

# The 2024 Mobile Network Test in the Netherlands

For the ninth time, we – umlaut and connect – have conducted our comprehensive benchmark of the mobile networks in the Netherlands. Its results show three outstanding operators.

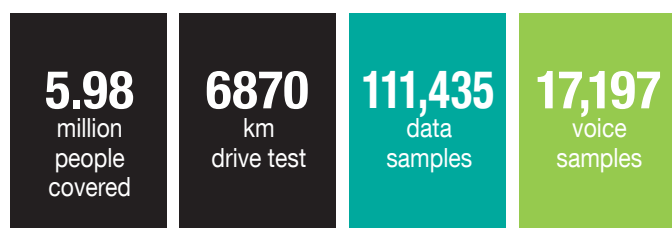
The carefully designed methodology of our 2024 benchmark in the Netherlands represents a holistic approach to network benchmarking. It combines drive tests and walk tests for executing detailed voice and data measurements under controlled circumstances combined with a sophisticated crowdsourcing methodology. The drive tests and walk tests allow for the maximum capabilities of the networks to be evaluated. Crowdsourcing provides profound insights into the overall coverage of voice, data and 5G services as well as real-world User Download and Upload Speeds as well as Latencies. We have thoroughly weighed these components in order to give a realistic and conclusive assessment of the rated networks' true potential and performance.



## Scope

The 2024 umlaut connect Mobile Network Test in the Netherlands consists of drive tests and walk tests conducted from January 24th to February 1st, 2024. Four drive test cars together covered a total of 6870 kilometres, visiting 16 cities and 14 towns. Additionally, two walk test teams visited eight cities. The test areas account for 5.98 million people, or approx. 34.8 percent of the total population of the Netherlands. In addition, the results of extensive crowdsourcing analyses, considering 24 weeks from mid-August 2023 (calendar week 33) to late January 2024 (CW 4) are included in the score. Our detailed methodology is described on pages 12/13.

### DRIVE TEST AND WALK TEST FACTS



### CROWDSOURCING FACTS



# The 2024 Mobile Network Test in the Netherlands

## The Dutch Mobile Operators



In 2000, Deutsche Telekom bought a minority of the Dutch mobile network operator Ben, which was later extended to a 100 per cent acquisition. In 2003, Ben was renamed T-Mobile Netherlands, with the brand "Ben" becoming a "no-frills" offer within its portfolio. In 2007, T-Mobile NL additionally acquired Orange. At the end of 2018, the company completed its acquisition of Tele2. In 2020, T-Mobile NL also acquired the former virtual network operator Simpel.

In the fall of 2021, T-Mobile NL was acquired by the private equity investors Apax and Warburg Pincus. In September 2023, the operator was rebranded Odido.

In Q1 2022, the company reported figures for T-Mobile NL for the last time. In these, it reported approx. 7.2 million mobile customers. At the time of writing, Odido reported a total of 7 million customers, but does not differentiate mobile and fixed-line subscribers in this number. However, based on the information available, we still assess Odido to have the largest mobile customer base in the Netherlands. Odido switched off 2G in June 2023 and now offers 3G, 4G/LTE and 5G.

T-Mobile NL (today Odido) launched 5G soon after the end of the spectrum auction in July 2020. It meanwhile claims that around 98 per cent of the Dutch population lives within its 5G coverage area.



The Koninklijke PTT Nederland N.V. emerged from the privatisation of the formerly state-owned PTT in 1998. The company focuses on marketing its flagship KPN brand, however with Simyo, it also has offerings in the "no-frills" segment. For 2023, the company reported a total number of 5.9 million revenue-generating SIM cards (consumer and business). In connect's assessment this makes KPN the second largest mobile operator in the Netherlands.

KPN offers 2G/GSM and 4G/LTE. The phaseout of 3G in KPN's mobile network was completed by April 2022, which the company used to refarm its spectrum to 4G and 5G.

KPN launched 5G at the end of July 2020, reaching about half of the Dutch population at the start. In early 2024, it claimed to offer a population coverage for 5G of above 90 percent.



The Dutch subsidiary of the international Vodafone Group acquired the operator Libertel in 2003, forming Vodafone Netherlands. In 2016, it merged with the cable and fibre operator Ziggo.

Today, 50 percent of the joint company VodafoneZiggo is owned by the Vodafone Group and another 50 percent by Liberty Global.

At the time of writing, VodafoneZiggo reports approx. 5.6 million mobile customers. Thus VodafoneZiggo is in a neck-and-neck race with KPN in terms of mobile subscriber numbers, but based on the information available to us, we assess VodafoneZiggo to be the currently smallest of the three Dutch mobile networks. The company operates 2G and 4G/LTE, having been the first Dutch operator to phase out 3G in order to devote its spectrum to 4G and 5G.

At the end of April 2020, VodafoneZiggo was the first carrier to offer 5G in the Netherlands, starting on already available frequencies and later extending the service to spectrum acquired in the frequency auction which had ended in July 2020. Meanwhile, VodafoneZiggo claims to have reached national coverage with 5G.

Note: All claims about network coverage reported here are based on the operators' own statements, and are in no way benchmark results determined by umlaut.

# The 2024 Mobile Network Test in the Netherlands

## Results at a Glance



**KPN** wins our Mobile Network Test in the Netherlands with the highest score achieved so far in our international mobile network benchmarks. It achieves the grade “outstanding” and improves by seven points over its result from the previous year. The lead is manifested by achieving the highest scores in all three sub-categories, Voice, Data and Crowd. In addition, KPN is also ahead in the Reliability assessment and shows a high share of 5G samples in the measurement values collected in our drivetests and walktests.



**Odido** ranks second, also achieving the overall grade “outstanding”. Compared to previous year’s result, the operator improved by an impressive nine points. In the Voice and Data categories, Odido achieves the second-strongest results, in the Crowdsourcing it shares the second rank with Vodafone. In the Reliability assessment, Odido is on a par with KPN in the Crowdsourcing category. In our view at 5G, Odido showed the highest data rates in the cities.



**Vodafone** ranks on a strong third place, also achieving the overall grade “outstanding”. The operator manages to improve by eight points over its already strong result from the previous year. So Vodafone keeps pace with the two leading contenders. In the Crowd category, it shares the second rank with Odido, in the Reliability assessment, it scores just one point behind second-ranking Odido. In the 5G category, Vodafone shows high shares, and relies heavily on Dynamic Spectrum Sharing (DSS).



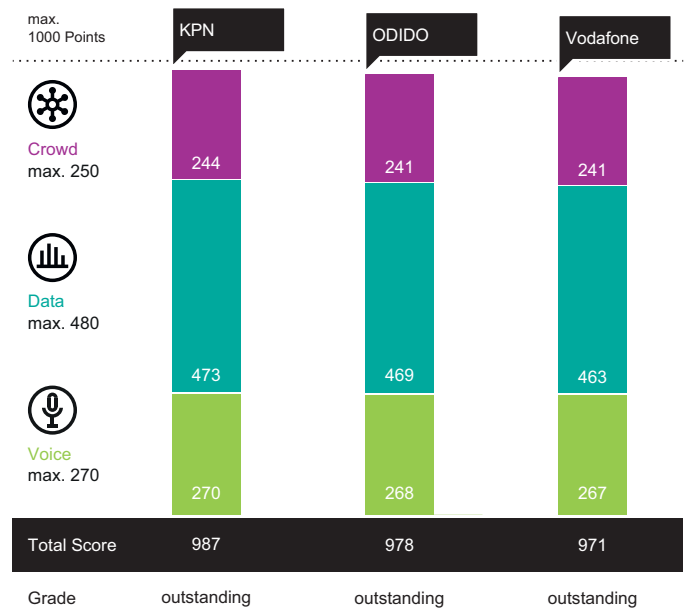
*“Congratulations to KPN for again winning the race in highly competitive markt of the Netherlands. Odido and Vodafone also show outstanding results. It is not only impressive that all three Dutch competitors achieve the grade ,outstanding’ both in the overall as well as in the Reliability assessment, but also that each of them managed to improve over their already strong results of our previous year’s test.”*



*Hakan Ekmen, Global Networks Lead, Comms Industry and CEO umlaur*

Overall Results		KPN	ODIDO	Vodafone
<b>Voice</b>	max. 270.00 P.	270	268	267
Cities (Drivetest)	121.50	100%	100%	99%
Cities (Walktest)	40.50	100%	100%	99%
Towns (Drivetest)	54.00	100%	100%	99%
Roads (Drivetest)	33.75	100%	100%	99%
Railways (Walktest)	20.25	99%	91%	95%
<b>Data</b>	max. 480.00 P.	473	469	463
Cities (Drivetest)	216.00	99%	98%	97%
Cities (Walktest)	72.00	97%	98%	94%
Towns (Drivetest)	96.00	99%	98%	97%
Roads (Drivetest)	60.00	100%	98%	98%
Railways (Walktest)	36.00	97%	92%	90%
<b>Crowd</b>	max. 250.00 P.	244	241	241
Crowd	250.00	97%	97%	96%
<b>Connect Rating</b>	max. 1000 P.	987	978	971

Percentages and points rounded to integer numbers. For the calculation of points and totals, the accurate, unrounded values were used.



All scores shown in this document are rounded.

# The 2024 Mobile Network Test in the Netherlands

## Voice

### Voice

270 of 1000 Points

■ KPN  
■ ODIDO  
■ Vodafone

#### KPN AND ODIDO ACHIEVE FULL AMOUNT OF SCORE POINTS IN BIG CITIES VOICE DRIVETESTS, VODAFONE FOLLOWING VERY CLOSELY

KPN and Odido both achieve the full number of possible score points in the voice tests, conducted by umlaut's test cars while driving in the Netherlands's big cities. With 99 percent of the possible points, Vodafone follows at a very small gap. All three operators offer high success ratios, short call setup times, high speech quality and almost perfect MultiRAB connectivity.

**CITIES DRIVETEST**

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KPN & ODIDO

#### KPN AND ODIDO ALSO ACHIEVE FULL AMOUNT OF SCORE POINTS IN BIG CITIES VOICE WALKTESTS, VODAFONE FOLLOWS AT VERY CLOSE DISTANCE

In the walktests, conducted in Amsterdam, Den Haag, Dordrecht, Eindhoven, Groningen, Rotterdam, Tilburg, Utrecht, KPN and Odido share the first place in the voice assessment and, as in the drivetests, achieve the full number of possible points. Vodafone follows at a minor gap of one percentage point.

**CITIES WALKTEST**

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KPN & ODIDO

#### KPN AND ODIDO ON A PAR ACHIEVING 100 PERCENT OF POSSIBLE POINTS IN SMALLER TOWN VOICE DRIVETESTS. VODAFONE FOLLOWS AT A MINIMAL GAP.

In the voice tests conducted by umlaut's test cars while visiting 14 smaller towns of the Netherlands (see route map on page 1), KPN and Odido also take the lead together, achieving the full amount of possible points. As in the categories before, Vodafone follows closely at a gap of only one percentage point.

**TOWNS DRIVETEST**

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KPN & ODIDO

#### KPN AND ODIDO ALSO ACHIEVE FULL AMOUNT OF POINTS IN THE VOICE DRIVETESTS ON THE ROADS, VODAFONE FOLLOWS AT VERY CLOSE DISTANCE

As in the voice tests performed in the larger cities and smaller towns, KPN and Odido also achieve a 100 percent of the possible score, sharing the top rank in the voice drivetests on Dutch roads. Again, Vodafone follows at minimal distance. The high performance level makes conducting phone calls while driving in the Netherlands most convenient.

**ROADS DRIVETEST**

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KPN & ODIDO

#### HIGH LEVEL OF PERFORMANCE IN VOICE TESTS ON DUTCH RAILWAYS. KPN LEADS, VODAFONE FOLLOWS ON SECOND RANK, ODIDO RANKS THIRD

An the most demanding voice test scenario, the tests performed in Dutch trains, KPN again shows an almost perfect level of performance. Here, Vodafone follows on the second rank, showing slightly lower call success ratios and call setup times. Odido comes in third with still very good results, but still falling behind the performance of second-placed Vodafone.

**RAILWAYS WALKTEST**

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KPN



Operator	KPN	ODIDO	Vodafone
<b>Cities (Drivetest)</b>			
Success Ratio (%)	100.0	100.0	99.9
Call Setup Time P90 (s)	0.6	0.6	1.0
Speech Quality P10 (MOS-LQO)	4.7	4.7	4.7
Multirab Connectivity (%)	100.0	100.0	100.0
<b>Cities (Walktest)</b>			
Success Ratio (%)	100.0	100.0	99.7
Call Setup Time P90 (s)	0.5	0.7	1.0
Speech Quality P10 (MOS-LQO)	4.7	4.7	4.7
Multirab Connectivity (%)	100.0	100.0	99.9
<b>Towns (Drivetest)</b>			
Success Ratio (%)	100.0	100.0	99.9
Call Setup Time P90 (s)	0.6	0.6	1.0
Speech Quality P10 (MOS-LQO)	4.7	4.7	4.6
Multirab Connectivity (%)	100.0	100.0	100.0
<b>Roads (Drivetest)</b>			
Success Ratio (%)	100.0	100.0	99.8
Call Setup Time P90 (s)	0.6	0.6	1.0
Speech Quality P10 (MOS-LQO)	4.7	4.7	4.5
Multirab Connectivity (%)	100.0	100.0	100.0
<b>Railways (Walktest)</b>			
Success Ratio (%)	99.7	97.7	98.7
Call Setup Time P90 (s)	0.6	0.7	1.1
Speech Quality P10 (MOS-LQO)	4.7	4.6	4.6
Multirab Connectivity (%)	100.0	100.0	99.6

# The 2024 Mobile Network Test in the Netherlands

## Data

## Data

480 of 1000 Points

KPN  
ODIDO  
Vodafone

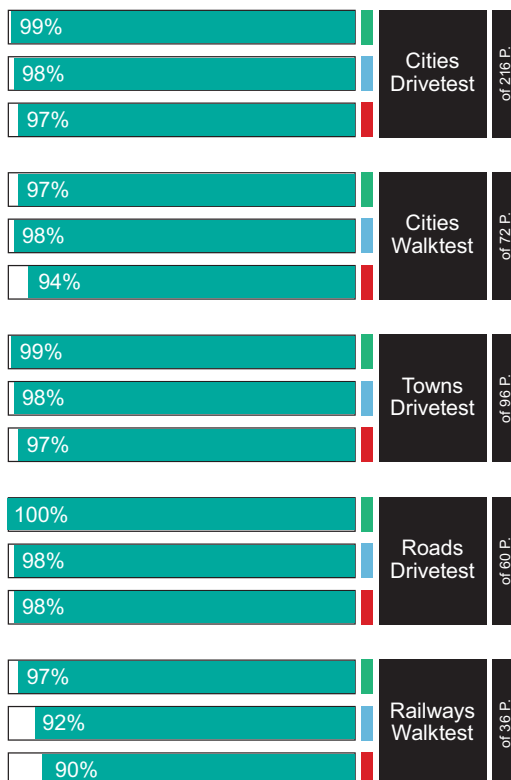
### KPN AHEAD IN BIG CITIES DATA DRIVETESTS

In the data drivetests conducted in big Dutch cities, KPN takes the lead. Odido and Vodafone follow at close distance which one percentage point between each of them. KPN and Odido both use mainly 700 MHz for their 5G downlink traffic, while Vodafone mostly uses 1800 MHz. In the KPN samples, we see a significant share of 5G New Radio plus LTE 4CA (four carrier aggregation) in all scenarios – well above 80 percent.



### ODIDO CLOSELY AHEAD IN BIG CITY DATA WALKTESTS

In the walktests conducted in the Netherlands' bigger cities, Odido takes a narrow lead, one percentage point ahead of KPN. The results of Vodafone show a little more distinct gap in this scenario. This becomes for example visible in the Download and upload data rates. But all three operators achieve success ratios of a 100 percent or quite close to 100 percent in most of the test cases.



Data Cities (Drivetest)	KPN	ODIDO	Vodafone
<b>Web-Page Download</b>			
Success Ratio/Avg. Session Time (%/s)	99.9/0.8	100.0/0.9	100.0/0.9
<b>File Download (10 MB)</b>			
Success Ratio/Avg. Session Time (%/s)	100.0/0.8	100.0/1.2	100.0/1.4
90%/10% faster than (Mbps)	71.0/261.7	37.9/207.3	43.7/134.2
<b>File Upload (5 MB)</b>			
Success Ratio/Avg. Session Time (%/s)	100.0/0.9	100.0/1.0	100.0/1.3
90%/10% faster than (Mbps)	36.0/84.6	29.0/79.1	20.8/74.3
<b>File Downloads (7 Seconds)</b>			
Success Ratio (%)	100.0	100.0	100.0
10% faster than (Mbps)	357.7	444.2	272.9
Speed > 20Mbps / 100Mbps (%)	99.9/87.0	99.3/86.3	98.1/69.6
<b>File Upload (7 Seconds)</b>			
Success Ratio (%)	99.9	100.0	100.0
10% faster than (Mbps)	128.0	114.4	100.6
Speed > 2Mbps / 5Mbps (%)	100.0/100.0	100.0/99.9	99.8/99.5
<b>Youtube</b>			
Success Ratio/Start Time (%/s)	99.9/1.5	100.0/1.5	100.0/1.6
Average Video Resolution (p)	1079	1079	1079
<b>Youtube live</b>			
Success Ratio/Start Time (%/s)	100.0/1.8	99.9/1.9	100.0/2.0
Average Video Resolution (p)	1080	1080	1080
<b>Conversational-App</b>			
Success Ratio (%)	99.9	100.0	100.0
Speech Quality P10 (MOS-LQO)	4.3	3.7	3.6
<b>Interactivity e-Gaming</b>			
Success Ratio/Interactivity e-Gaming (%)	99.8/88.4	99.6/84.4	98.3/80.0

Data Cities (Walktest)	KPN	ODIDO	Vodafone
<b>Web-Page Download</b>			
Success Ratio/Avg. Session Time (%/s)	99.9/0.9	100.0/0.9	99.3/1.0
<b>File Download (10 MB)</b>			
Success Ratio/Avg. Session Time (%/s)	100.0/1.1	100.0/1.3	99.8/1.8
90%/10% faster than (Mbps)	43.9/239.5	33.2/190.5	34.2/132.6
<b>File Upload (5 MB)</b>			
Success Ratio/Avg. Session Time (%/s)	100.0/1.3	100.0/1.3	99.4/1.8
90%/10% faster than (Mbps)	30.2/80.1	23.8/74.1	14.4/75.4
<b>File Downloads (7 Seconds)</b>			
Success Ratio (%)	99.8	100.0	100.0
10% faster than (Mbps)	325.6	394.9	290.0
Speed > 20Mbps / 100Mbps (%)	97.3/71.5	98.3/79.8	97.6/67.9
<b>File Upload (7 Seconds)</b>			
Success Ratio (%)	100.0	100.0	99.6
10% faster than (Mbps)	123.5	108.0	105.7
Speed > 2Mbps / 5Mbps (%)	100.0/99.4	99.8/99.6	99.6/97.9
<b>Youtube</b>			
Success Ratio/Start Time (%/s)	100.0/1.6	100.0/1.6	99.1/1.7
Average Video Resolution (p)	1078	1079	1079
<b>Youtube live</b>			
Success Ratio/Start Time (%/s)	99.6/2.0	100.0/2.0	99.6/2.1
Average Video Resolution (p)	1079	1080	1078
<b>Conversational-App</b>			
Success Ratio (%)	100.0	100.0	99.7
Speech Quality P10 (MOS-LQO)	4.4	4.1	3.7
<b>Interactivity e-Gaming</b>			
Success Ratio/Interactivity e-Gaming (%)	99.2/87.1	99.4/84.8	94.4/78.1

# The 2024 Mobile Network Test in the Netherlands

## Data

### KPN LEADS IN DATA DRIVETESTS IN TOWNS

In the data drivetests performed in the visited smaller towns, KPN is ahead – but Odido and Vodafone follow each at a very close gap, again with just one percentage point between each of them. The performance differences can be seen for example in the data rates achieved in the file download and upload tests. But the success ratios are comparably high in the towns as in the larger cities.

#### TOWNS DRIVETEST

KPN

### KPN AHEAD IN DATA DRIVETESTS ON DUTCH ROADS

In the data tests performed by our test cars on Dutch roads, KPN once again leads the field, with Odido and Vodafone following at close distance on a par. The high level of the results and particularly the success ratios in this category are good news for motorists who want to use any kind of data services while driving in their cars.

#### ROADS DRIVETEST

KPN



Photo: Pavlo Glazkov, shutterstock

Data Towns (Drivetest)	KPN	ODIDO	Vodafone
<b>Web-Page Download</b>			
Success Ratio/Avg. Session Time (%/s)	100.0/0.8	100.0/0.9	100.0/0.8
<b>File Download (10 MB)</b>			
Success Ratio/Avg. Session Time (%/s)	100.0/0.7	100.0/1.3	100.0/1.2
90%/10% faster than (Mbps)	90.6/254.9	37.3/204.4	48.8/140.4
<b>File Upload (5 MB)</b>			
Success Ratio/Avg. Session Time (%/s)	100.0/0.9	100.0/1.1	100.0/1.3
90%/10% faster than (Mbps)	34.5/82.9	24.5/71.7	20.8/74.6
<b>File Download (7 Seconds)</b>			
Success Ratio (%)	100.0	100.0	100.0
10% faster than (Mbps)	375.9	347.5	279.4
Speed > 20Mbps / 100Mbps (%)	100.0/93.4	99.0/81.2	98.6/72.9
<b>File Upload (7 Seconds)</b>			
Success Ratio (%)	100.0	100.0	100.0
10% faster than (Mbps)	123.7	106.6	100.4
Speed > 2Mbps / 5Mbps (%)	100.0/100.0	100.0/99.8	100.0/99.0
<b>Youtube</b>			
Success Ratio/Start Time (%/s)	100.0/1.4	100.0/1.6	100.0/1.5
Average Video Resolution (p)	1079	1079	1079
<b>Youtube live</b>			
Success Ratio/Start Time (%/s)	100.0/1.8	100.0/1.9	100.0/1.9
Average Video Resolution (p)	1080	1080	1080
<b>Conversational-App</b>			
Success Ratio (%)	99.9	100.0	100.0
Speech Quality P10 (MOS-LQO)	4.3	3.7	3.7
<b>Interactivity e-Gaming</b>			
Success Ratio/Interactivity e-Gaming (%)	100.0/89.2	98.4/80.4	98.6/80.7

Data Roads (Drivetest)	KPN	ODIDO	Vodafone
<b>Web-Page Download</b>			
Success Ratio/Avg. Session Time (%/s)	100.0/0.8	100.0/0.9	100.0/0.8
<b>File Download (10 MB)</b>			
Success Ratio/Avg. Session Time (%/s)	100.0/0.7	100.0/1.4	100.0/1.2
90%/10% faster than (Mbps)	79.8/270.4	32.1/202.9	47.9/145.7
<b>File Upload (5 MB)</b>			
Success Ratio/Avg. Session Time (%/s)	100.0/1.1	100.0/1.5	100.0/1.7
90%/10% faster than (Mbps)	26.7/81.1	18.3/72.5	11.8/76.0
<b>File Download (7 Seconds)</b>			
Success Ratio (%)	100.0	100.0	100.0
10% faster than (Mbps)	393.0	359.5	290.8
Speed > 20Mbps / 100Mbps (%)	99.6/92.3	99.3/78.9	98.6/74.0
<b>File Upload (7 Seconds)</b>			
Success Ratio (%)	100.0	100.0	99.6
10% faster than (Mbps)	120.3	107.6	103.4
Speed > 2Mbps / 5Mbps (%)	100.0/100.0	99.6/98.9	99.6/99.6
<b>Youtube</b>			
Success Ratio/Start Time (%/s)	100.0/1.5	100.0/1.6	100.0/1.5
Average Video Resolution (p)	1080	1079	1079
<b>Youtube live</b>			
Success Ratio/Start Time (%/s)	100.0/1.8	100.0/1.9	100.0/1.9
Average Video Resolution (p)	1080	1080	1080
<b>Conversational-App</b>			
Success Ratio (%)	100.0	99.7	100.0
Speech Quality P10 (MOS-LQO)	4.2	3.2	3.4
<b>Interactivity e-Gaming</b>			
Success Ratio/Interactivity e-Gaming (%)	99.2/88.1	97.8/80.4	97.4/81.3

# The 2024 Mobile Network Test in the Netherlands

## Data

**KPN AHEAD IN RAILWAYS DATA TESTS, HERE ODIDO AND VODAFONE FOLLOW AT MORE DISTINCT GAPS** In the walktests that were specifically conducted on Dutch trains, KPN holds up a high level of performance quite well. Odido ranks second, and Vodafone third, each at more distinct gaps than in the other data scenarios. However, compared to the results of railway data tests in other countries, all three Dutch operators show very high results.

### RAILWAYS WALKTEST

KPN

Data Railways (Walktest)	KPN	ODIDO	Vodafone
<b>Web-Page Download</b>			
Success Ratio/Avg. Session Time (%/s)	99.8/0.9	98.8/1.1	99.5/1.1
<b>File Download (10 MB)</b>			
Success Ratio/Avg. Session Time (%/s)	100.0/1.4	99.7/1.9	100.0/2.3
90%/10% faster than (Mbps)	29.8/213.3	19.6/179.6	21.9/125.1
<b>File Upload (5 MB)</b>			
Success Ratio/Avg. Session Time (%/s)	99.7/1.9	99.0/3.9	99.7/5.1
90%/10% faster than (Mbps)	11.1/65.8	4.9/53.4	3.5/55.1
<b>File Download (7 Seconds)</b>			
Success Ratio (%)	100.0	99.3	99.6
10% faster than (Mbps)	286.3	283.8	204.5
Speed > 20Mbps / 100Mbps (%)	95.9/69.3	96.4/60.4	86.7/39.4
<b>File Upload (7 Seconds)</b>			
Success Ratio (%)	99.7	98.3	98.9
10% faster than (Mbps)	85.8	68.7	65.3
Speed > 2Mbps / 5Mbps (%)	99.7/97.9	97.2/95.0	94.7/89.0
<b>Youtube</b>			
Success Ratio/Start Time (%/s)	100.0/1.7	99.7/1.8	99.3/2.0
Average Video Resolution (p)	1079	1078	1079
<b>Youtube live</b>			
Success Ratio/Start Time (%/s)	99.7/2.1	97.2/2.4	97.2/2.5
Average Video Resolution (p)	1080	1077	1072
<b>Conversational-App</b>			
Success Ratio (%)	99.7	99.7	99.9
Speech Quality P10 (MOS-LQO)	4.2	3.5	3.7
<b>Interactivity e-Gaming</b>			
Success Ratio/Interactivity e-Gaming (%)	96.5/85.1	93.6/73.1	88.3/72.9

**KPN SHOWS HIGHEST SHARE OF 5G SAMPLES IN ALL AGGREGATIONS AND HIGHEST DATA RATES IN TOWNS AND ON ROADS, ODIDO SHOWS HIGHEST 5G DATA RATES IN CITIES** 5G is assumed to be the standard in our measurements. But to shed light on the progress of the 5G rollout, we look at the results of the KPI "Data rates of the 7 second Download tests". This gives a good indication of the data rates which are supported thanks to the 5G technology. But as this assessment does not limit the overall results to the 5G-related aspects or factors such as 5G coverage or the measured latencies of 5G-only connections, we do not identify a separate 5G category winner.

5G



Photo: S. Borisov, Shutterstock

That said, in this assessment, KPN shows the highest share of 5G samples in all aggregations – in cities and towns, on the roads and on trains. In the smaller towns and on the roads, KPN also shows the highest 5G data rates, both average and maximum. Odido also achieves a considerably high share of 5G samples in all aggregations and shows the highest 5G data rates in the larger cities, both in the drivetests as well as in the walktests. While KPN shows a small share of 5G Dynamic Spectrum Sharing (DSS), Vodafone relies heavily on this bridging technology.

Data rates 7s Download	KPN			Odido			Vodafone		
	Share	Average (Mbps)	10% faster than (Mbps)	Share	Average (Mbps)	10% faster than (Mbps)	Share	Average (Mbps)	10% faster than (Mbps)
<b>Samples with 5G</b>									
Cities – Drivetest	98.7%	214.6	358.6	90.1%	247.8	450.1	7.8%	179.2	292.4
Cities – Walktest	98.1%	176.9	326.0	88.8%	225.8	404.3	6.2%	155.5	235.0
Towns – Drivetest	99.4%	246.1	376.0	93.8%	203.7	351.7	12.1%	177.0	296.5
Roads – Drivetest	98.9%	259.0	393.8	95.7%	200.3	365.1	20.2%	189.3	284.0
Trains – Walktest	93.1%	162.5	286.7	81.3%	158.0	287.8	7.5%	170.9	230.3
<b>Samples with 5G-DSS</b>									
Cities – Drivetest	0.4%	106.8	146.2	–	–	–	90.1%	151.0	271.2
Cities – Walktest	1.9%	110.9	198.1	–	–	–	88.5%	155.1	291.7
Towns – Drivetest	–	–	–	–	–	–	81.4%	162.8	280.6
Roads – Drivetest	0.4%	16.6	16.6	–	–	–	75.8%	164.7	300.3
Trains – Walktest	3.1%	80.6	130.6	–	–	–	81.0%	92.2	199.8

# The 2024 Mobile Network Test in the Netherlands

## Crowd

### KPN LEADS IN COVERAGE QUALITY AND COVERAGE REACH, ODIDO CLOSELY AHEAD IN TIME ON BROADBAND

In terms of Coverage Quality (see definitions on page 13), KPN takes a narrow lead, with Odido and Vodafone following on a par on second place. In Coverage Reach, KPN also takes the lead, ahead of Odido and then Vodafone. In the Time on Broadband assessment, Odido is slightly ahead of KPN, follow at close distance by Vodafone.

#### BROADBAND COVERAGE

KPN

### VODAFONE AHEAD IN PASSIVE DOWNLOAD ANALYSIS

In the passively observed download data rates, Vodafone is leading in the Basic Internet class (minimum of 2 Mbps) as well as in the HD Video class (at least 5 Mbps). In both KPIs, KPN follows at close distance behind Vodafone, with Odido coming in third. In the demanding UHD Video class (at least 20 Mbps), KPN is ahead, followed by Vodafone and then Odido.

#### DOWNLOADS PASSIVE

VODAFONE

### KPN AND ODIDO LEADING TOGETHER IN ACTIVE DOWNLOAD ANALYSIS

The actively performed download tests are conducted to better approximate the maximum performance of a mobile internet connection. In this metric, KPN and Odido are very close together in the average throughput rates. In the P10 (90 percent faster than) results, Vodafone takes the lead, while in the P10 (90 percent faster) assessment, Odido is closely ahead of KPN.

#### DOWNLOADS ACTIVE

KPN & ODIDO

### KPN AHEAD IN ACTIVE UPLOAD TESTS

In the active Upload tests, the ranking is clear in all three considered KPIs: KPN is ahead in the average throughput rates, as well as in the P10 and P90 values. In each of these assessments, Odido ranks second, and Vodafone third.

#### UPLOADS ACTIVE

KPN

### KPN PROVIDES THE SHORTEST LATENCIES, VODAFONE SCORES AHEAD OF ODIDO IN GAMING CLASS

KPN also achieves the best results in the latency category, both for the more relaxed OTT Voice class (roundtrip times up to 100 milliseconds) as well as in the more demanding Gaming class (up to 50 ms). In the Gaming Class, Vodafone achieves slightly higher scores than Odido, in the OTT Voice class, the ranking is vice versa, but at a very close gap.

#### LATENCY

KPN

Operators	KPN	ODIDO	Vodafone
<b>Broadband Coverage</b>			
Coverage Quality (%)	99.6	99.5	99.5
Coverage Reach (%)	98.4	97.7	97.0
Time on Broadband (%)	99.6	99.7	99.3
<b>Download Speed (Passive)</b>			
Basic Internet Class(%)	95.8	95.4	96.3
HD Video Class / UHD Video Class (%)	90.1/41.6	88.9/37.0	90.3/38.1
<b>Download Speed (Active)</b>			
Avg. Throughput (Mbit/s)	118.6	118.3	93.7
90% / 10% faster than (Mbit/s)	16.7/258.0	12.3/266.9	18.1/194.4
<b>Upload Speed (Active)</b>			
Avg. Throughput (Mbit/s)	32.4	28.6	21.8
90% / 10% faster than (Mbit/s)	4.6/68.1	3.6/65.1	2.6/49.0
<b>Latency</b>			
Gaming Class / OTT Voice Class (%)	97.0/99.0	93.1/98.3	94.6/98.2
<b>Voice</b>			
HD Voice (%)	97.8	99.0	98.6
<b>Stability</b>			
Transaction Success (%)	97.8	97.6	96.8

### ODIDO LEADS IN HD VOICE AVAILABILITY, FOLLOWED BY VODAFONE

In the analysis of the availability of HD voice connections (i.e Voice over LTE with the current state of mobile network implementations in the Netherlands), Odido takes the first place. In this assessment, Vodafone ranks second best, ahead of KPN – while all three operators show an overall high score level.

VOICE

ODIDO

### KPN AHEAD IN CROWDSOURCED ASSESSMENT OF TRANSACTION STABILITY

In the Stability category, which looks at the success rates of regular transaction tests, the overall ranking is once more confirmed: KPN takes the lead, with Odido following at very close distance and Vodafone coming in third at a slightly more pronounced gap.

STABILITY

KPN



# The 2024 Mobile Network Test in the Netherlands

## Reliability

Reliability is not an additional category of our tests, but rather a different angle of looking at the results: For each KPI, our scoring distinguishes between “Qualifiers” (the expected basic performance) and “Differentiators” (the additional performance that exceeds the expected basics). The view at Reliability limits itself to most of the Qualifiers and the basic KPIs of the crowdsourcing – thus conveying an impression of the standards, a user can reasonably expect from a mobile network. The reference values in this representation are therefore only the subset of score points which we assigned to the Qualifiers. The resulting scores state the reliability with which an operator offers its network services.

This approach concentrates on the compulsory basics instead of the highest peaks of a network’s performance. It shows that, analogous to the overall assessment, all three Dutch operators also achieve outstanding results in Reliability – overall and in the separate categories (Voice, Data and Crowd).

Operator		KPN	ODIDO	Vodafone
Voice	max. 148.5 points	148	147	146
Drivetest	115.1	100%	100%	99%
Walktest	33.4	99%	95%	95%
Data	max. 264.0 points	263	262	261
Drivetest	204.6	100%	100%	100%
Walktest	59.4	99%	97%	95%
Crowd	max. 116.9 points	113	113	112
Crowd	116.9	97%	96%	96%
Total	max. 529.4 points	524	522	519

### KPN LEADS IN VOICE RELIABILITY

In the overall assessment of the Reliability of voice connections, KPN achieves the highest score, closely followed by Odido and then Vodafone, each of them one score point apart. While the voice drivetests show perfect or almost perfect results for all three contenders, the differences become a little more pronounced in the walktests: In this subcategory, KPN is clearly ahead, followed at a small gap by Odido and Vodafone who score on a par.

VOICE

KPN

### KPN LEADS IN DATA RELIABILITY

In the Reliability assessment in the Data tests, KPN also takes a narrow lead, one score point ahead of Odido. Vodafone follows, again a gap of one score point. In the drivetests, all three operators achieve the full amount of possible points. In the walktests, KPN leads, followed by Odido and then Vodafone, each at a gap of two percentage points.

DATA

KPN

### KPN AND ODIDO LEADING ON A PAR IN CROWDSOURCED RELIABILITY, VODAFONE FOLLOWS AT CLOSE GAP

In the crowdsourced KPIs, KPN and Odido share the first rank in terms of achieved score points, while Vodafone follows at a close gap of just one score point. The variations in the achieved percentages can be explained by rounding effects.

CROWD

KPN &  
ODIDO

# The 2024 Mobile Network Test in the Netherlands

## City Scores

In addition to the nationwide assessment, it is always interesting to have a closer look at a more regional level. Thus, we have analysed the individual results in the five largest cities of the Netherlands this year again. The results provide valuable insights to their inhabitants, which if the three operators shows the highest performance in their regional environment.

### KPN AND ODIDO LEADING ON A PAR IN AMSTERDAM

The Netherlands' capital has also the largest number of inhabitants among the Dutch cities. This makes it particularly worthwhile for all operators to present themselves at their best in Amsterdam. KPN and Odido are leading on a par with exactly the same number of points in all three main categories, Voice, Data and Crowd. Vodafone follows at a distinct distance.



### KPN LEADING IN DEN HAAG, CLOSE AHEAD OF ODIDO

In the North Sea city, KPN also leads in the overall regional assessment. In the Voice category, KPN and Odido score on a par, but KPN manifests its lead at a lead of one score point both in the Data and Crowd categories. Vodafone follows at some distance. However, in the Voice category it falls only one point behind the two leading contenders.



### NECK-AND-NECK RACE IN EINDHOVEN: KPN AND ODIDO ON A PAR, VODAFONE ONLY ONE POINT BEHIND THE LEADING DUO. ALL THREE OPERATORS ON A PAR IN VOICE

In the Nordbrabant city, once more KPN and Odido take the lead together. With also strong results, Vodafone follows at a gap of only one point. In the Voice assessment, all three operators score on a par. In the Crowd category, Odido and Vodafone score on a par, with KPN following at a distance of one point.



### ODIDO AHEAD IN ROTTERDAM, KPN FOLLOWING AT CLOSE DISTANCE, ALL THREE OPERATORS ON A PAR IN VOICE;

In the famous port city, Odido takes the lead, with KPN following at a gap of two points. As in Eindhoven, in the Voice category, all three operators score on a par. The ranking order is determined in the Data category, where Odido clearly leads. In the Crowdsourcing, KPN leads, but Odido and Vodafone follows at close gaps of just one point between each of the operators.



### KPN AHEAD IN UTRECHT, ODIDO FOLLOWING CLOSE BEHIND, ONLY SMALL GAPS IN VOICE AND CROWDSOURCING

In the Netherlands' fourth biggest city, located in the center of the country, KPN is again ahead. In the Voice category, KPN and Odido score on a par, with Vodafone following at a gap of only one point. In the Crowdsourcing, the order is KPN-Odido-Vodafone with one score point between each of the contenders. In the Data category, KPN is one point ahead of Odido, with Vodafone following at a gap of three points.



# The 2024 Mobile Network Test in the Netherlands

## Fairness and Transparency

Testing a mobile network involves more than just measuring, analysing and writing about the result. Transparency for all parties and ensuring that everyone plays by the same rules is paramount. To achieve this, connect and umlaut have developed a set of best practices over the past 30 years of testing mobile networks.

Informing the operators at an early stage about the basic parameters of our tests is among the things, we found helpful during the years. A framework lists the smartphones and the firmware installed on them, the KPIs to be measured and the basic scheme for scoring them. A timeline for the test, with some contingency, is also made transparent in the framework, and operators are encouraged to comment on the information.

We are open to feedback but reserve the right to reject inappropriate claims. Close to the start of the benchmark, we ask all operators to abide by our fair play rules, which are designed to ensure that each network operates under test conditions in the same way as it does for real customers. If we or another operator see a potential violation of our rules, we investigate.

If we see a problematic behaviour, we immediately ask the operator to stop it, and if the benchmark has already started, we remove the affected samples from our measurements.

This year we and also one of its competitors noticed some unusual behaviour in the KPN network prior to the benchmark. Upon consultation, KPN explained this with trialling new features of the latest software release from their vendor. According to KPN this feature proved not to be mature enough, so it was stopped and thus not seen during the benchmark.

Keeping pace with evolving network technology is always a challenge for umlaut and connect, but a challenge we are happy to accept for the benefit of our customers.



# The 2024 Mobile Network Test in the Netherlands

## Methodology

The umlaut connect Mobile Network Test is the result of extensive drivetests and walktests, combined with a sophisticated crowdsourcing analysis.

### Logistics

connect's network test partner umlaut sent four measurement vehicles through the country, each equipped with nine smartphones. For each network operator, a Samsung Galaxy S23 took the voice measurements, and another S23 established the connections for the test case "conversational app" (see section "Data connections" below). For the actual data test, we used a third Samsung Galaxy S23 per operator. For all measurements, the smartphones were set to "5G preferred" – so wherever supported by the network, the data tests took place via 5G.

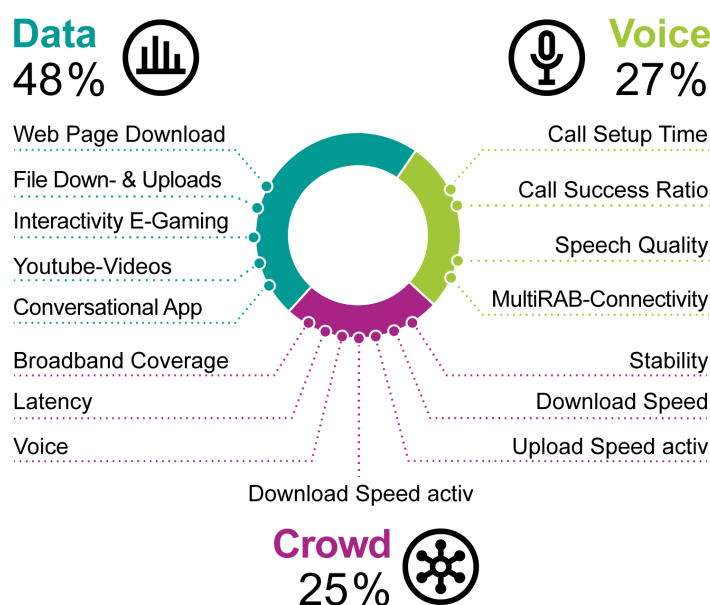
In addition to the drive tests, two walk test teams carried out measurements on foot in each country, in zones with heavy public traffic such as railway station concourses, airport terminals, cafés, public transport and museums. The walk test programme also included journeys on long-distance railway lines. For the walk tests, the same smartphone types were used per network operator for the same measurements as in the drive tests. The walk test teams transported the smartphones in backpacks or trolleys equipped with powerful batteries. The firmware of the test smartphones corresponded to the original network operator version in each case.

The drive and walk tests took place between 8 am and 10 pm. For the drive tests, two vehicles were in the same city, but not in the same place, so that one car would not falsify the measurements of the other. On the connecting roads, two vehicles each drove the same routes, but one after the other with some time and distance between them. For the selection of the test routes, umlaut created four different suggestions for each country, from which connect blindly selected a route.

### Voice connections

Voice connections account for 27 percent of the overall result. For this purpose, mobile telephone calls were established from vehicle to vehicle ("mobile-to-mobile") and their success rates, call set-up time and voice quality were measured. The smartphones of the walk test teams made calls to a stationary (smartphone) remote station for the voice tests.

To ensure realistic conditions, data traffic was handled simultaneously in the background. We also recorded MultiRAB connectivity: the use of several "radio access bearers" provides data connections in the background of the voice calls. The transmission quality was evaluated with the POLQA wideband method suitable for HD voice. "VoLTE preferred" was configured on all phones – from 5G, the phones thus fall back to telephony via LTE.



### Data connections

The data measurements account for 48 percent of the total result. Several popular live pages (dynamic) and the ETSI reference page known as the Kepler page (static) were retrieved to assess internet page calls. In addition, 10 MB and 5 MB files were downloaded and uploaded, respectively, in order to determine the performance for smaller data transfers. We also determined the data rate within a 7-second period when uploading and downloading large files. As Youtube dynamically adapts the resolution to the available bandwidth, the evaluation takes into account the average image resolution or number of lines of the videos as well as the success rate and the time until playback starts.

A typical over-the-top voice connection (OTT) is represented by the "conversational app" test case. To do this, we set up a voice channel via the SIP and STUN protocols using the OPUS codec and determined the success rate and voice quality. In addition, for our test point "Interactivity of eGaming" our measurements simulated a highly interactive UDP multiplayer session to determine the latency times of the connection and any possible packet losses. >>

# The 2024 Mobile Network Test in the Netherlands

## Methodology

### Crowdsourcing

Crowdsourcing results accounted for 25 per cent of the overall rating. They show which network performance actually arrives at the user – however, the end devices and tariffs used also have an impact on these results.

To obtain the data basis for these analyses, thousands of popular apps recorded the parameters described below in the background – provided the user agreed to the completely anonymous data collection. The measured values were recorded in 15-minute intervals and transmitted to the umlaut servers once a day. The reports contain only a few bytes, so they hardly burden the user's data volume.

### Broadband Coverage

In order to determine the broadband *coverage reach*, umlaut laid a grid of 2 x 2 km tiles ("Evaluation Areas", in short EAs) over the test area. A minimum number of users and measured values had to be available for each EA. For the evaluation, umlaut awarded one point per EA if the network under consideration offered 3G coverage. Three points were awarded if 4G or 5G was available in the EA. The score achieved was divided by the achievable number of points (three points per EA in the "union footprint" – the area of the country measured by all testers with their smartphones).

We also looked at the *coverage quality*. For each operator, it indicates the average percentage of 4G or 5G coverage on an EA, averaged over all EAs in the common footprint, i.e. the area in which data is served by all operators.

The *time on broadband* in turn tells us how often a user had 4G or 5G reception in the period under consideration – regardless of the EAs in which the samples were recorded. For this purpose, umlaut sets the samples that show 4G/5G coverage in relation to the total number of all samples. Important: The percentage values determined for all three parameters reflect the respective degree of fulfilment – and not a percentage of 4G/5G mobile coverage in relation to area or population.

### Data rates and Latencies

The *passive* determination of *download data rates* and *latencies* was carried out independently of the EAs and focused on the experience of each user. Samples that were captured via Wi-fi or when flight mode was activated, for example, were filtered out by umlaut before the analysis.

To take into account that many mobile phone tariffs throttle the data rate, umlaut defined three application-related speed classes: *Basic internet* requires a minimum of 2 Mbit/s, *HD video* requires 5 Mbit/s and *UHD video* requires 20 Mbit/s. For a sample to be valid, a minimum amount of data must have flowed in a 15-minute period.

Similarly, the latency of the data packets is assigned to an application-related class: Roundtrip times up to 100 ms are sufficient for

*OTT voice services*, less than 50 ms qualify a sample for *gaming*. This way, the evaluation also does justice to the fact that the passively observed data rates depend on the applications used in each case.

In order to better assess the maximum possible throughput, umlaut also conducted *active* measurements of *upload* and *download* data rates once a month. They determine the amount of data transferred in 3.5 seconds. For the determined values, we consider the average data rate, the P10 value (90% of the values higher than the specified threshold, a good approximation of the typical minimum speed) and the P90 (10% above this threshold), a view at the peak values.

### Stability

Based on the determined data rates and additional browsing and connection tests, umlaut also examined when a broadband connection could be used at all. The averaged and weighted results define the percentage of *transaction success*.

### HD Voice

The parameter *HD voice* shows the proportion of the user's voice connections that were established in HD quality – and thus via VoLTE (Voice over LTE). A prerequisite was that the smartphone supports this standard.

### Reliability

umlaut divided all measured values into basic requirements ("Qualifier KPIs") and values related to peak performance ("Differentiator KPIs"). The presentation of *reliability* takes into account only the "Qualifier KPIs" from the voice and data category as well as the basic KPIs from crowdsourcing.

