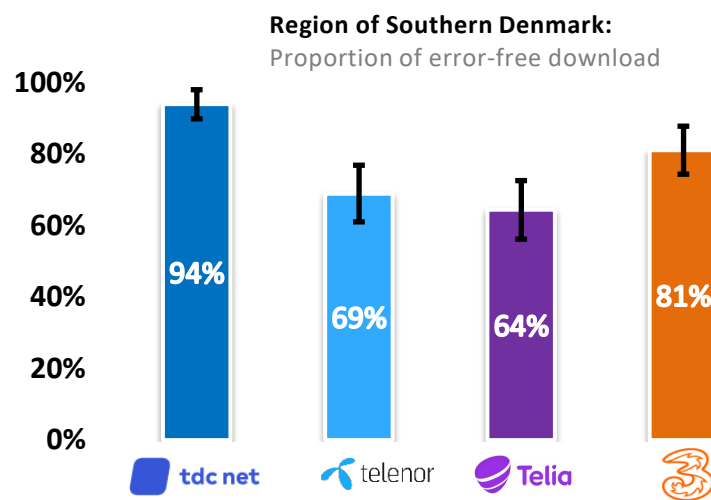


DANISH TECHNOLOGICAL INSTITUTE

TDC NET has much faster and more error-free* downloads and uploads than Telenor, Telia, and 3 in the Region of Southern Denmark



Medals for total assessment of average speed and error-free application

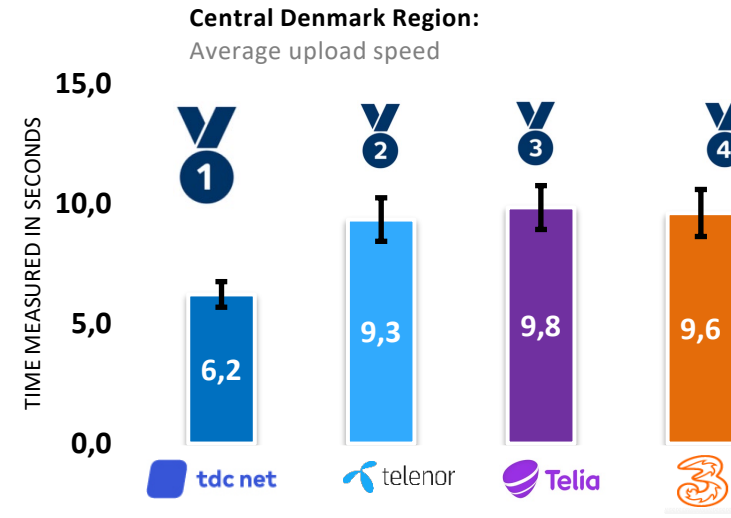
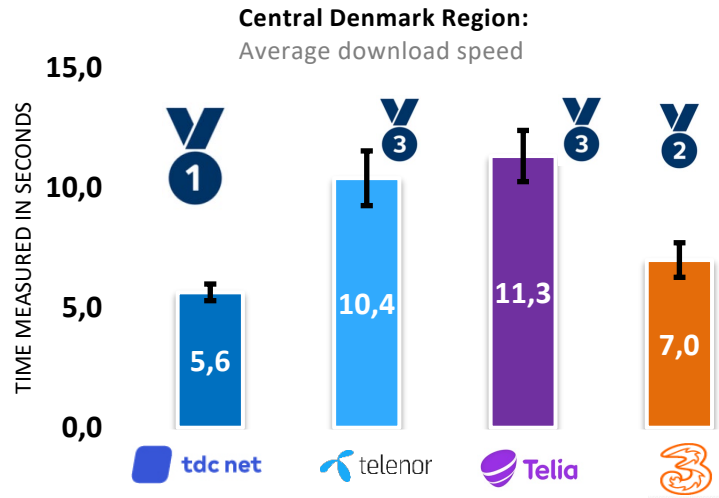


*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time. Vertical black lines indicate a 95% statistical confidence interval.

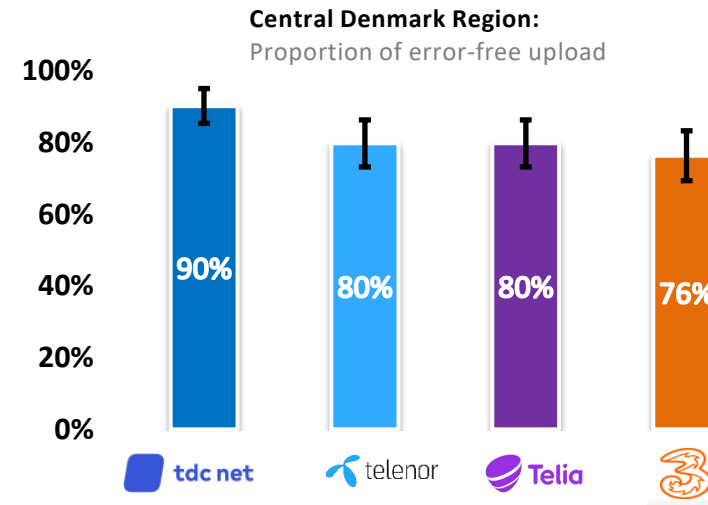
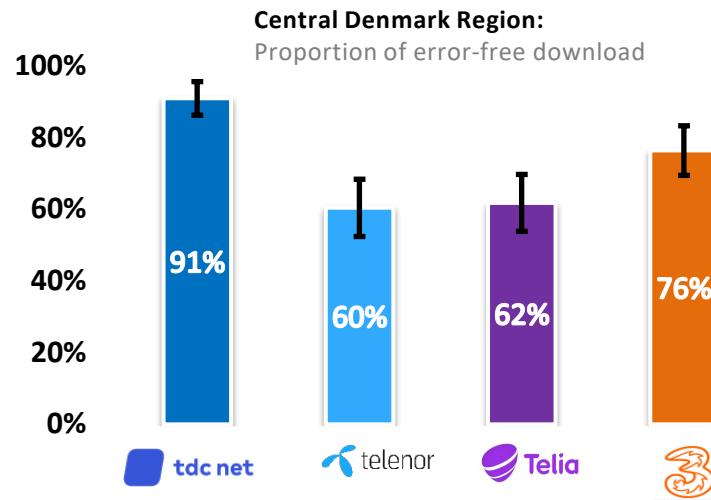


Regional results of download and upload speeds in 2022 with a 5G phone

TDC NET has much faster and more error-free* downloads and uploads than Telenor, Telia, and 3 in Central Denmark Region



Medals for total assessment of average speed and error-free application

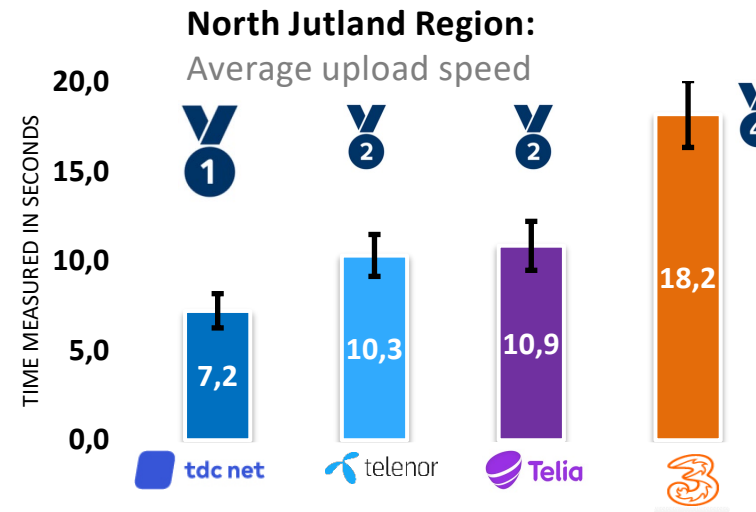
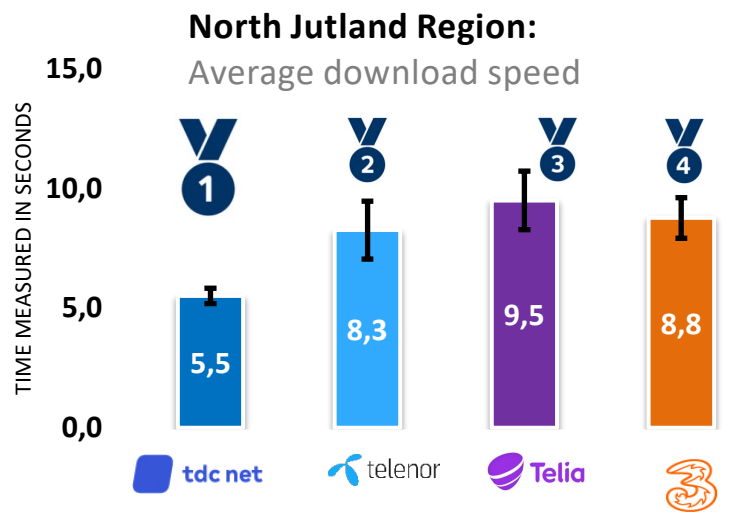


*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time. Vertical black lines indicate a 95% statistical confidence interval.

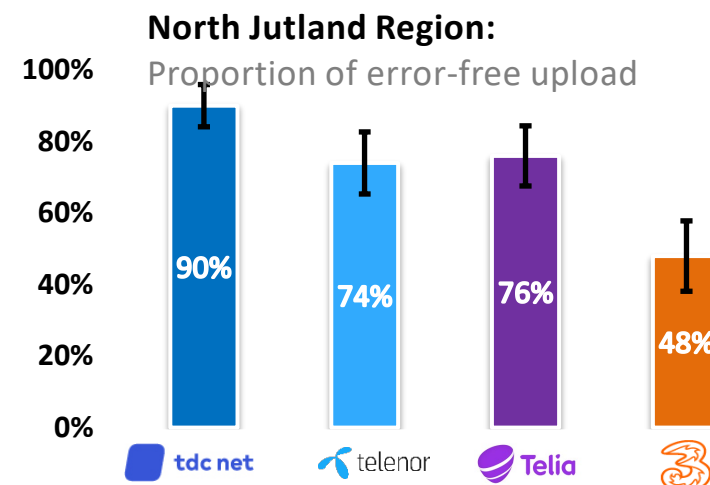
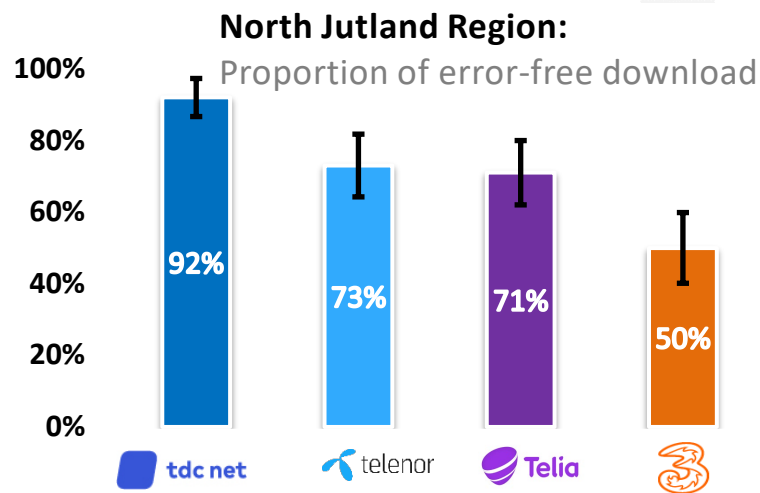


Regional results of download and upload speeds in 2022 with a 5G phone

TDC NET has much faster and more error-free* downloads and uploads than Telenor, Telia, and 3 in the North Jutland Region



Medals for total assessment of average speed and error-free application



*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time. Vertical black lines indicate a 95% statistical confidence interval.

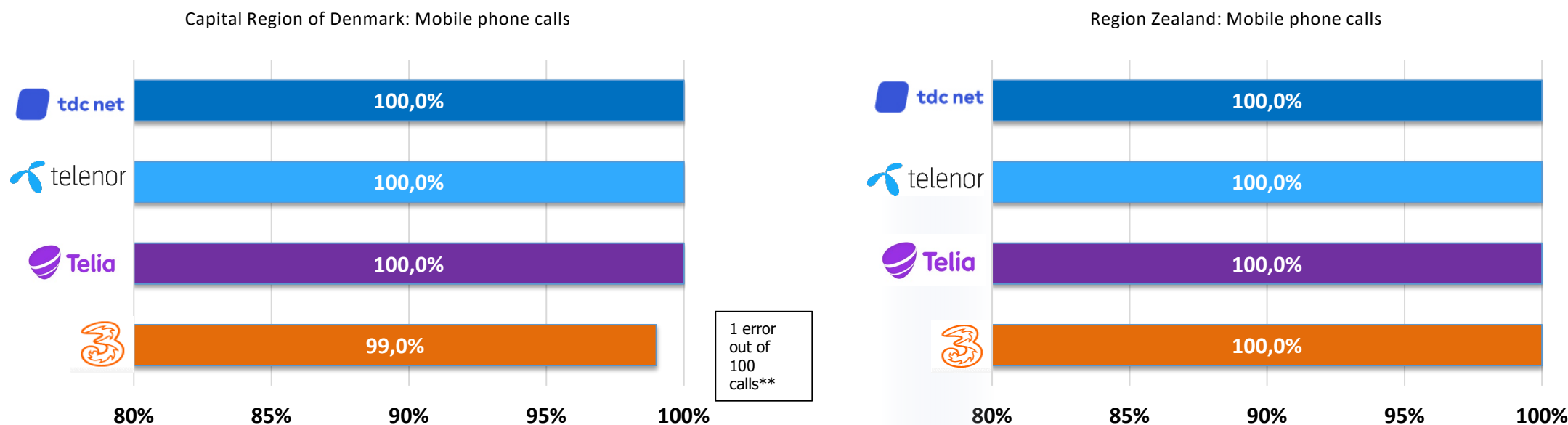


A van from Danish Technological Institute at one of the randomly selected test locations – here at Tisvilde beach in North Zealand



Regional results of ordinary mobile phone conversations in 2022 with a 5G phone

Ordinary mobile phone conversations* show no significant differences between TDC NET, Telenor, Telia, and 3



*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time.

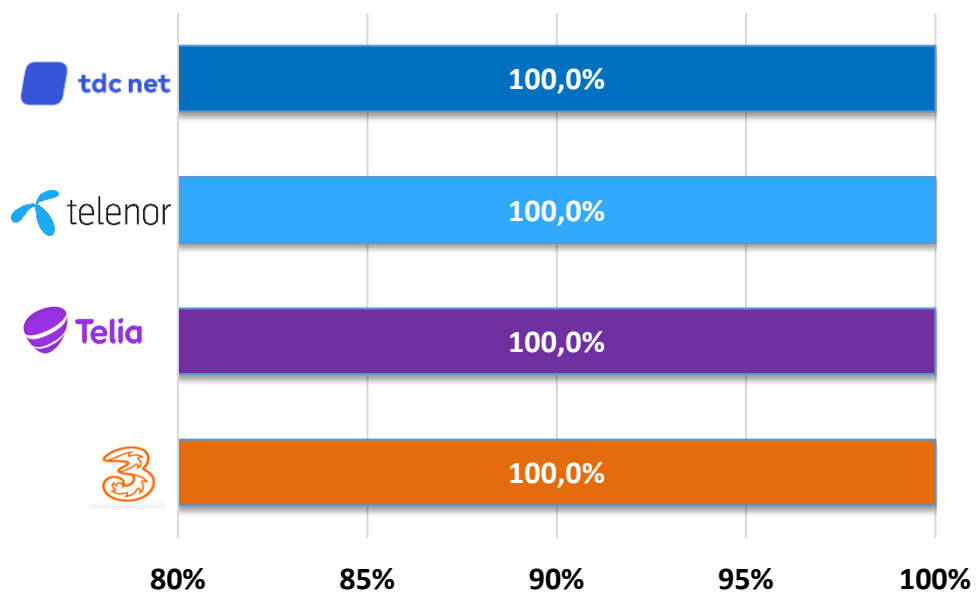
** In case of error, one redial is made. If the redial is successful, then the phone call is approved.



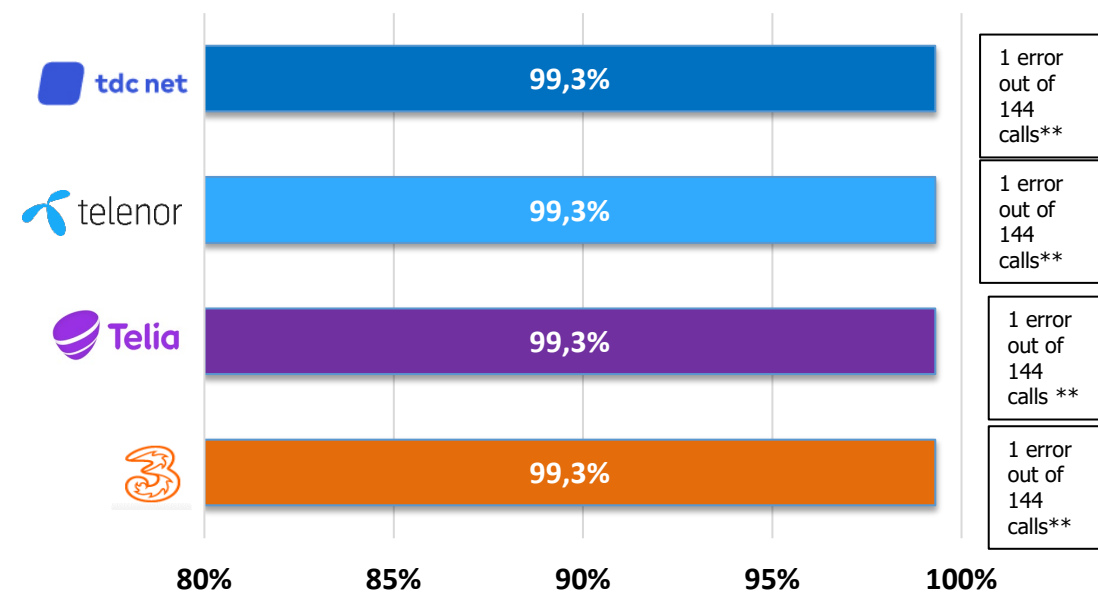
Regional results of ordinary mobile phone conversations in 2022 with a 5G phone

Ordinary mobile phone conversations* show no significant differences between TDC NET, Telenor, Telia, and 3

Region of Southern Denmark: Mobile phone calls



Central Denmark Region: Mobile phone calls



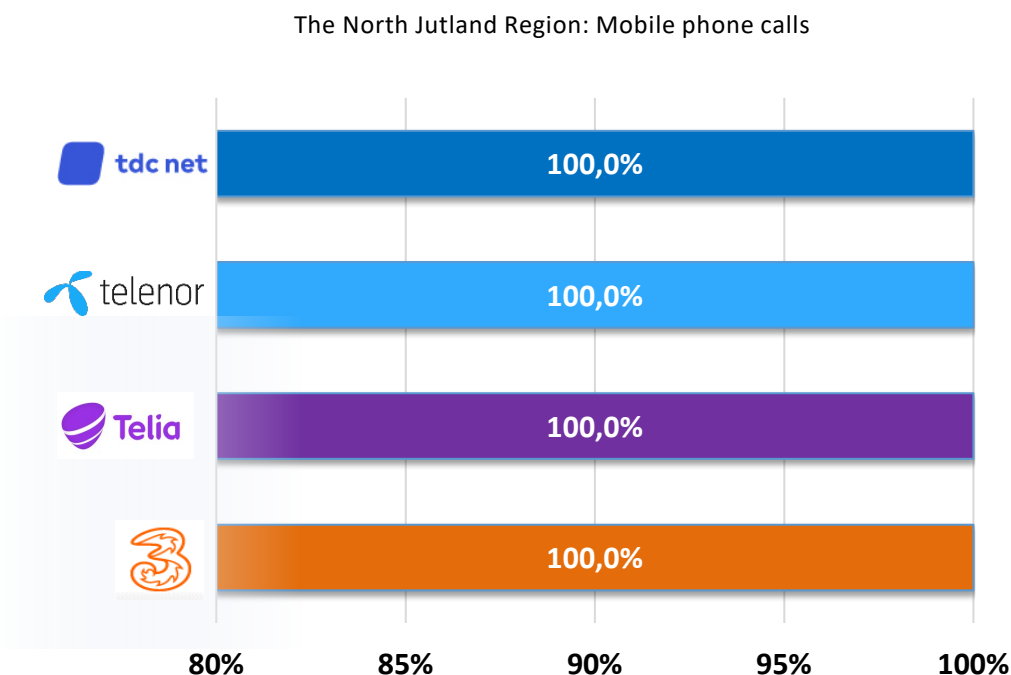
*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time.

** In case of error, one redial is made. If the redial is successful, then the phone call is approved.



Regional results of ordinary mobile phone conversations in 2022 with a 5G phone

Ordinary mobile phone conversations* show no significant differences between TDC NET, Telenor, Telia, and 3



*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time.

** In case of error, one redial is made. If the redial is successful, then the phone call is approved.



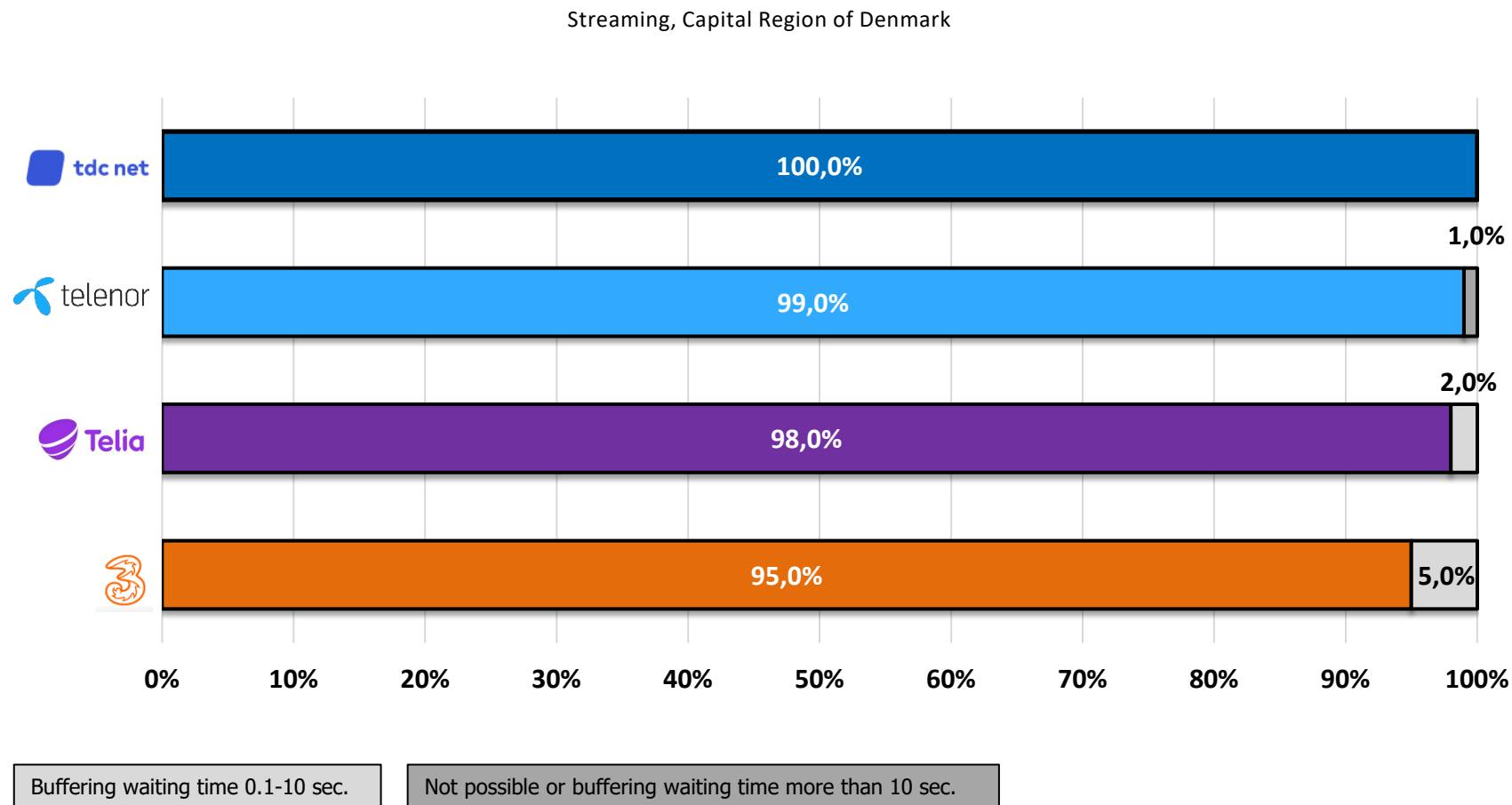
A van from Danish Technological Institute at one of the randomly selected test locations – here in Hundested forest in North Zealand



Regional results of video streaming in 2022 with a 5G phone

TDC NET has completely error-free video streaming in the Capital Region of Denmark

Telenor and Telia have almost error-free video streaming in the Capital Region of Denmark



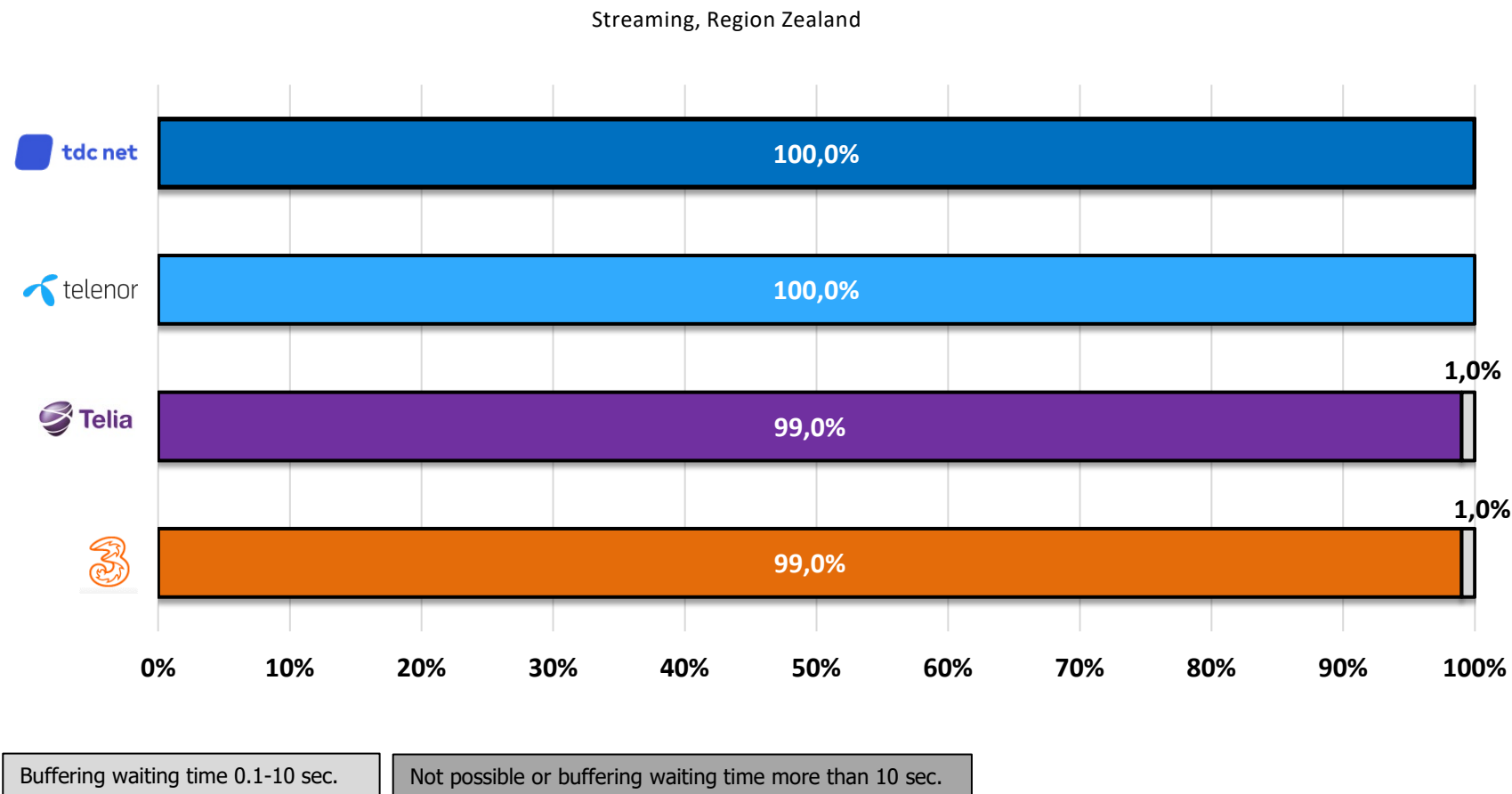
*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time.



Regional results of video streaming in 2022 with a 5G phone

TDC NET has completely error-free video streaming in Region Zealand

Telenor and Telia have almost error-free video streaming in Region Zealand



*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time.

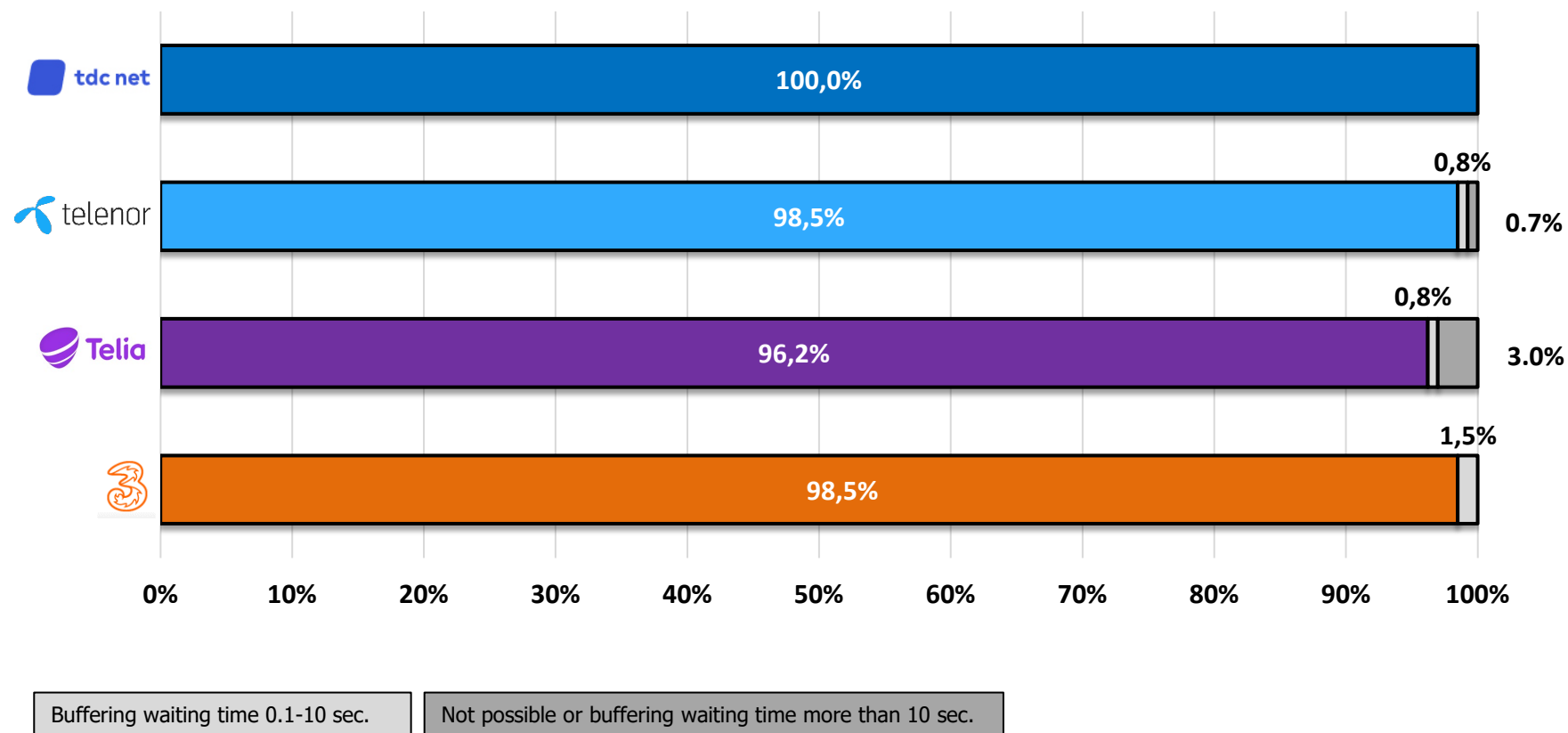


Regional results of video streaming in 2022 with a 5G phone

TDC NET has completely error-free video streaming in the Region of Southern Denmark

Telenor and 3 have almost error-free video streaming in the Region of Southern Denmark

Streaming, Region of Southern Denmark

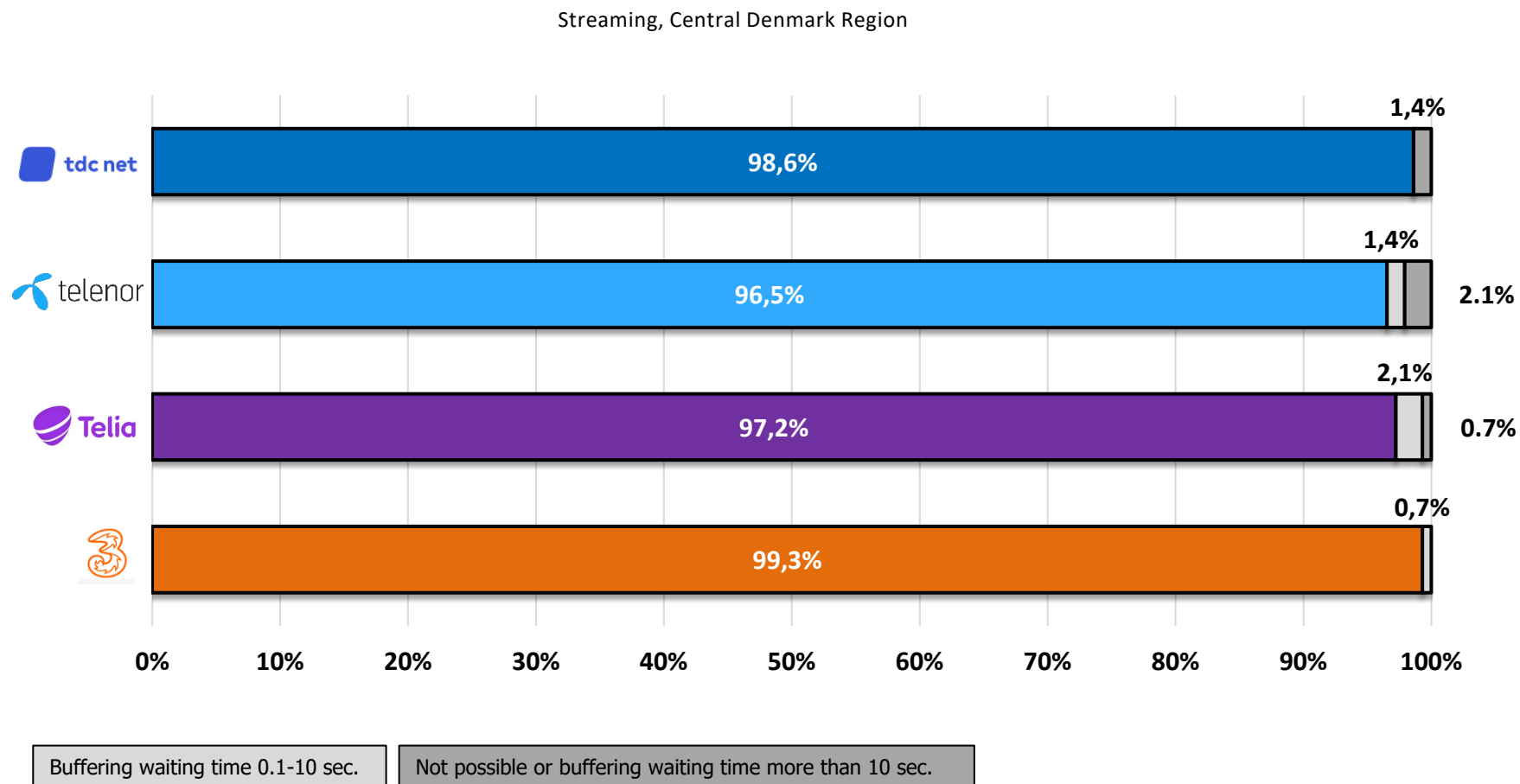


*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time.



Regional results of video streaming in 2022 with a 5G phone

3 and TDC NET have almost error-free video streaming in Central Denmark Region



*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time.

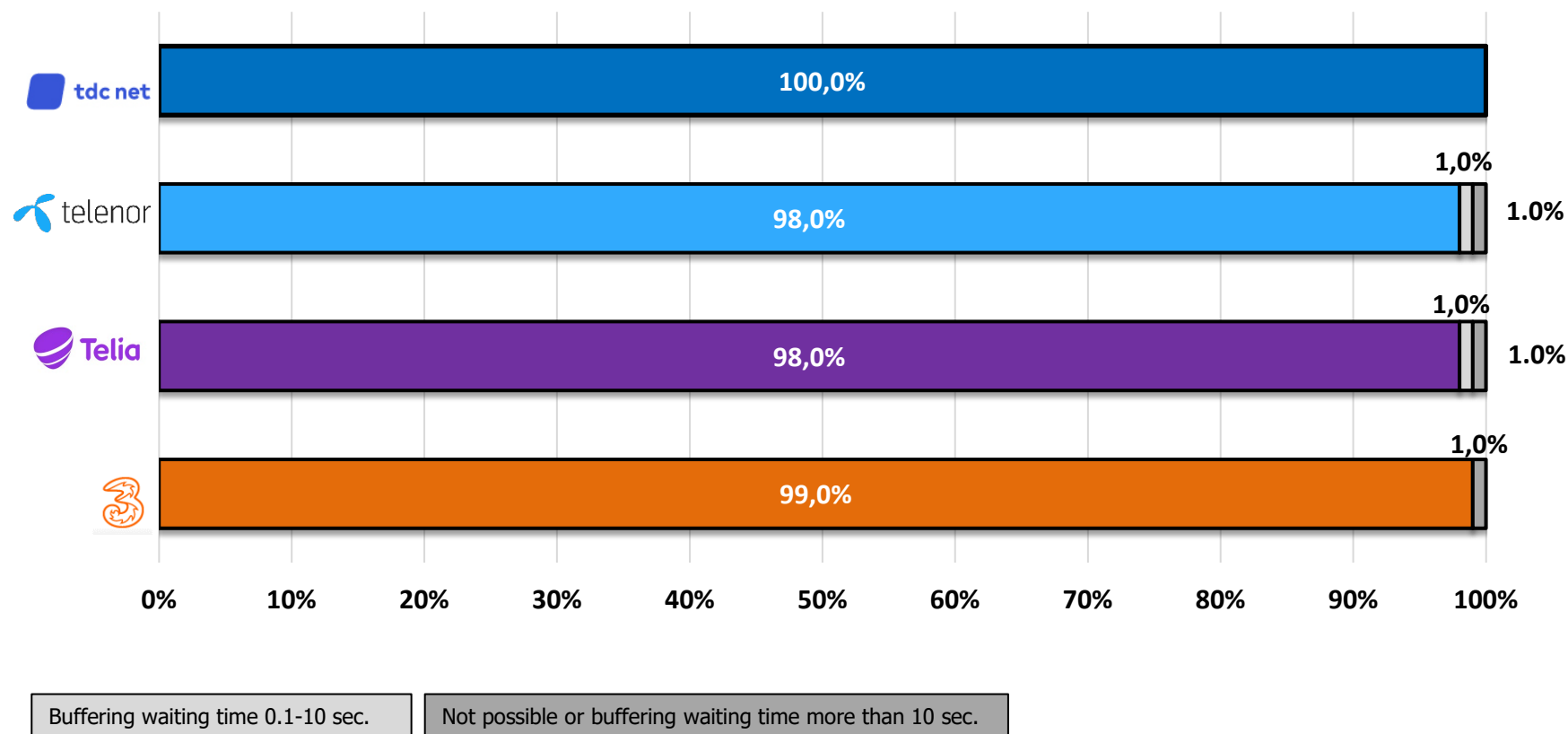


Regional results of video streaming in 2022 with a 5G phone

TDC NET has completely error-free video streaming in the North Jutland Region

Telenor, Telia , and 3 have almost error-free video streaming in the North Jutland Region

Streaming, North Jutland Region



*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 8 sec. - 10 MB upload within 15 sec. - 60 sec. DR TV without buffering waiting time.



A van from Danish Technological Institute at one of the randomly selected test locations – here at the fort called 'Kongelundsfortet' on Amager

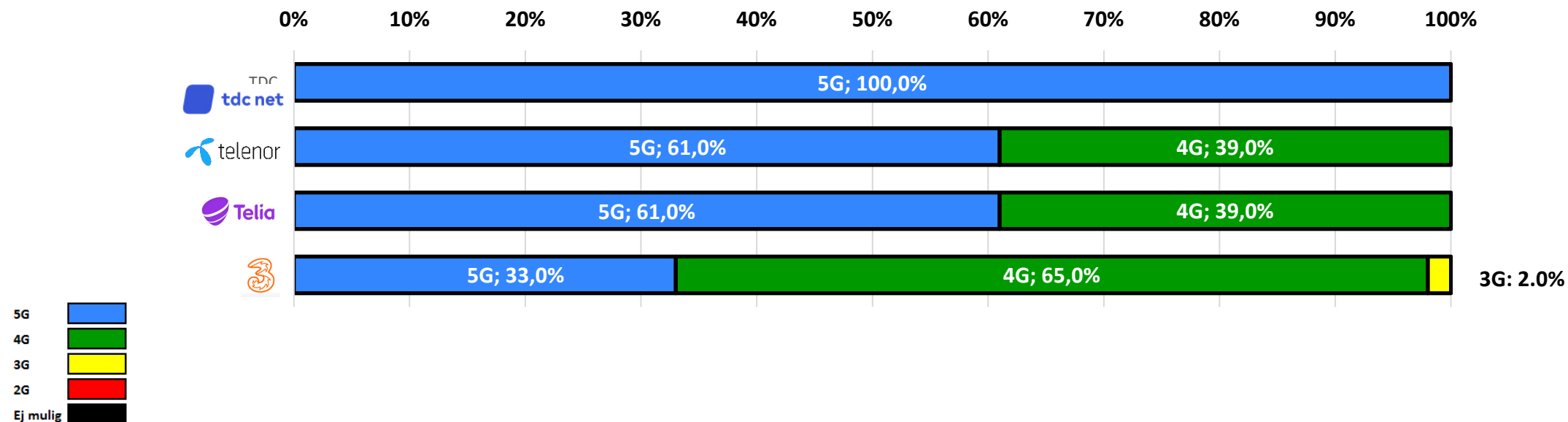


Regional results of of access to 5G and 4G in 2022 with a 5G phone

In the Capital Region of Denmark, TDC NET has 100% access to 5G

Telenor and Telia have 61% access to 5G

CAPITAL REGION OF DENMARK: ACCESS TO 5G, 4G, 3G, AND 2G

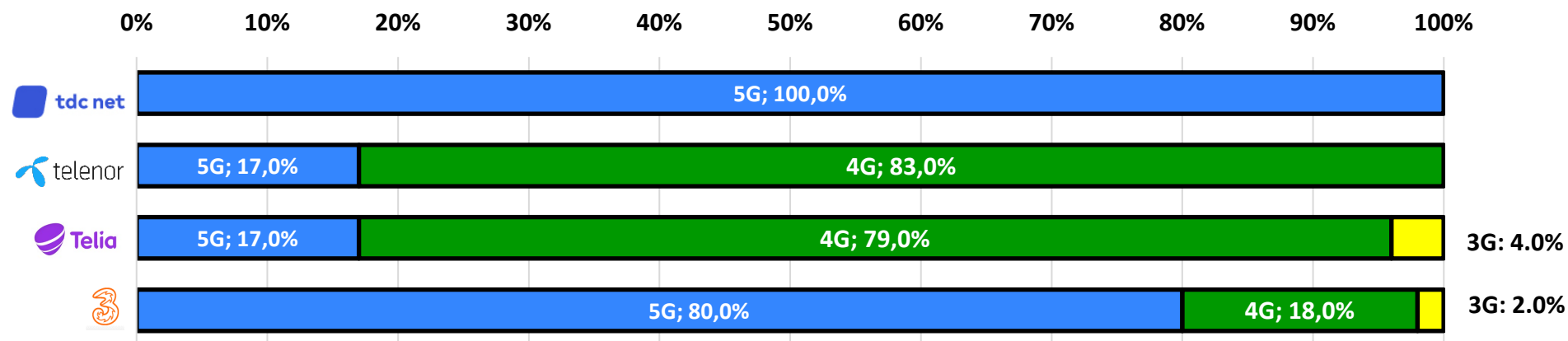




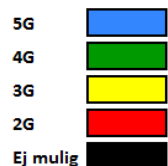
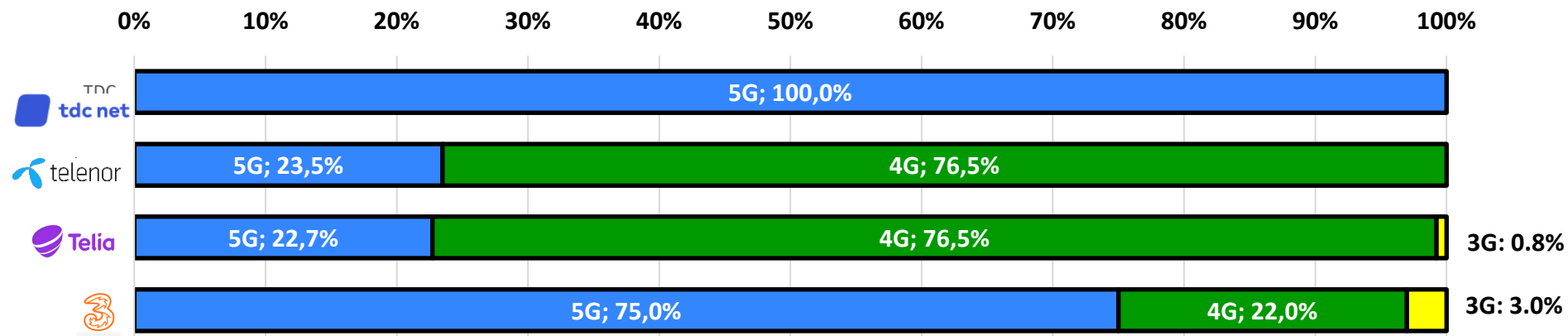
Regional results of access to 5G and 4G in 2022 with a 5G phone

In Region Zealand and the Region of Southern Denmark, TDC NET has 100% access to 5G
3 has 80% access to 5G and 75% access to 3G

REGION ZEALAND: ACCESS TO 5G, 4G, 3G, AND 2G



REGION OF SOUTHERN DENMARK: ACCESS TO 5G, 4G, 3G, AND 2G



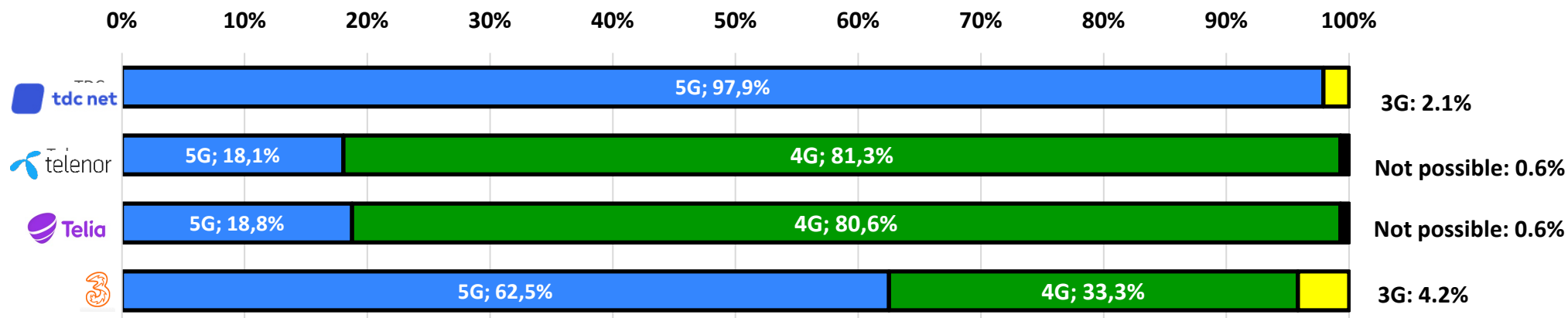


Regional results of access to 5G and 4G in 2022 with a 5G phone

In Central Region Denmark and North Jutland Region, TDC NET has 97.9% and 99% access to 5G

In Central Region Denmark, 3 has 62.5% access to 5G

CENTRAL REGION DENMARK: ACCESS TO 5G, 4G, 3G, AND 2G



NORTH JUTLAND REGION: ACCESS TO 5G, 4G, 3G, AND 2G

