

Audit Report

Denmark 2024





Foreword



For the inhabitants of Denmark, it is interesting to see how the operators' mobile networks perform due to the ongoing 5G rollout. In 2024 the scope of the report has been extended. On top on the four most populated cities of Denmark –

Copenhagen, Aalborg, Aarhus and Odense – we have analysed 21 cities and connecting roads across Denmark. In comparison to 2023 the performance of all the Danish mobile networks has been improved. Telia shows the highest overall performance.



Intro

The leader in mobile benchmarking umlaut, has analyzed the mobile networks in Denmark. This year, the approach has been extended to a nationwide approach. On top to the 4 large cities Copenhagen, Aalborg, Aarhus and Odense we measured the mobile network performance in 21 towns and connecting roads.

This report has been requested by Telia. City test area has been provided by third party, Methodology, drive routes and times have been independently selected by umlaut. As the de-facto industry standard, our benchmarking methodology focuses on customer-perceived network quality and covers a wide range of mobile services.

Today, more than 200 mobile networks in more than 120 countries are being evaluated by our unique methodology. It allows a technical analysis that is unprecedented in its level of detail and enables comparisons between the network performance and capability of each mobile network.

Our benchmarks help network operators to demonstrate how well they are delivering wireless connections to consumers, business users and enterprises and reveals the areas of improvement.

Drivetest	Voice	Data
Device	Samsung Galaxy S23+(5G)	Samsung Galaxy S23+(5G)
Test Cases	Mobile-to-Mobile (M2M) Side1 (5G Preferred) to Side2 (5G Preferred) 105 sec call window 70 sec call duration 15 sec call setup timeout Multi-RAB traffic injection on both sides Conversational speech app	Data 5G preferred HTTP DL DataStream 7s HTTP UL DataStream 7s HTTPS 10MB DL fixed file transfer HTTPS 5MB UL fixed file transfer Web Browsing – Kepler E-Gaming Live web pages 1 YouTube Full HD video ~ 45s 1 YouTube live stream ~ 45s
Mobility and Route Types	100% Drivetest Small Country Approach	
Samples	13059	105038
Dates	17 measurement days 08.01.2024 – 26.01.2024	



Testing area



6506km
measuring distance



50%
of the population
was covered

Cities

- Copenhagen (incl. Taastrup)
- Odense
- Aarhus
- Aalborg (incl. Norresundby)

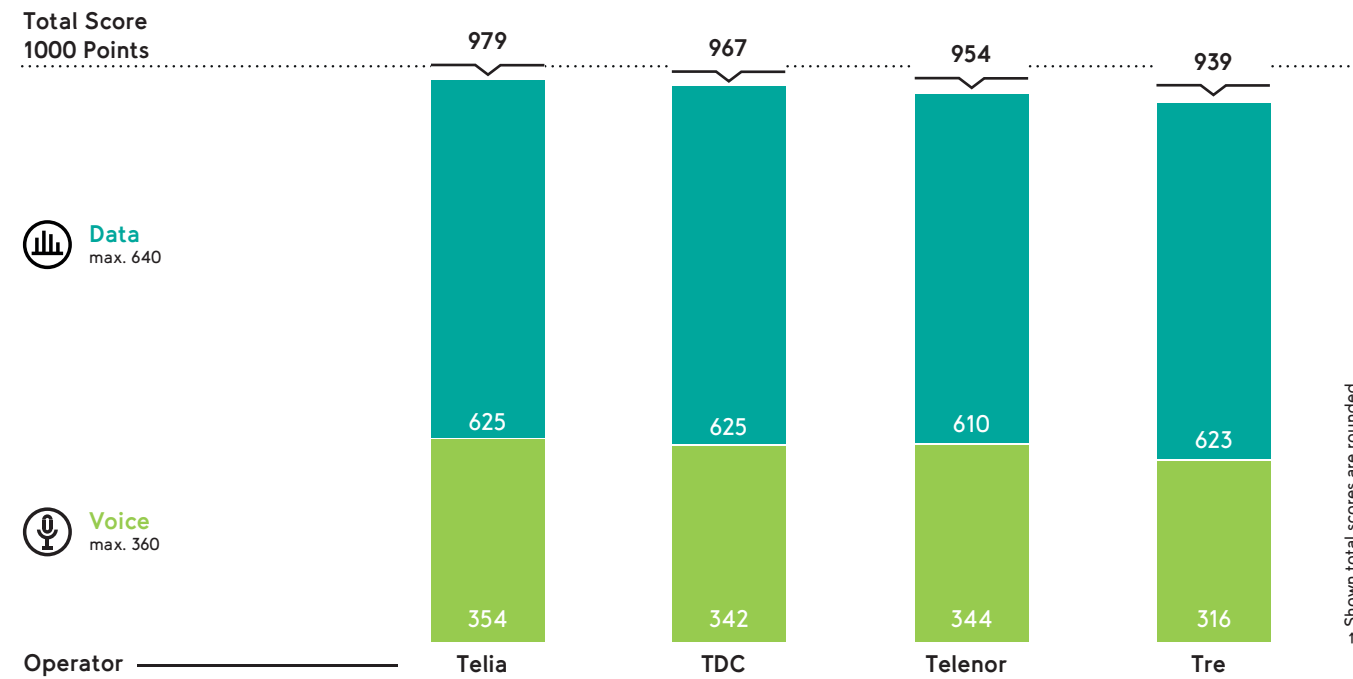
Towns

- Horsholm
- Hillerod
- Holbaek
- Koge
- Svendborg
- Sonderborg
- Kolding
- Viborg
- Vejle
- Silkeborg
- Hjorring
- Helsingor
- Roskilde
- Naestved
- Slagelse
- Fredericia
- Esbjerg
- Holstebro
- Horsens
- Herning
- Randers



Total Score

Overall results for nationwide assessment



Overall score considering Voice and Data.

Total score

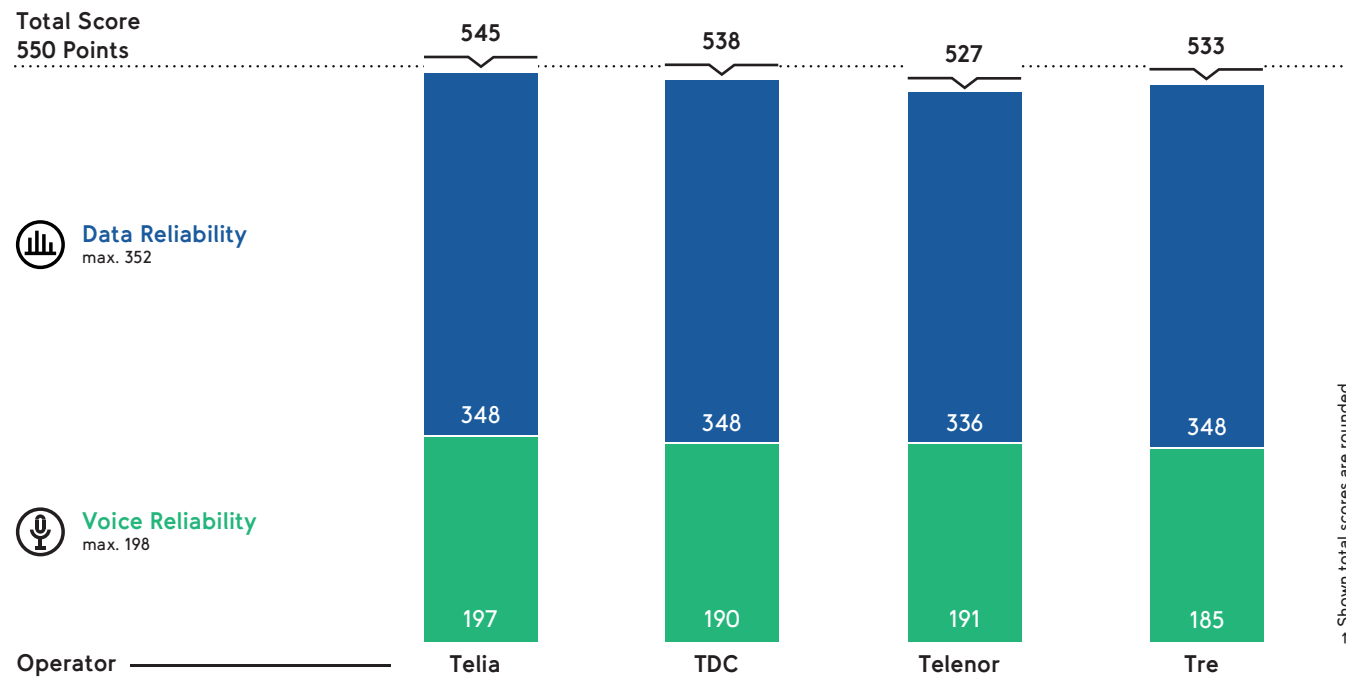
		Telia	TDC	Telenor	Tre
Voice	max. 360	354	342	344	316
Cities	216	99%	94%	96%	87%
Towns	72	97%	95%	94%	88%
Roads	72	98%	97%	95%	90%
Data	max. 640	625	625	610	623
Cities	384	98%	98%	96%	98%
Towns	128	98%	97%	95%	97%
Roads	128	95%	97%	93%	94%
Total	1000	979	967	954	939

Shown scores are rounded. The umlaut Score is based on a scale from 0–1000 points. Score achievement in school grades: outstanding (>950), very good (>850 and <950), good (>750 and <850), satisfactory (<650 and <750), sufficient (<550 and <650).



Reliability Score — nationwide

Reliability distinguishes between "Qualifiers", the expected basic performance, and "Differentiators", the additional performance that exceeds the expected basics. This approach concentrates on the compulsory basics and fulfillment of minimum expectations to a working service instead of the highest peaks of a network's performance.



Reliability score considering Voice Reliability and Data Reliability.

Total score

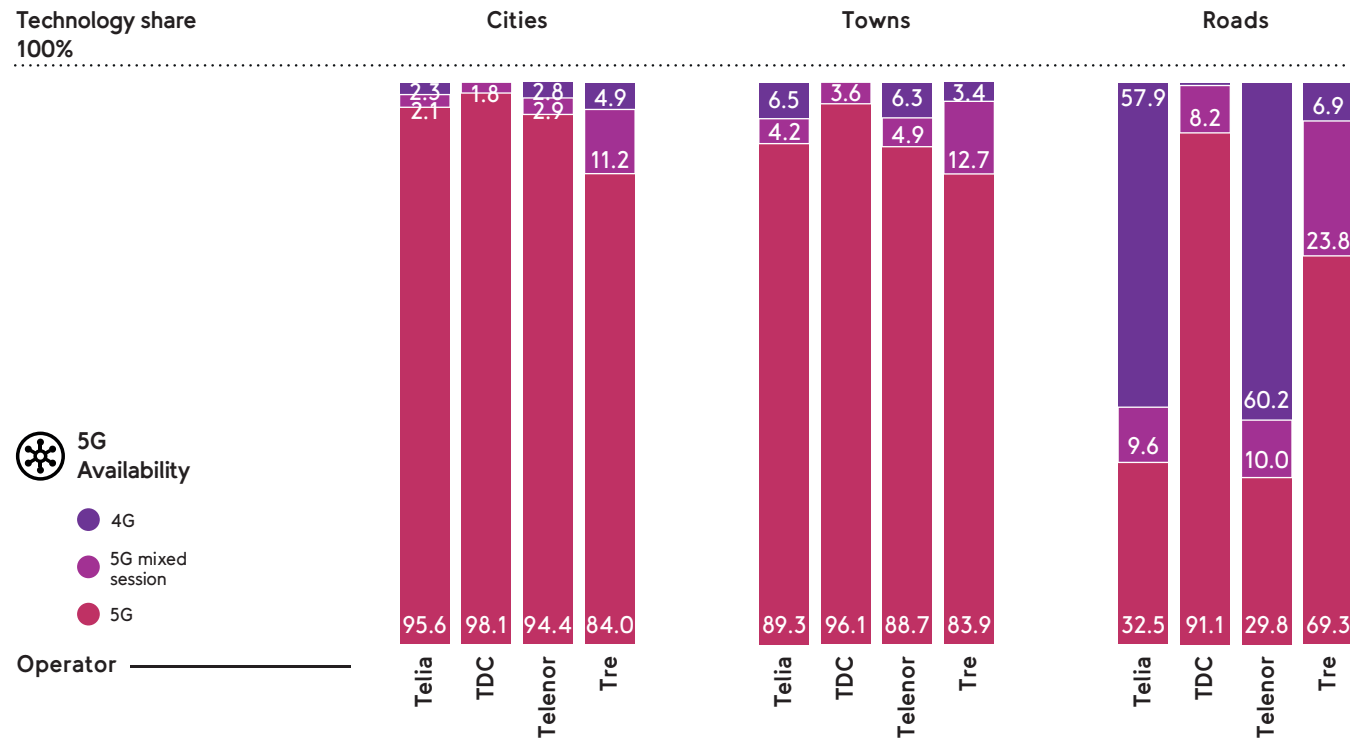
Service Group		max	Telia	TDC	Telenor	Tre
Reliability	Voice Reliability	198	99%	96%	96%	93%
	Data Reliability	352	99%	99%	96%	99%

Score achievement in school grades: outstanding (>95%), very good (>85% and <95%), good (> 75% and < 85%), satisfactory (< 65% and <75%), sufficient (<55% and <65%).



5G Availability — nationwide

Technology share overall



Overall share of technology used for conveying data traffic per aggregation.

* Share of technology is lower than 3%.





Voice KPI overview

Achieved values of all networks under test in each of the relevant Voice Key Performance Indicators (KPIs) for the geographical category "Cities", "Towns" and "Roads".

Voice	Service Group	Unit	Telia	TDC	Telenor	Tre
Cities	Qualifier	[%]	100,0	99,5	99,7	99,2
	Call Setup Time (P90)	[s]	1,1	2,0	1,9	4,1
	Speech Quality (P10)	[MOS-LQO]	4,4	4,2	4,4	4,1
	Multirab connectivity	[%]	100,0	100,0	99,9	100,0
Towns	Qualifier	[%]	99,8	99,6	99,4	99,3
	Call Setup Time (P90)	[s]	1,0	2,1	2,0	4,2
	Speech Quality (P10)	[MOS-LQO]	4,4	4,2	4,4	4,2
	Multirab connectivity	[%]	100,0	100,0	100,0	100,0
Roads	Qualifier	[%]	99,8	99,8	99,3	99,5
	Call Setup Time (P90)	[s]	1,2	2,0	2,1	4,3
	Speech Quality (P10)	[MOS-LQO]	4,3	4,2	4,3	4,1
	Multirab connectivity	[%]	100,0	100,0	100,0	99,8



Data Services KPI overview

Achieved values of all networks under test in each of the relevant Data Key Performance Indicators (KPIs) for the geographical category "Cities".

Data Cities	KPI Name	Unit	Telia	TDC	Telenor	Tre
HTTP Web Page DL Smartphone	Qualifier	[%]	99,9	99,9	99,9	100,0
	Overall Session Time	[s]	0,9	1,0	1,1	1,1
HTTP 10MB DL Smartphone	Qualifier	[%]	100,0	100,0	100,0	100,0
	Overall Session Time	[s]	0,5	0,6	0,6	0,6
	90% faster than	[Mbit/s]	157,8	147,3	182,0	138,2
	10% faster than	[Mbit/s]	459,8	410,3	404,0	362,0
HTTP 5MB UL Smartphone	Qualifier	[%]	99,9	100,0	96,9	100,0
	Average Session Time	[s]	1,1	1,4	1,6	1,3
	90% faster than	[Mbit/s]	26,5	19,5	23,3	21,4
	10% faster than	[Mbit/s]	99,6	90,5	94,4	77,7
HTTP DL FDDT	Qualifier	[%]	99,9	99,9	100,0	100,0
	10% faster than	[Mbit/s]	758,4	999,0	1029,8	913,2
	faster than 20 Mbit/s	[%]	99,9	99,6	99,8	99,2
	faster than 100 Mbit/s	[%]	99,3	97,0	99,1	96,1
HTTP UL FDDT	Qualifier	[%]	99,8	100,0	99,9	100,0
	10% faster than	[Mbit/s]	135,2	135,1	135,0	149,4
	faster than 2 Mbit/s	[%]	100,0	100,0	100,0	100,0
	faster than 5 Mbit/s	[%]	99,8	99,9	100,0	100,0
YouTube	Qualifier	[%]	99,9	99,5	99,7	100,0
	Start Time	[s]	1,6	1,6	1,7	1,7
	AVG Resolution	[p]	1079,1	1079,5	1079,6	1079,5
YouTube Live Smartphone	Qualifier	[%]	100,0	100,0	99,7	99,9
	Start Time	[s]	2,0	2,0	2,2	2,1
	AVG Resolution	[p]	1079,7	1079,9	1080,0	1080,0
Interactivity	Qualifier	[%]	98,2	96,3	98,8	98,3
	Interactivity egaming	[%]	83,1	81,9	80,5	79,8
Conversational App	Qualifier	[%]	99,8	99,9	99,9	99,8
	Speech Quality (P10)	[MOS-LQO]	3,4	3,7	3,4	3,4



Data Services KPI overview

Achieved values of all networks under test in each of the relevant Data Key Performance Indicators (KPIs) for the geographical category "Towns".

Data Towns	KPI Name	Unit	Telia	TDC	Telenor	Tre
HTTP Web Page DL Smartphone	Qualifier	[%]	100,0	100,0	100,0	100,0
	Overall Session Time	[s]	1,0	1,2	1,2	1,1
HTTP 10MB DL Smartphone	Qualifier	[%]	100,0	100,0	100,0	100,0
	Overall Session Time	[s]	0,5	1,0	0,6	0,7
	90% faster than	[Mbit/s]	145,2	59,4	154,4	116,2
	10% faster than	[Mbit/s]	452,0	347,8	396,0	347,8
HTTP 5MB UL Smartphone	Qualifier	[%]	100,0	100,0	96,5	100,0
	Average Session Time	[s]	1,2	1,6	1,8	1,7
	90% faster than	[Mbit/s]	22,9	16,9	22,7	15,6
	10% faster than	[Mbit/s]	94,9	83,2	89,4	79,2
HTTP DL FDTT	Qualifier	[%]	100,0	99,6	100,0	99,8
	10% faster than	[Mbit/s]	732,6	941,8	1020,9	903,2
	faster than 20 Mbit/s	[%]	99,6	98,0	99,8	99,1
	faster than 100 Mbit/s	[%]	97,3	83,8	96,3	69,0
HTTP UL FDTT	Qualifier	[%]	99,8	100,0	100,0	100,0
	10% faster than	[Mbit/s]	132,4	128,6	125,3	138,1
	faster than 2 Mbit/s	[%]	99,3	100,0	99,8	100,0
	faster than 5 Mbit/s	[%]	98,9	99,6	98,8	99,6
YouTube	Qualifier	[%]	100,0	99,4	99,8	100,0
	Start Time	[s]	1,7	1,8	1,8	1,7
	AVG Resolution	[p]	1079,1	1079,2	1079,5	1079,1
YouTube Live Smartphone	Qualifier	[%]	99,8	100,0	99,2	99,8
	Start Time	[s]	2,1	2,1	2,3	2,2
	AVG Resolution	[p]	1080,0	1079,9	1080,0	1077,4
Interactivity	Qualifier	[%]	97,6	95,4	98,5	97,4
	Interactivity egaming	[%]	80,8	77,9	77,5	77,3
Conversational App	Qualifier	[%]	100,0	100,0	99,8	99,8
	Speech Quality (P10)	[MOS-LQO]	3,4	3,1	3,3	3,3



Data Services KPI overview

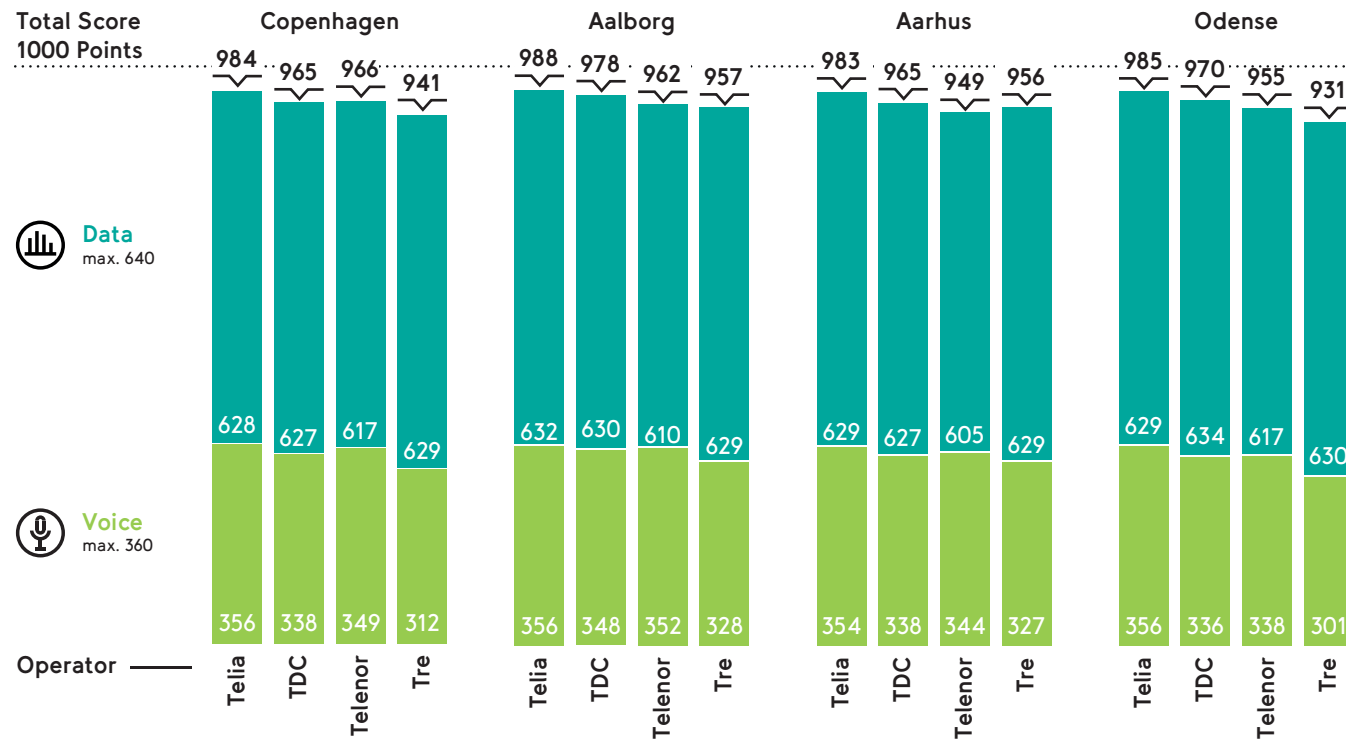
Achieved values of all networks under test in each of the relevant Data Key Performance Indicators (KPIs) for the geographical category "Roads".

Data Roads	KPI Name	Unit	Telia	TDC	Telenor	Tre
HTTP Web Page DL Smartphone	Qualifier	[%]	99,9	99,9	99,8	99,8
	Overall Session Time	[s]	1,2	1,2	1,5	1,3
HTTP 10MB DL Smartphone	Qualifier	[%]	100,0	100,0	100,0	100,0
	Overall Session Time	[s]	1,6	1,7	1,6	1,7
	90% faster than	[Mbit/s]	25,3	26,4	35,9	27,7
	10% faster than	[Mbit/s]	378,8	264,2	339,6	322,3
HTTP 5MB UL Smartphone	Qualifier	[%]	100,0	100,0	97,4	100,0
	Average Session Time	[s]	2,2	1,7	2,6	2,4
	90% faster than	[Mbit/s]	10,5	13,5	9,2	8,5
	10% faster than	[Mbit/s]	71,1	77,5	65,6	64,3
HTTP DL FDTT	Qualifier	[%]	99,6	100,0	99,6	99,6
	10% faster than	[Mbit/s]	549,4	499,5	689,8	753,6
	faster than 20 Mbit/s	[%]	93,8	97,3	95,7	93,3
	faster than 100 Mbit/s	[%]	72,8	64,6	75,2	74,0
HTTP UL FDTT	Qualifier	[%]	99,2	99,6	100,0	100,0
	10% faster than	[Mbit/s]	99,0	126,7	94,1	107,9
	faster than 2 Mbit/s	[%]	98,8	99,2	97,9	99,6
	faster than 5 Mbit/s	[%]	96,4	97,7	94,2	97,7
YouTube	Qualifier	[%]	99,6	100,0	98,8	98,8
	Start Time	[s]	2,3	1,8	2,5	2,0
	AVG Resolution	[p]	1078,5	1079,2	1078,6	1078,8
YouTube Live Smartphone	Qualifier	[%]	99,2	100,0	98,8	98,8
	Start Time	[s]	2,8	2,2	2,8	2,5
	AVG Resolution	[p]	1079,8	1079,9	1077,5	1079,1
Interactivity	Qualifier	[%]	93,9	93,5	94,5	86,5
	Interactivity egaming	[%]	72,5	76,4	70,4	71,5
Conversational App	Qualifier	[%]	99,4	99,8	99,6	99,8
	Speech Quality (P10)	[MOS-LQO]	3,1	2,8	3,1	2,6



Total Score — Cities

Overall results in Copenhagen, Aalborg, Aarhus and Odense



Overall score considering Voice and Data in Copenhagen, Aalborg, Aarhus and Odense.





Methodology

umlaut score

As the de-facto industry standard, our benchmarking methodology focuses on customer-perceived network quality and covers a wide range of mobile services. Today, more than 200 mobile networks in more than 120 countries are being evaluated by our unique scoring methodology. It allows a technical analysis that is unprecedented in its level of detail – enabling comparisons between the network performance and capability of each mobile network. Our public benchmarks as well as the certificate benchmarks help network operators to demonstrate how well they deliver wireless connections to consumers, business users and enterprises while revealing the areas of improvement.



Data Test Cases Setup

Voice Test

- Mobile-to-Mobile calls, with controlled background PS data traffic
- Evaluating user experience
- Speech Quality

Web Browsing Test

- Popular live pages download (global and local page selection mix) plus one reference web page
- Evaluating user experience

Data Download/Upload Test

- Data Stream – Fixed duration, multi socket, HTTP download and upload
- File Download – Fixed size, single socket, HTTP/S file download and upload
- Evaluating network capability and User Experience

Interactivity (eGaming) Test

- TWAMP-based test of UDP Latency and Packet Loss for eGaming Traffic
- Traffic pattern representing a real time high activity multiplayer game
- Evaluating network capability

Youtube Test

- YouTube Video download & playout
- Testing Video-on-Demand and Live streaming
- Evaluating user experience – up to 1080p/FHD
- Evaluating network capability – up to 2160p/4K VoD

Conversational Apps

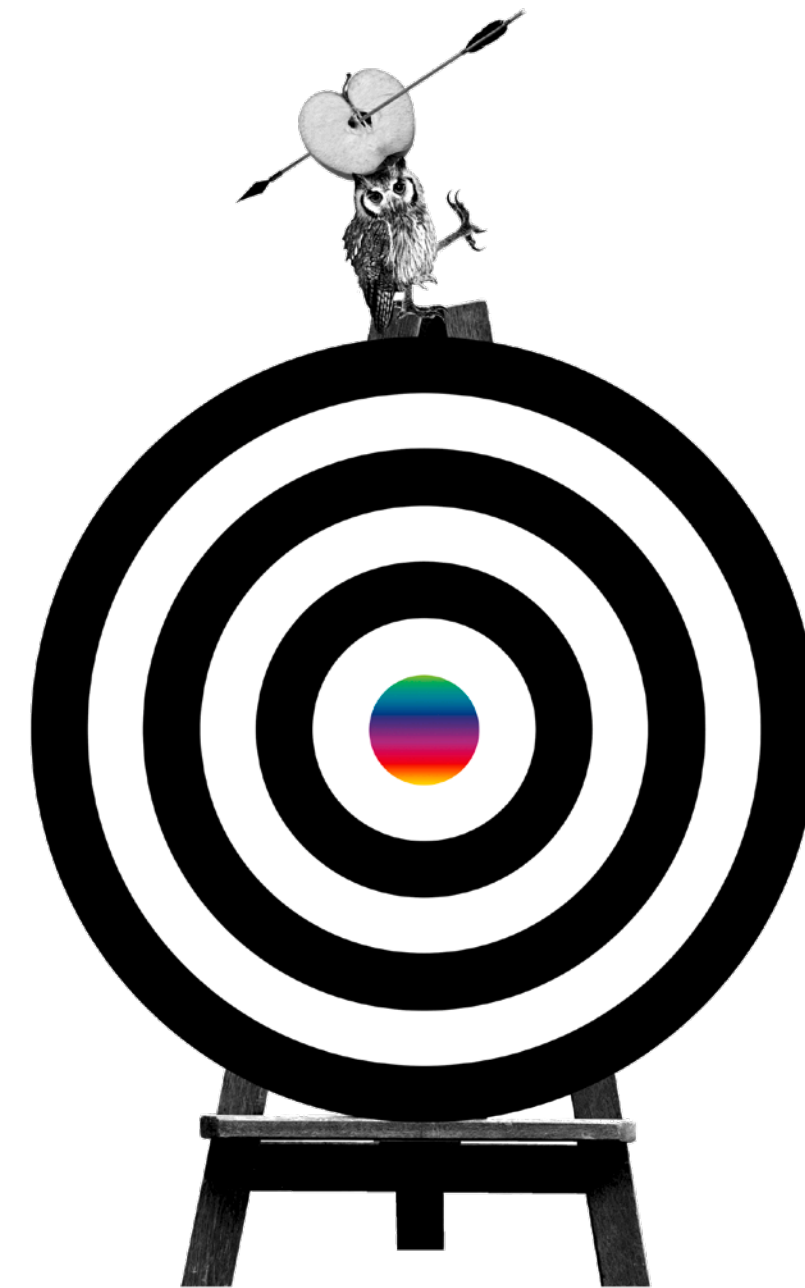
- Generic VoIP Mobile-to-Mobile call, aligned with popular conversational speech apps
- Evaluating user experience

Following our international benchmarking methodology standard the Samsung Galaxy S23+ has been used for voice measurements including Conversational Apps and for data measurements. For more details of our Framework please visit: www.umlaut.com/benchmarking



Key takeaways

- ☰ On nationwide level, Telia achieved the highest overall score with 979 points out of 1000.
- ☰ In the voice category, Telia achieves the highest score nationwide and per category in cities, towns and roads.
- ☰ In the data category, Telia is on par with TDC in nationwide performance. In towns Telia is leading, on connecting roads TDC shows the highest performance, while both operators are on same level in cities.
- ☰ Telia achieved the highest overall score in the test areas of Copenhagen, Aalborg, Aarhus and Odense, which was also the case in 2023.
- ☰ Telia achieved the highest nationwide reliability score.
- ☰ TDC, Telia and Telenor with outstanding 5G availability in cities of at least 97%. All operators are showing very high 5G availability in towns, TDC and Tre as well on connecting roads.





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