

**Assessment of mobile  
network experience  
27 February – 24 March 2023  
in Denmark**



A van from Danish Technological Institute at one of the randomly selected test locations – here between Funen and Helnæs



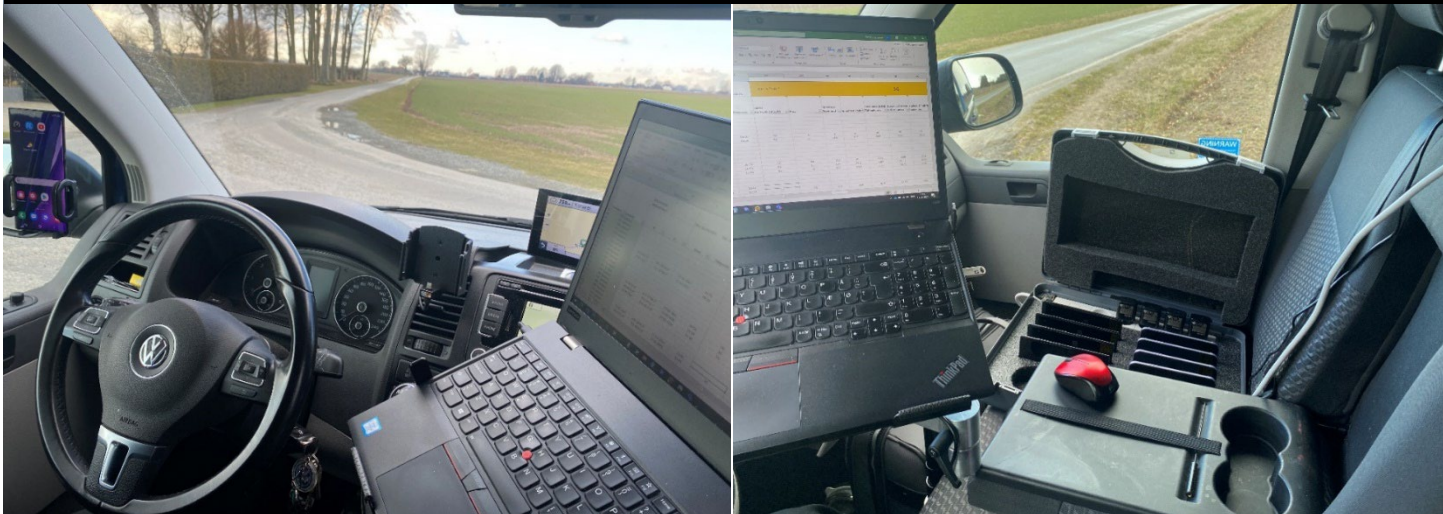
# Contents



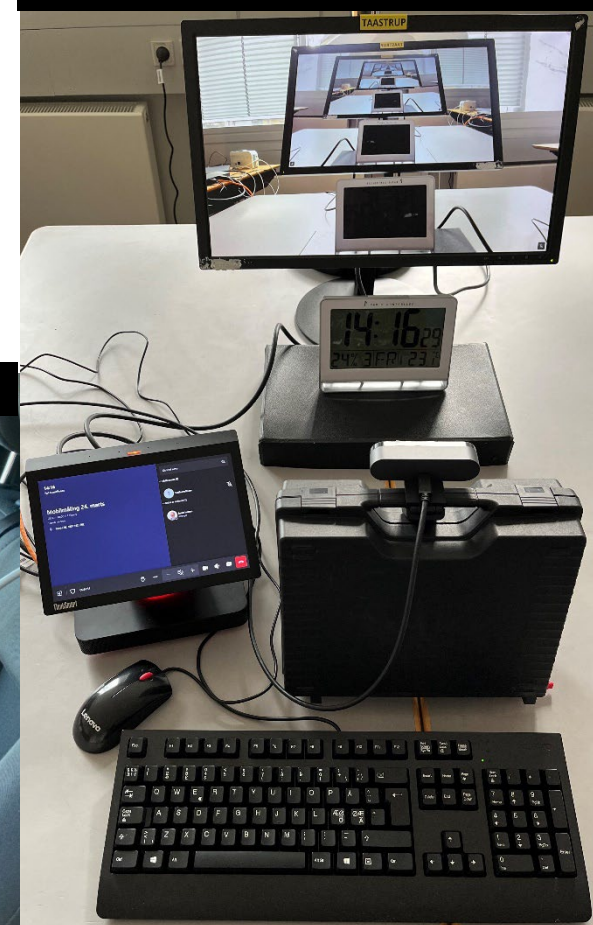
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Measurement in van



Teams set-up for additional measurements



# 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, 2021, and 2022. 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 13 - 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.
  - **30 MB\* download within 15 sec.** TDC NET considers 90 sec. or more as useless mobile coverage.
  - **30 MB\* upload within 30 sec.** TDC NET considers 90 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.

\*Download and upload times were increased from 10 MB in 2022 to 30 MB in 2023, as short download and upload times with 10 MB would give too large uncertainty of measurement during timekeeping in 2023. With 30 MB, the lowest measured download time was 0.66 sec., and the lowest measured upload time was 1.98 sec.

# Extent and test method

- The 691 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 2022 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 13 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.

## Additional supplementary Teams measurement

In 2023, an additional supplementary measurement was carried out of error-free connectivity to a Teams video meeting. The connection time was max. 30 seconds. The initial 30 seconds of the Teams meeting were tested. In order to put the four network providers on an equal footing, the connection was made during the same meeting.



The 691  
selected test  
locations



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# 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 88% error-free mobile network experience\*. Nationally, Telia has a 64% error-free mobile network experience\*. Telenor and 3 have 58%.
- Nationally and regionally, TDC NET has faster and more error-free download and upload than Telenor, Telia, and 3.
- 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. 3 has 99.6%, Telenor has 98.8%, and Telia has 98.5% 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% access. The other network providers are in a transitional phase. 3 has 91.6%, and Telenor and Telia have 57% access to 5G.
- ADDITIONAL MEASUREMENT: Nationally, TDC NET has more error-free connectivity to Teams meetings.

# 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.**
- The mobile data traffic continues to increase considerably, but not as quickly as in previous years. That is demonstrated by figures from the Danish Agency for Data Structure and Infrastructure: from the first 6 months in 2021 to the first 6 months of 2022, the mobile data traffic (up- and downloads) increased by 18.9%, whereas the mobile data traffic increased 32.7% from the first 6 months of 2020 to the first six months of 2021.
- 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 busy with 5G and other upgrades. As the busy period with upgrades will continue for many months, the test period is regarded as representative.



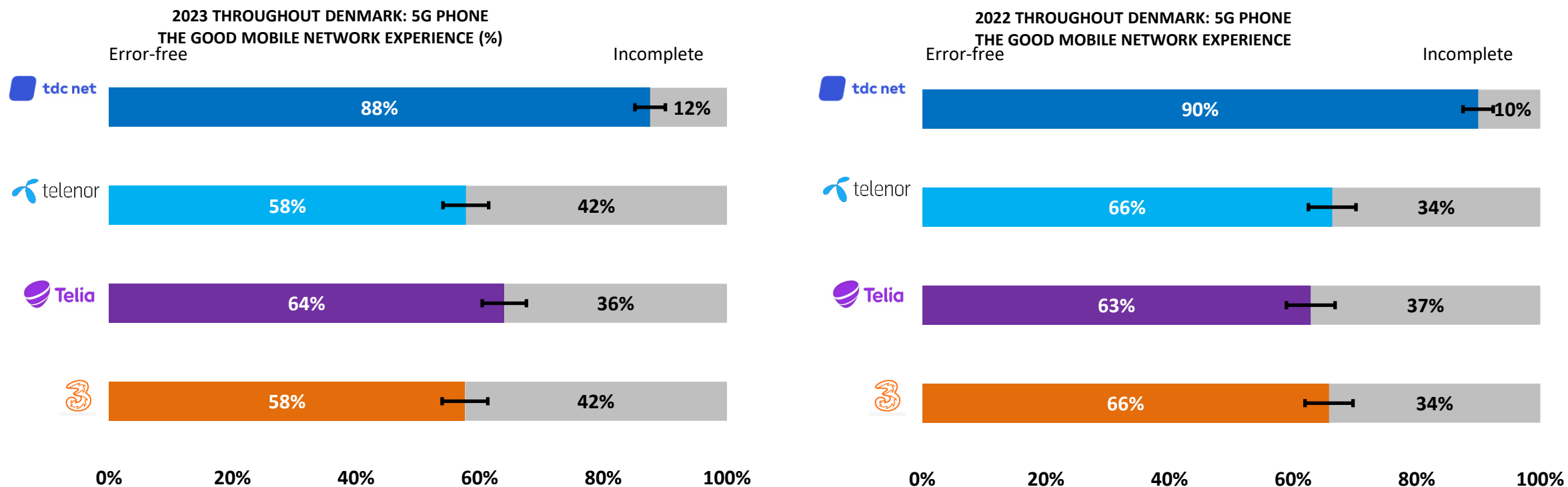


A van from Danish Technological Institute at one of the randomly selected test locations – here a drone photo with Frederikshavn in the background

# National result of mobile network experience in 2023 with a 5 G phone

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

Please note that the criteria for a good mobile network experience\* improved in 2023



\*TDC NET defined a good mobile network experience as:

**2023:** 30 sec. error-free mobile phone conversation - 30 MB download within 15 sec. - 30 MB upload within 30 sec. - 60 sec. DR TV without buffering waiting time.

**2022:** 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 Helgenæs, Syddjurs Municipality, with the Bay of Aarhus in the background



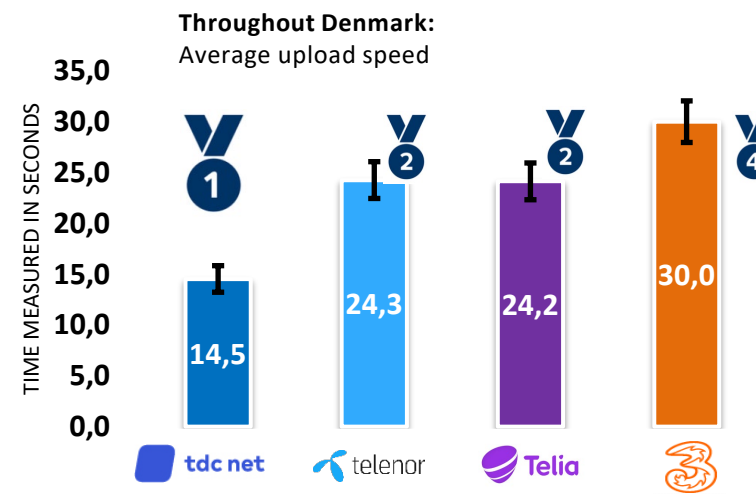
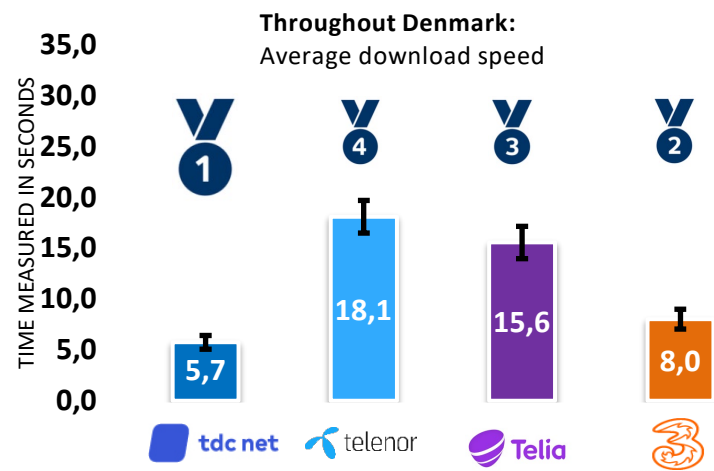
# National result of download and upload speeds in 2023 with a 5G phone



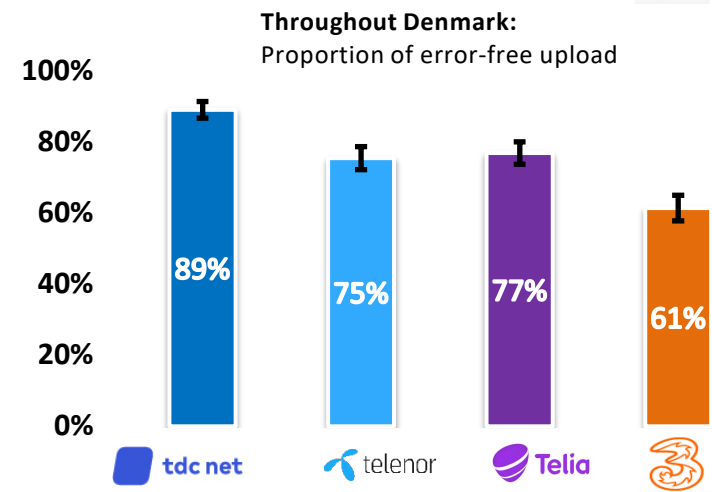
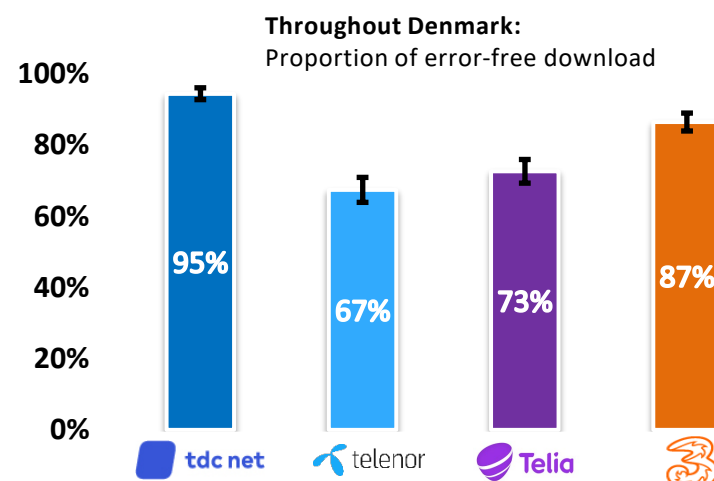
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TDC NET has a much faster and more error-free downloads and uploads than Telenor, Telia, and 3

When comparing with 2022 it should be noted that the data amount is 30 MB, i.e., 3 times larger in 2023



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

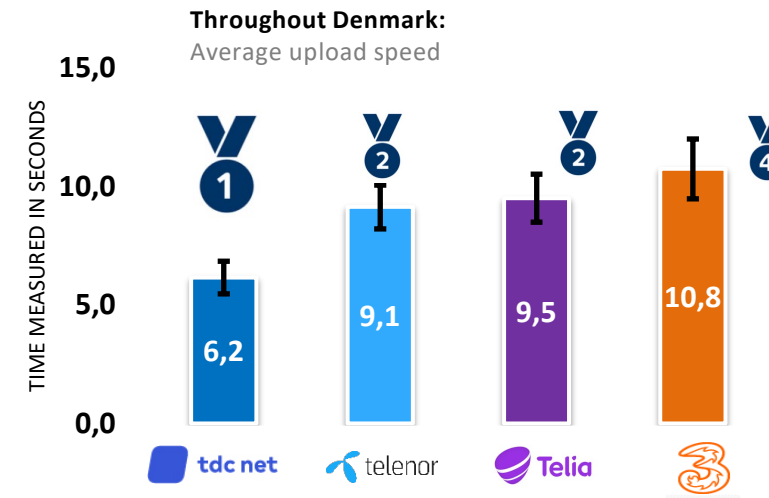
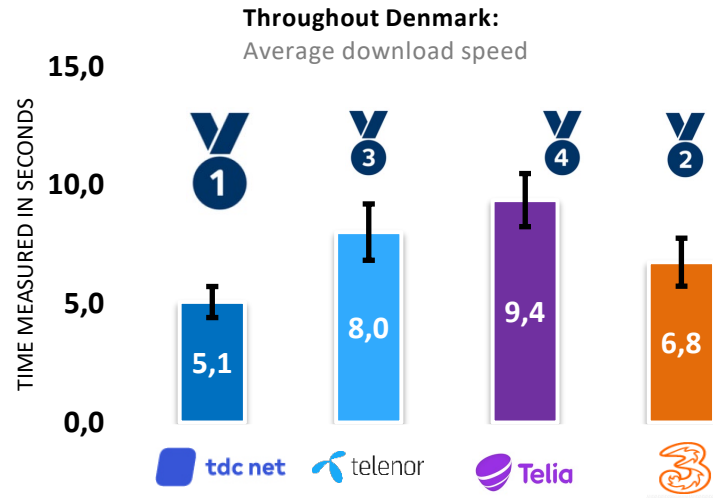


\*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 30 MB download within 15 sec. - 30 MB upload within 30 sec. - 60 sec. DR TV without buffering waiting time. Vertical black lines indicate a 95% statistical confidence interval.

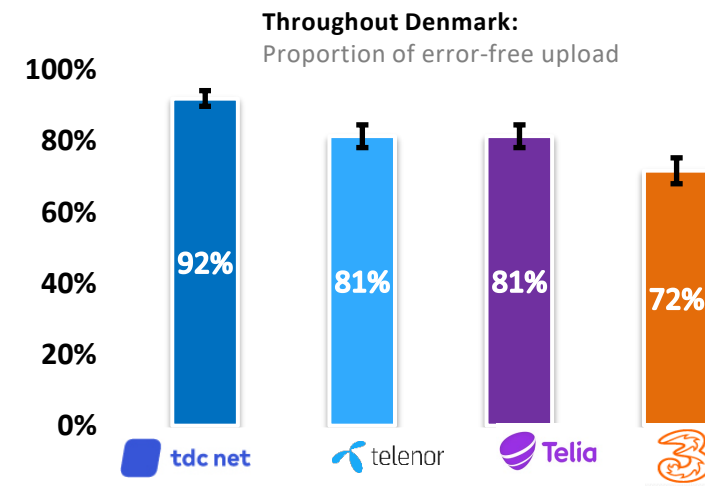
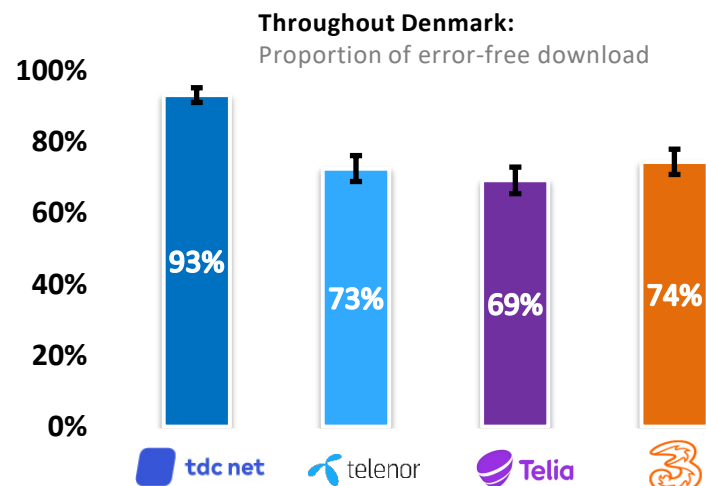
# National result of download and upload speeds in 2022 with a 5G phone

TDC NET has a 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.

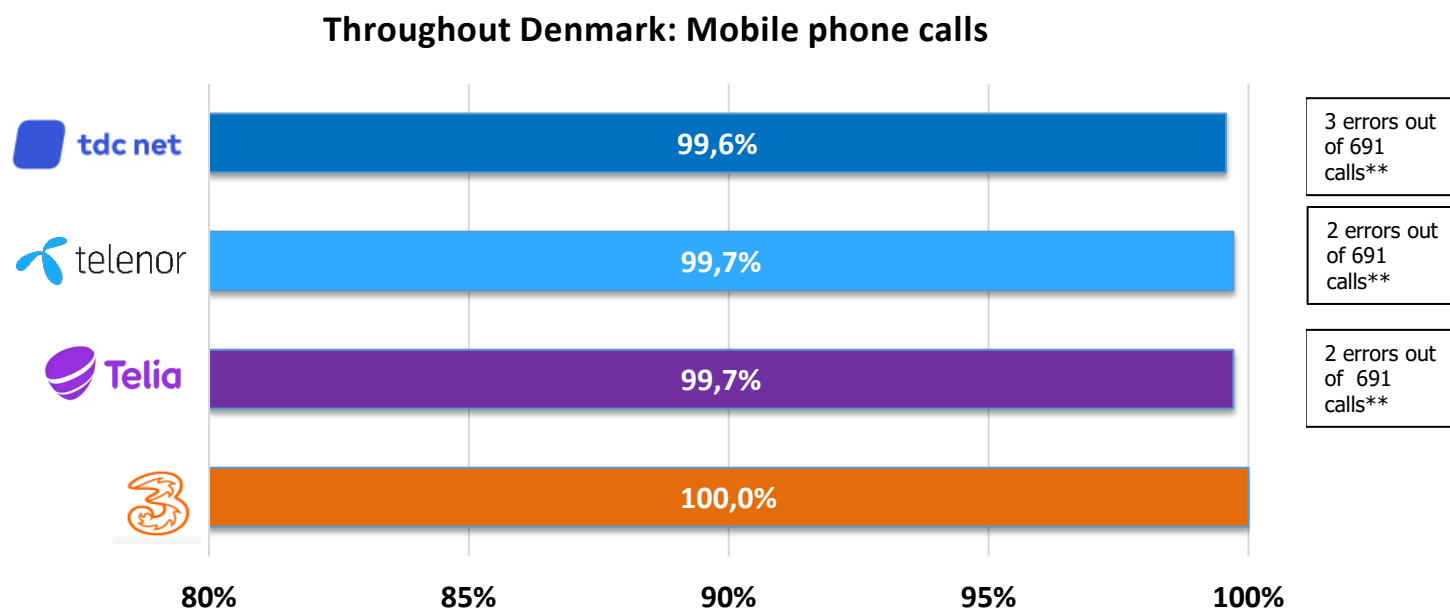


A van from Danish Technological Institute at one of the randomly selected test locations - here at Lalandia near Rødby



# National result of ordinary mobile phone conversations in 2023 with a 5G phone

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

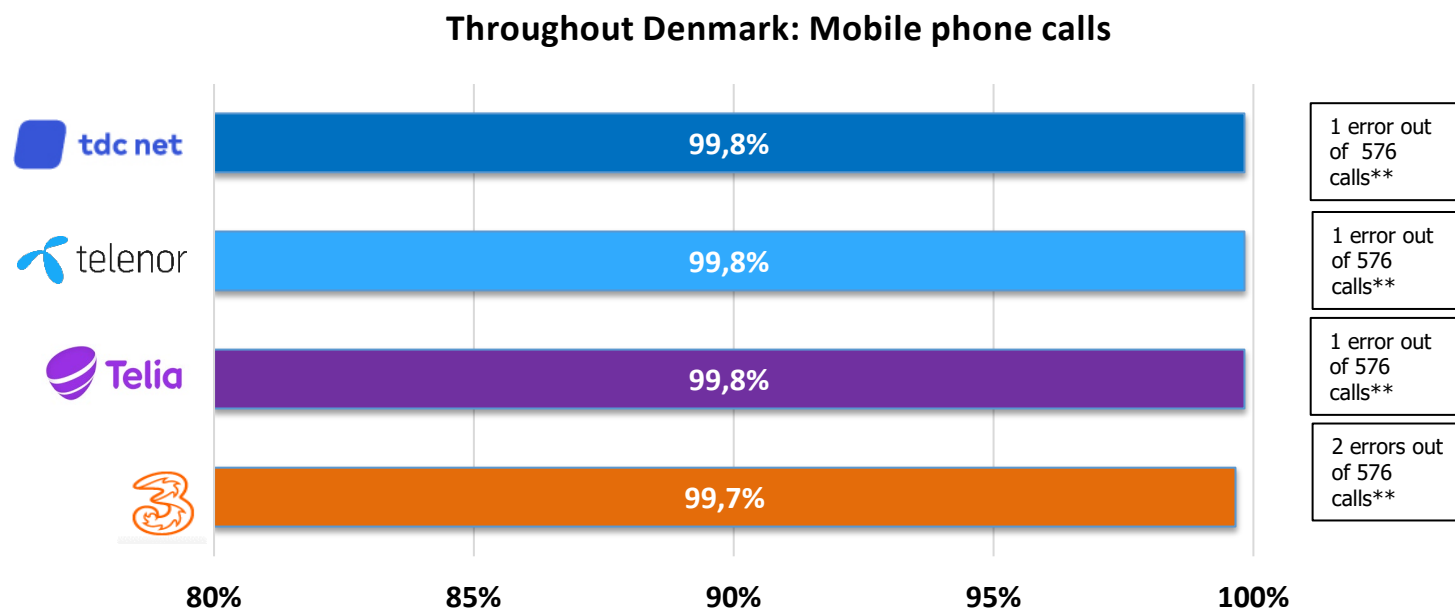


\*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 30 MB download within 15 sec. - 30 MB upload within 30 sec. - 60 sec. DR TV without buffering waiting time.

\*\* 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 2022 with a 5G phone

Ordinary mobile phone conversations\* showed 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 at Koldinghus

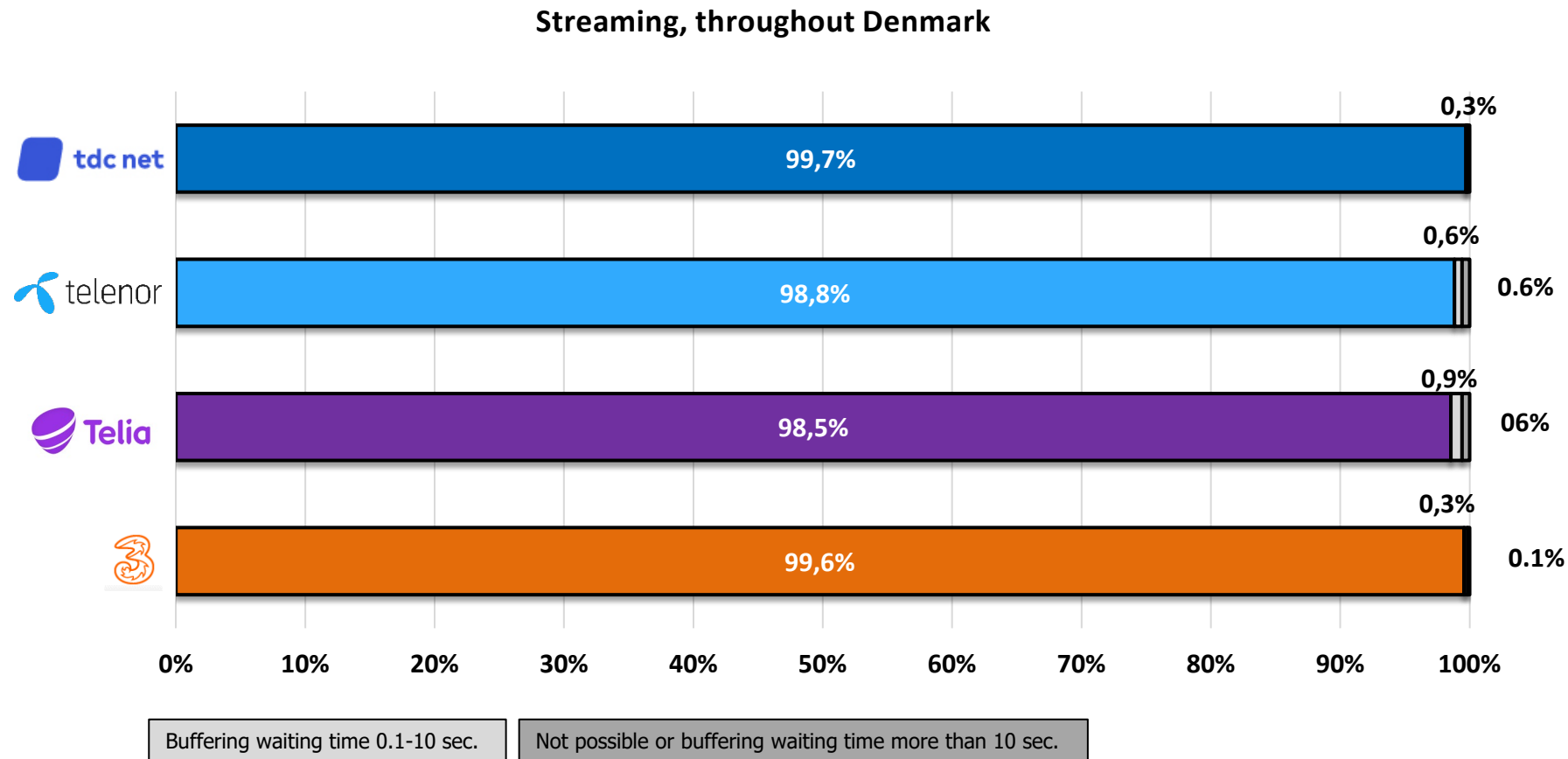


# National result of video streaming in 2023 with a 5G phone



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



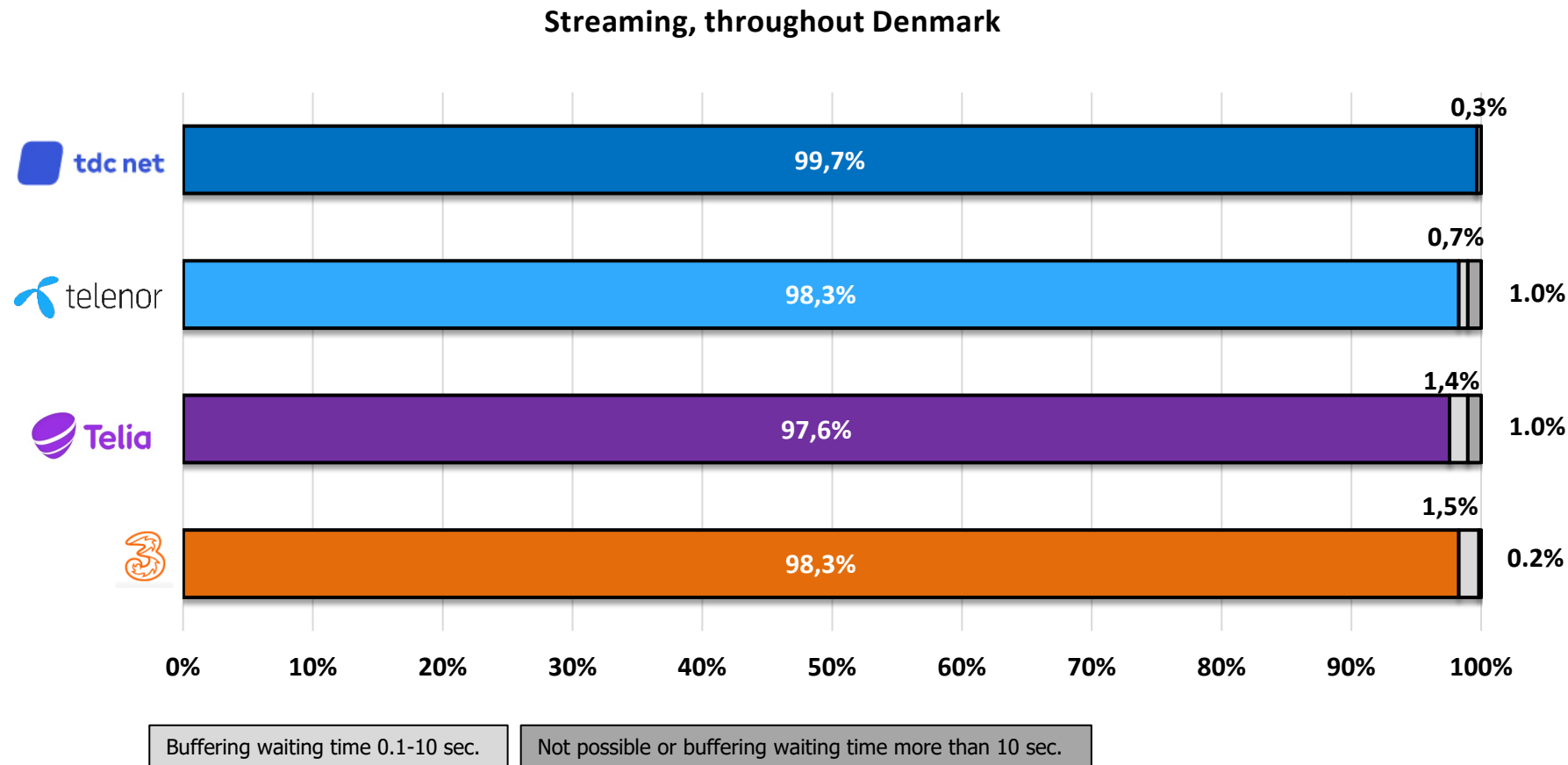
\*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 30 MB download within 15 sec. - 30 MB upload within 30 sec. - 60 sec. DR TV without buffering waiting time.

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



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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.

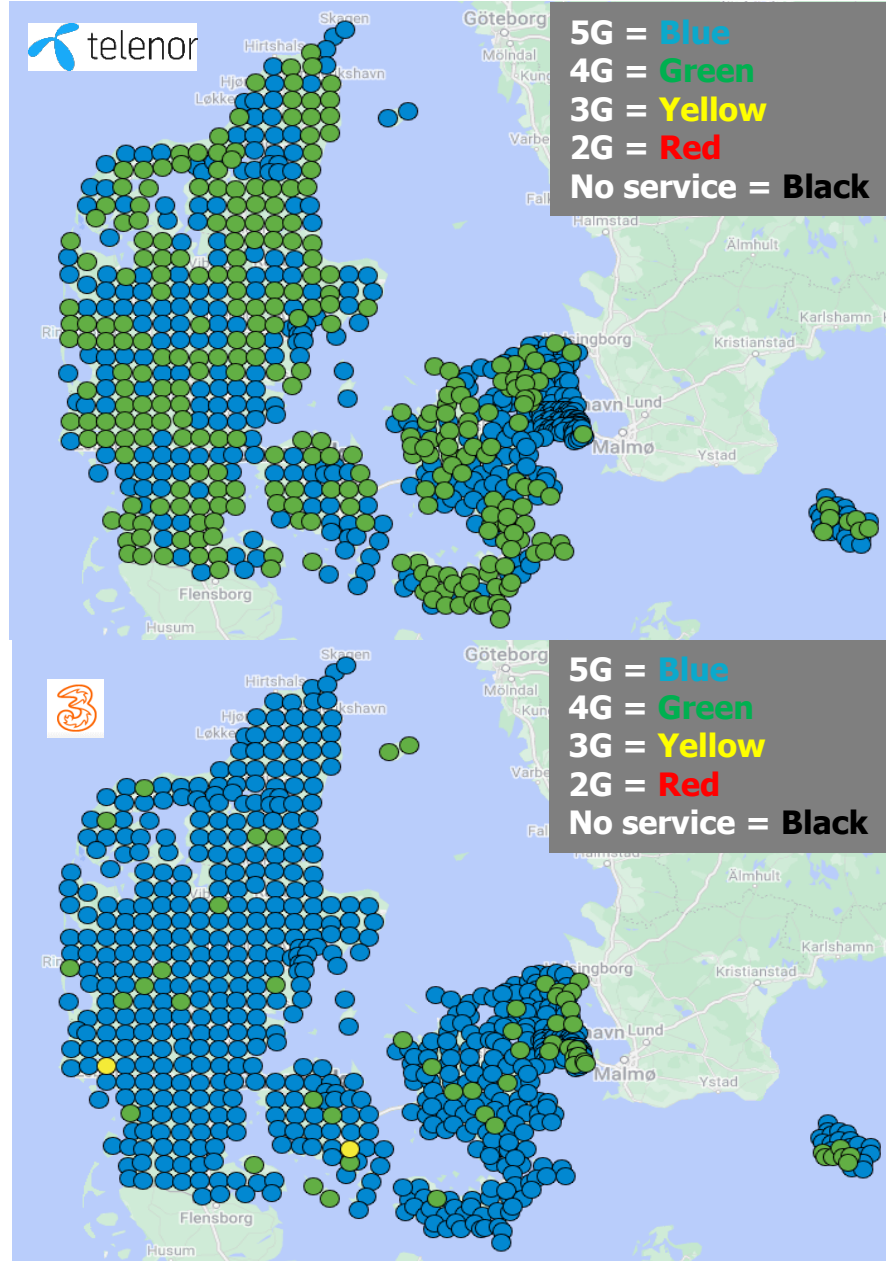
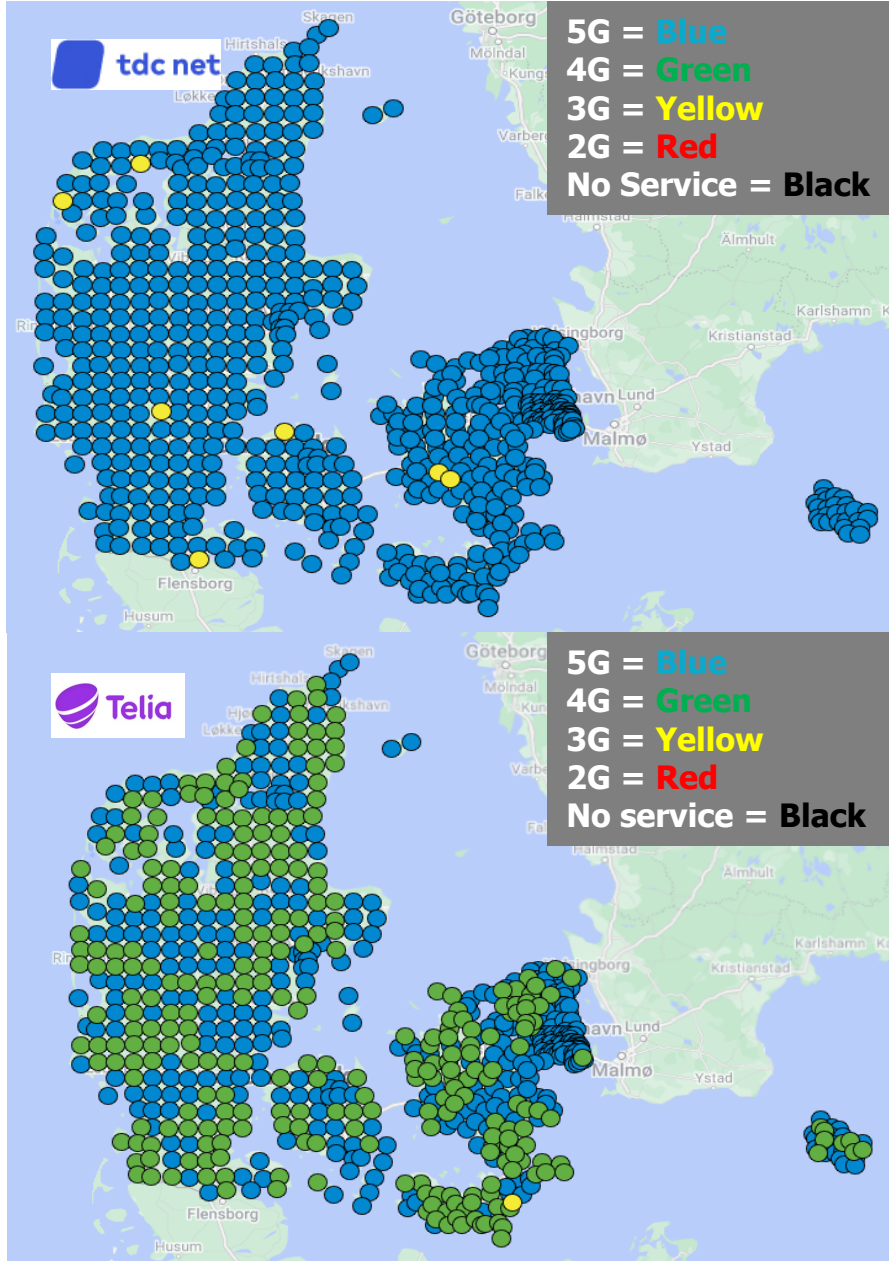




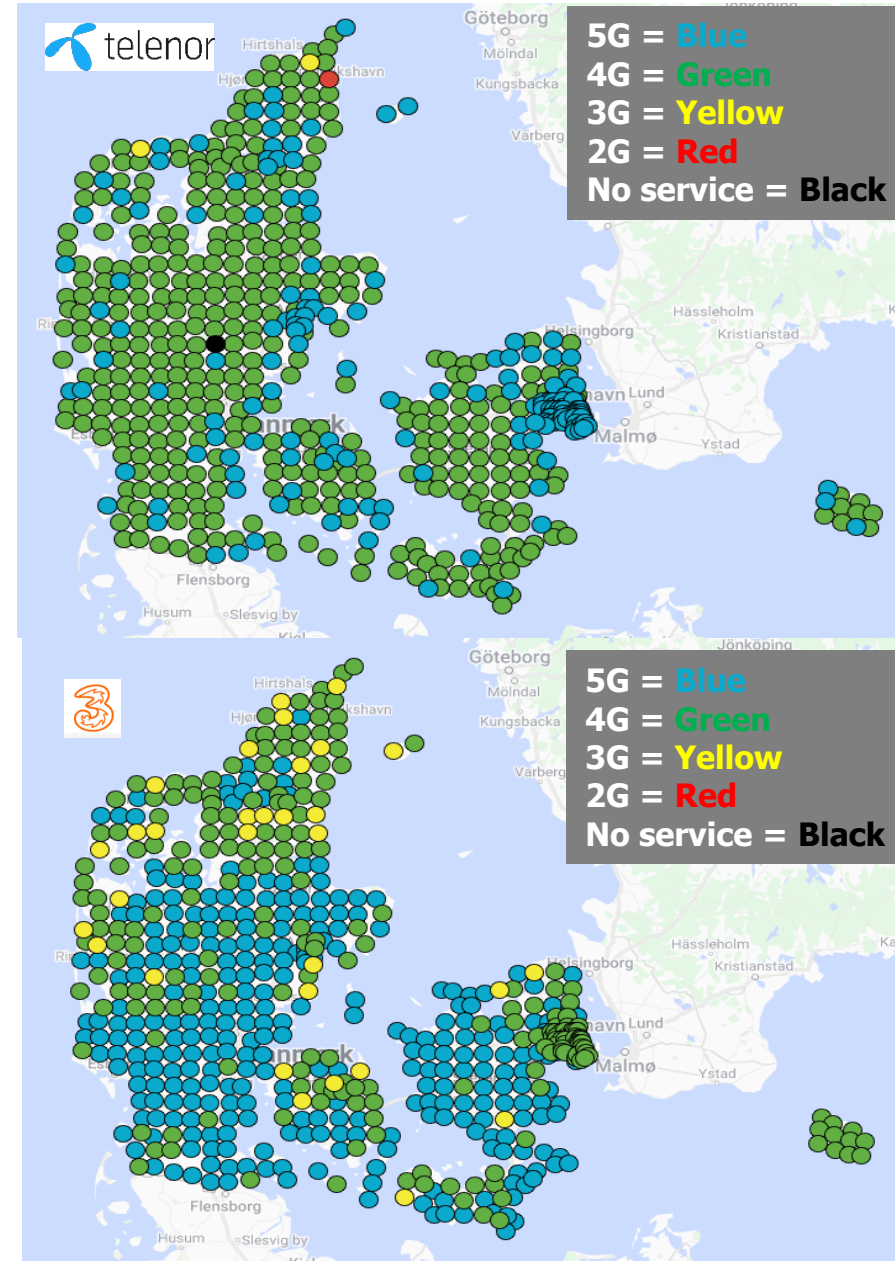
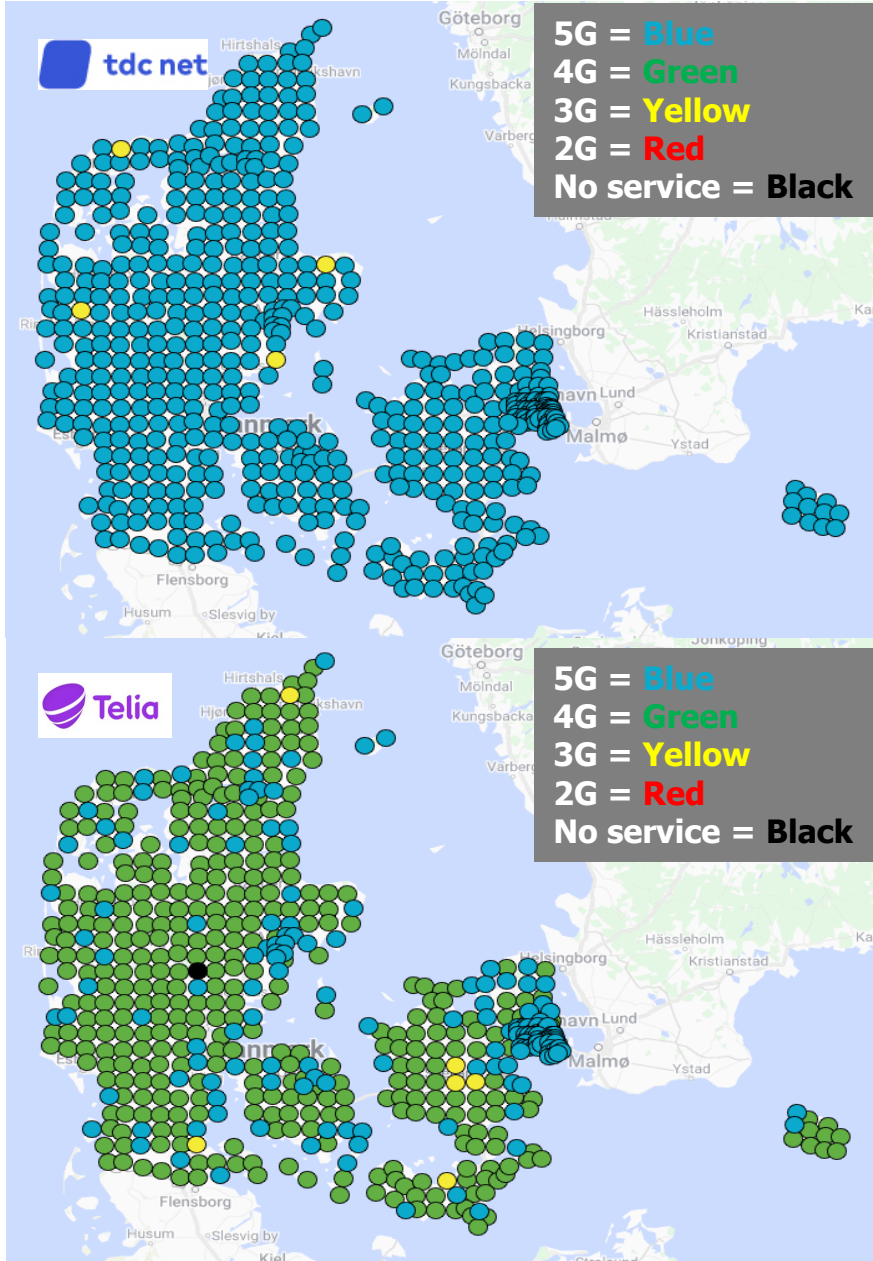
A van from Danish Technological Institute at one of the randomly selected test locations – here at the driveway to Lerchenborg near Kalundborg



# 2023: Access to 5G, 4G, 3G, and 2G with a 5G phone



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

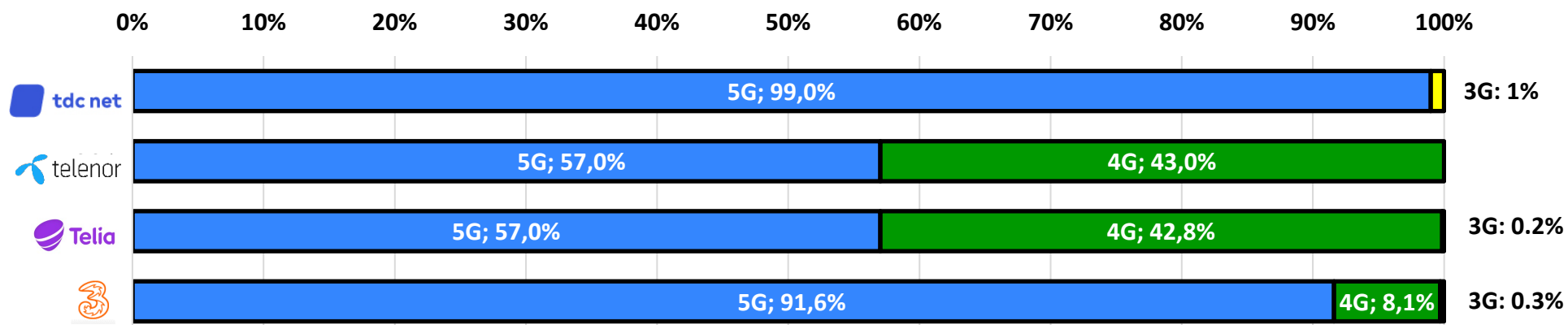




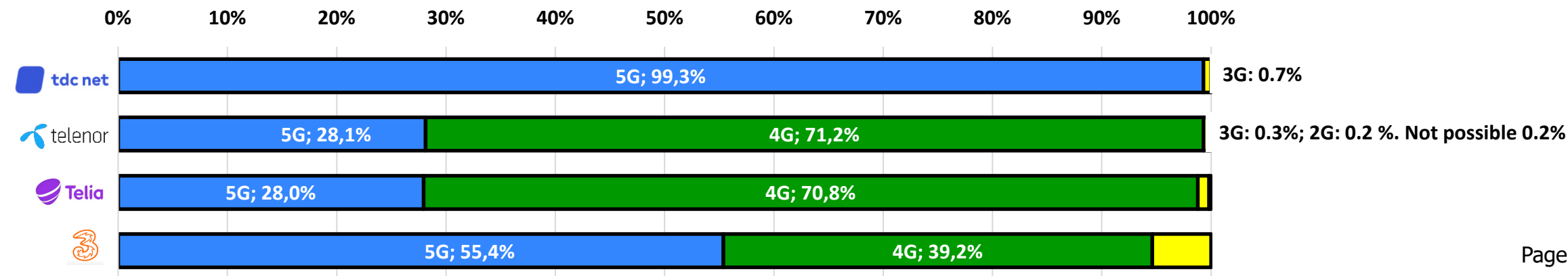
# National result of access to 5G and 4G in 2023 and 2022 with a 5G phone

TDC NET has 99% access to 5G; 3 has 91.6% access to 5G. Telenor and Telia have 57% access to 5G

2023 THROUGHOUT DENMARK: ACCESS TO 5G, 4G, AND 3G



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







A van from Danish Technological Institute at one of the randomly selected test locations – here at Alrø near Horsens Fjord

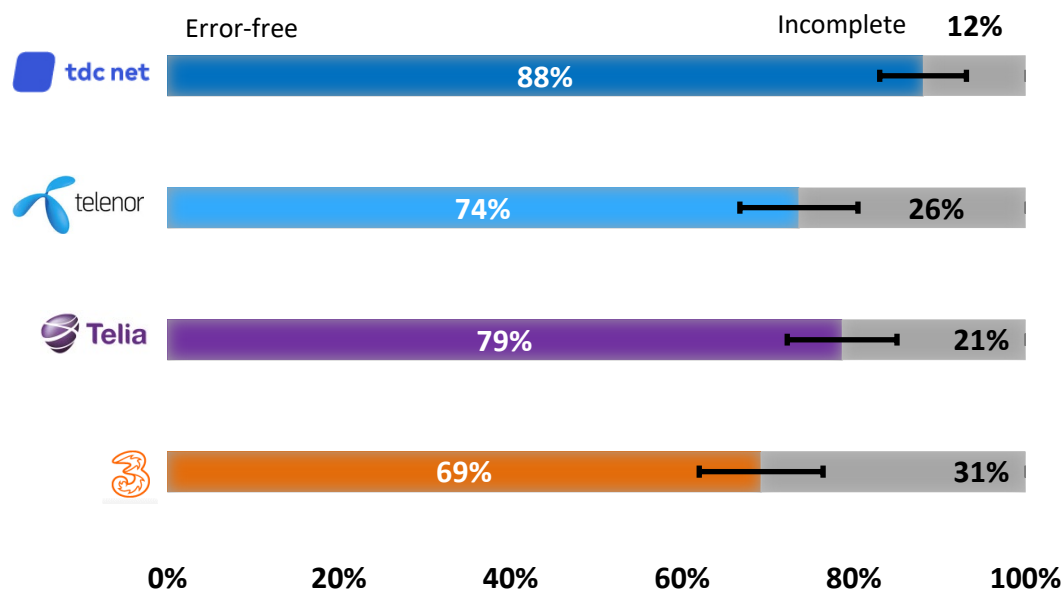


# Regional results of mobile network experience in 2023 with a 5G phone

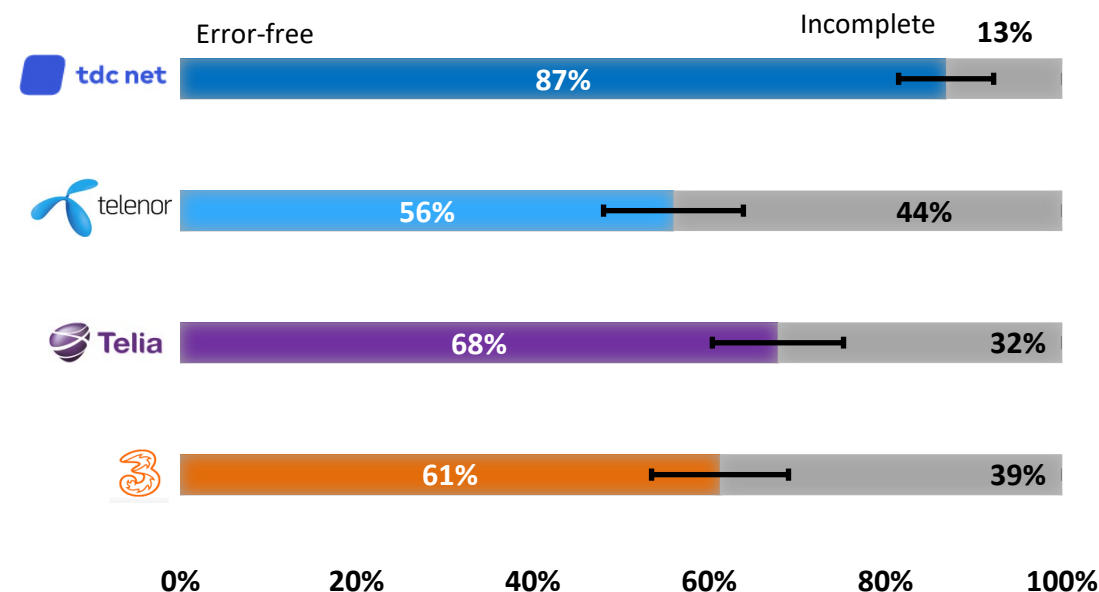
TDC NET has a better total mobile network experience\* in the Capital Region of Denmark and a much better total mobile network experience \* than Telenor, Telia, and 3 in Region Zealand

Telenor and Telia come in second in the Capital Region of Denmark. Telia and 3 come in second in Region Zealand

**CAPITAL 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 - 30 MB download within 15 sec. - 30 MB upload within 30 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 2023 with a 5G phone

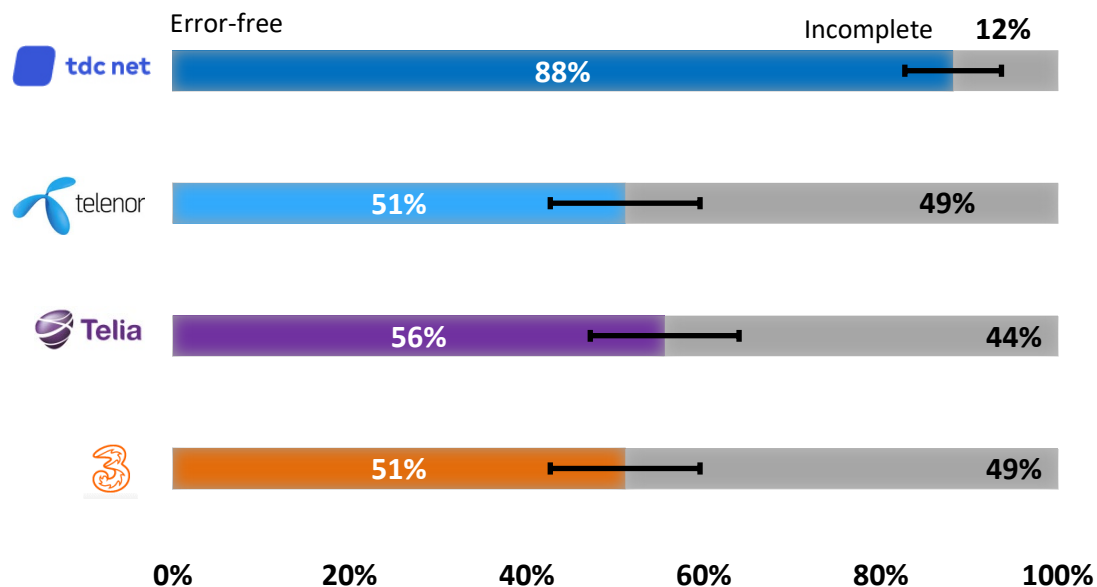


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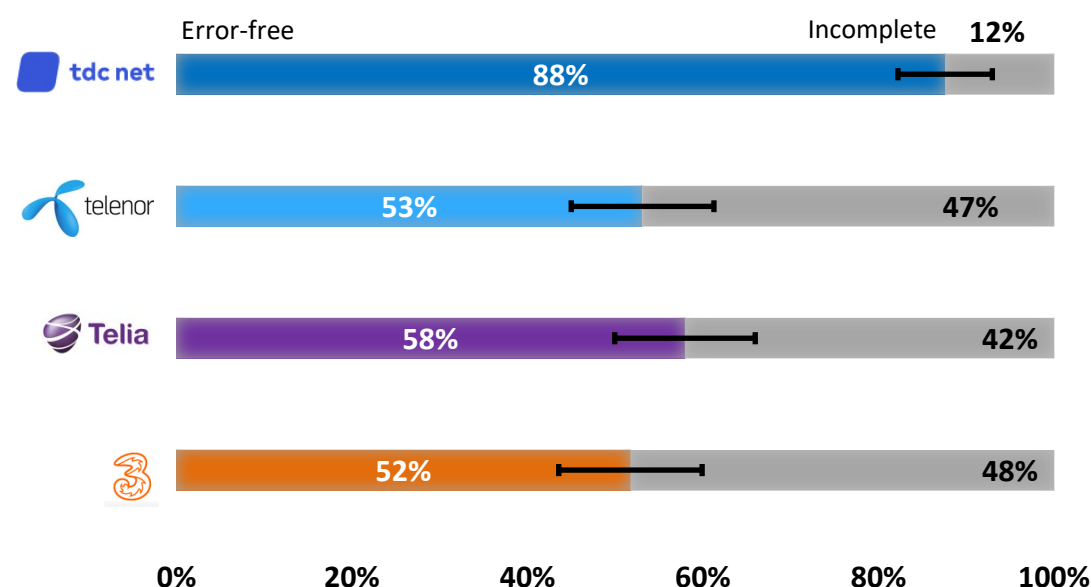
TDC NET has a much better total mobile network experience\* than Telenor, Telia, and 3 in the Region of Southern Denmark and Central Denmark Region

Telenor, Telia, and 3 come in second

REGION OF SOUTHERN DENMARK: %  
THE GOOD MOBILE NETWORK EXPERIENCE



CENTRAL DENMARK REGION: %  
THE GOOD MOBILE NETWORK EXPERIENCE



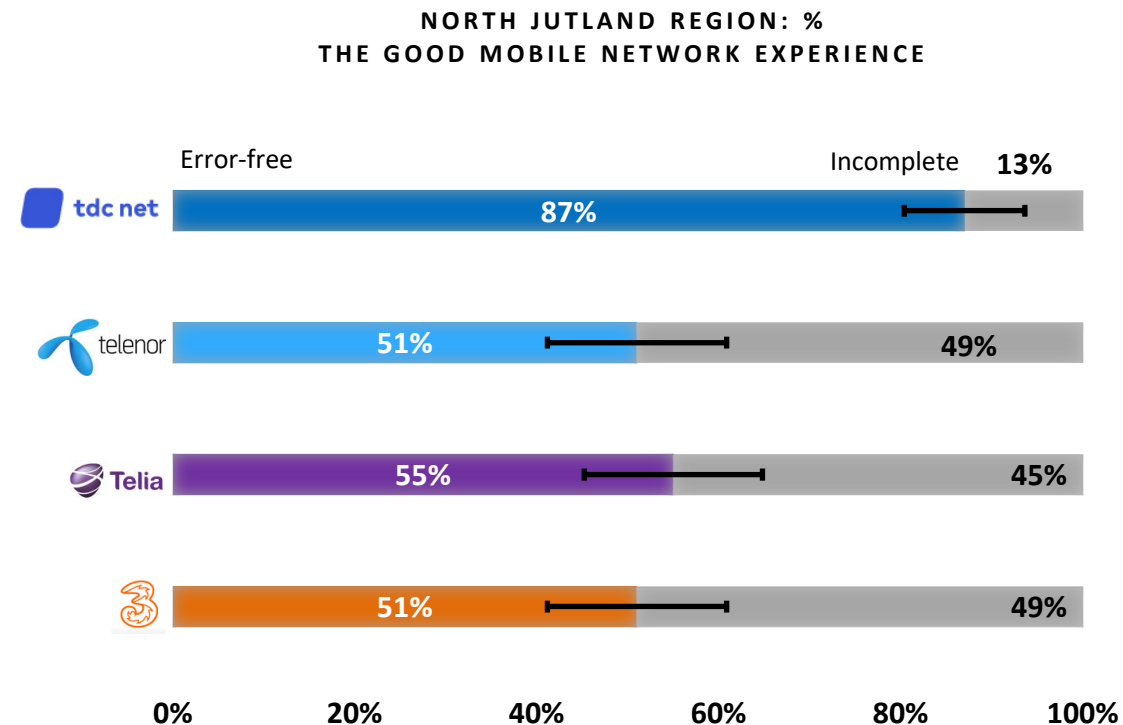
\*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 30 MB download within 15 sec. - 30 MB upload within 30 sec. - 60 sec. DR TV without buffering waiting time. Horizontal black lines indicate a 95% statistical confidence interval.





# Regional results of mobile network experience in 2023 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, Telia, and 3 come in second



**\*TDC NET defined a good mobile network experience as:** 30 sec. error-free mobile phone conversation - 30 MB download within 15 sec. - 30 MB upload within 30 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 Nørre Asminderød Church south of Nykøbing Sjælland



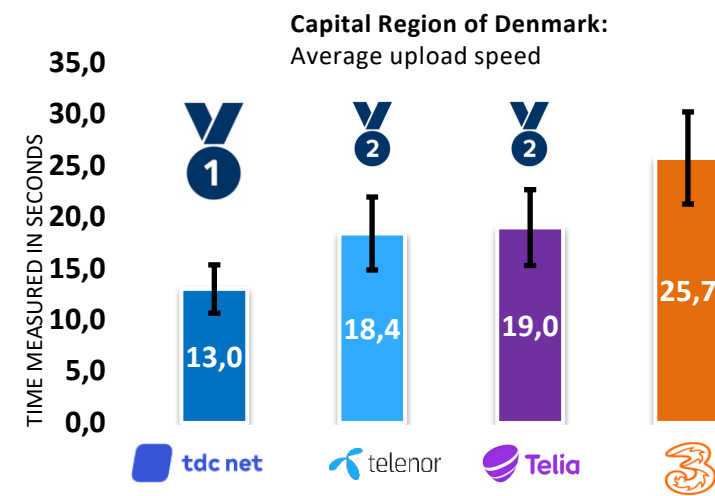
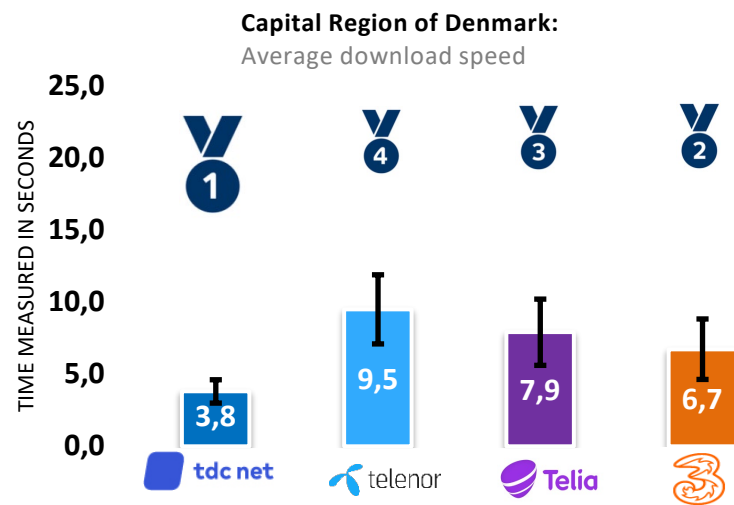
# Regional results of download and upload speeds in 2023

## with a 5G phone

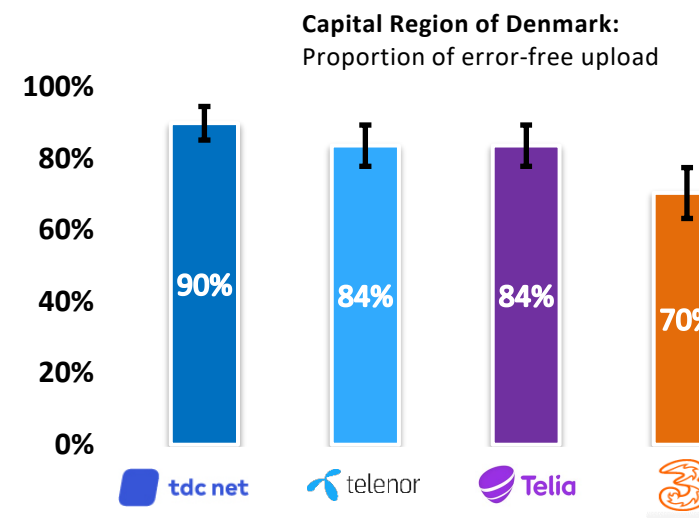
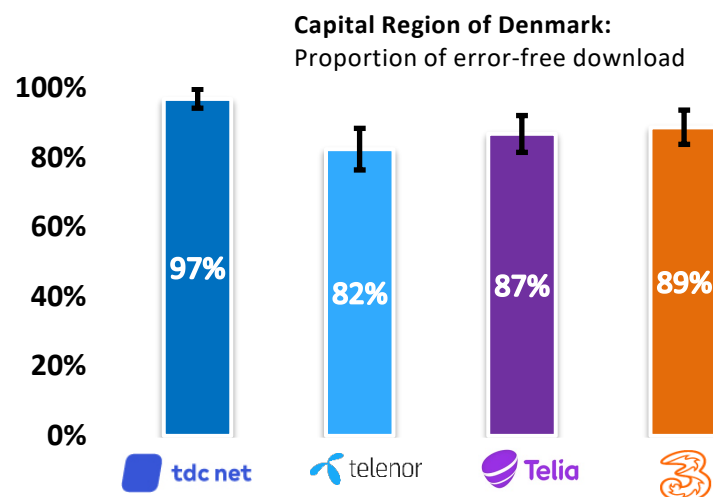


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TDC NET has a much faster download and upload speeds than Telenor, Telia, and 3 in the Capital Region of Denmark. TDC NET has far more error-free downloads and more error-free uploads than Telenor, Telia, and 3.



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 - 30 MB download within 15 sec. - 30 MB upload within 30 sec. - 60 sec. DR TV without buffering waiting time. Vertical black lines indicate a 95% statistical confidence interval.

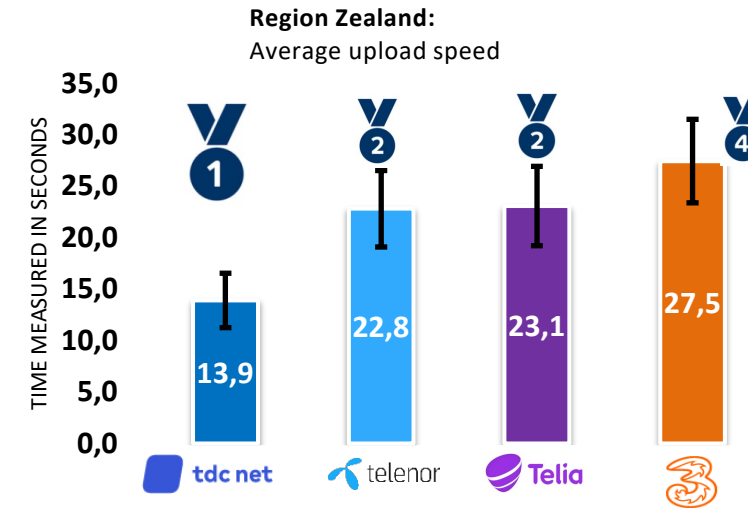
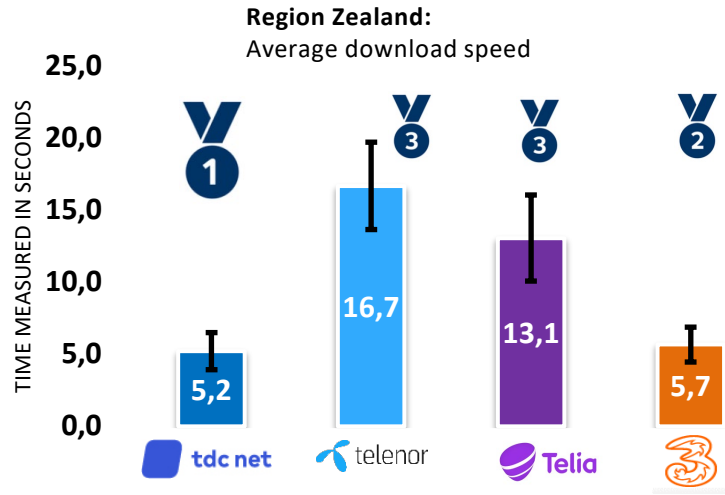


# Regional results of download and upload speeds in 2023 with a 5G phone

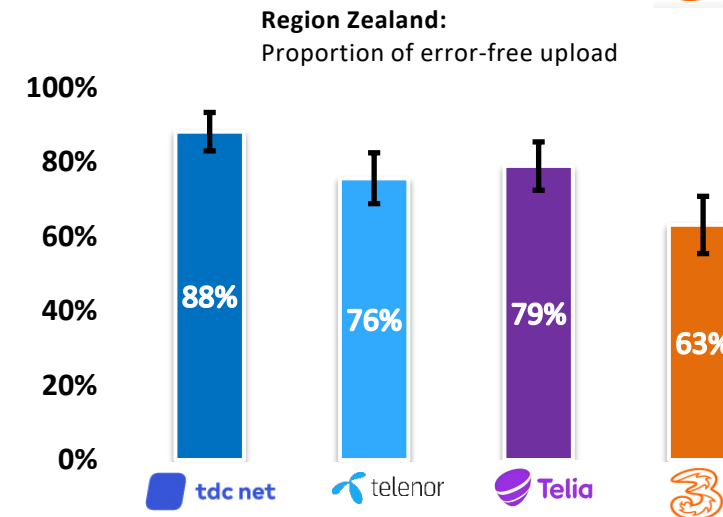
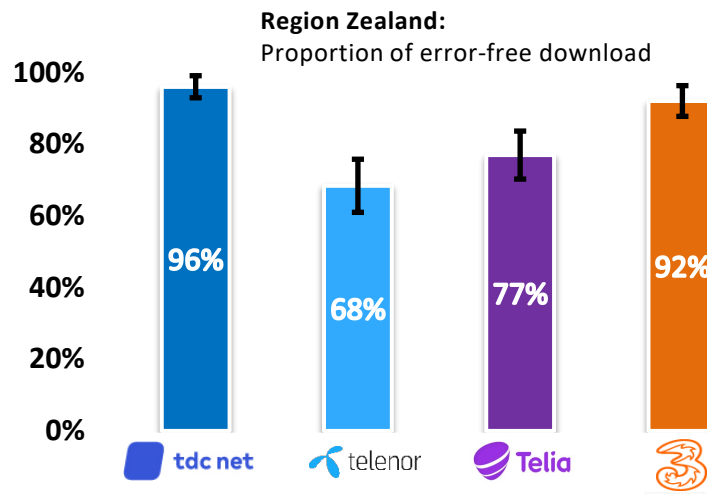


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TDC NET has somewhat faster download speeds and much faster upload speeds and far more error-free uploads\* than Telenor, Telia, and 3 in Region Zealand



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



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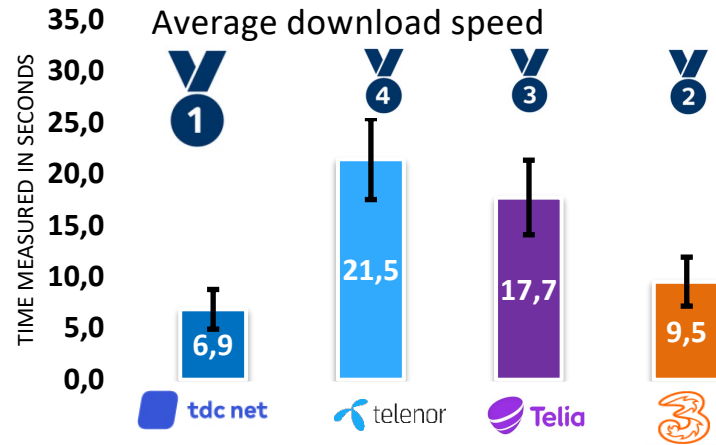
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# Regional results of download and upload speeds in 2023

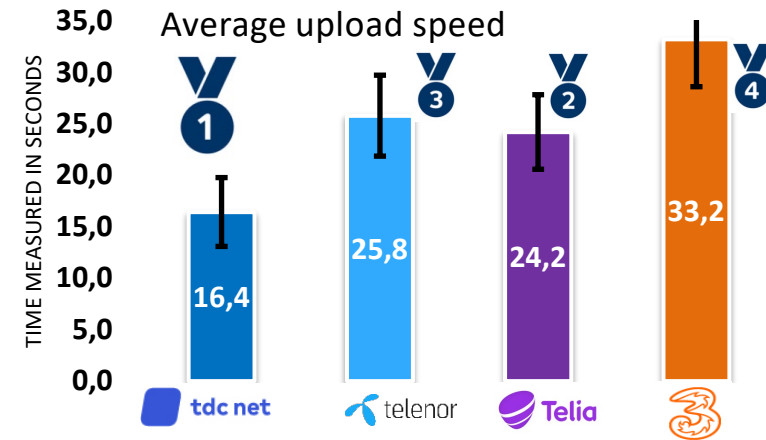
## with a 5G phone

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

Region of Southern Denmark:  
Average download speed

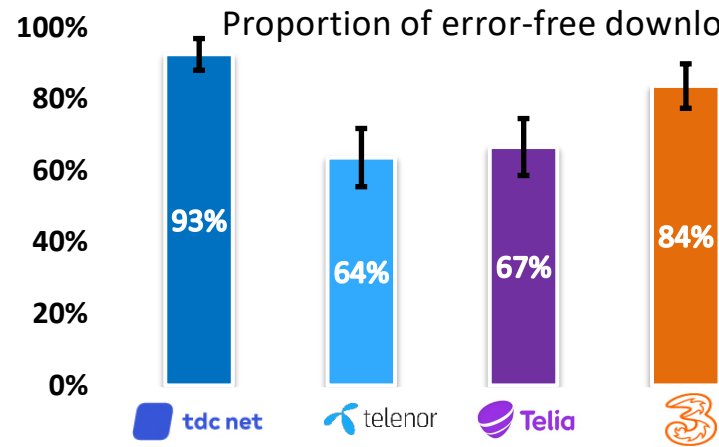


Region of Southern Denmark:  
Average upload speed

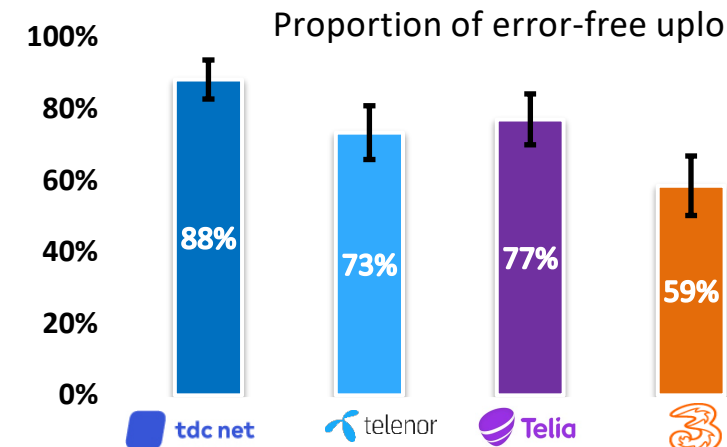


Medals for total assessment of average speed and error-free application

Region of Southern Denmark:  
Proportion of error-free download



Region of Southern Denmark:  
Proportion of error-free upload



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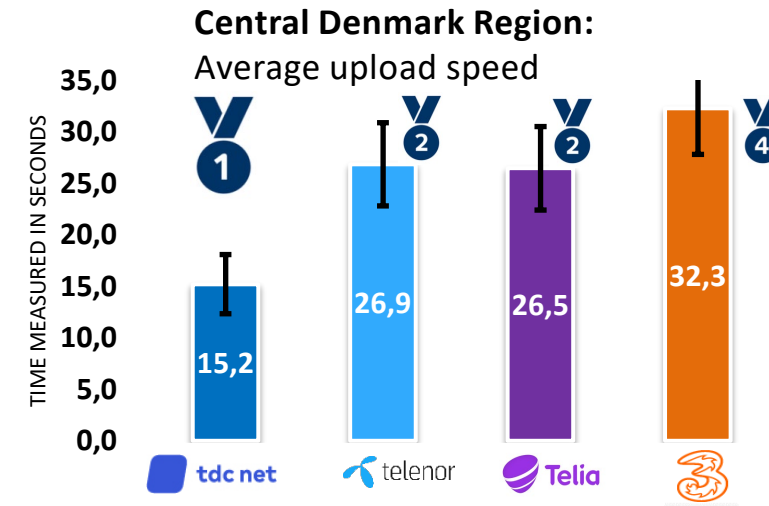
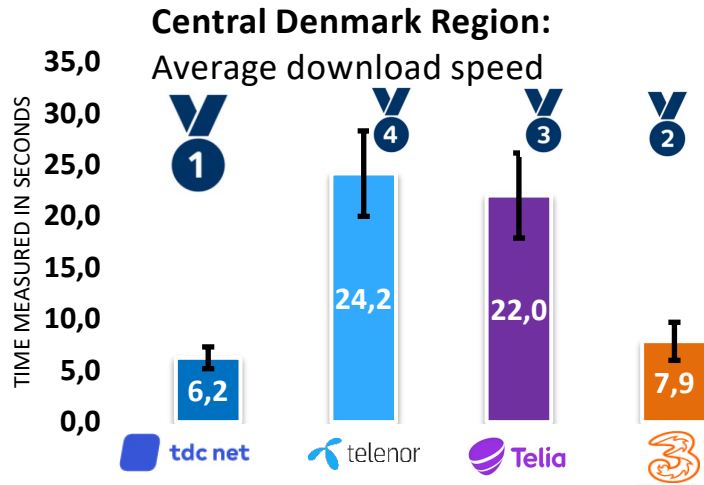
# Regional results of download and upload speeds in 2023

## with a 5G phone

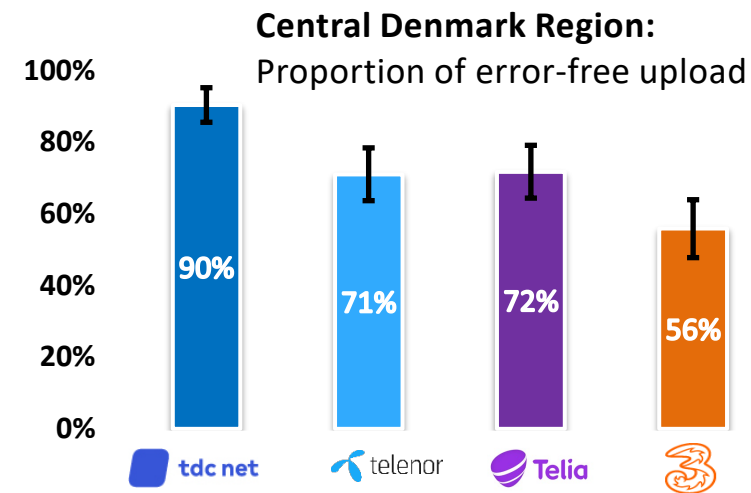
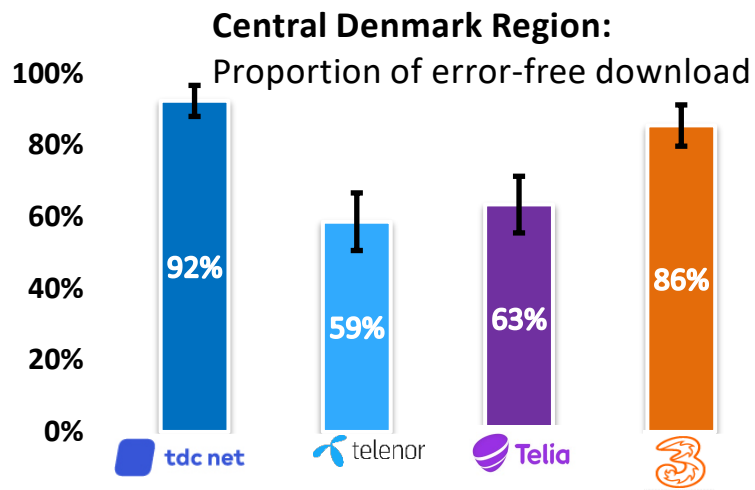


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TDC NET has faster downloads, much faster uploads and far more error-free\* downloads and uploads than Telenor, Telia, and 3 in Central Denmark Region



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



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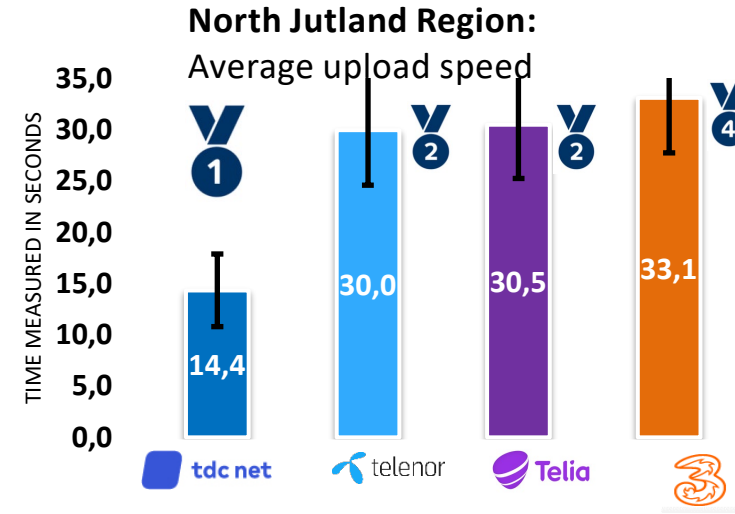
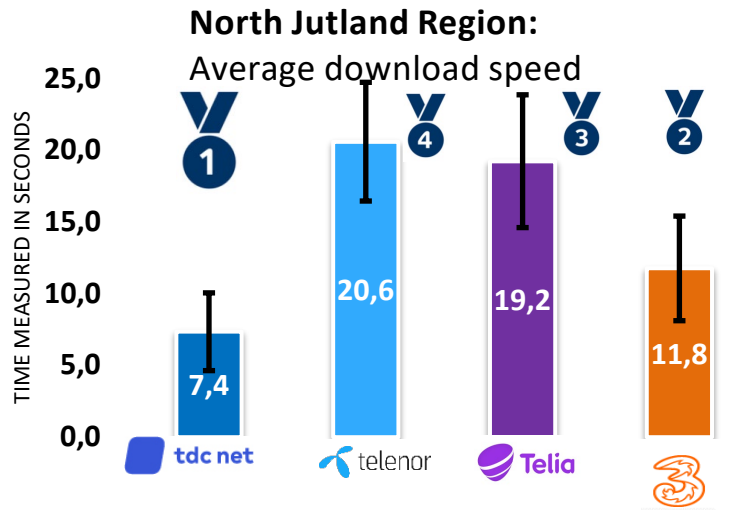


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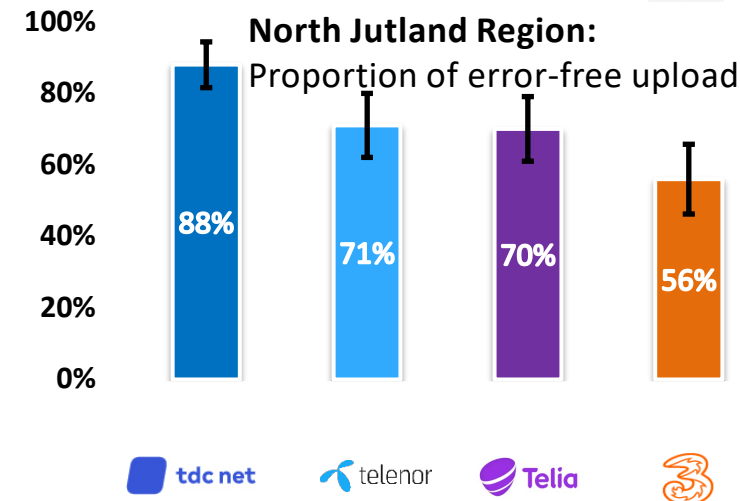
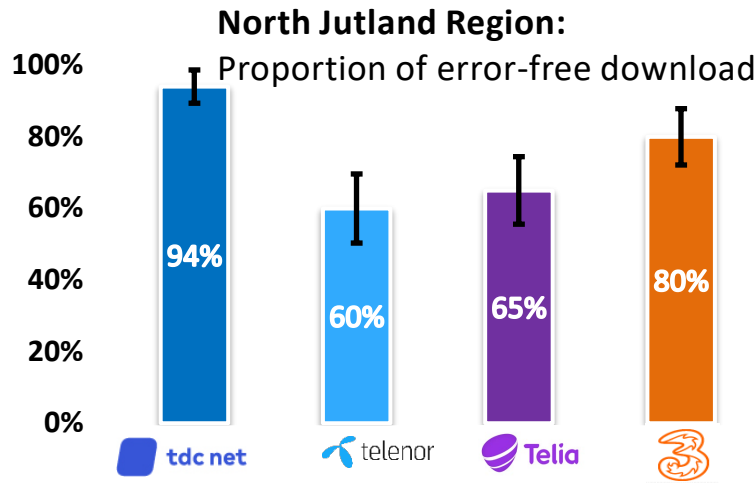
# Regional results of download og upload speeds in 2023

## with a 5G phone

TDC NET has much faster and far 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 - 30 MB download within 15 sec. - 30 MB upload within 30 sec. - 60 sec. DR TV without buffering waiting time. Vertical black lines indicate a 95% statistical confidence interval.





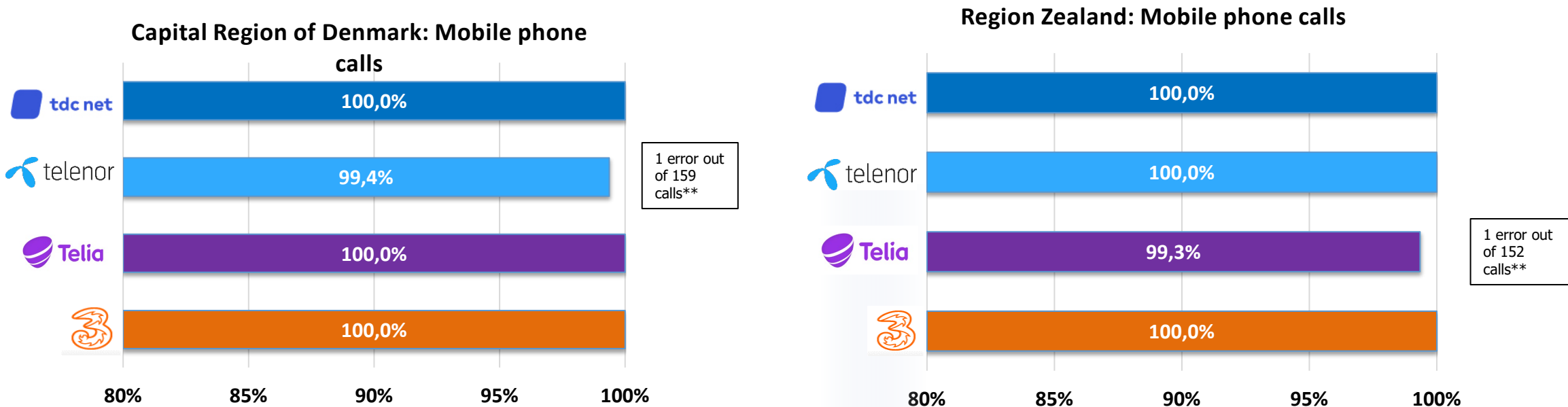
A van from Danish Technological Institute at one of the randomly selected test locations - here a drone photo of a measurement on Læsø (island)

# Regional results of ordinary mobile phone conversations in 2023 with a 5G phone



DANISH  
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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 - 30 MB download within 15 sec. - 30 MB upload within 30 sec. - 60 sec. DR TV without buffering waiting time.

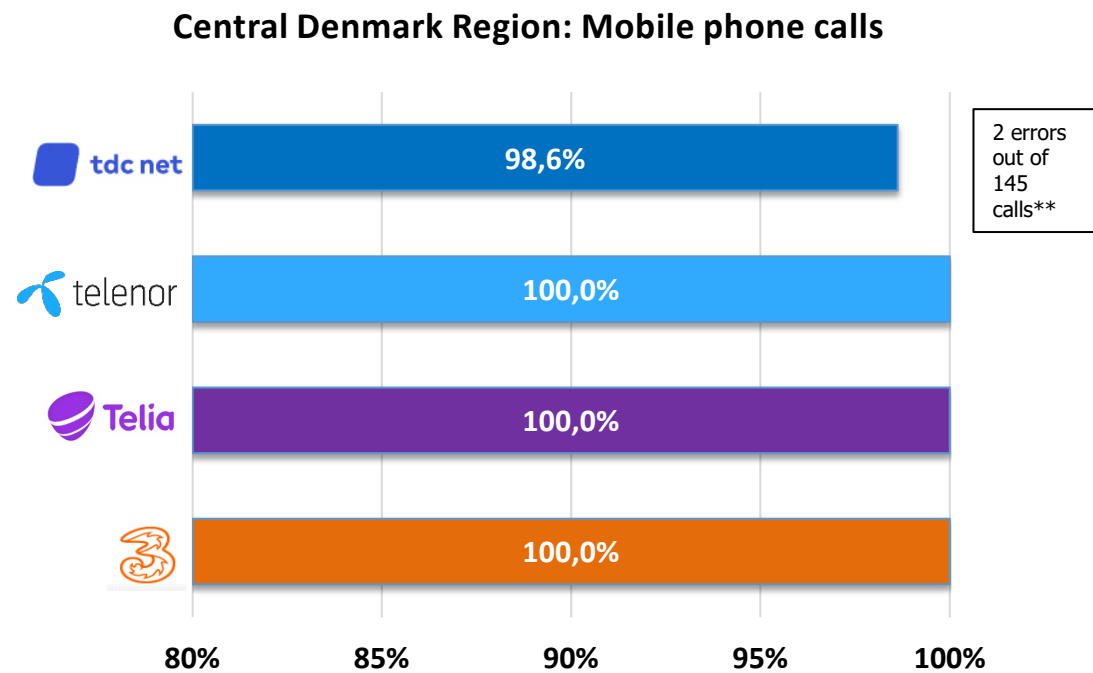
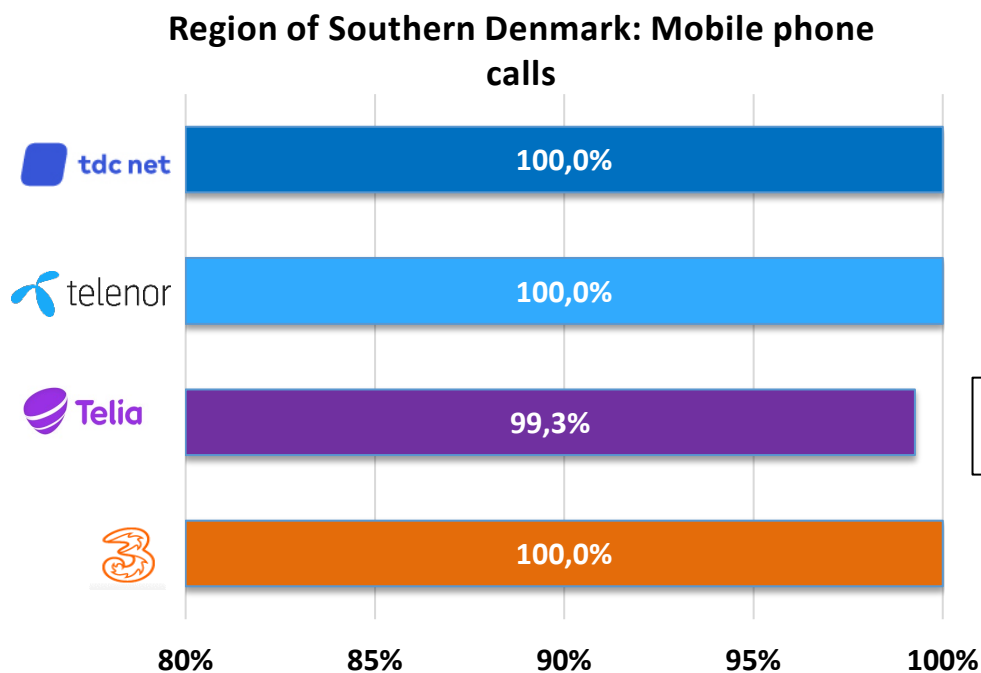
\*\* In case of error, one redial is made. If the redial is successful, then the phone call is approved.





# Regional results of ordinary mobile phone conversations in 2023 with a 5G phone

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



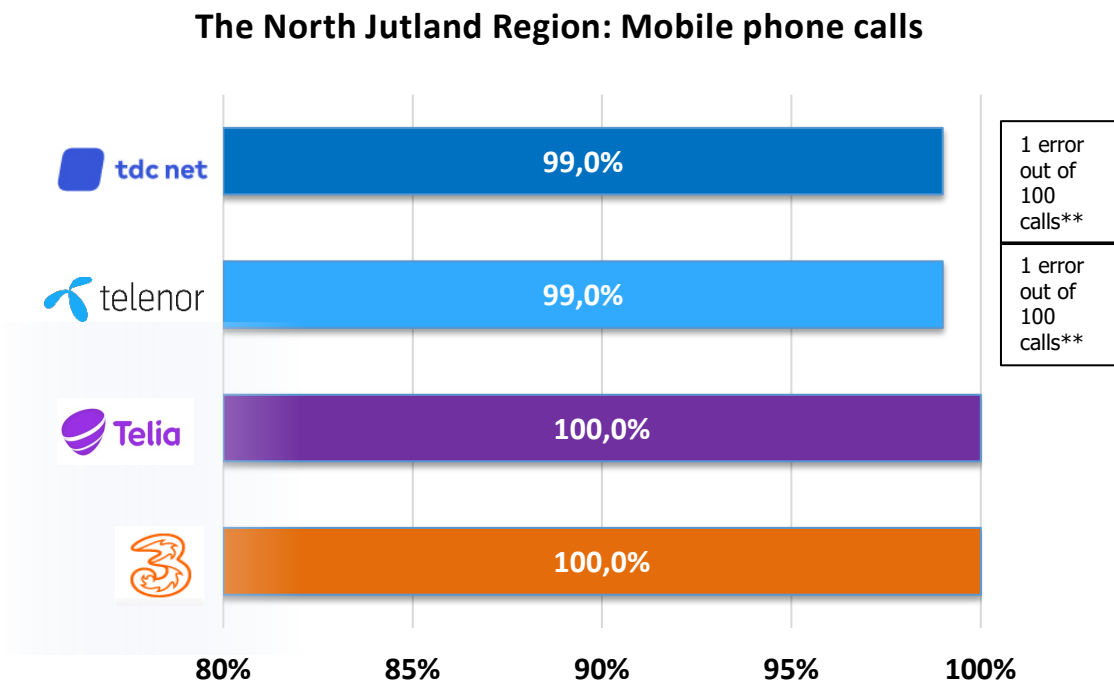
\*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 30 MB download within 15 sec. - 30 MB upload within 30 sec. - 60 sec. DR TV without buffering waiting time.

\*\* 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 2023 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 - 30 MB download within 15 sec. - 30 MB upload within 30 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 at Klintebjerg overlooking Odense Fjord

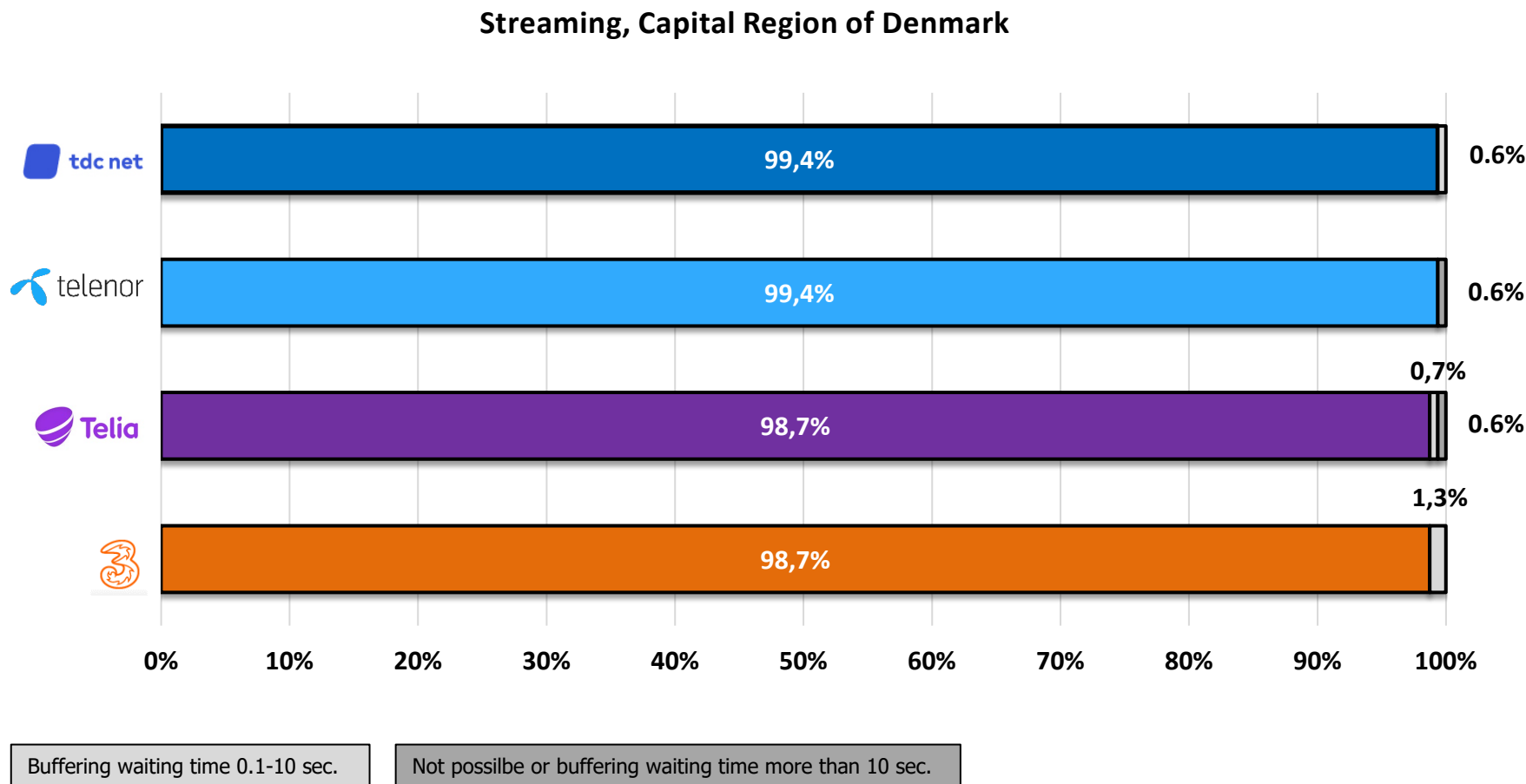


# Regional results of video streaming in 2023 with a 5G phone



DANISH  
TECHNOLOGICAL  
INSTITUTE

No significant differences in video streaming in the Capital Region of Denmark



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

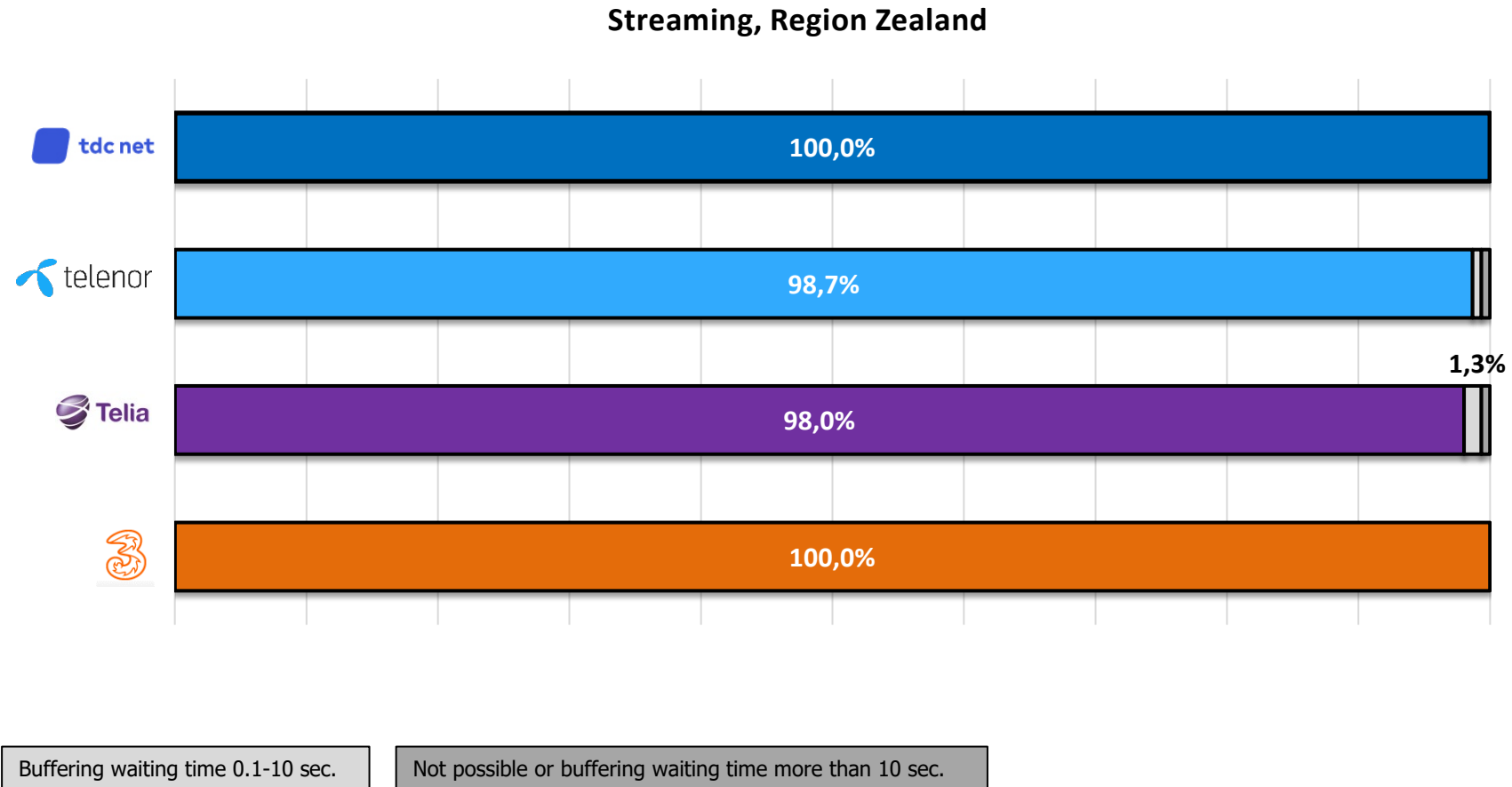
# Regional results of video streaming in 2023 with a 5G phone



DANISH  
TECHNOLOGICAL  
INSTITUTE

TDC NET and 3 have completely error-free video streaming in Region Zealand

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



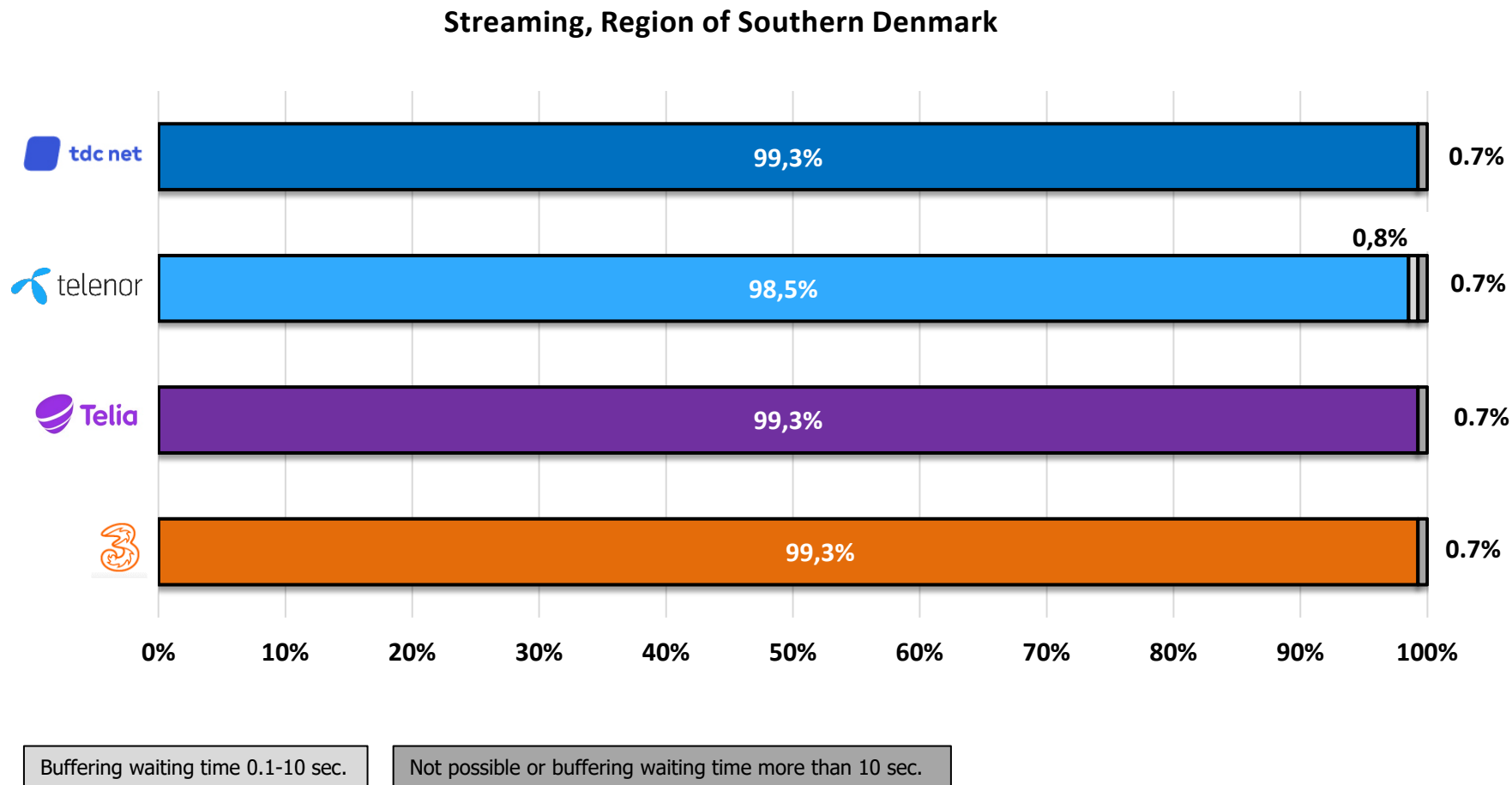
\*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 30 MB download within 15 sec. - 30 MB upload within 30 sec. - 60 sec. DR TV without buffering waiting time.

# Regional results of video streaming in 2023 with a 5G phone



DANISH  
TECHNOLOGICAL  
INSTITUTE

No significant differences in video streaming in the Region of Southern Denmark



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



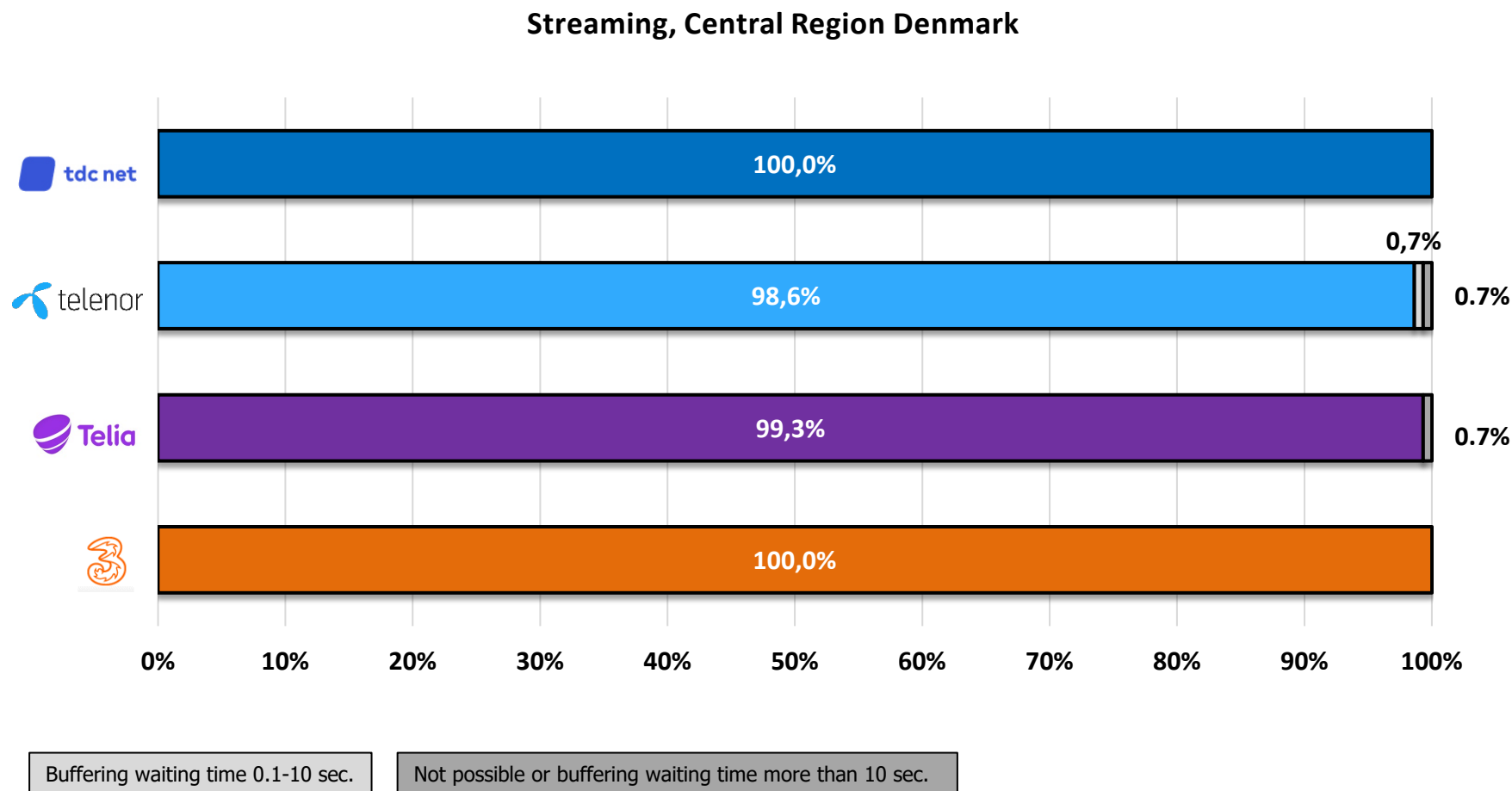
# Regional results of video streaming in 2023 with a 5G phone



DANISH  
TECHNOLOGICAL  
INSTITUTE

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

Telenor and Telia 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 - 30 MB download within 15 sec. - 30 MB upload within 30 sec. - 60 sec. DR TV without buffering waiting time.

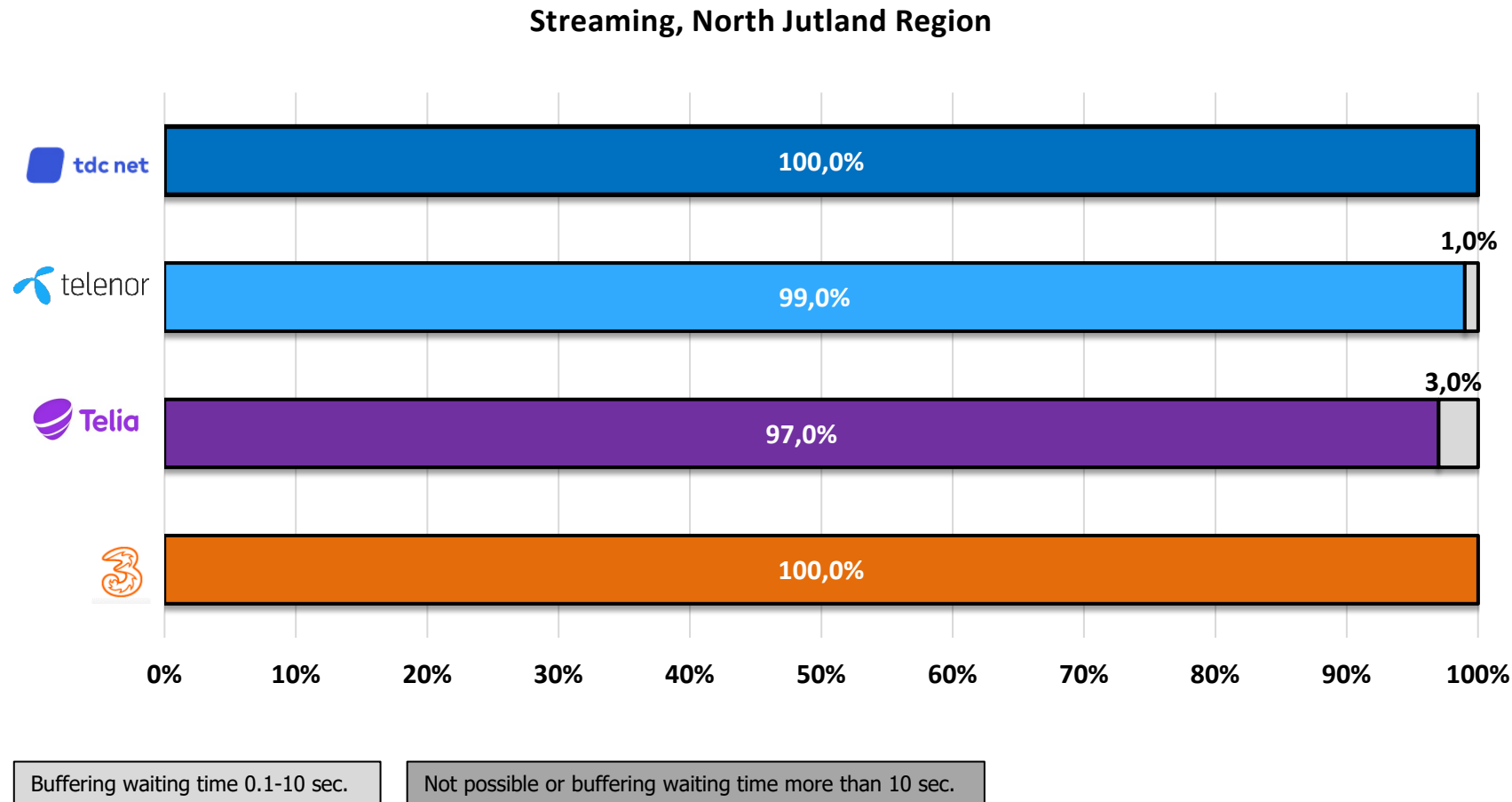
# Regional results of video streaming in 2023 with a 5G phone



DANISH  
TECHNOLOGICAL  
INSTITUTE

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

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



\*TDC NET defined a good mobile network experience as: 30 sec. error-free mobile phone conversation - 30 MB download within 15 sec. - 30 MB upload within 30 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 Thisted



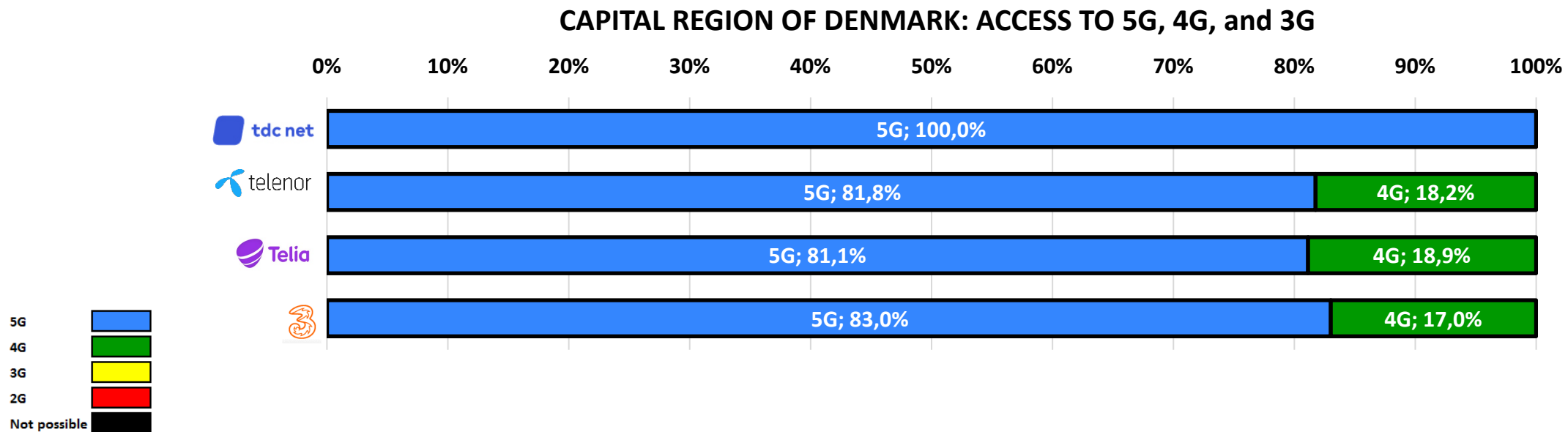
# Regional results of access to 5G and 4G in 2023 with a 5G phone



DANISH  
TECHNOLOGICAL  
INSTITUTE

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

3, Telenor, and Telia have a little more than 80% access to 5G in the Capital Region of Denmark



# Regional results of access to 5G and 4G in 2023 with a 5G phone

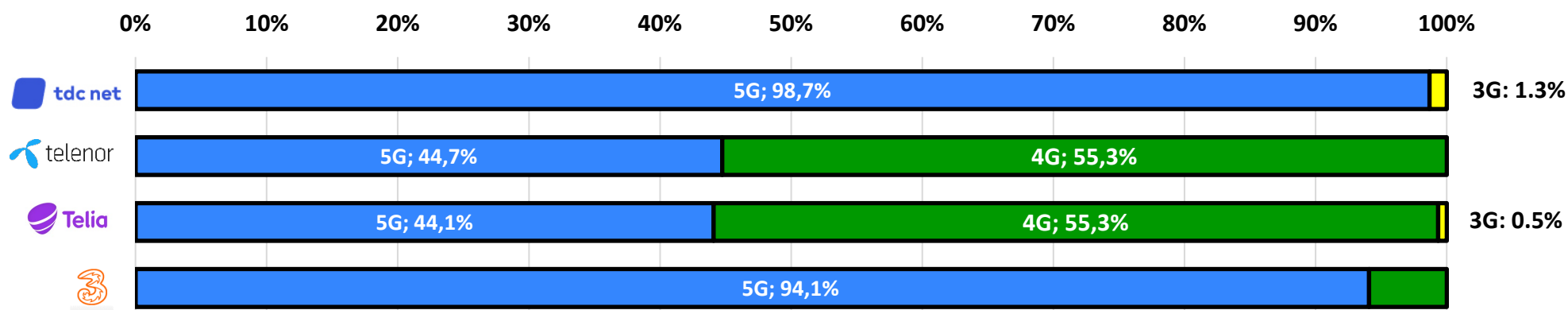


DANISH  
TECHNOLOGICAL  
INSTITUTE

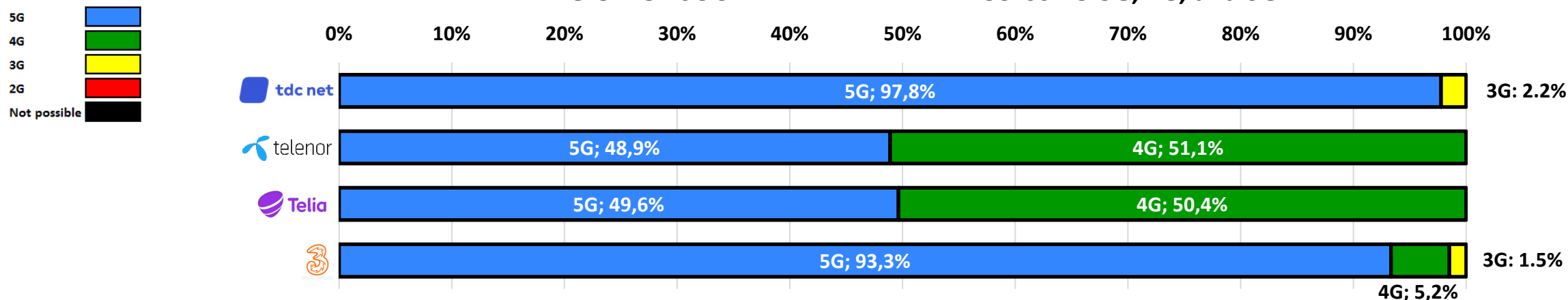
In Region Zealand and Region of Southern Denmark, TDC NET has 100% access to 5G

3 has 93 and 94% access to 5G

## REGION ZEALAND: ACCESS TO 5G, 4G, and 3G



## REGION OF SOUTHERN DENMARK: ACCESS TO 5G, 4G, and 3G





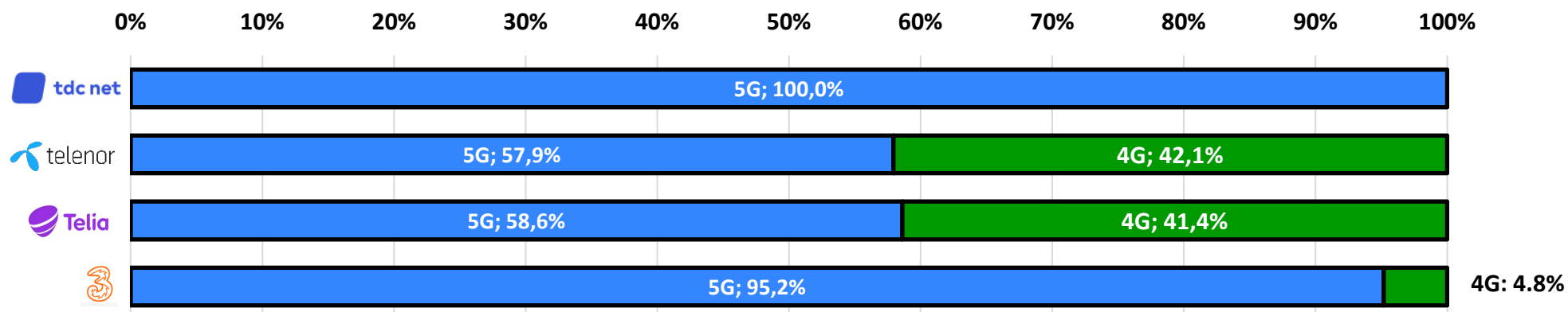
# Regional results of access to 5G and 4G in 2023

## with a 5G phone

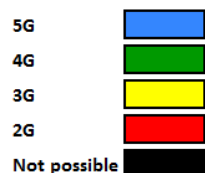
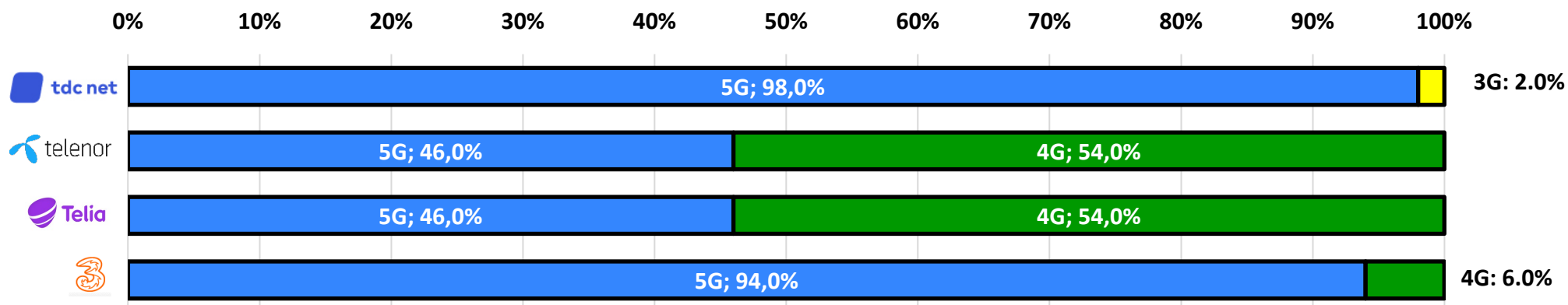
In Central Region Denmark and North Jutland Region, TDC NET has 100% and 98% access to 5G

In Central Region Denmark and North Jutland Region, 3 has 95% and 94% access to 5G

### CENTRAL REGION DENMARK: ACCESS TO 5G, 4G, and 3G



### NORTH JUTLAND REGION: ACCESS TO 5G, 4G, and 3G





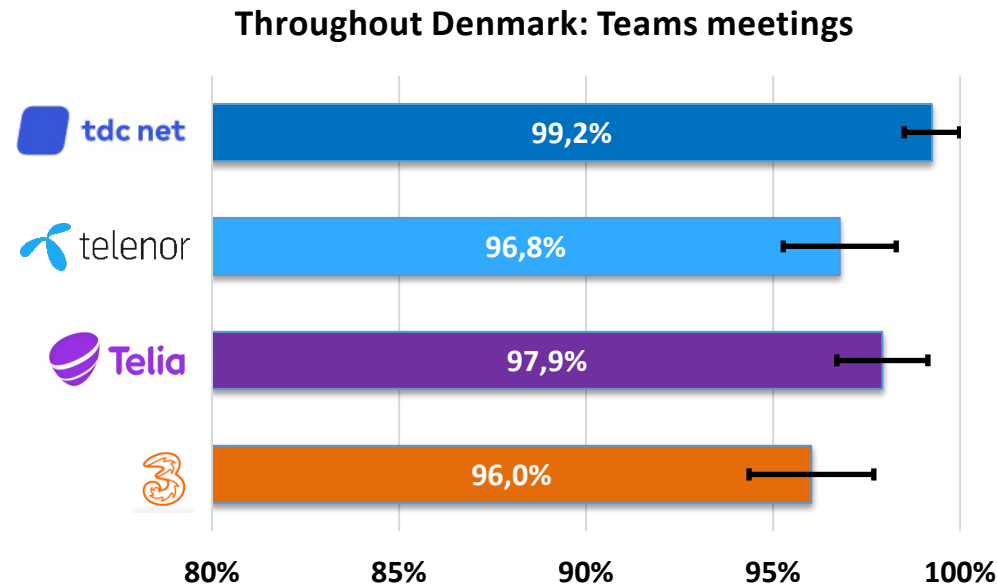


A van from Danish Technological Institute at one of the randomly selected test locations – here in the business region on Sintrupvej in Brabrand (suburb of Aarhus)



# Additional measurement: National result of Teams measurement in 2023 with a 5G phone

Nationally, TDC NET has more error-free mobile connectivity to Teams meetings. There are only minor differences between the network providers.



Please note that Teams meetings via a 5G phone have 2 substantial sources of error that are beyond the network provider: the Teams app in question, and the server where the electronic Teams meeting is hosted. Therefore, problems may be experienced that are not owing to the network provider. Danish Technological Institute experienced problems with the Teams app and that increased the uncertainty of measurement.