

Assessment of mobile coverage, upload/ download speeds, video streaming and conversations

The measurements were carried out in Denmark from 22 October – 11 November 2019



Measuring at Lilliendal Estate on South Zealand

Contents

- Extent and test method
- The 500 randomly selected locations of test points
- Summary of results
- National results
- Regional results



Extent and test method

- TDC NET commissioned and paid for the assignment. It was performed in the same way as the surveys in 2014, 2015, 2016, 2017 and 2018.
- The assignment was commissioned to have a large geographical spread with stationary measurements of the mobile network experience throughout Denmark. The latest and most popular mobile phone (iPhone XR) was used.
- TDC NET defines **a good mobile network experience** as:
 - **A 30 sec. uninterrupted mobile conversation** where you can hear the recipient is defined as approved. In case of failure, one redial is made. If redial is successful, the phone call is approved.
 - **10 MB download within 15 sec.** TDC NET considers 60 seconds or more as poor mobile coverage.
 - **10 MB upload within 30 sec.** TDC NET considers 60 seconds or more as poor mobile coverage.
 - **60 sec. YouTube video without buffering waiting time**, corresponding to previous surveys. A buffering waiting time of 0.1-10 sec. is categorised as defective. TDC NET compares a buffering waiting time of more than 10 sec. with video streaming not being possible.

Extent and test method

- The 500 test locations were evenly distributed in 10x10 km squares **throughout** Denmark. The test locations 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 the larger towns, as large buildings can affect coverage locally. The number of measurements was increased in the Capital Region of Denmark 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.
- TDC NET, Telenor, Telia and 3 were tested at every single test location.
- Stationary measurements were carried out in a van.
- An iPhone XR was used. TDC NET supplied the iPhone XR 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 iPhone XR.
- Before the test started, Danish Technological Institute informed Telenor, Telia and 3 that a mobile coverage survey would be conducted for an anonymous client; i.e., the four network providers were put on an equal footing.



The 500 randomly selected test locations

Summary of results

- Nationally, TDC NET has the best mobile network experience*
- 3 has moved from a fourth place and comes in second. They are now ahead of Telenor and Telia. In February 2019, 3 entered into a roaming agreement with TDC NET, which especially has improved the coverage in the outer regions. Previously, 3 had a roaming agreement with Telia.
- For the first time in 6 years, a slight decline has been observed in the download speeds of TDC NET, Telenor and Telia. However, it will not be noticed in actual practice.
- Ordinary mobile conversations are almost error-free. There are no statistically measurable differences between TDC, Telenor, Telia and 3. Differences compared to previous surveys can be due to statistical coincidences.
- All 4 network providers have improved access to 4G. The improvement is significant for the network provider 3.
- Nationally, TDC NET has faster download and upload speeds than Telenor, Telia and 3.
- All 4 network providers have improved their upload speeds. TDC NET, Telenor and Telia have the same upload and download speeds.
- TDC NET has fewer download and upload errors than Telenor, Telia and 3.
- TDC NET, Telenor, Telia and 3 have the same high level of video streaming.

***TDC NET defines a good mobile network experience as:** 30 sec. stable mobile phone conversation - 10 MB download within 15 sec. - 10 MB upload within 30 sec. - 60 sec. YouTube video without buffering waiting time.



Comments to results

- The results in this report are national and regional results and therefore AVERAGE FIGURES.
- **Coverage where you currently are using your smartphone 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. It is assumed that a significant increase in data traffic (40%) has taken place since the previous survey took place 12 months ago.
- Although Telenor and Telia share masts and frequencies, their results differ. That might be due to only in-part joint ownership of the underlying transmission technology.

A van from Danish Technological Institute at one of the randomly selected test locations – here at Rørbæk lake in Nørre Snede, Central Jutland

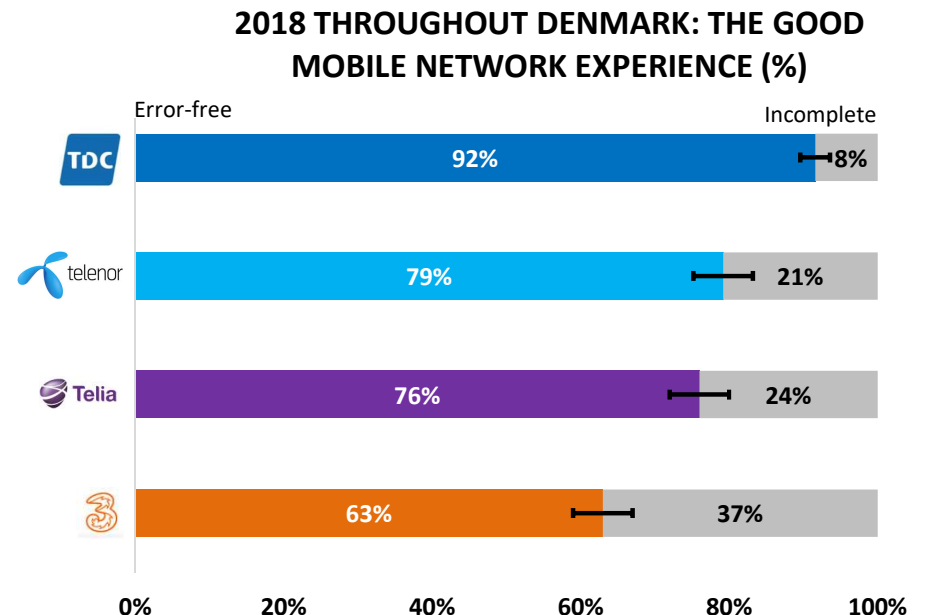
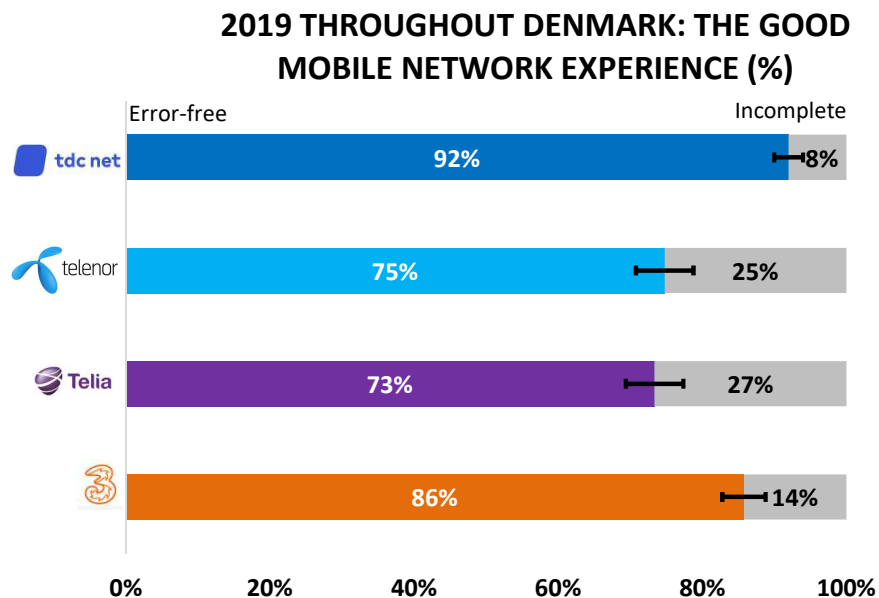


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National result of mobile network experience in 2019 and 2018

TDC NET has a better mobile network experience* than Telenor, Telia and 3.
3 has progressed and comes in second. Telenor and Telia have lost a little ground.



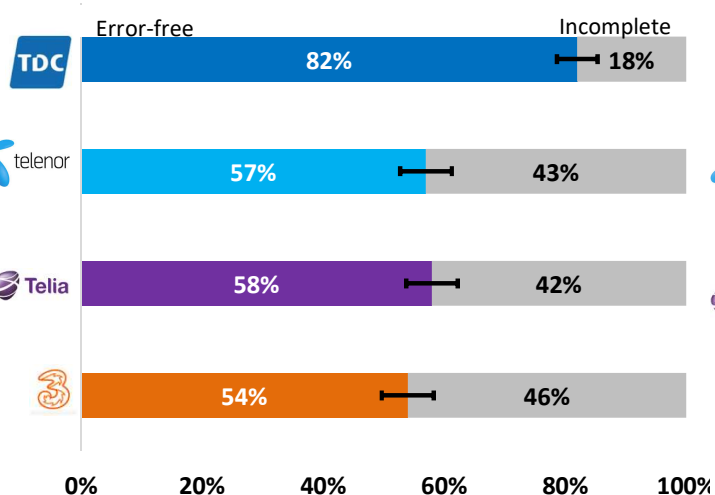
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National result of mobile network experience in 2017 and 2016

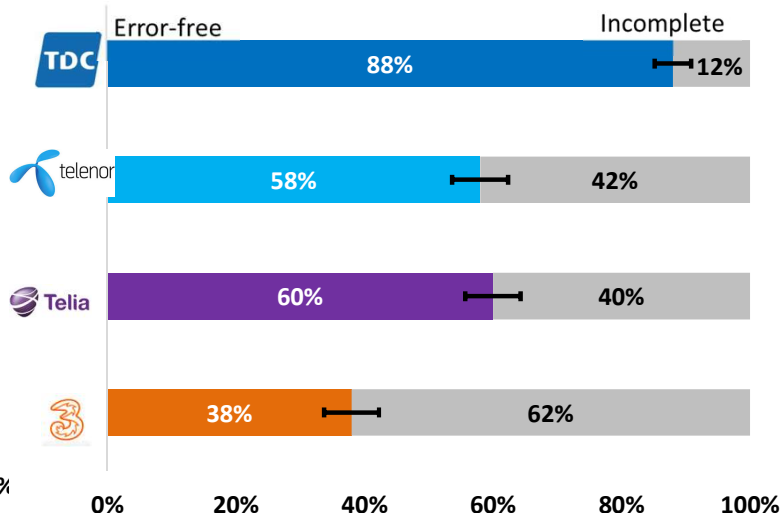
TDC has a better mobile network experience* than Telenor, Telia and 3.

Telenor and Telia come in second. All network providers have progressed significantly since 2017.

2017 THROUGHOUT DENMARK: THE GOOD MOBILE NETWORK EXPERIENCE (%)



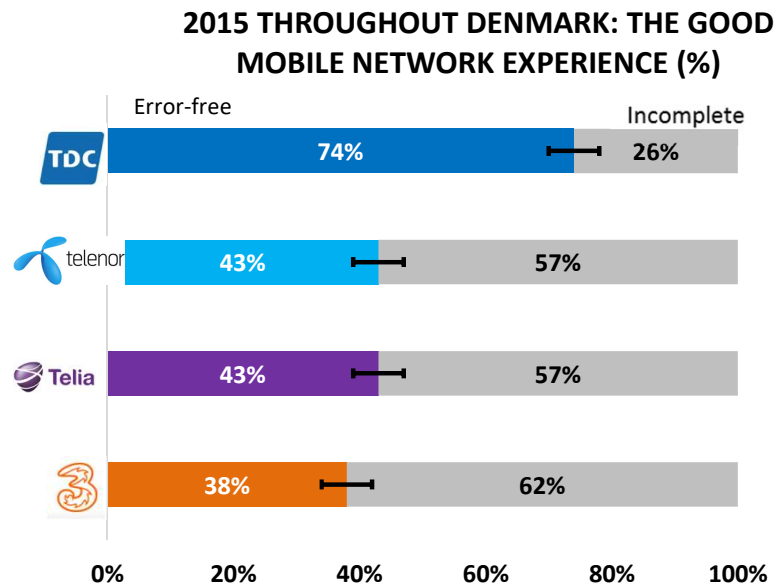
2016 THROUGHOUT DENMARK: THE GOOD MOBILE NETWORK EXPERIENCE (%)



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National result of mobile network experience in 2015

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Telenor and Telia came in second.



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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 Ørby north of Haderslev

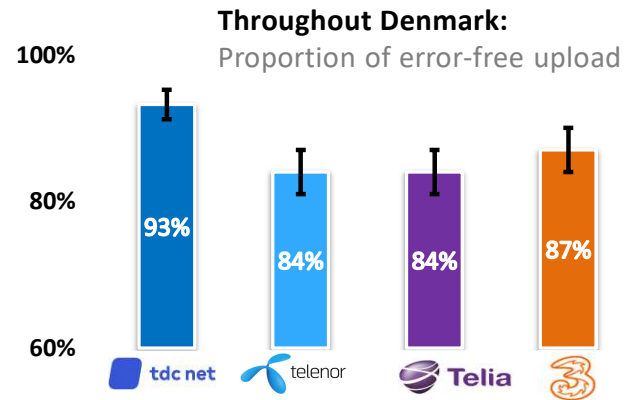
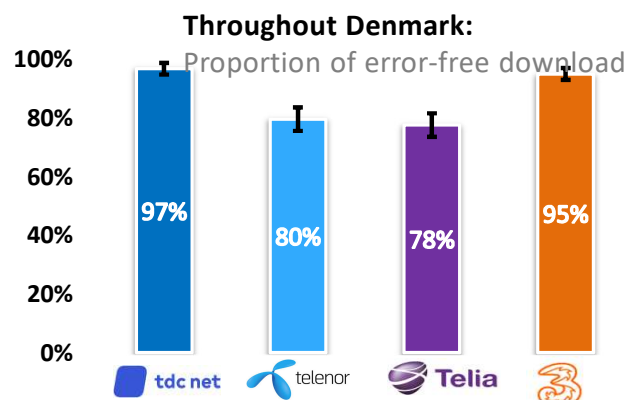
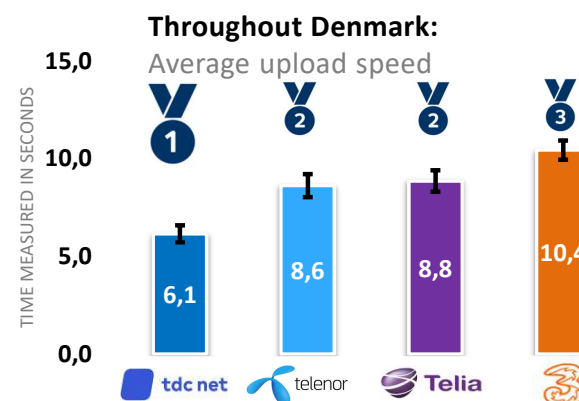
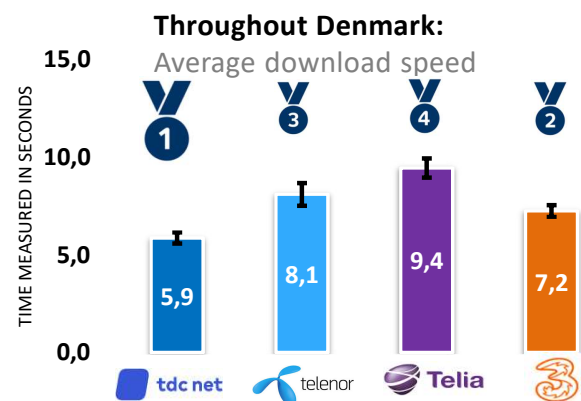


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National result of download and upload speeds 2019

TDC NET has faster and more error-free* download and upload speeds than Telenor, Telia and 3.

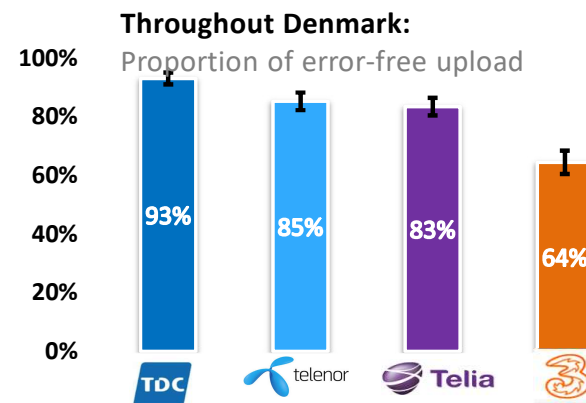
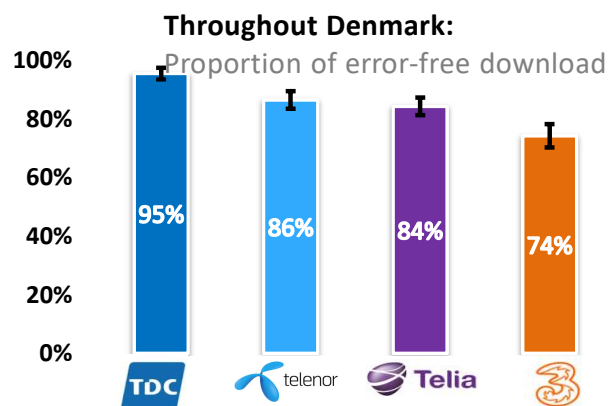
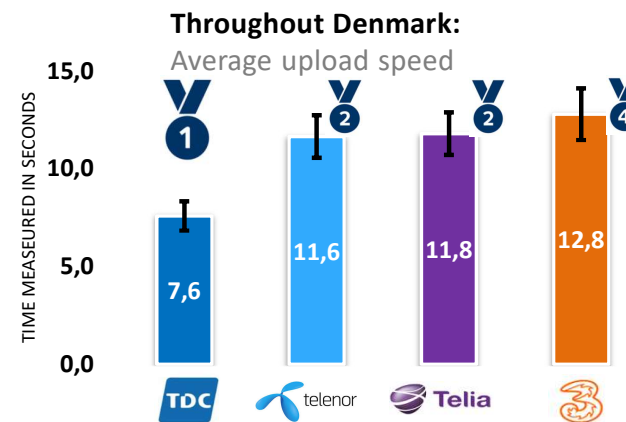
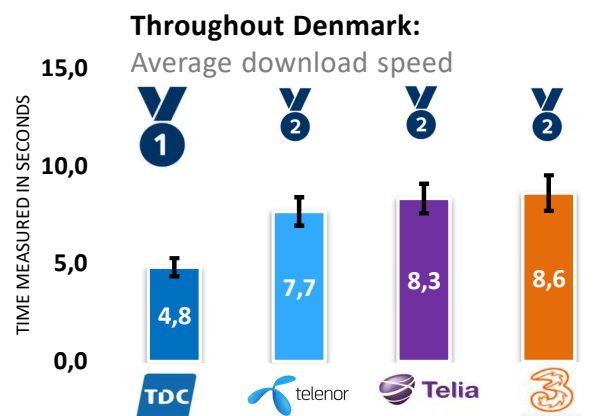


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National result of download and upload speeds 2018

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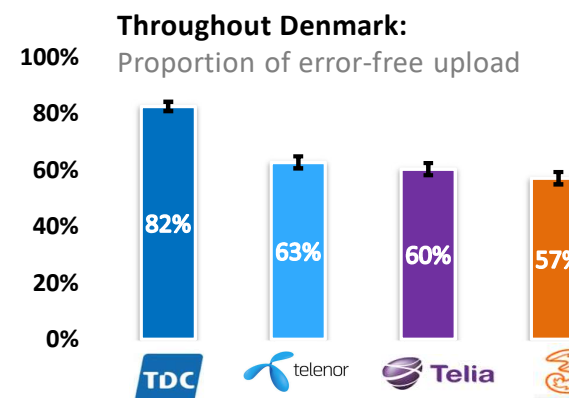
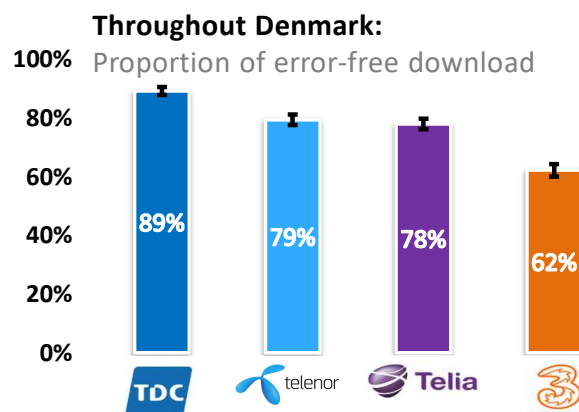
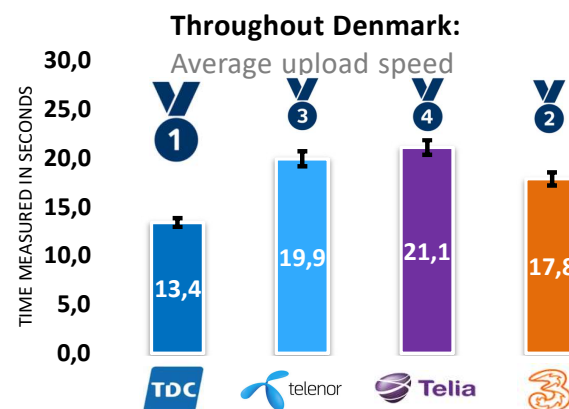
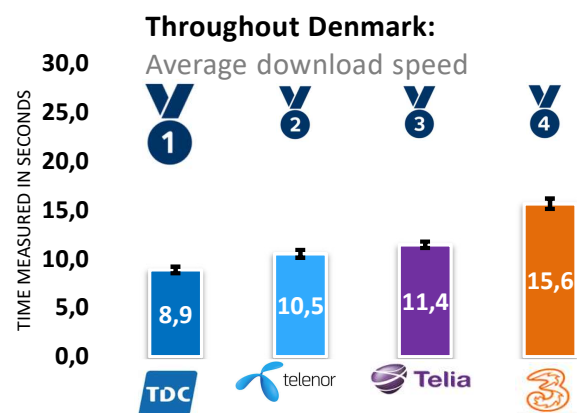
TDC has faster and more error-free* download speeds and significantly faster and more error-free* upload speeds than Telenor, Telia and 3.



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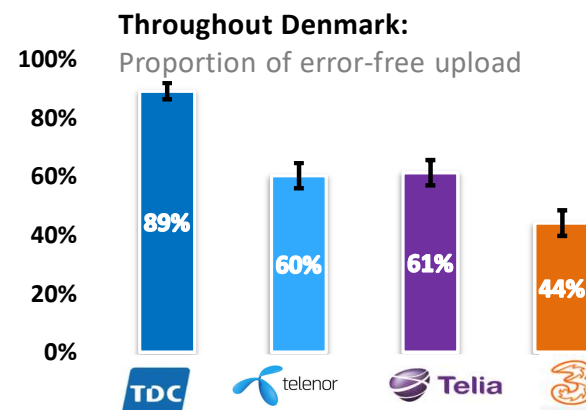
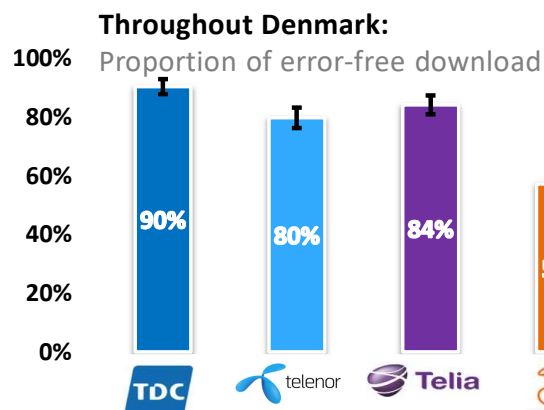
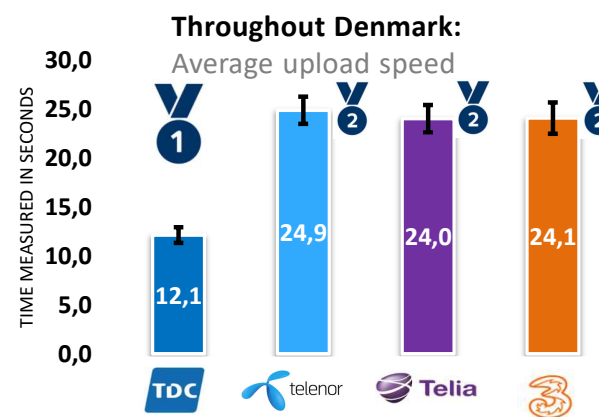
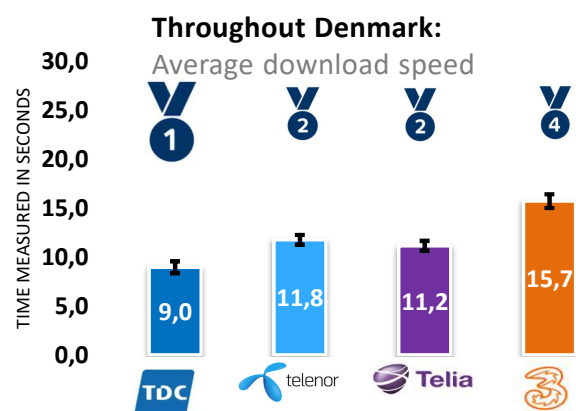


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National result of download and upload speeds 2016

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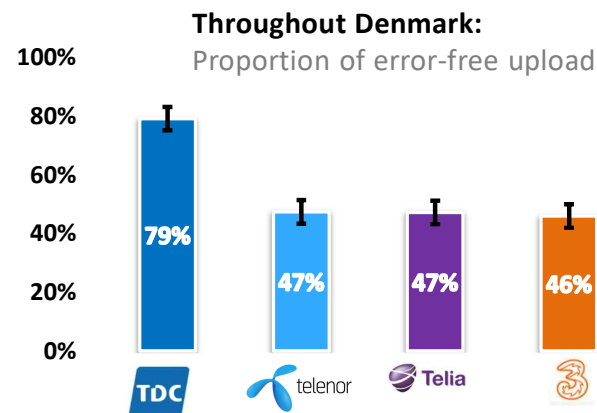
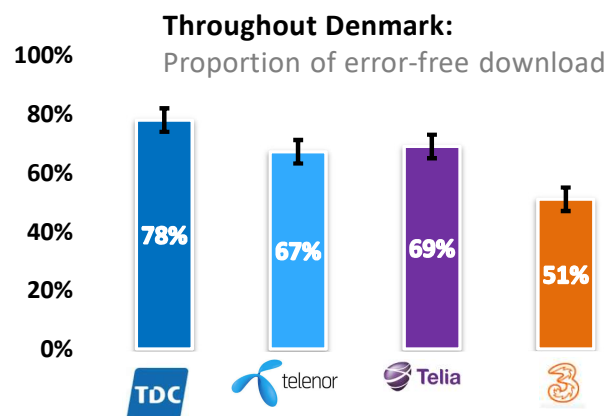
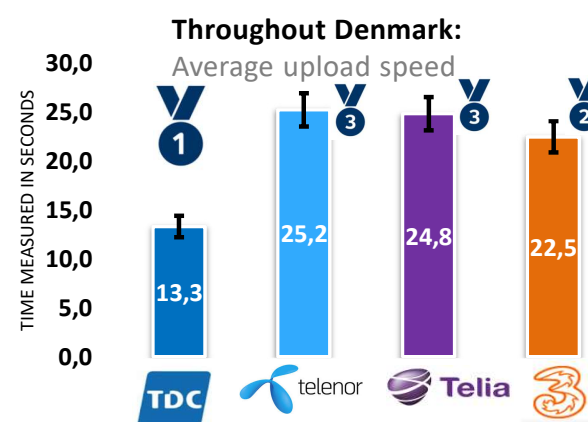
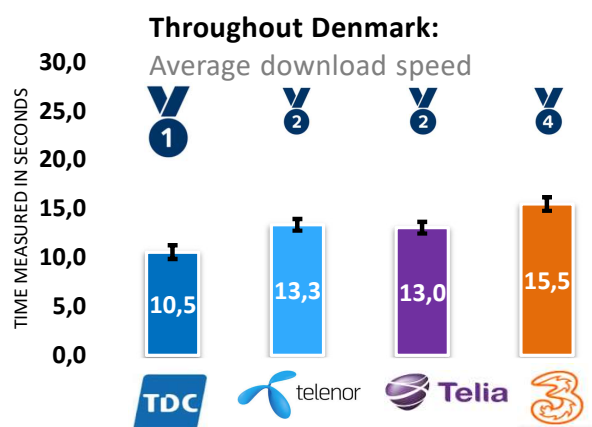
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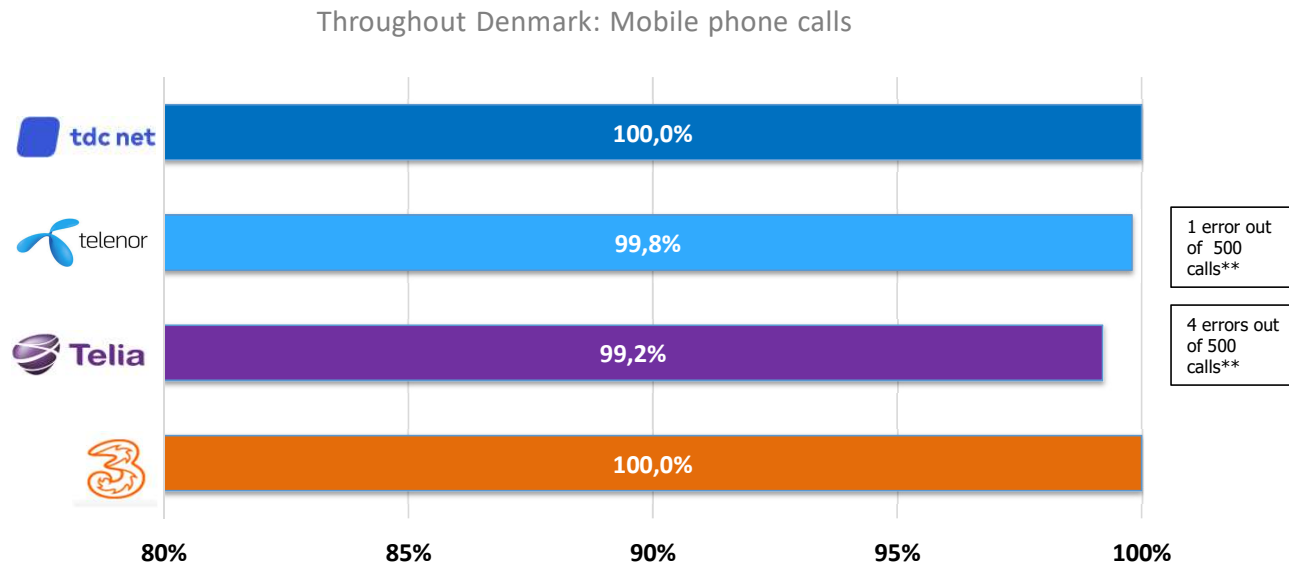
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National result of ordinary mobile phone conversations 2019

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

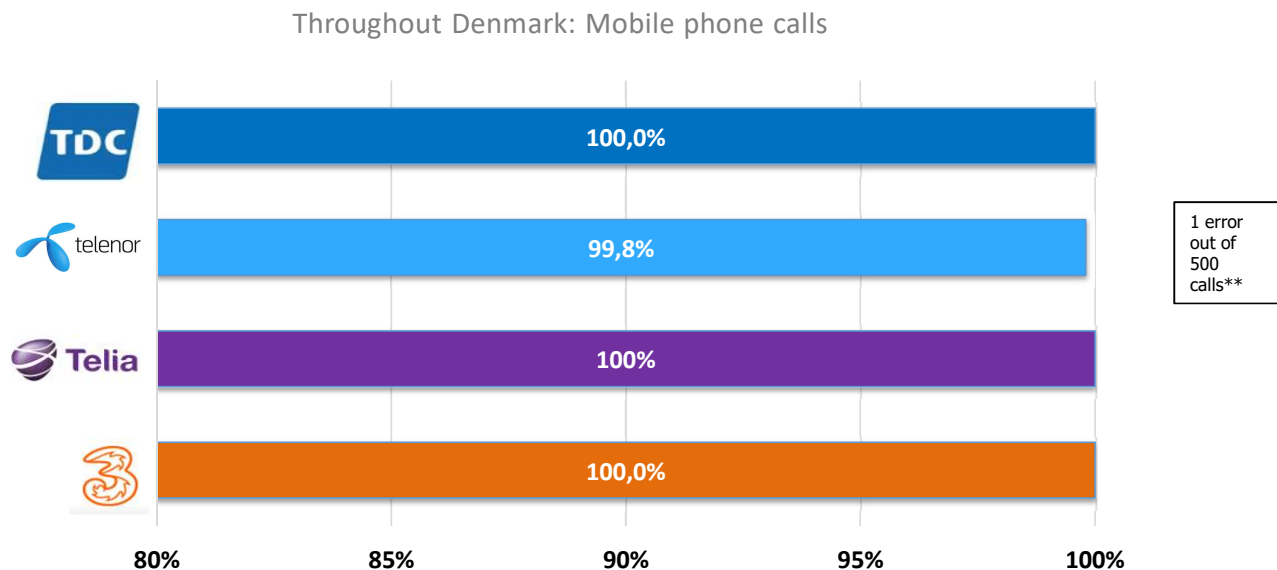


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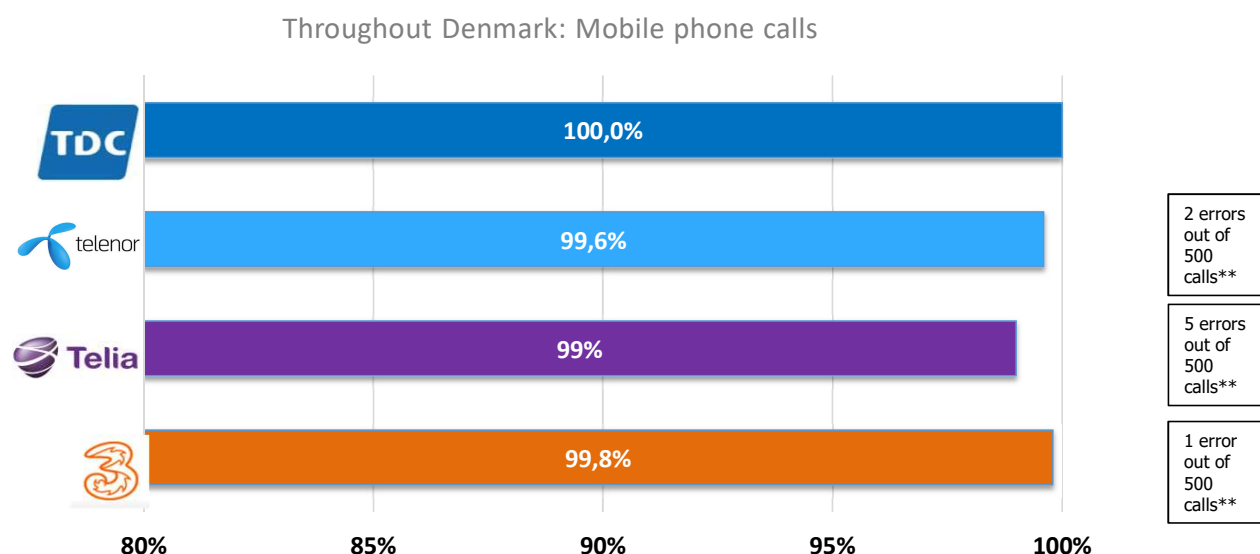


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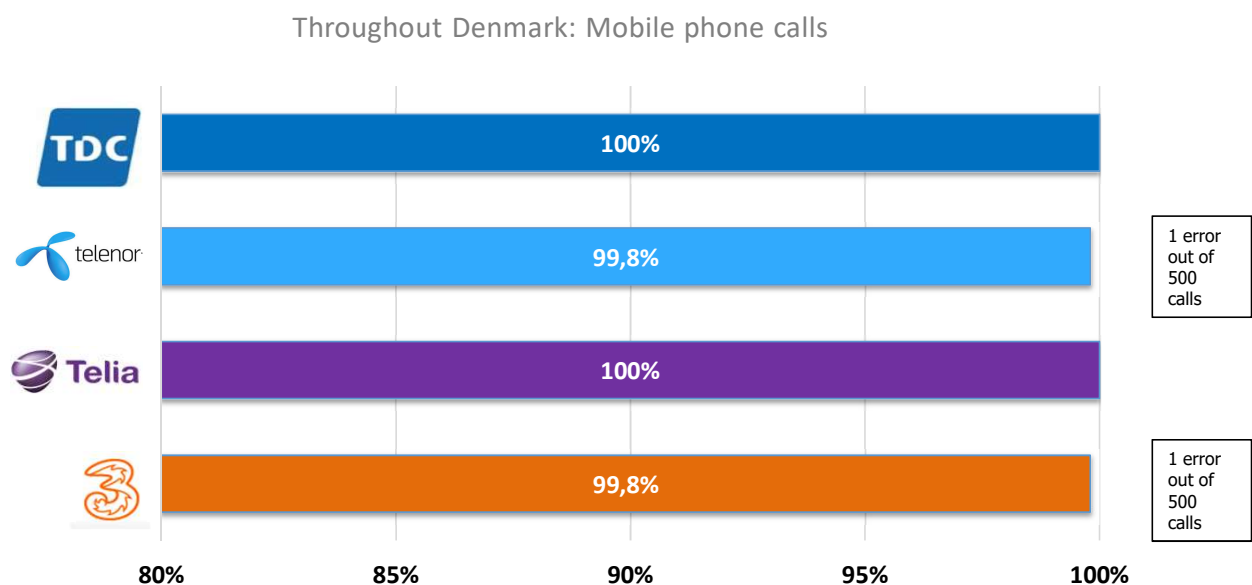


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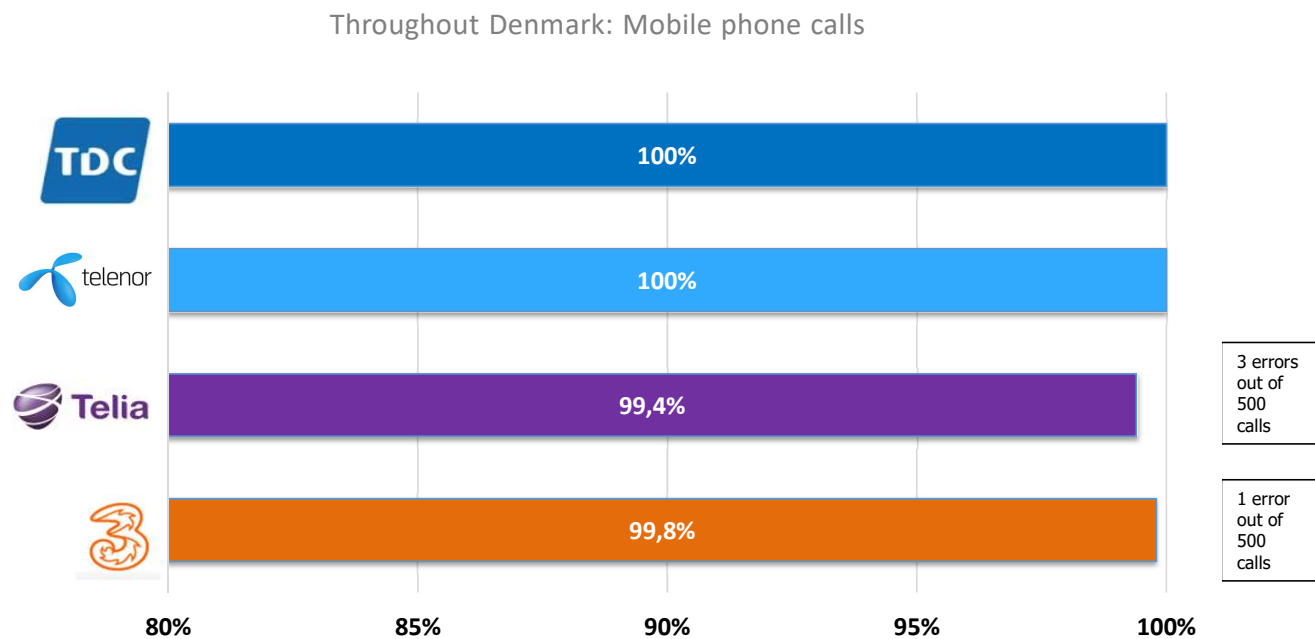
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National result of ordinary mobile phone conversations 2015

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A van from Danish Technological Institute
at one of the randomly selected test
locations – here Oksbøl military centre near
Varde

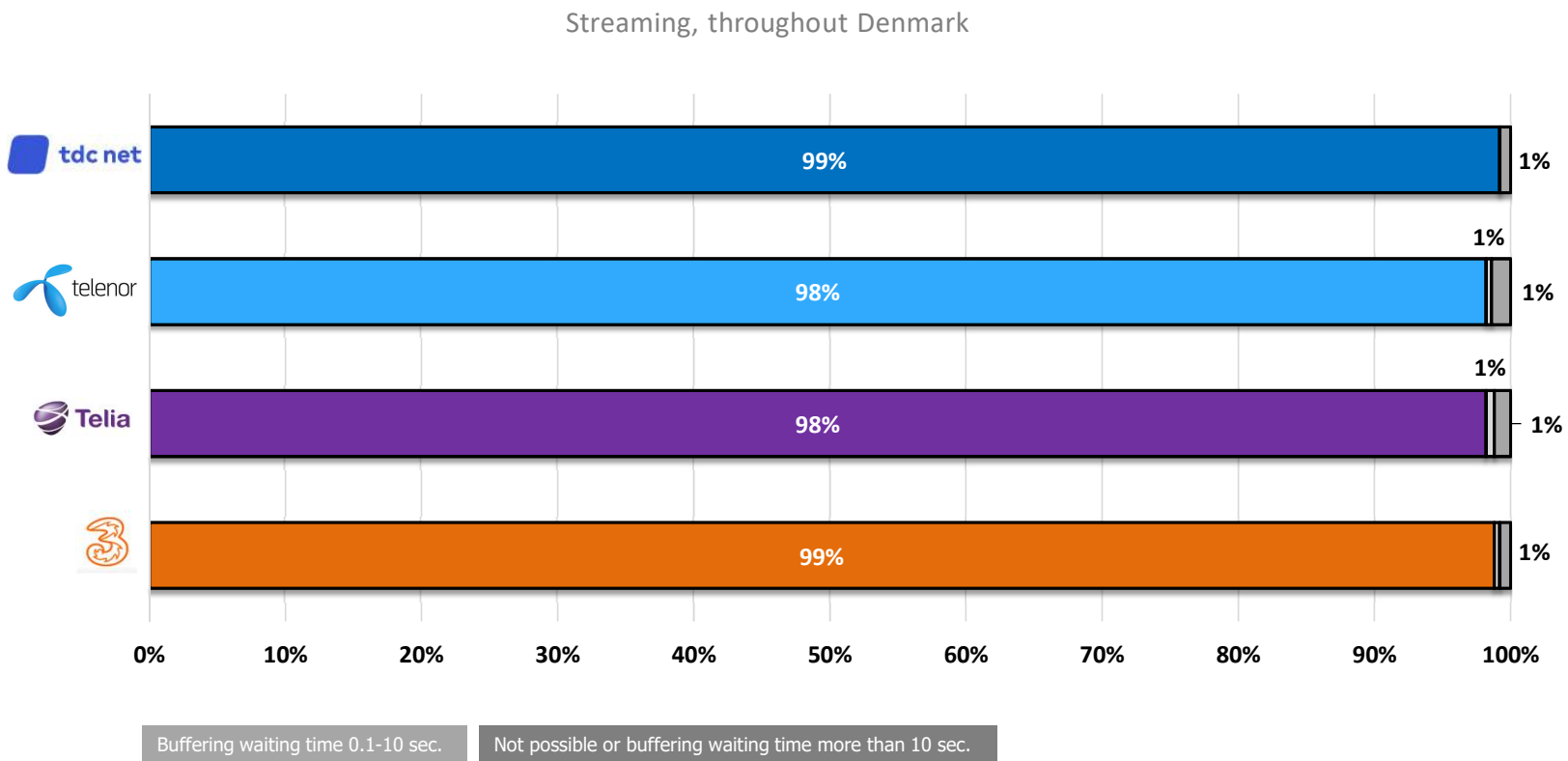


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National result of video streaming 2019

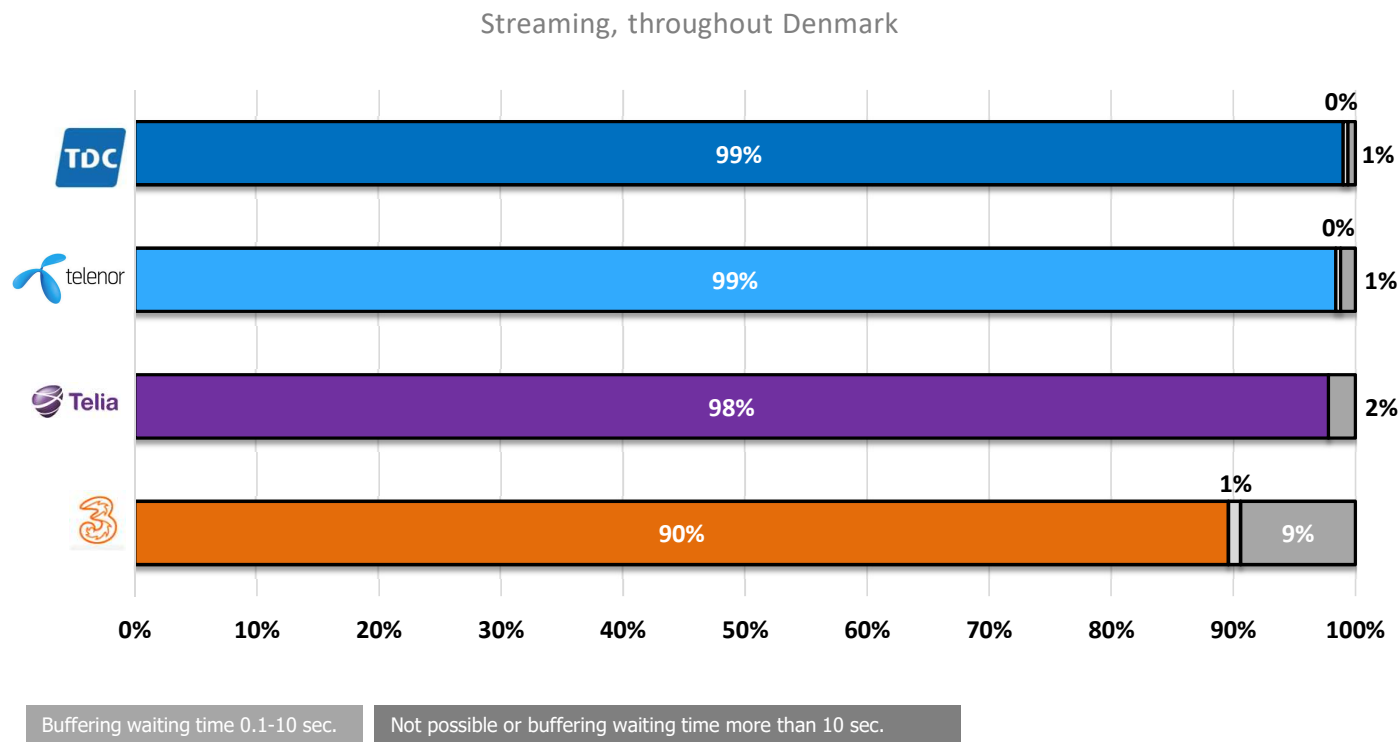
At national level, TDC NET, Telenor and Telia have the same high level of video streaming. 3 has progressed.



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National result of video streaming 2018

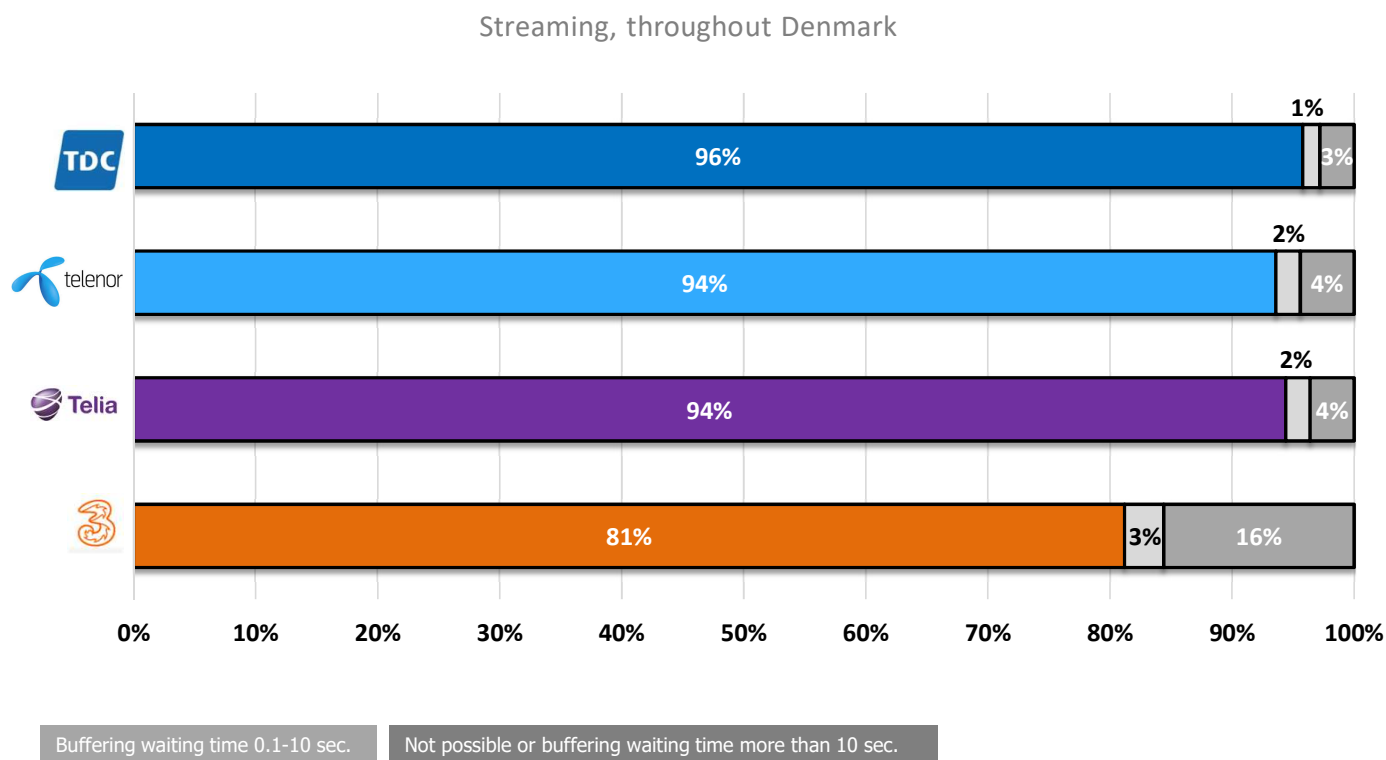
At national level, TDC, Telenor and Telia have the same high level of video streaming. All four network providers have progressed.



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National result of video streaming 2017

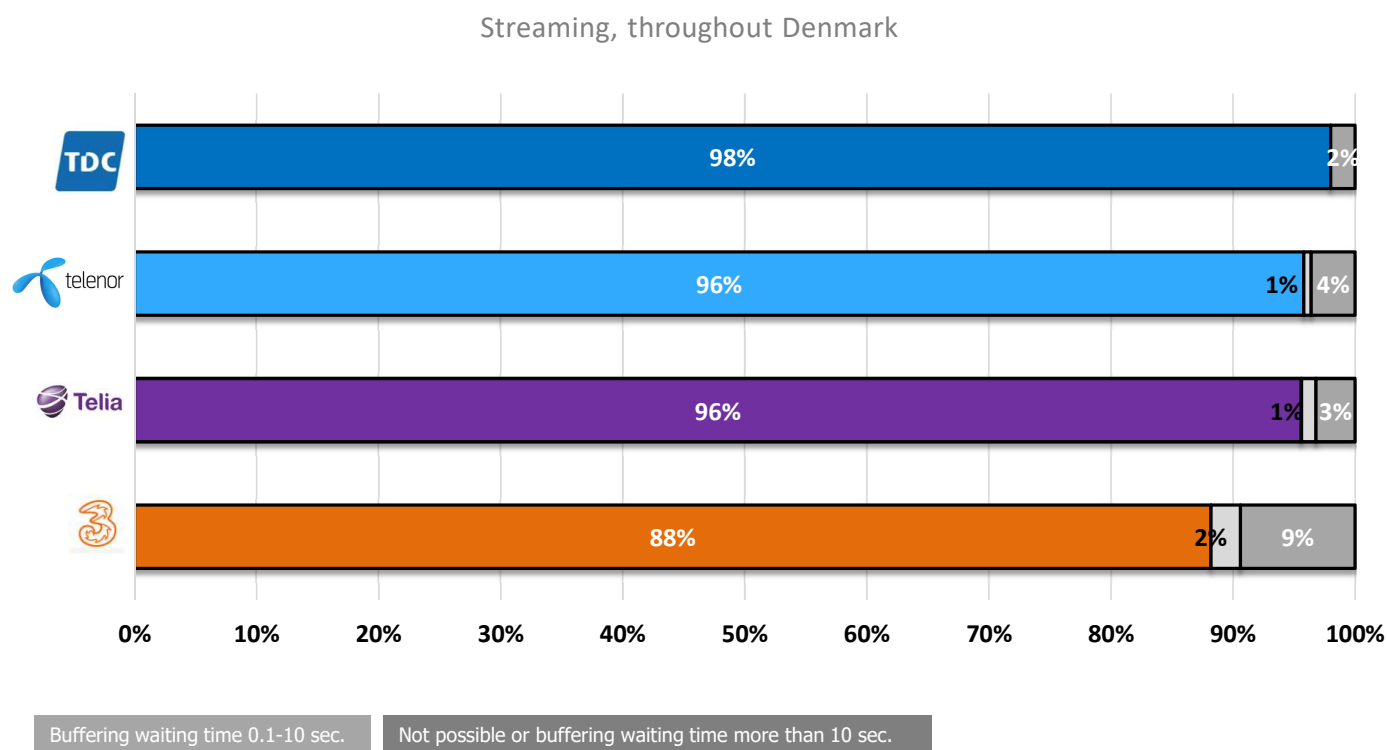
At national level, TDC delivered better video streaming than Telenor, Telia and 3. All four network providers have lost a little ground compared to 2016.



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National result of video streaming 2016

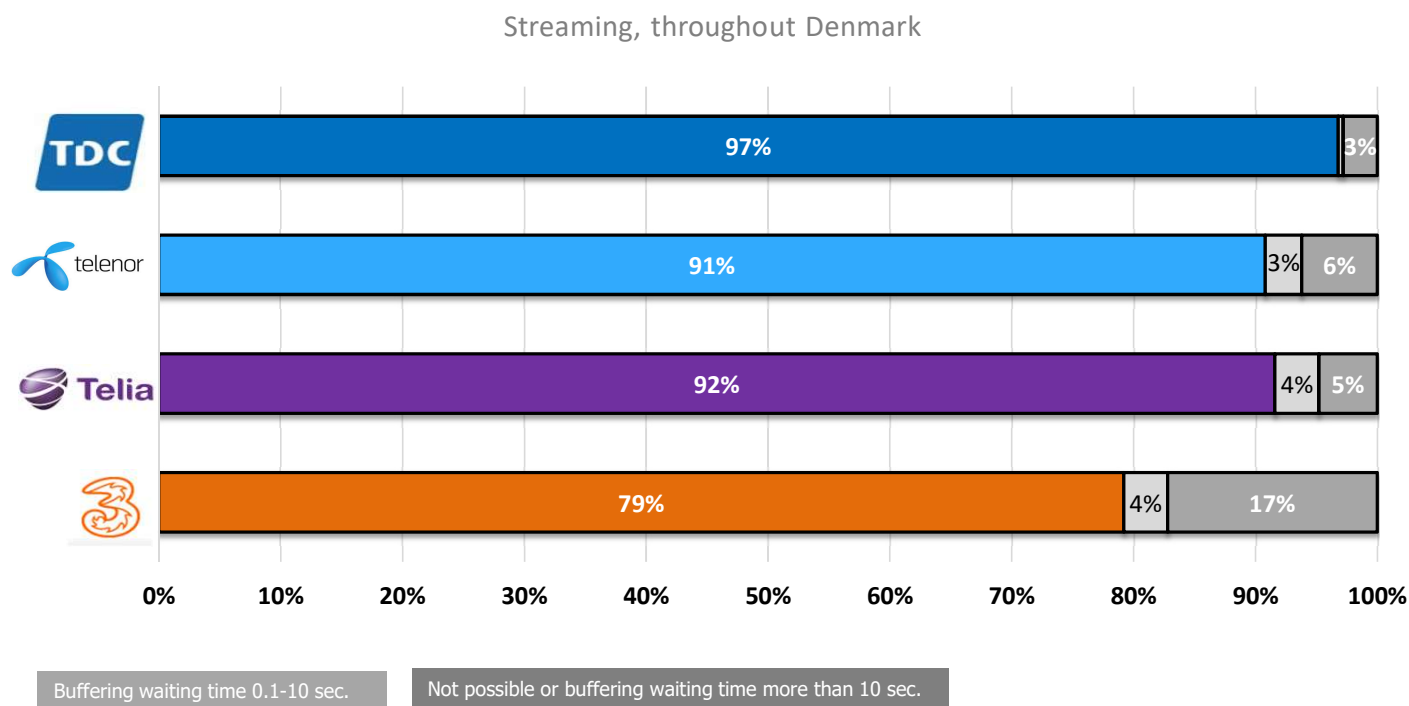
At national level, TDC delivered slightly better video streaming than Telenor, Telia and 3.



***The good mobile network experience is by TDC defined as:** 30 sec. error-free mobile phone conversation - 10 MB download within 15 sec.
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National result of video streaming 2015

At national level, TDC delivered better video streaming than Telenor, Telia and 3.



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A van from Danish Technological Institute at one of the randomly selected test locations – here at Paaø beach on the south of Funen

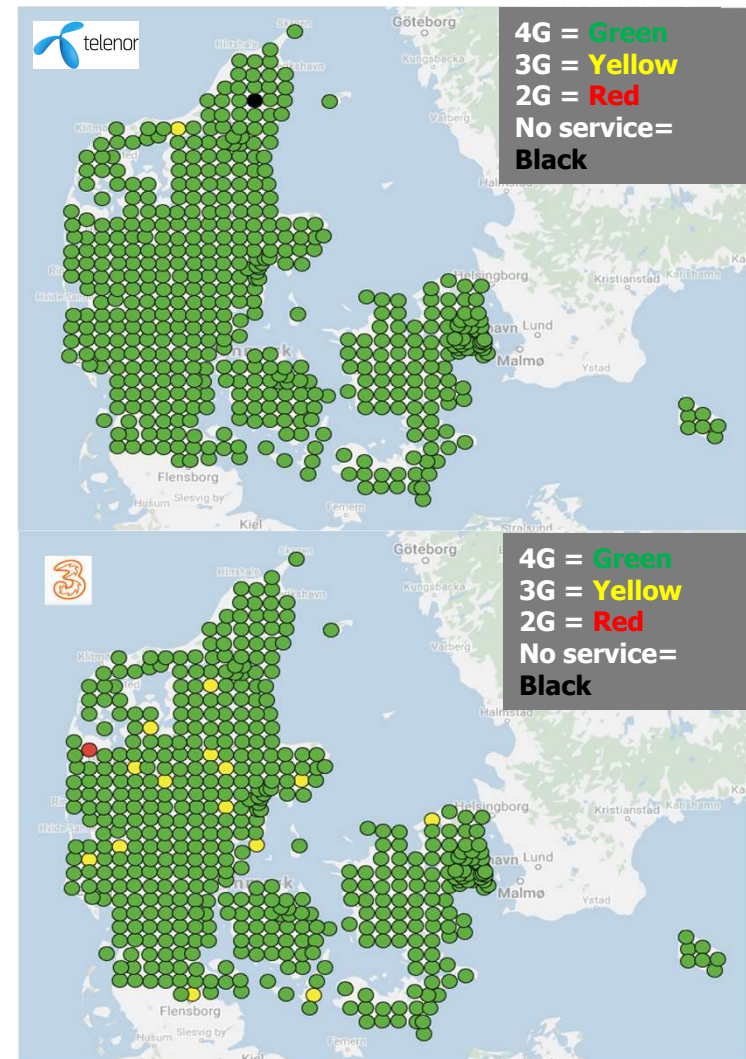
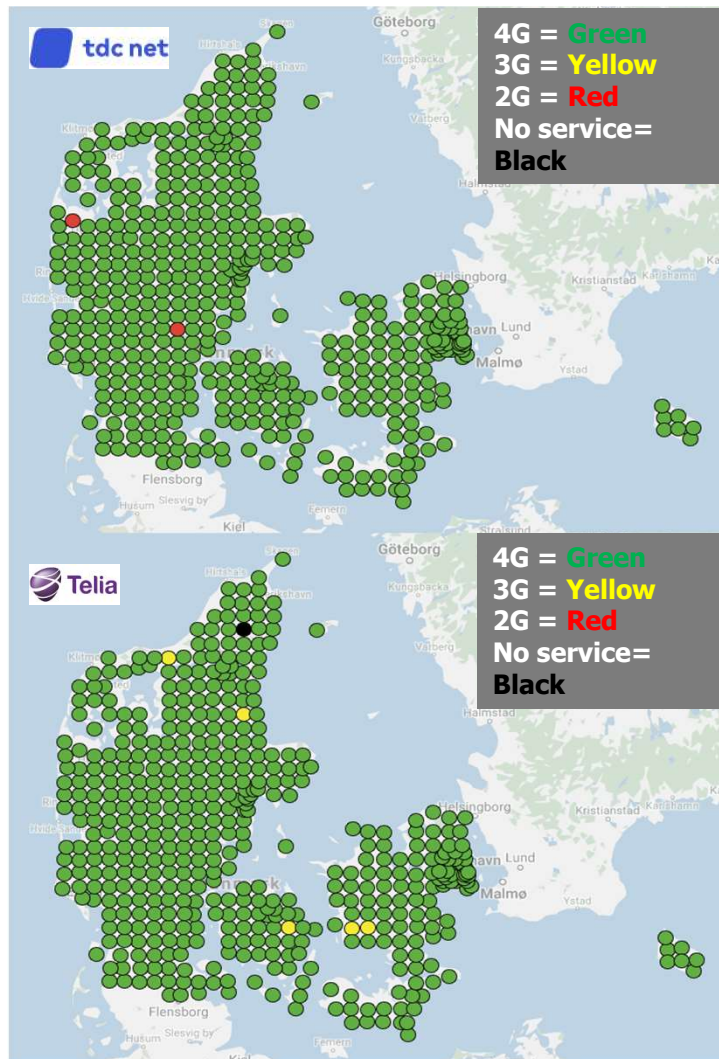


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2019: Access to 4G, 3G and 2G



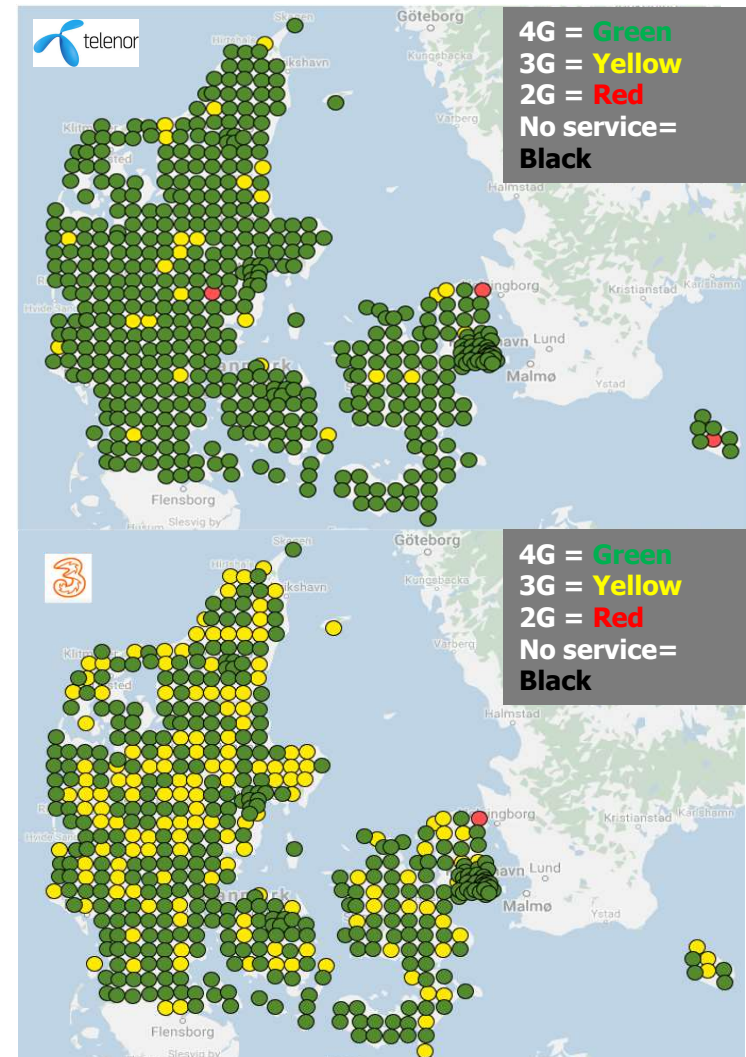
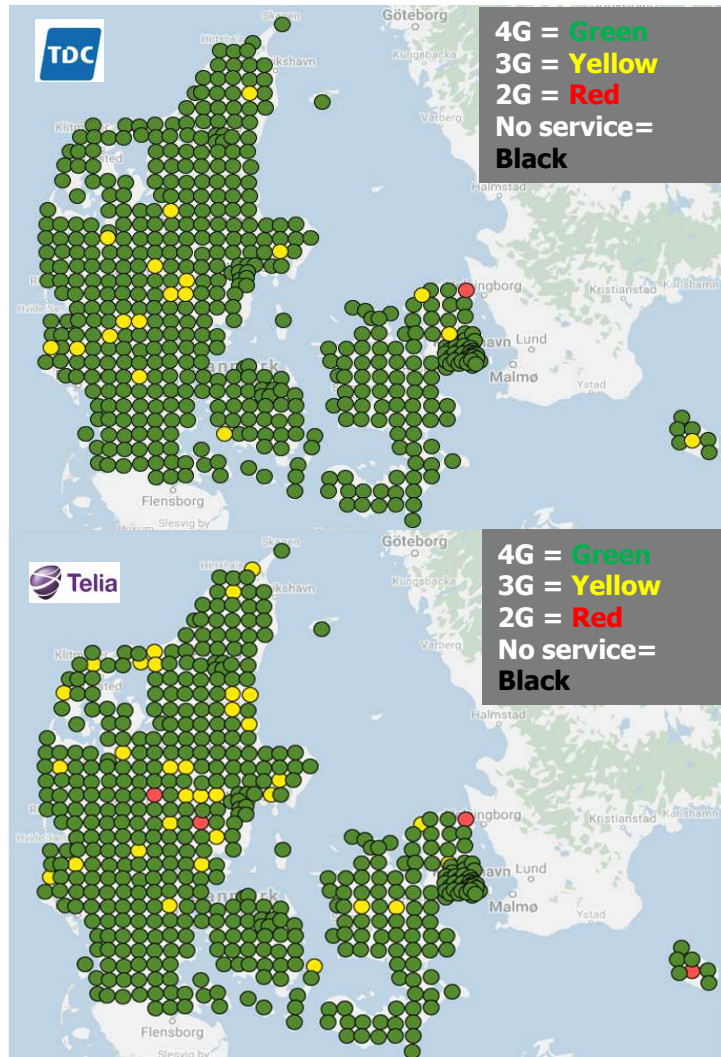
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2018: Access to 4G, 3G and 2G

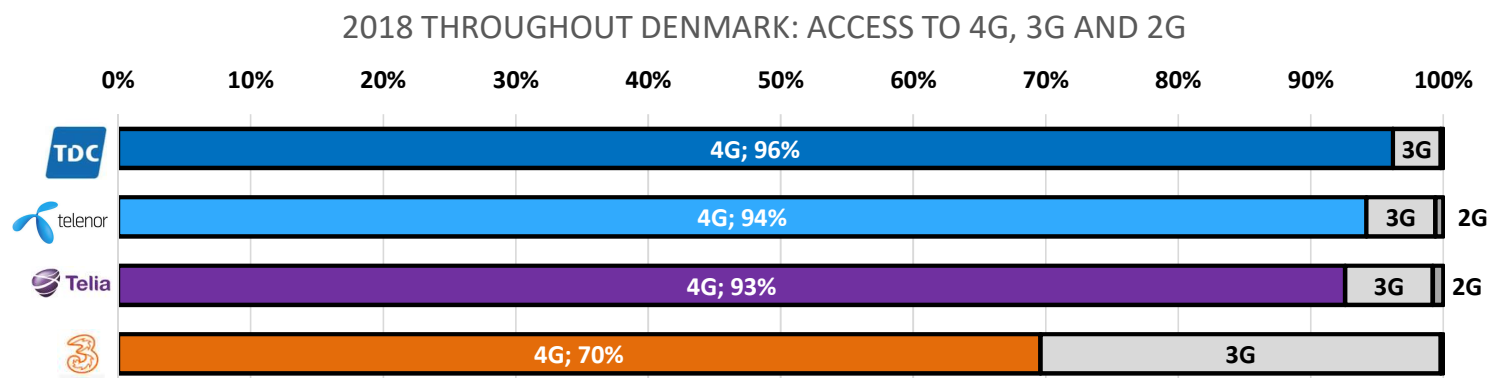
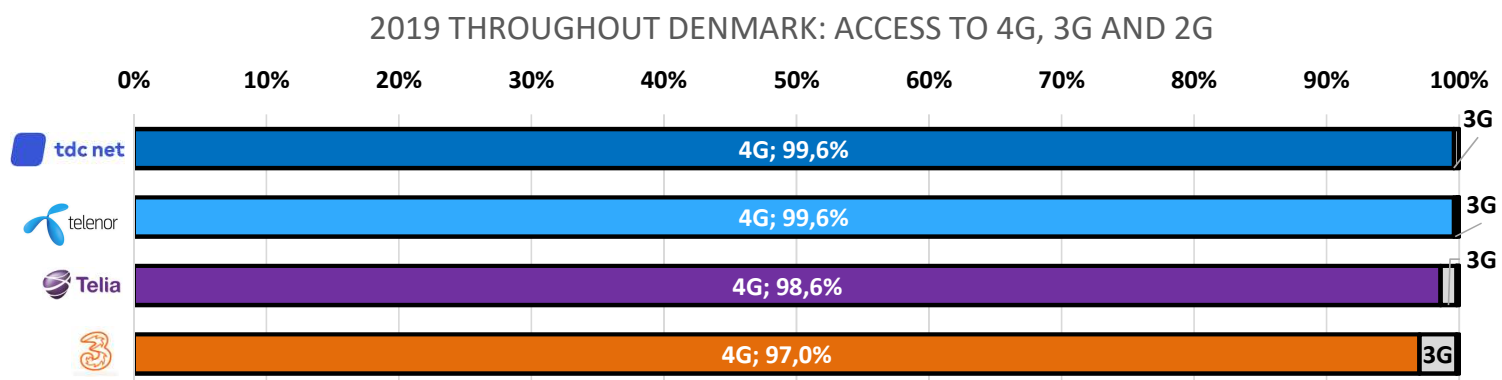


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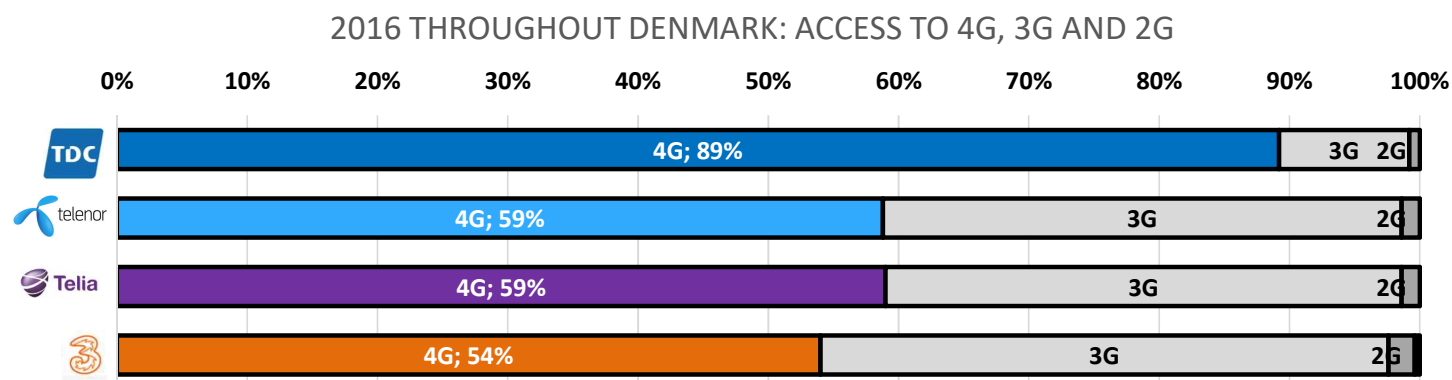
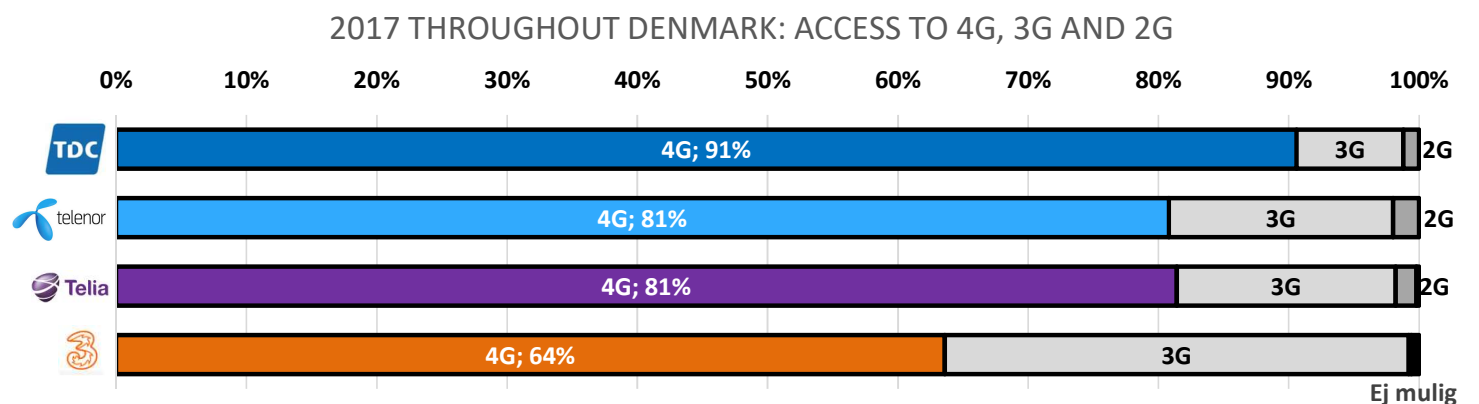
National result of access to 4G in 2019 and 2018

In 2019, all 4 network providers by and large had the same access to 4G



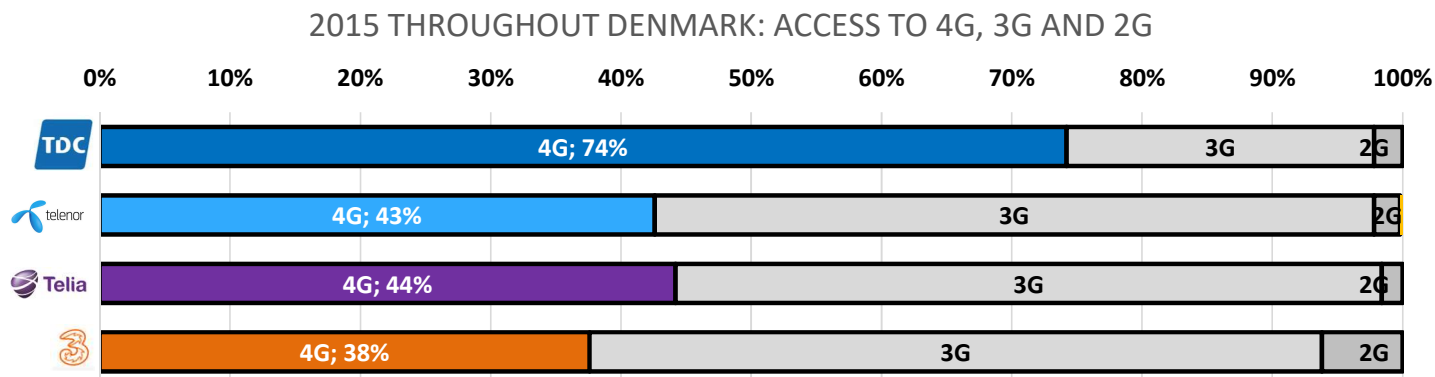
National result of access to 4G in 2017 and 2016

Nationally, TDC had slightly better access to 4G than the other network providers.



National result of access to 4G in 2015

Nationally, TDC had significantly better access to 4G than the other network providers.



A van from Danish Technological Institute at one of the randomly selected test locations – here at a wind turbine farm east of Ringkøbing



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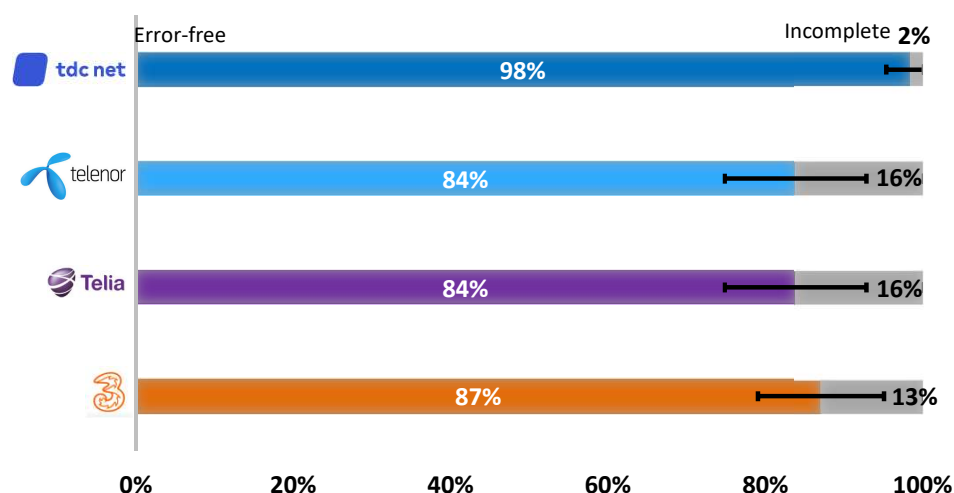


Regional results of mobile network experience 2019

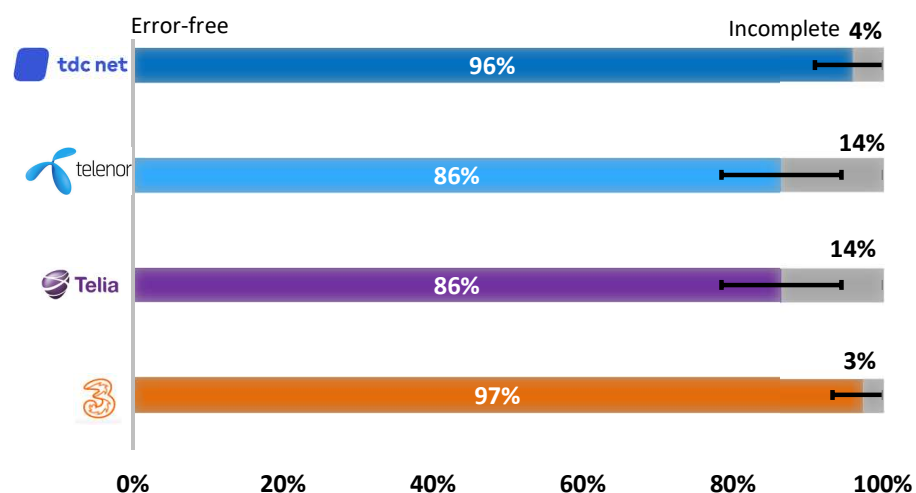
TDC NET has a better mobile network experience* than Telenor, Telia and 3 in the Capital Region of Denmark.

In Region Zealand, 3 and TDC NET statistically take the lead. Telenor and Telia come in second.

**CAPITAL REGION OF DENMARK: %
THE GOOD MOBILE NETWORK EXPERIENCE**



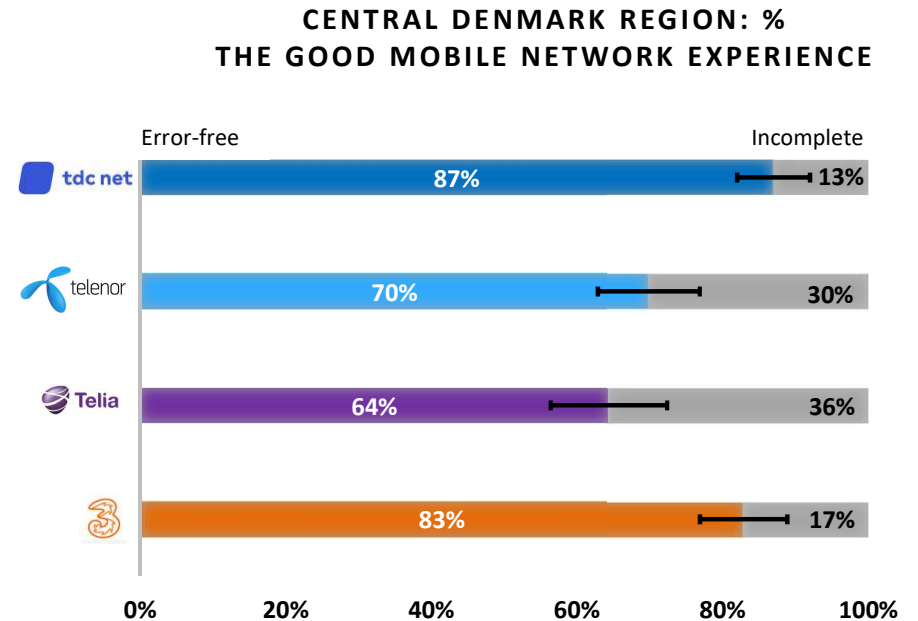
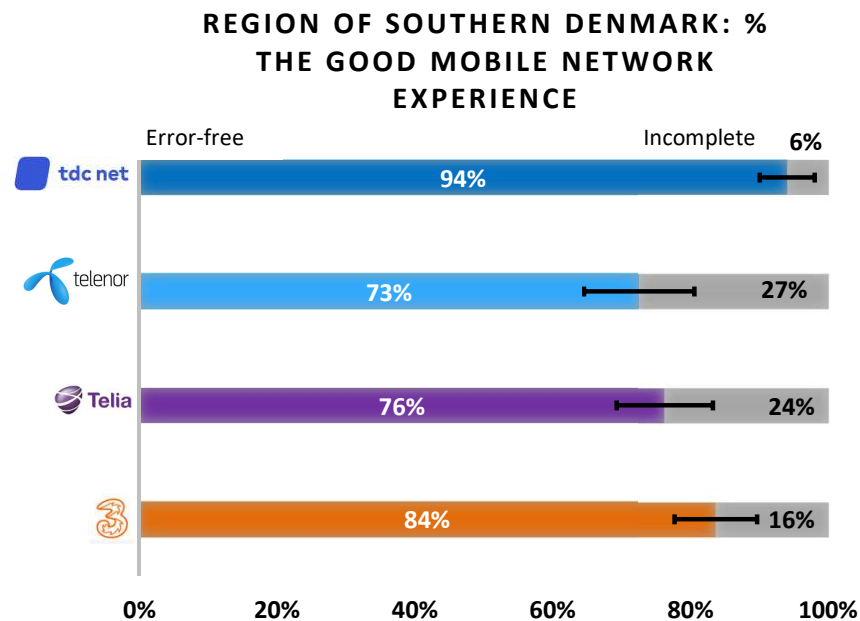
**REGION ZEALAND: %
THE GOOD MOBILE NETWORK EXPERIENCE**



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Regional results of mobile network experience 2019

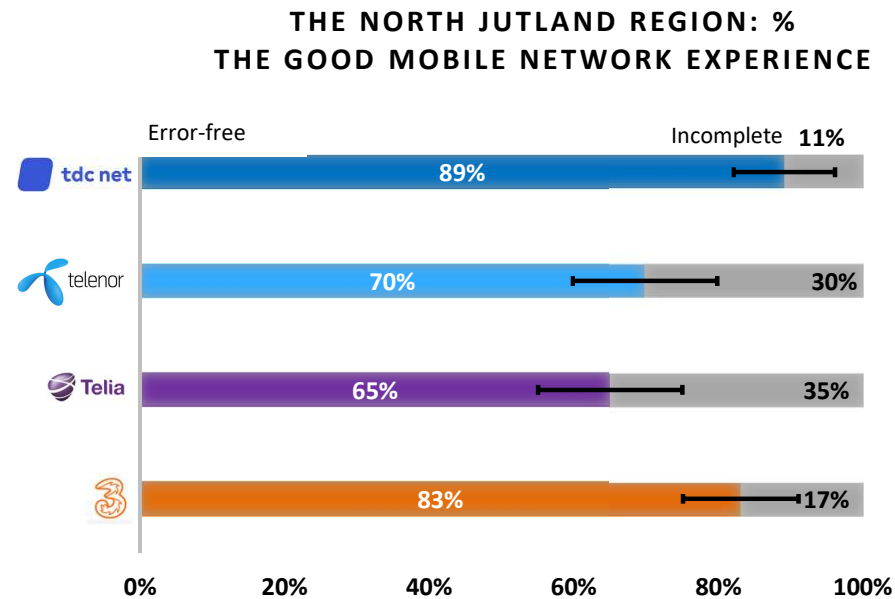
TDC NET has a better mobile network experience* than Telenor, Telia and 3.
3 comes in second in the Region of Southern Denmark and in the Central Denmark Region.



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Regional results of mobile network experience 2019

TDC NET has a better mobile network experience* than Telenor, Telia and 3.
3 comes in second and Telenor takes third place.



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A van from Danish Technological Institute at one of the randomly selected test locations – here at Østerild wind turbine farm north of Thisted

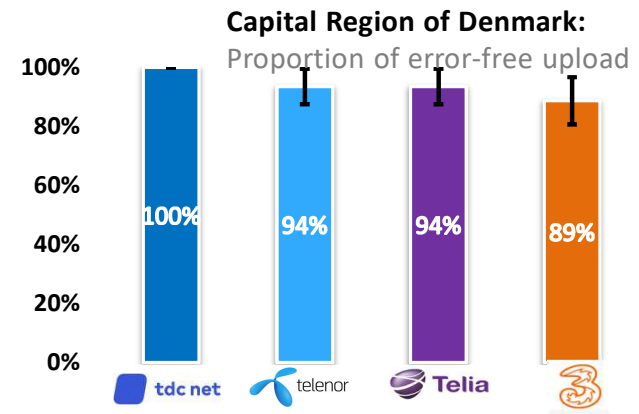
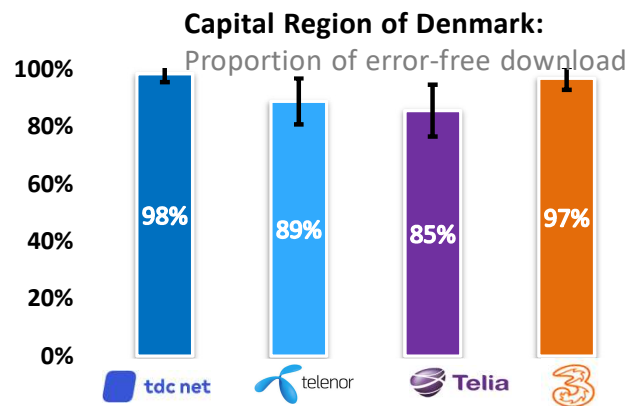
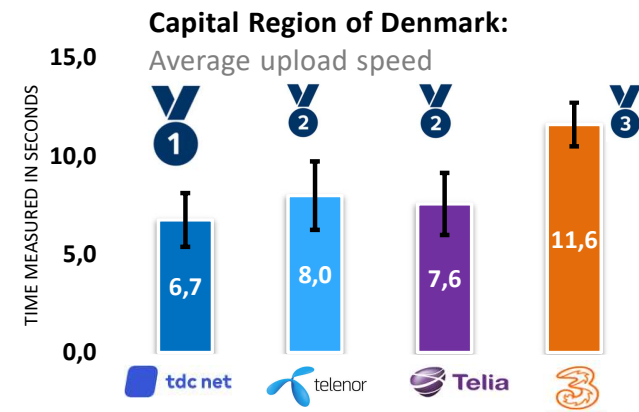
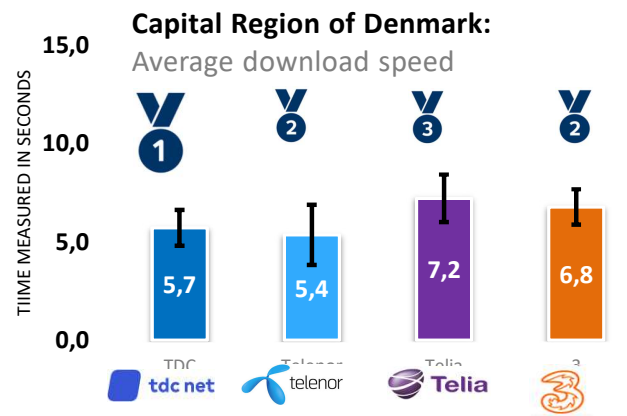


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Regional results of download and upload speeds 2019

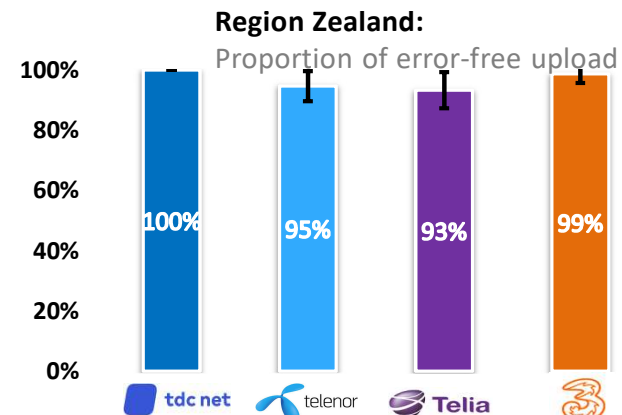
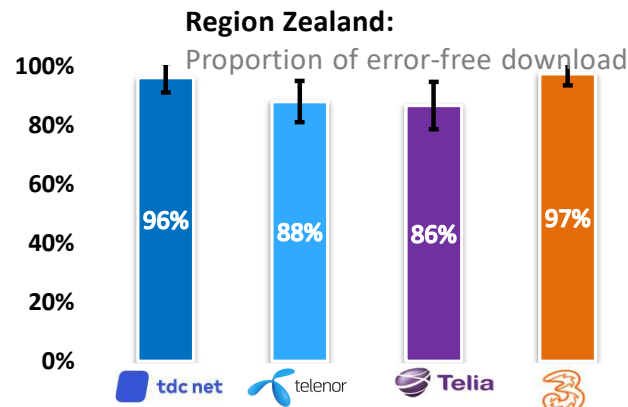
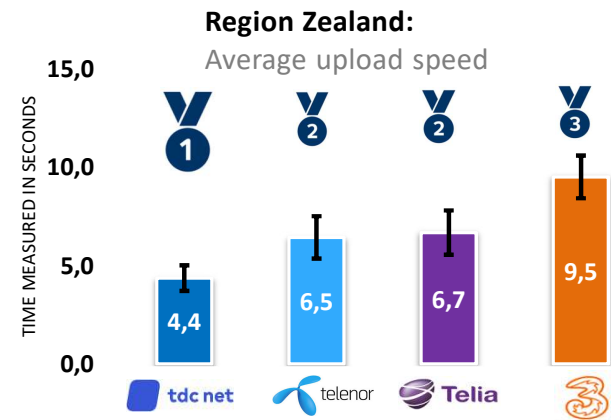
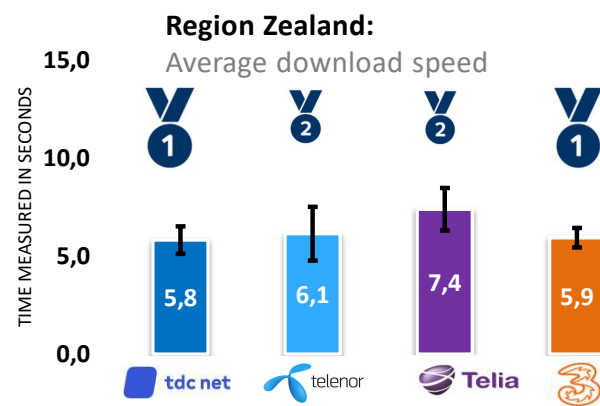
TDC NET has the best upload speed in the Capital Region of Denmark. Telenor and TDC NET by and large have the same download speeds, but TDC NET is most error-free and therefore the best.



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

Regional results of download and upload speeds 2019

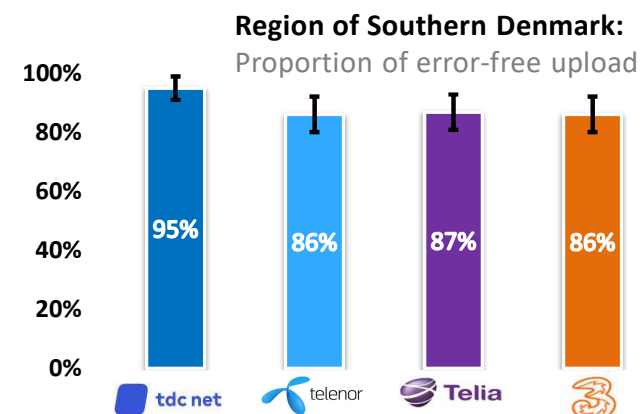
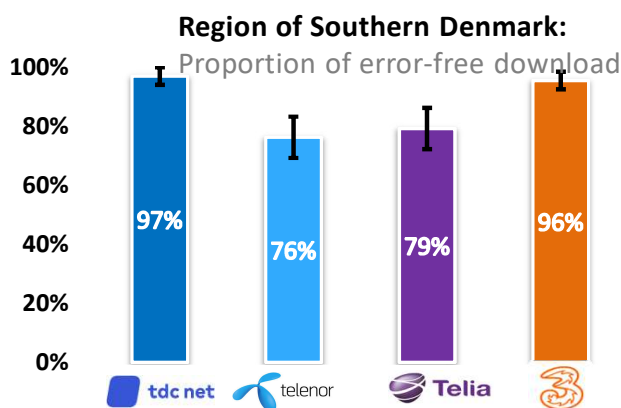
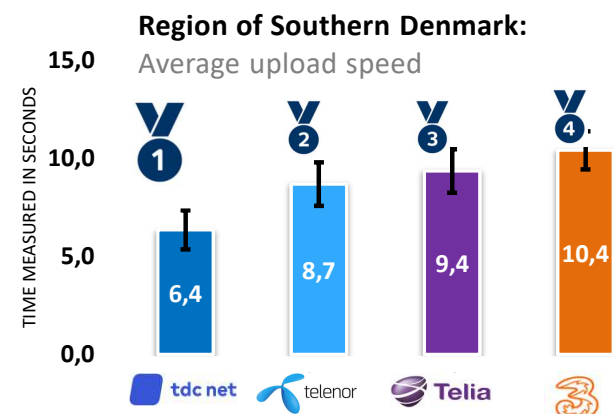
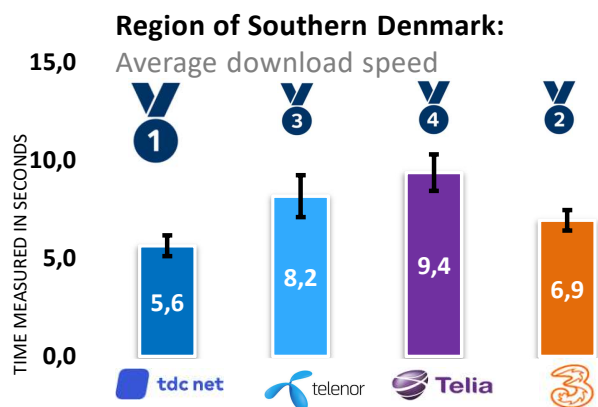
TDC NET has the best upload speed in Region Zealand, but Telenor, 3 and TDC NET by and large have the same download speeds.



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

Regional results of download and upload speeds 2019

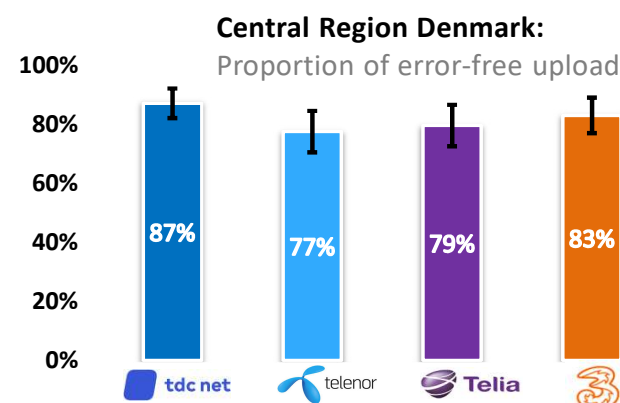
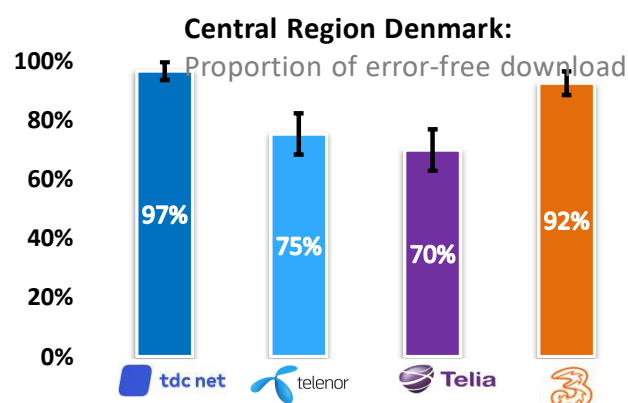
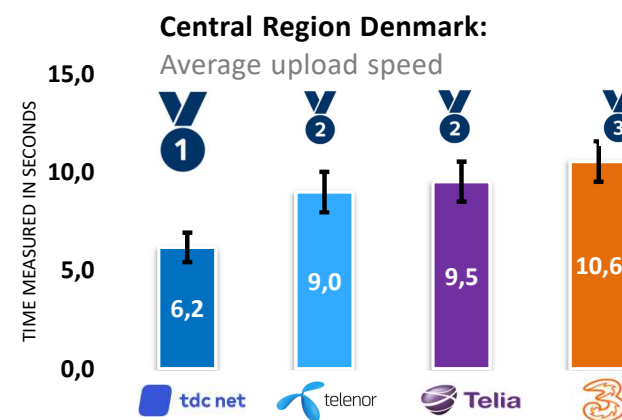
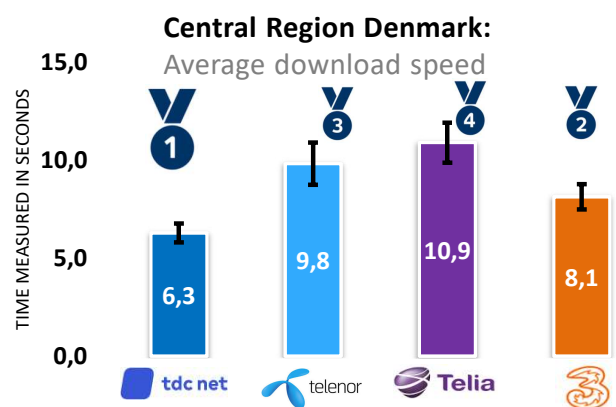
TDC NET has faster and more error-free* download and upload speeds than Telenor, Telia and 3 in the Region of Southern Denmark.



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

Regional results of download and upload speeds 2019

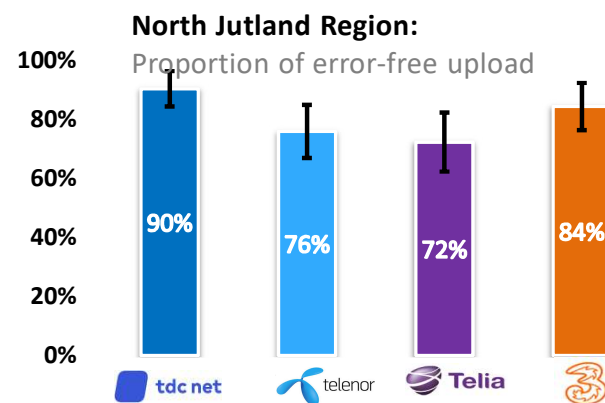
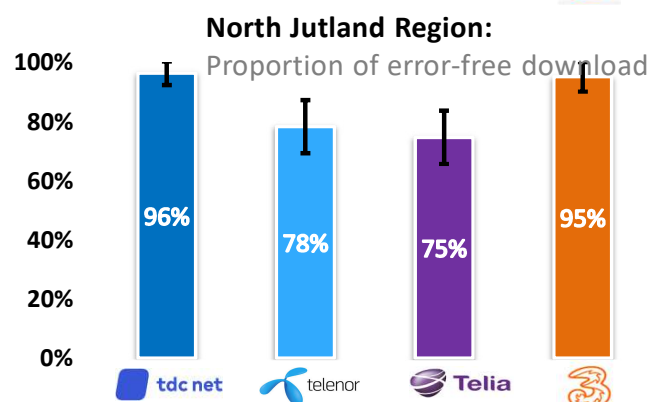
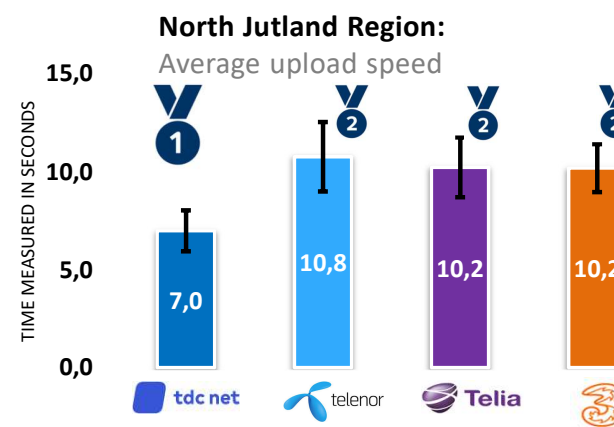
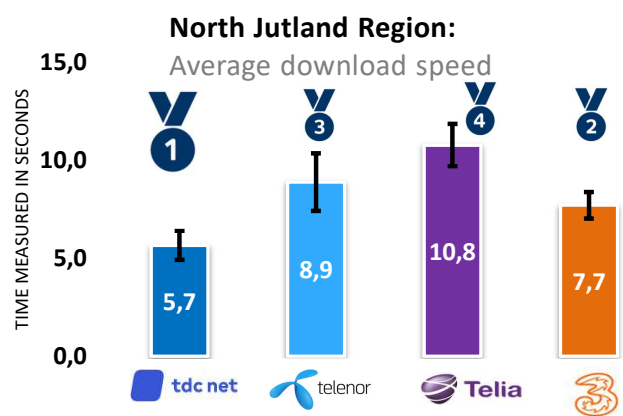
TDC NET has significantly faster and more error-free* download and upload speeds than Telenor, Telia and 3 in the Central Denmark Region.



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

Regional results of download and upload speeds 2019

TDC NET has significantly faster and more error-free* download and upload speeds than Telenor, Telia and 3 in the North Jutland Region.



*TDC NET defines a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 15 sec. - 10 MB upload within 30 sec. - 60 sec. YouTube video 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 south of Højer, west of Tønder

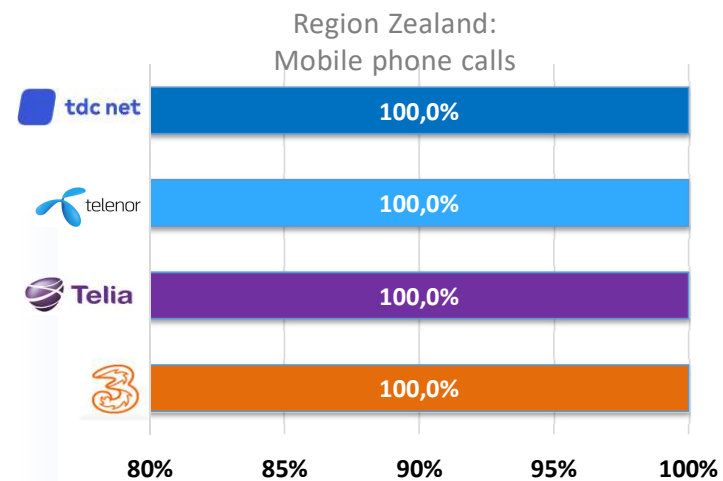
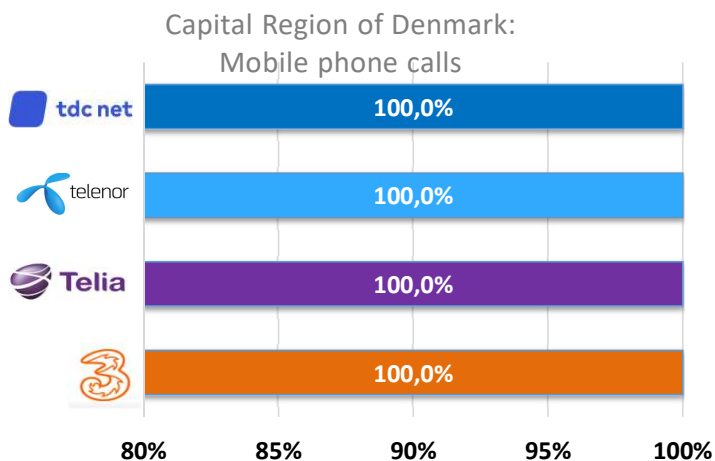


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Regional results of ordinary mobile phone conversations 2019

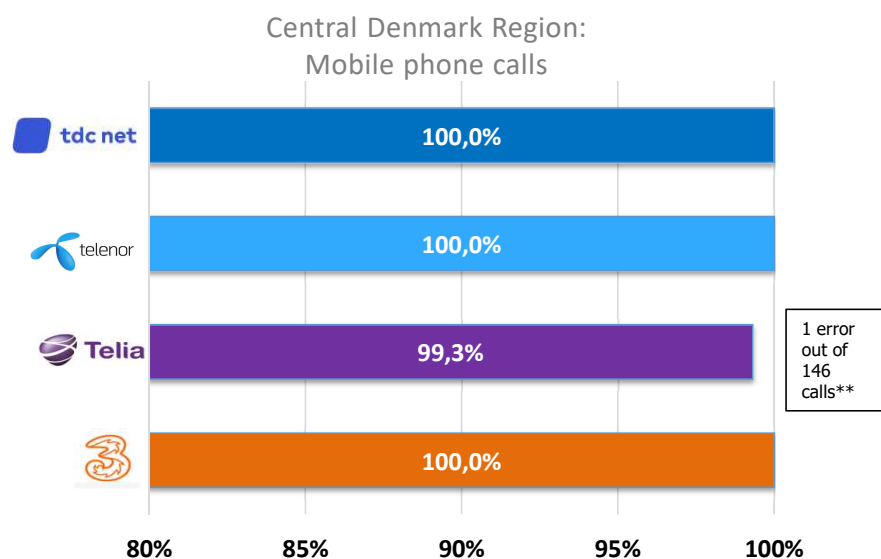
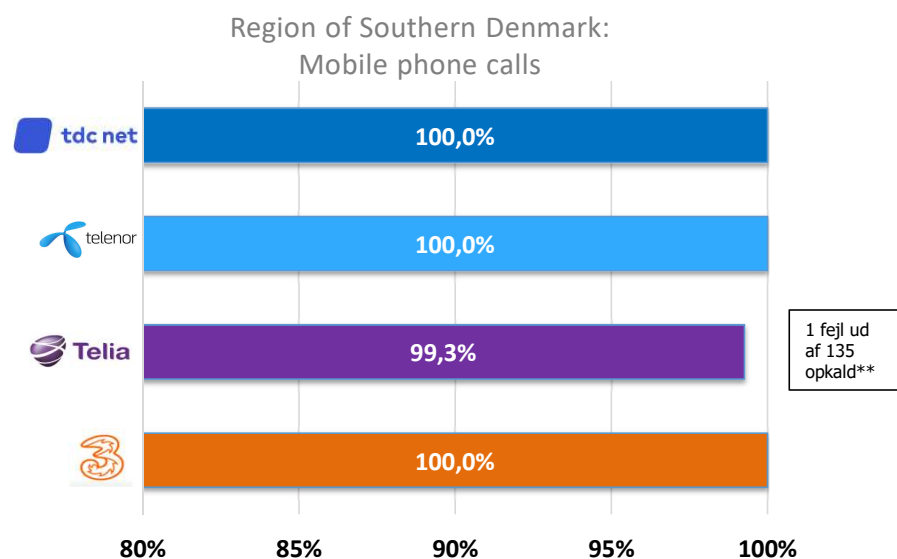
Ordinary mobile phone conversations* show no significant differences between TDC NET, Telenor, Telia and 3.



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

Regional results ordinary mobile phone conversations 2019

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

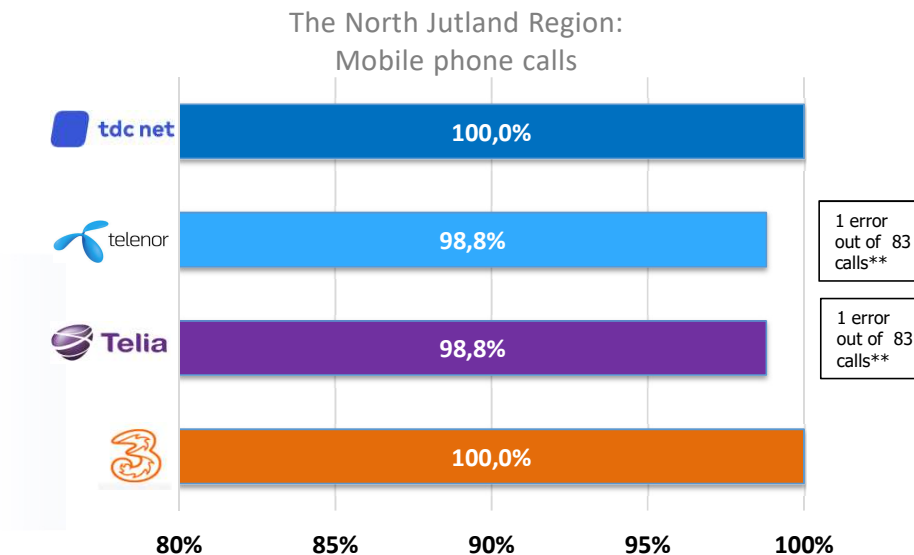


*TDC NET defines a good mobile network experience as: 30 sec. error-free mobile phone conversation - 10 MB download within 15 sec. - 10 MB upload within 30 sec. - 60 sec. YouTube video without buffering waiting time.

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

Regional results ordinary mobile phone conversations 2019

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



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

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

A van from Danish Technological Institute at one of the randomly selected test locations – here in nature reserve Thy

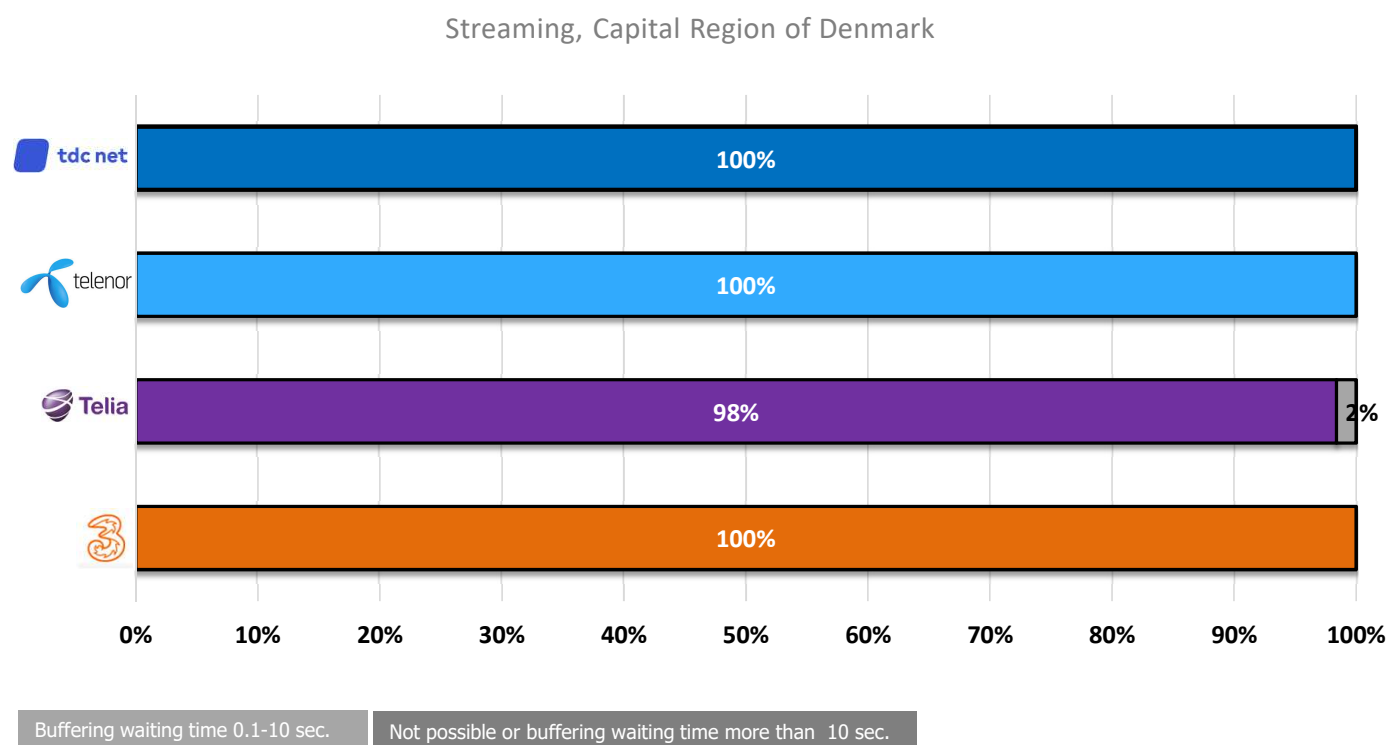


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Regional results video streaming 2019

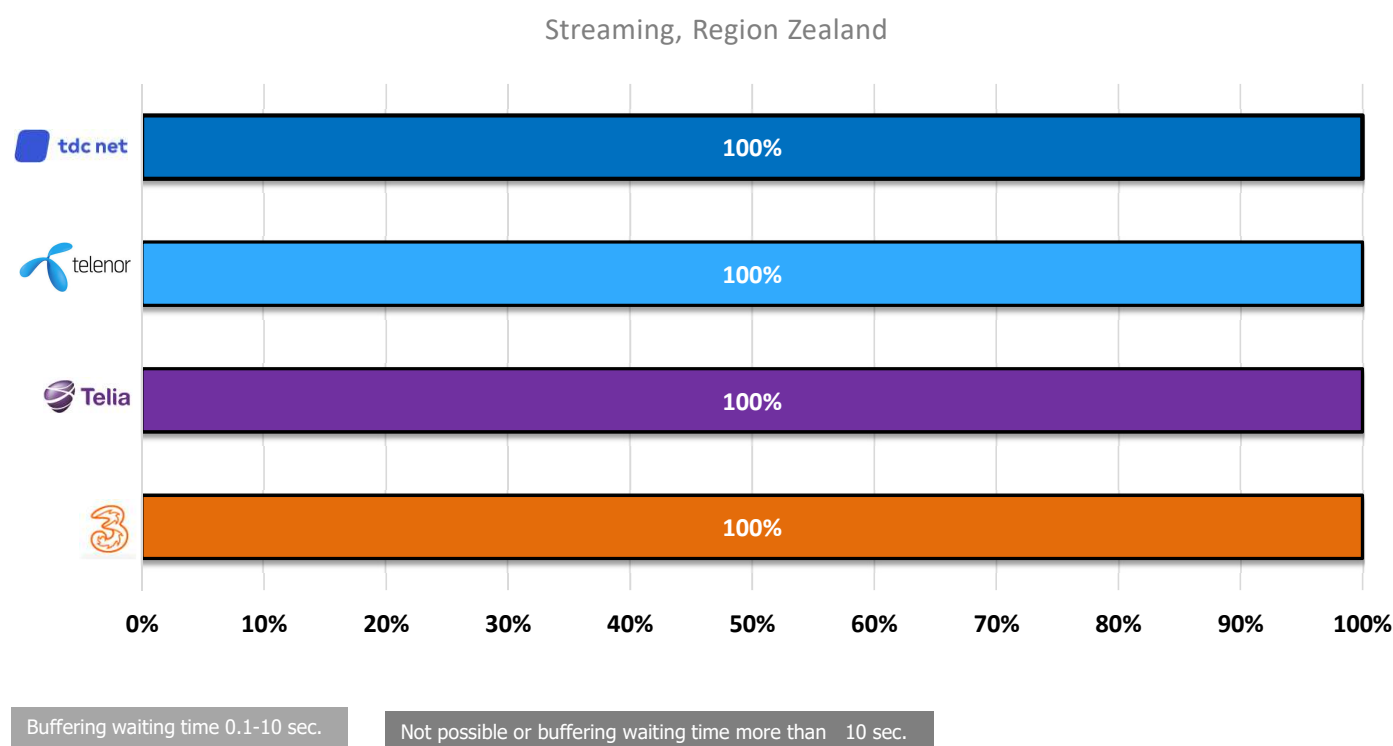
No significant difference in video streaming in the Capital Region of Denmark.



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

Regional results video streaming 2019

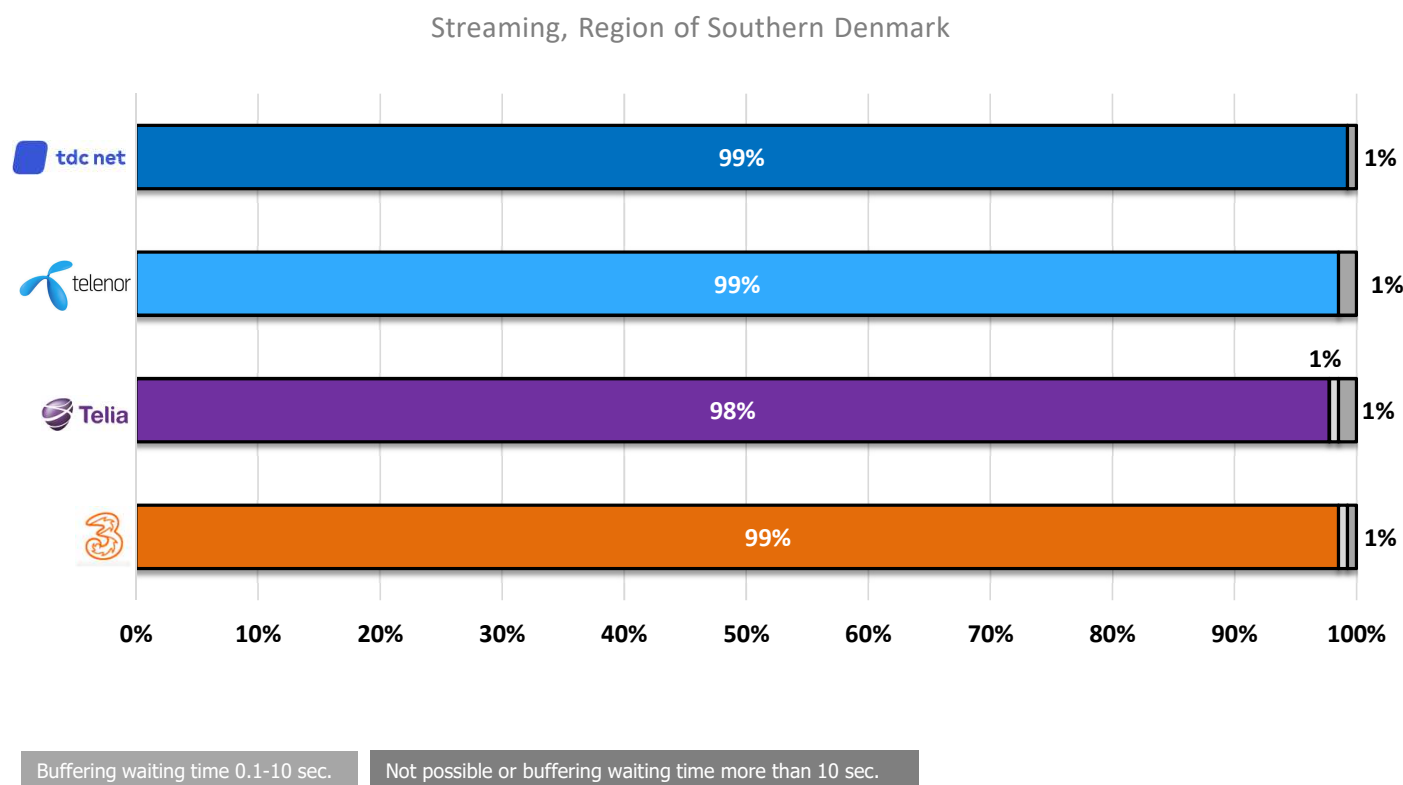
No difference in video streaming in Region Zealand.



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

Regional results video streaming 2019

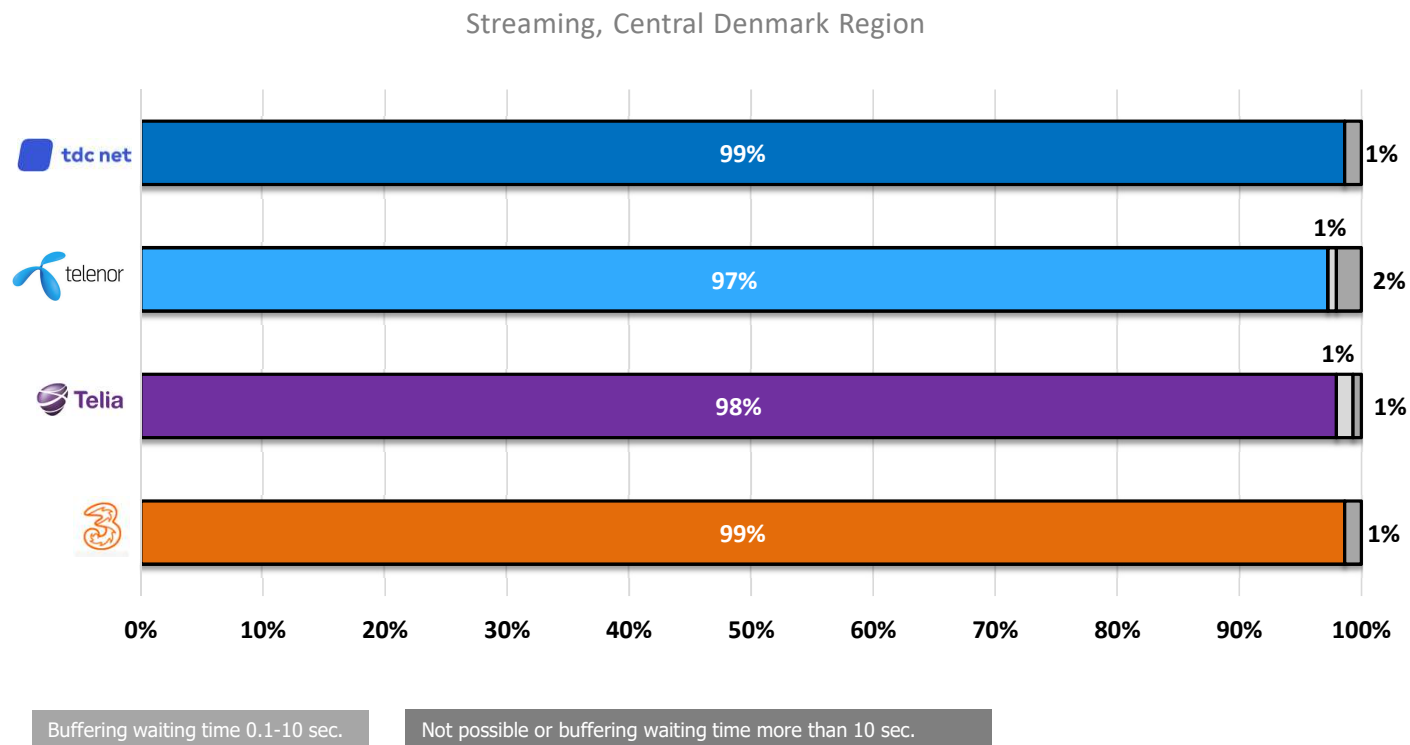
No significant difference in video streaming in the Region of Southern Denmark.



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

Regional results video streaming 2019

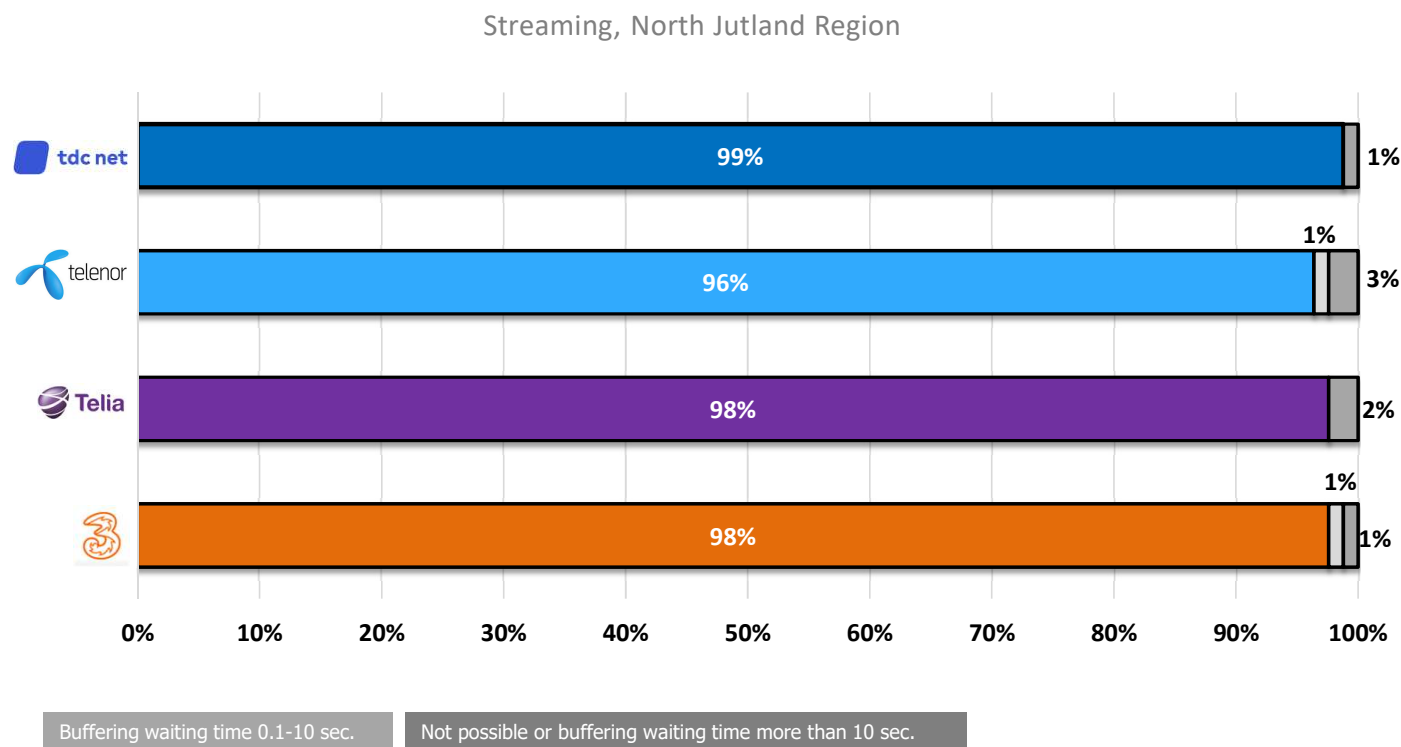
No significant difference in video streaming in Central Denmark Region.



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

Regional results video streaming 2019

No significant difference between TDC NET, Telia and 3 in video streaming in North Jutland Region. Telenor is a bit lower.



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

A van from Danish Technological Institute at one of the randomly selected test locations – here in Rold Forest between Hobro and Aalborg

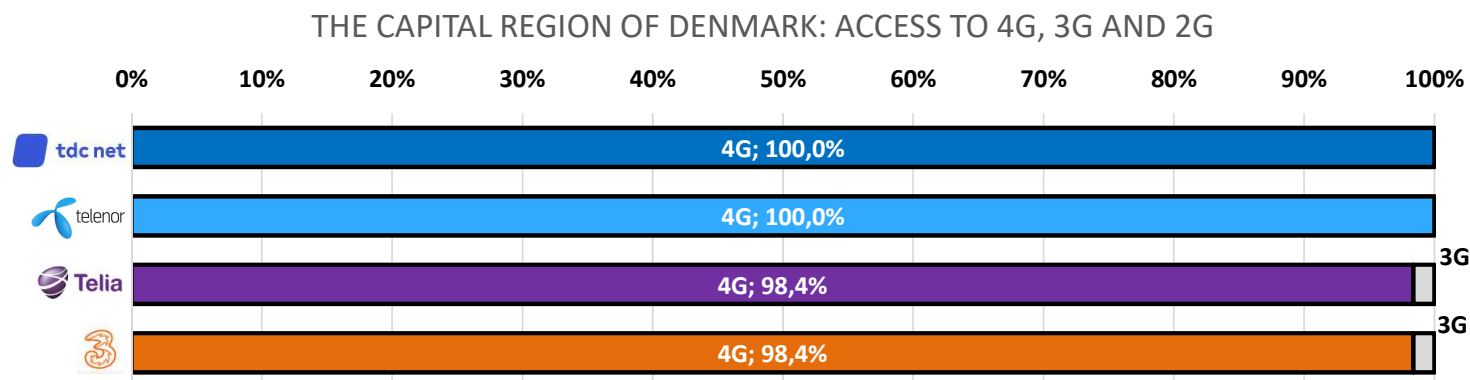


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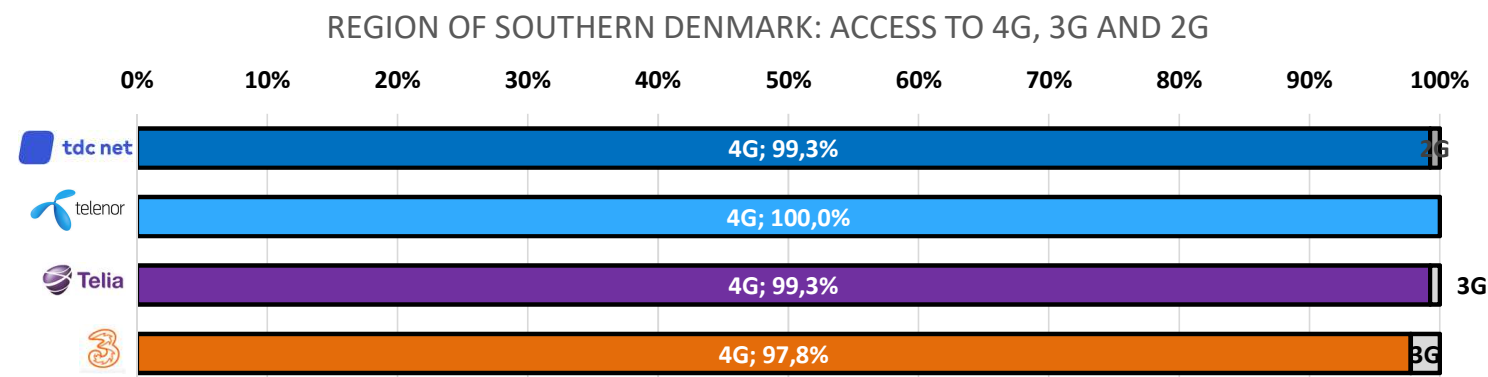
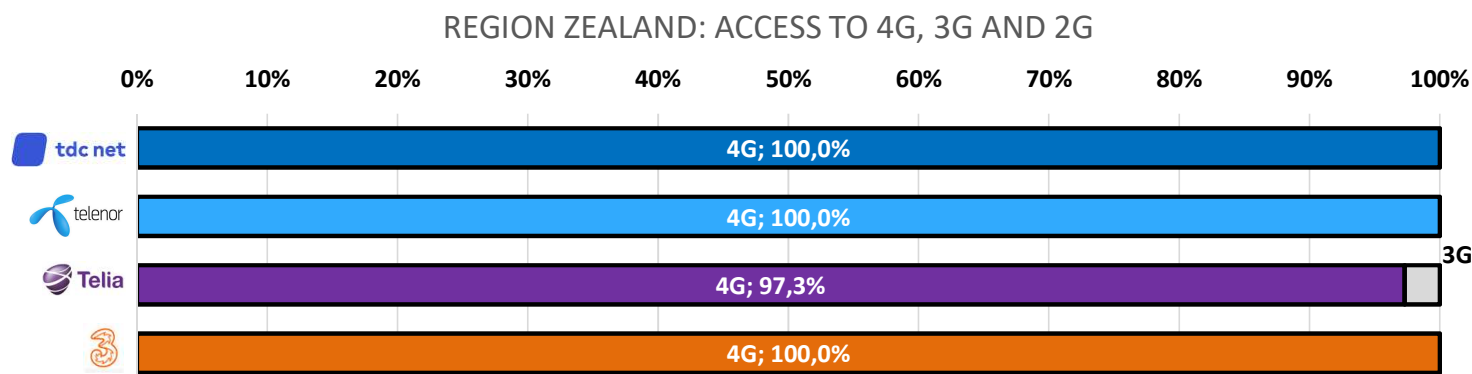
Regional results of access to 4G in 2019

In the Capital Region of Denmark, the 4 network providers by and large have the same access to 4G.



Regional results access to 4G in 2019

In Region Zealand and the Region of Southern Denmark, the 4 network providers by and large have the same access to 4G.

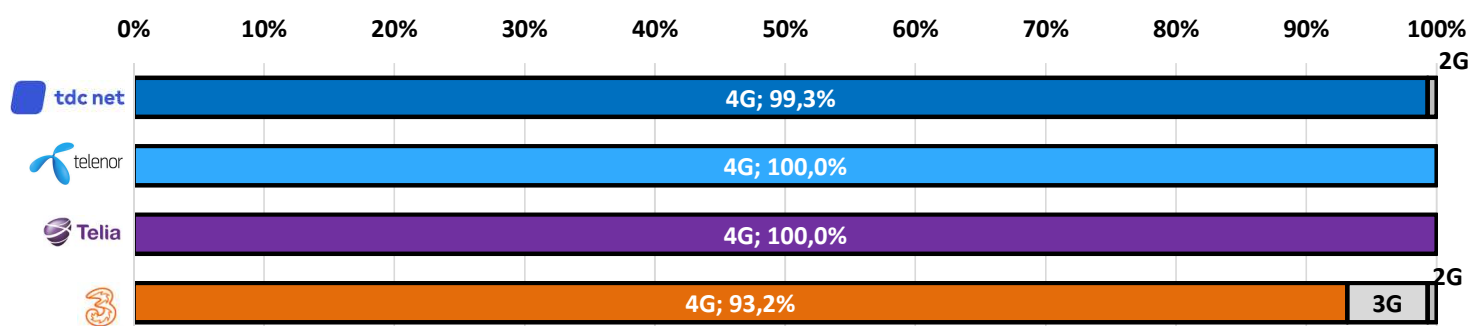


Regional results of access to 4G in 2019

In the Central Denmark Region and in the North Jutland Region, TDC NET, Telenor and Telia by and large have the same access to 4G.

3 has had less access to 4G in Central Denmark Region. Please also refer to map on page 31.

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



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

