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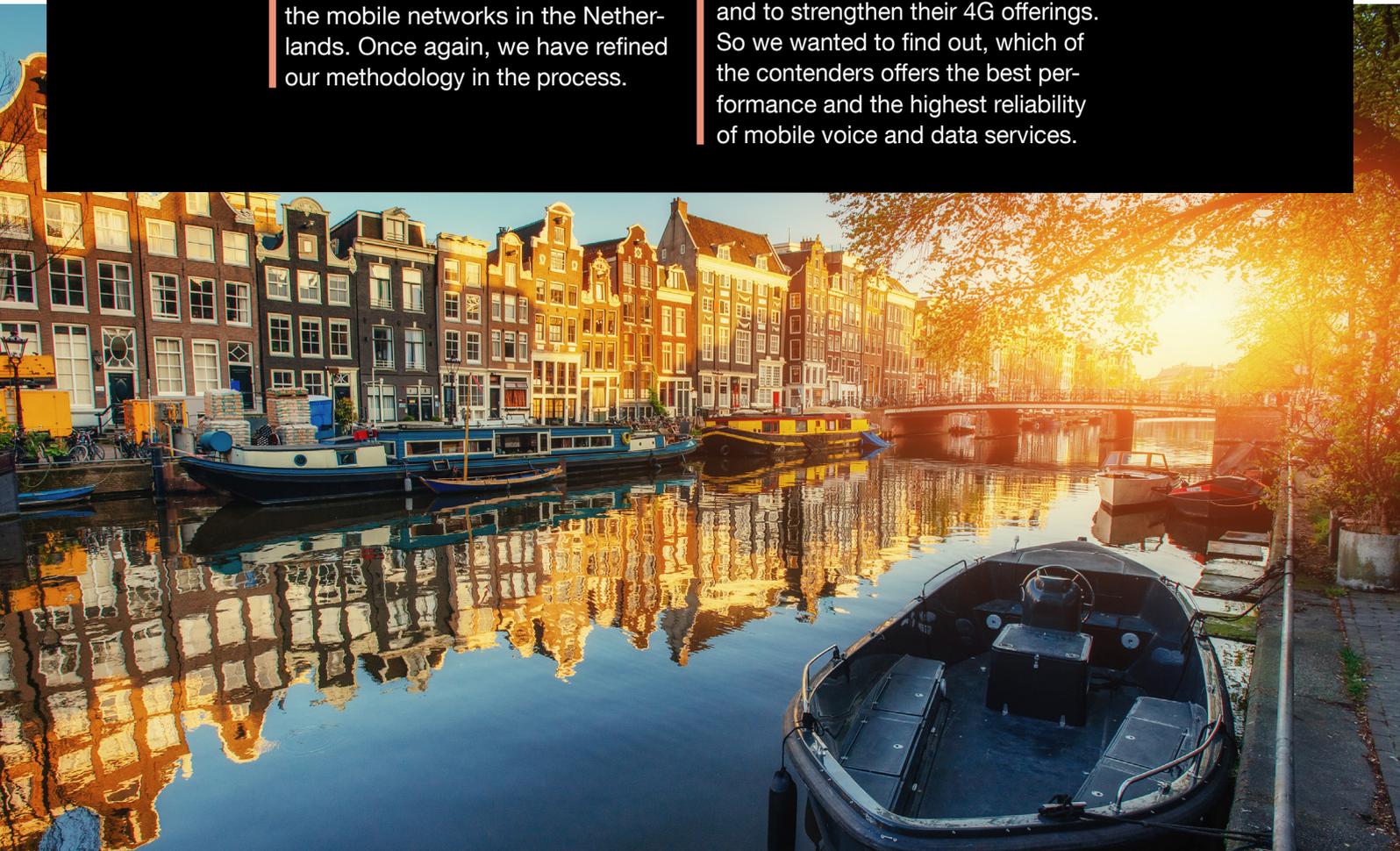
connect

THE 2022 MOBILE NETWORK TEST IN THE NETHERLANDS



For the seventh time, we – the benchmarking expert umlaut and connect magazine – have conducted our tough benchmark of the mobile networks in the Netherlands. Once again, we have refined our methodology in the process.

All Dutch operators have worked hard to expand their 5G coverage and to strengthen their 4G offerings. So we wanted to find out, which of the contenders offers the best performance and the highest reliability of mobile voice and data services.



RESULTS IN A NUTSHELL

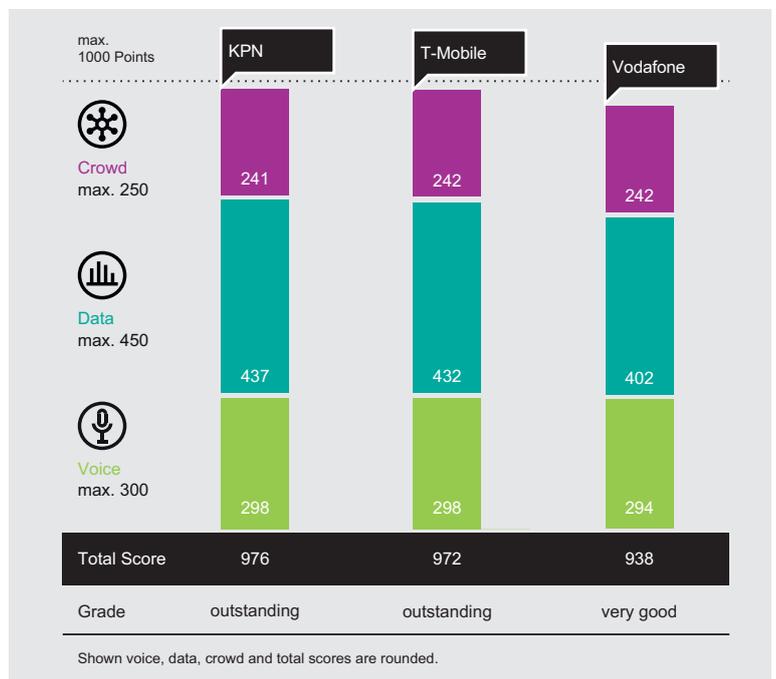
KPN wins the umlaut connect Mobile Benchmark in the Netherlands for the first time and reaches the highest score achieved in our 2021/2022 benchmarking season. T-Mobile, who had won five times in a row before, ranks second this year at a narrow gap in a neck and neck race. As in the previous benchmark, Vodafone comes in third with the grade “very good”.

The network benchmarks conducted by umlaut, part of Accenture, and connect are widely accepted as the de-facto industry standard and for being highly objective. The carefully designed methodology of our 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. This provides profound insights into the overall coverage of voice, data and 5G services as well as real-world User Download Speeds and Latencies. The drive tests and walk tests allow for the maximum capabilities of the networks to be evaluated. Crowdsourcing unveils the service quality and performance actually experienced by real users. We have thoroughly weighed these components in order to give a realistic and conclusive assessment of the rated networks’ true potential and performance.

KPN IS THE OVERALL WINNER, WITH T-MOBILE FOLLOWING CLOSELY AND BOTH ACHIEVING THE GRADE “OUTSTANDING”. VODAFONE RANKS THIRD WITH THE OVERALL GRADE “VERY GOOD”.

In a neck and neck race on a very high technological level, this year KPN manages to outscore the also extremely strong T-Mobile, which had won the previous umlaut connect Mobile Benchmarks in the Netherlands five times in a row. Both operators deservedly achieve the rare grade “outstanding”. KPN scored highest in the data category and also leads in the voice category, together with T-Mobile. In an isolated consideration of its 5G performance, KPN leads in terms of 5G coverage in the bigger Dutch cities. T-Mobile is co-best together KPN in the voice category and co-best together with Vodafone in the crowdsourcing category. This operator also provides the highest share of 5G coverage in towns and on roads. Vodafone comes in third with the overall grade “very good”. It scores relatively close to its competitors in the voice category and is ahead together with T-Mobile in the crowd category. The third place is obtained mainly due to a slight drop in performance in the data category. In terms of 5G, Vodafone offers a good coverage and good performance KPIs, but somewhat falls behind its two competitors in both aspects.

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KPN is this year’s winner with the impressive grade “outstanding.” T-Mobile ranks second at a close gap, also achieving the grade “outstanding”. Vodafone comes in third with the grade “very good”.



Overall Results		KPN	T-Mobile	Vodafone
Voice	max. 300.00 P.	298	298	294
Cities (Drivetest)	135.00	99%	100%	98%
Cities (Walktest)	45.00	100%	100%	99%
Towns (Drivetest)	60.00	100%	99%	98%
Roads (Drivetest)	37.50	98%	99%	96%
Railways (Walktest)	22.50	99%	99%	98%
Data	max. 450.00 P.	437	432	402
Cities (Drivetest)	202.50	97%	96%	90%
Cities (Walktest)	67.50	98%	97%	91%
Towns (Drivetest)	90.00	97%	96%	88%
Roads (Drivetest)	56.25	97%	97%	92%
Railways (Walktest)	33.75	95%	93%	86%
Crowd	max. 250.00 P.	241	242	242
Crowd	250.00	97%	97%	97%
Connect Rating	max. 1000 P.	976	972	938

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

THE DUTCH OPERATORS

Traditionally, the mobile operators in the Netherlands compete on the highest performance level. The history of relatively frequent mergers and acquisitions on the Dutch mobile market was seamlessly continued in 2021 – however the ranking of market shares remained unchanged in comparison to our previous test, which was published in late 2020.



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 the smallest Dutch mobile operator, Tele2. In 2020, T-Mobile NL also acquired the former virtual network operator Simpel. In the fall of 2021, T-Mobile Netherlands was acquired by the private equity investors Apax and Warburg Pincus. At this time, the company reported a total of 6.9 million mobile customers, which corresponds to a market share of approx. 42 per cent, making T-Mobile the largest Dutch mobile operator.

T-Mobile’s network offers 2G mostly at 900 MHz, 3G at 900 MHz and 4G/LTE at 800, 900, 1800, 2100 and 2600 MHz. Its 4G network supports both VoLTE as well as “4G+” (carrier aggregation) up to 1 Gbps. T-Mobile 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 2021, the company reported a total number of 6.5 million revenue-generating SIM cards (consumer and business). This makes KPN the second largest mobile operator in the Netherlands. KPN operates 2G/GSM at 900 MHz, 3G/UMTS at 900 and 2100 MHz and 4G/LTE at 800, 1400, 1800, 2100 and 2600 MHz. The company announced to complete the phase-out of 3G by April 2022 and 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. Over the past two years, the company has renewed a large part of this antenna network. It announced that the modernization will be largely completed by the end of this year. In early 2022, it claimed to offer the largest 5G antenna footprint of all Dutch operators and a population coverage for 5G of 81 per cent. The operator expects 95 per cent of the Netherlands to be covered by its 5G network by the end of 2022.

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 per cent of the joint company VodafoneZiggo is owned by the Vodafone Group and another 50 per cent by Liberty Global. Currently, VodafoneZiggo is the smallest mobile operator in the Netherlands, reporting approx. 5 million mobile customers (5.4 million mobile SIMs, of which the company designates 2.4 million “converged” SIMs). VodafoneZiggo also specifies 3.7 million fixed (broadband, video and telephony) subscribers.

The company operates 2G networks at 900 and 1800 MHz, 3G at 2100 MHz and 4G/LTE at 800, 1800, 2100 and 2600 MHz. It was the first Dutch operator to phase out 3G in order to devote its spectrum to 4G and 5G. VoLTE is supported all over its 4G network, and with “4G+” the operator offers carrier aggregation up to 1 Gbps. 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.

The network benchmarks conducted by umlaut and connect are widely accepted as a completely objective authority. In 2022, we present the umlaut connect Mobile Benchmark in the Netherlands for the seventh time, further enhancing its methodology.

A CLOSE LOOK AT THE DUTCH NETWORKS



Congratulations to KPN for winning the umlaut connect Mobile Benchmark in the Netherlands for the first time! We would also like to recognize T-Mobile's co-best in voice and crowd performance, and Vodafone's co-best result in the crowdsourcing category."

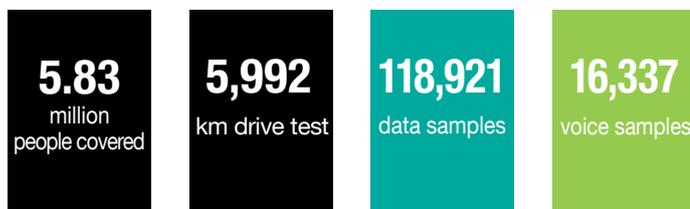
Hakan Ekmen, CEO umlaut

umlaut, headquartered in Aachen, Germany, is a world leader in mobile network testing. The company was formerly known as P3, changed its name in autumn 2019, and has become a part of Accenture in 2021. umlaut has over 4,300 employees, distributed in over 50 locations all around the world, with a turnover of more than 400 million Euros. umlaut is partnering with the international telecommunications magazine connect, which has 29 years of editorial expertise and is one of the leading test authorities in Europe for telecommunication products and services. Together, we – umlaut and connect – have been conducting the most important network benchmark test in Germany for almost 20 years, extending it to other European

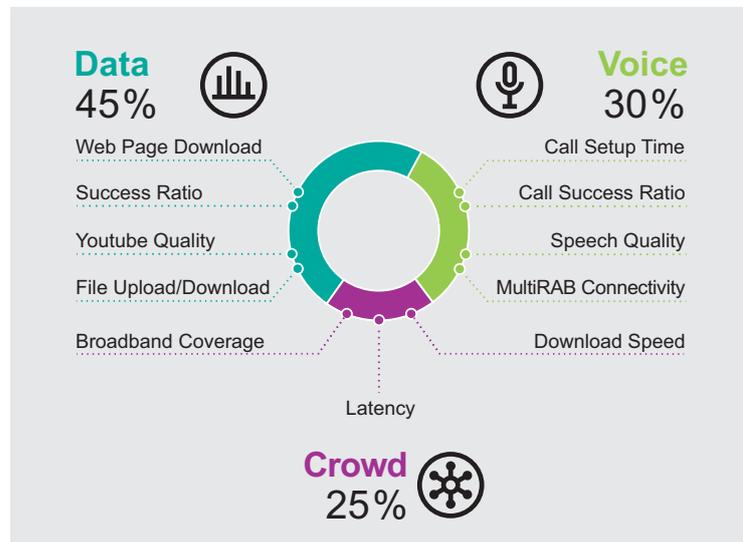
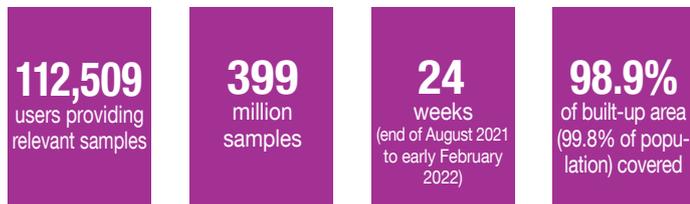
countries since 2009. As the de-facto industry standard, our benchmarking methodology focuses on customer-perceived network quality.

The 2022 umlaut connect Mobile Benchmark in the Netherlands consists of drive tests and walk tests conducted from February 1st to 11th, 2022. Two drive test cars together covered about 6000 kilometres, visiting 21 cities and 13 towns. Additionally, two walk test teams visited eight cities and travelled on trains between them. The test areas account for 5.83 million people, or approx. 34 per cent of the total Dutch population. In addition, the results of extensive crowdsourcing analyses, considering 24 weeks from end of August 2021 to early February 2022 are included in the score.

DRIVE TEST AND WALK TEST FACTS



CROWDSOURCING FACTS



VOICE

Although messaging, e-mails and social media communications have gained in importance, voice telephony is still important. When taking or placing a phone call, customers expect reliable connections. How do the Dutch mobile networks fulfil these expectations?

All three mobile operators in the Netherlands have been supporting Voice over LTE (VoLTE) for years now. VoLTE transmits voice calls as data packets over a 4G connection and thus is a clear improvement over the „circuit-switched“ connections in 3G or 2G networks. But with 5G a new challenge arises: For 5G-based telephony, “Voice over 5G“ or “Voice over New Radio“ would be required – but this technology has not yet found its way into the current network implementations. So as before from 4G to 3G, a new kind of fallback is needed – this time from 5G to 4G/VoLTE.

For the voice rating, each of the two drive test cars and each of the two walk test teams carried one Samsung Galaxy S21+ per operator. The phones in the cars called a counterpart in one of the other cars. The phones carried by the walk test teams in the cities and travelling on trains called a stationary counterpart. The connected testing equipment registered the success ratios, call setup times and speech quality of the test calls. In order to simulate normal smartphone usage, additional data transfers took place in the background of the calls. Also, the so-called MultiRAB (Multi Radio Access Bearer) Connectivity denominates whether data connectivity was available during the test calls. The voice scores account for 30 per cent of the total result.

CITIES DRIVE TEST

T-MOBILE

T-MOBILE LEADS IN A NECK-AND-NECK RACE IN THE DRIVE TESTS IN CITIES, CLOSELY FOLLOWED BY KPN AND VODAFONE

In the larger cities, T-Mobile achieves the highest score by offering the shortest call setup times and excellent speech quality. But the gaps to KPN and Vodafone are very small, at only one percentage point each. All Dutch operators show almost perfect call reliability in this scenario and the other ones.

CITIES WALK TEST

KPN AND T-MOBILE

KPN AND T-MOBILE ON A PAR IN CITY WALK TESTS, CLOSELY FOLLOWED BY VODAFONE

In the walk tests conducted in the Netherlands’s larger cities, KPN and T-Mobile both achieve an impressive score of 100 per cent, again by offering almost perfect call reliability, excellent speech quality and very short call setup times. Vodafone follows closely at a gap of one percentage point which can be explained mostly by slightly longer call setup times.

KPN AND T-MOBILE ARE CO-BEST IN THE VOICE CATEGORY. THEY ARE FOLLOWED AT CLOSE DISTANCE BY VODAFONE, WHICH ALSO SHOWS VERY GOOD RESULTS.

Voice

300 of 1000 Points

- KPN
- T-Mobile
- Vodafone



**TOWNS
DRIVE TEST**

KPN

KPN TAKES THE LEAD IN THE VOICE DRIVE TESTS CONDUCTED IN TOWNS, CLOSELY FOLLOWED BY T-MOBILE AND VODAFONE

In the drive tests conducted in smaller towns, KPN takes the overall lead, but the two other contenders follows at a very narrow distance – at a gap of one percentage point each.

KPN’s lead comes from the highest success ratio, while T-Mobile achieves the shortest call setup times. Vodafone performs on a similar level, but again shows slightly higher call setup times – with the exact same results in smaller towns as were already determined in the larger cities.

**ROADS
DRIVE TEST**

T-MOBILE

T-MOBILE CLOSELY LEADS IN VOICE DRIVE TESTS CONDUCTED ON DURCH ROADS. KPN FOLLOWS AT NARROW GAP

While travelling on the connecting roads between the cities and towns, the drive test cars determined the best voice results for T-Mobile, followed at a narrow gap of just one percentage point by KPN. Again, T-Mobile shows the shortest call setup times – and it is also slightly ahead in terms of speech quality. KPN also shows excellent results, but is behind T-Mobile in these KPIs as well as in MultirAB Connectivity. The gap between to Vodafone is slightly more pronounced with a minimally lower speech quality and slightly lower success ratios – but Vodafone still performs on a very good level.

**RAILWAYS
WALK TEST**

KPN AND
T-MOBILE

T-MOBILE AND KPN ON A PAR WITH VERY GOOD RESULTS IN VOICE TESTS ON TRAINS. VODAFONE FOLLOW AT A VERY NARROW DISTANCE

Providing voice connectivity for passengers travelling on trains is particularly demanding. Still, even in this scenario, the Dutch operators achieve very high success ratios, short setup times and a very good speech quality. In this scenario, T-Mobile and KPN score on a par – with impressive call setup times and success ratios. Due to slightly longer call setup times, Vodafone is one percentage point behind – but also offers very good results in this demanding scenario.



VOICE RESULTS AT A GLANCE

The competition in the voice category takes place on the highest level. All three Dutch mobile operators offer almost perfect call reliability, fast call setup times and excellent speech quality – even in the more demanding scenarios such as performing calls on the road or while travelling on trains. In the overall assessment, KPN and T-Mobile score on a par in the voice category, and Vodafone follows at a narrow distance with also very good voice results.

Operator	KPN	T-Mobile	Vodafone
Cities (Drivetest)			
Success Ratio (%)	100.0	100.0	99.9
Call Setup Time P90 (s)	0.8	0.7	1.5
Speech Quality P10 (MOS-LQO)	4.4	4.4	4.4
Multirab Connectivity (%)	99.9	100.0	100.0
Towns (Drivetest)			
Success Ratio (%)	100.0	99.9	99.9
Call Setup Time P90 (s)	1.0	0.7	1.5
Speech Quality P10 (MOS-LQO)	4.4	4.4	4.4
Multirab Connectivity (%)	100.0	100.0	100.0
Roads (Drivetest)			
Success Ratio (%)	99.8	99.8	99.4
Call Setup Time P90 (s)	1.5	0.7	1.7
Speech Quality P10 (MOS-LQO)	4.2	4.3	4.1
Multirab Connectivity (%)	99.8	100.0	99.6
Cities (Walktest)			
Success Ratio (%)	99.9	99.9	99.9
Call Setup Time P90 (s)	0.8	0.7	1.7
Speech Quality P10 (MOS-LQO)	4.6	4.5	4.5
Multirab Connectivity (%)	100.0	100.0	99.9
Railways (Walktest)			
Success Ratio (%)	99.8	100.0	99.7
Call Setup Time P90 (s)	0.9	0.7	1.7
Speech Quality P10 (MOS-LQO)	4.3	4.3	4.3
Multirab Connectivity (%)	99.8	100.0	100.0



DATA

With the volume of transmitted data permanently growing, data connectivity constantly becomes more important. Which operator in the Netherlands manages best to meet the increasing demand?

All three Dutch networks claim to cover a large part of the population with their 4G/LTE services. Their constant race for the best coverage and the highest data rates has helped to establish an overall very good availability of 4G in the Netherlands. Now the race continues regarding 5G – and again, there is a fierce competition among the three network operators to lead the field regarding this new mobile network technology.

The commercial deployment of 5G in the Netherlands has come so far that we assume this standard as a given in the data tests of this year’s umlaut connect Mobile Benchmark in the Netherlands. So, the Samsung S21+ smartphones carried by our two drive test cars and also by the two walk test teams were configured to prefer 5G – whenever this technology is available, it should also be used for our data measurements.

But also in terms of 4G/LTE, the mobile network technology has come a long way. In many areas where there is no 5G yet, the test smartphones could still benefit from “carrier aggregation” – the combined use of LTE carrier frequencies. It is the technical basis for the so-called “4G+” services which theoretically support data rates up to 1 Gbps.

umlaut’s testing rewards fast throughputs as well as the networks’ availability and stability. In order to assess typical performance as well as peak speeds, we consider two values: the minimum data rate that is available in 90 per cent of the cases, and additionally the peak data rate that is surpassed in 10 per cent of the cases. Web page and file downloads or file uploads reward fast speeds, while the determination of success ratios and assessing Youtube payouts concentrate on reliability aspects.

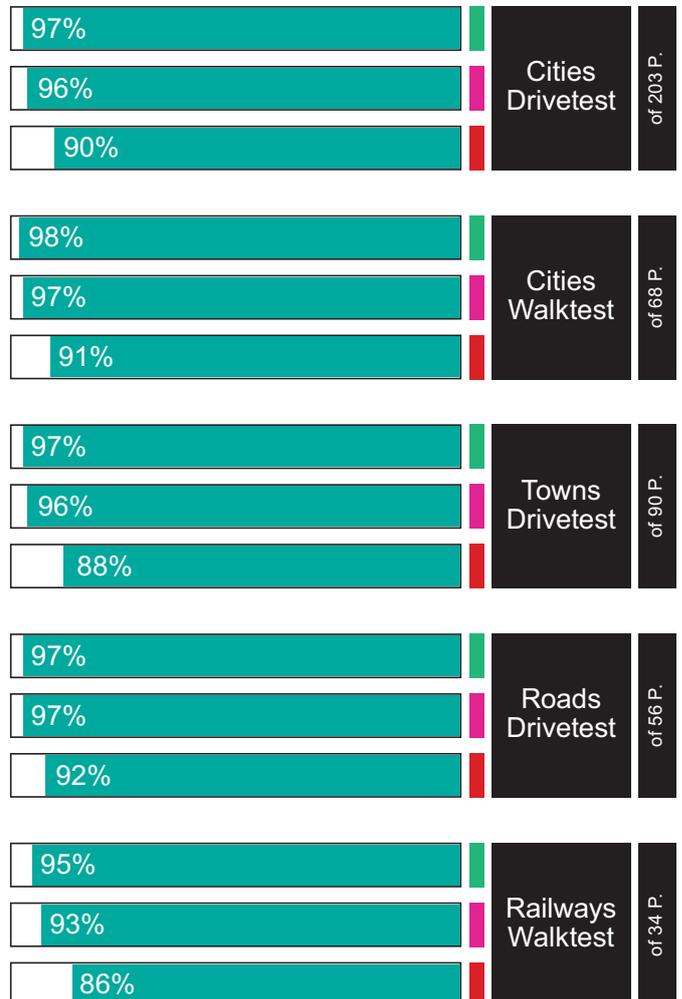


KPN IS AHEAD IN THE DATA CATEGORY, T-MOBILE FOLLOWS AT A NARROW GAP, AND VODAFONE AT A MORE DISTINCT DISTANCE.

Data

450 of 1000 Points

■ KPN
 ■ T-Mobile
 ■ Vodafone



CITIES DRIVE TEST
 KPN

KPN LEADS IN DATA DRIVE TESTS CONDUCTED IN THE BIG CITIES, T-MOBILE FOLLOWS CLOSELY AND VODAFONE A LITTLE FURTHER BEHIND

In the drive tests conducted in 21 larger Dutch cities, KPN leads by a narrow margin, followed by T-Mobile and at a little more distinct gap by Vodafone. KPN and T-Mobile offer excellent success ratios for all tested data services. In the Vodafone network, these numbers are still very good, but a little behind the top two competitors – particularly in the areas of web browsing and file uploads. Also, the throughputs determined in the Vodafone network rank a little behind the two top competitors.

CITIES WALK TEST
 KPN

KPN AHEAD OF T-MOBILE ALSO IN BIG CITY DATA WALK TESTS, VODAFONE ON THIRD RANK

In the overall results of the walk tests conducted in Amsterdam, Dordrecht, Eindhoven, Leiden, Rotterdam, the Hague, Tilburg and Utrecht, KPN also scores ahead of T-Mobile, Again, the distance between the two top contenders is very narrow, while Vodafone follows at a little more distinct distance. As observed in the big city drive tests, Vodafone loses some points regarding the success ratios of web browsing and file uploads as well as for the determined throughputs.

Data Cities (Drivetest)	KPN	T-Mobile	Vodafone
Web-Page Download			
Success Ratio (%)	100.0	100.0	98.8
Overall Session Time (s)	1.1	1.1	1.4
File Download (10 MB)			
Success Ratio/Avg. Session Time (%/s)	100.0/1.0	100.0/1.5	99.3/2.1
90%/10% faster than (Mbps)	57.4/210.5	33.2/173.5	22.5/124.0
File Upload (5 MB)			
Success Ratio/Avg. Session Time (%/s)	100.0/1.2	100.0/1.3	99.5/2.0
90%/10% faster than (Mbps)	25.4/65.0	25.1/61.2	13.0/56.1
File Download (7 Seconds)			
Success Ratio (%)	99.9	99.8	99.9
10% faster than (Mbps)	332.2	250.2	215.9
Speed > 5Mbps / 20Mbps (%)	100.0/99.3	99.9/99.5	99.6/90.6
File Upload (7 Seconds)			
Success Ratio (%)	100.0	99.9	98.7
10% faster than (Mbps)	100.4	98.8	81.0
Speed > 2Mbps / 5Mbps (%)	100.0/99.9	99.9/99.8	99.7/98.0
Youtube			
Success Ratio/Start Time (%/s)	100.0/2.1	100.0/2.1	99.8/2.2
Average Video Resolution (p)	974	978	976
Youtube live			
Success Ratio/Start Time (%/s)	99.9/1.1	99.6/1.2	97.6/1.3
Average Video Resolution (p)	1079	1080	1080
Youtube 4K Smartphone			
Success Ratio/Start Time (%/s)	100.0/2.1	99.8/2.1	99.5/2.3
Average Video Resolution (p)	1867	1760	1774

Data Cities (Walktest)	KPN	T-Mobile	Vodafone
Web-Page Download			
Success Ratio (%)	100.0	100.0	98.9
Overall Session Time (s)	0.9	1.1	1.3
File Download (10 MB)			
Success Ratio/Avg. Session Time (%/s)	100.0/0.8	100.0/1.4	99.2/1.6
90%/10% faster than (Mbps)	69.1/221.0	35.1/184.1	36.1/133.3
File Upload (5 MB)			
Success Ratio/Avg. Session Time (%/s)	100.0/1.1	100.0/1.2	99.8/2.0
90%/10% faster than (Mbps)	31.0/63.3	26.7/62.2	16.1/58.1
File Download (7 Seconds)			
Success Ratio (%)	100.0	100.0	99.8
10% faster than (Mbps)	325.5	290.6	245.3
Speed > 5Mbps / 20Mbps (%)	100.0/100.0	100.0/98.7	100.0/96.8
File Upload (7 Seconds)			
Success Ratio (%)	100.0	100.0	99.2
10% faster than (Mbps)	95.2	95.5	78.3
Speed > 2Mbps / 5Mbps (%)	100.0/99.2	99.8/99.1	99.0/97.8
Youtube			
Success Ratio/Start Time (%/s)	100.0/2.0	100.0/2.1	98.8/2.1
Average Video Resolution (p)	978	978	969
Youtube live			
Success Ratio/Start Time (%/s)	100.0/1.0	99.6/1.1	97.6/1.1
Average Video Resolution (p)	1080	1080	1079
Youtube 4K Smartphone			
Success Ratio/Start Time (%/s)	100.0/2.0	100.0/2.1	99.6/2.2
Average Video Resolution (p)	1898	1736	1780



**TOWNS
 DRIVE TEST**

KPN

KPN AHEAD IN DATA DRIVE TESTS IN SMALLER TOWNS, WITH T-MOBILE FOLLOWING CLOSELY AND VODAFONE AT A SOMEWHAT WIDER DISTANCE

In the data drive tests that our measurement cars performed in 13 smaller Dutch towns, KPN takes the lead with the highest success ratios and overall very good results. T-Mobile follows closely at a distance of just one percentage point, with also very good success ratios and data rates. The gap to Vodafone, which ranks third in this discipline, is a little more distinct.

**ROADS
 DRIVE TEST**

**KPN AND
 T-MOBILE**

KPN AND T-MOBILE ON A PAR ON CONNECTING ROADS, VODAFONE RANKS THIRD WITH A SLIGHTLY HIGHER PERFORMANCE LEVEL THAN IN CITIES OR TOWNS

On the connecting roads covered by our test cars, KPN and T-Mobile rank on a par. For motorists, it is good news that the overall performance level of the two leading contenders on Dutch roads is comparable to that in the larger cities. Vodafone again follows at a somewhat more distinct distance, but at an overall higher performance level than this operator reached in the towns or even in the cities.

Data Towns (Drivetest)	KPN	T-Mobile	Vodafone
Web-Page Download			
Success Ratio (%)	100.0	99.9	98.7
Overall Session Time (s)	1.0	1.1	1.4
File Download (10 MB)			
Success Ratio/Avg. Session Time (%/s)	100.0/1.1	100.0/1.3	98.8/2.3
90%/10% faster than (Mbps)	49.2/217.4	44.9/181.1	19.4/126.9
File Upload (5 MB)			
Success Ratio/Avg. Session Time (%/s)	99.8/1.4	99.8/1.4	99.2/2.3
90%/10% faster than (Mbps)	20.5/63.7	21.7/61.0	9.3/54.5
File Download (7 Seconds)			
Success Ratio (%)	100.0	99.7	99.7
10% faster than (Mbps)	338.7	261.3	184.4
Speed > 5Mbps / 20Mbps (%)	100.0/98.9	99.8/99.5	99.1/89.8
File Upload (7 Seconds)			
Success Ratio (%)	99.7	99.8	98.8
10% faster than (Mbps)	99.5	99.8	78.6
Speed > 2Mbps / 5Mbps (%)	99.8/99.2	99.7/99.2	99.7/97.1
Youtube			
Success Ratio/Start Time (%/s)	100.0/2.1	99.7/2.1	99.0/2.2
Average Video Resolution (p)	977	979	977
Youtube live			
Success Ratio/Start Time (%/s)	99.7/1.1	100.0/1.1	98.3/1.2
Average Video Resolution (p)	1080	1080	1080
Youtube 4K Smartphone			
Success Ratio/Start Time (%/s)	100.0/2.1	100.0/2.1	99.3/2.2
Average Video Resolution (p)	1869	1773	1783

Data Roads (Drivetest)	KPN	T-Mobile	Vodafone
Web-Page Download			
Success Ratio (%)	99.8	99.9	98.8
Overall Session Time (s)	1.1	1.1	1.4
File Download (10 MB)			
Success Ratio/Avg. Session Time (%/s)	100.0/1.3	100.0/1.5	99.6/2.6
90%/10% faster than (Mbps)	32.3/218.5	30.9/188.5	17.5/127.8
File Upload (5 MB)			
Success Ratio/Avg. Session Time (%/s)	100.0/1.7	100.0/2.1	99.2/3.6
90%/10% faster than (Mbps)	15.2/63.5	12.2/60.8	6.1/54.7
File Download (7 Seconds)			
Success Ratio (%)	99.2	100.0	99.6
10% faster than (Mbps)	331.3	297.0	167.7
Speed > 5Mbps / 20Mbps (%)	100.0/96.9	99.3/99.3	98.6/81.8
File Upload (7 Seconds)			
Success Ratio (%)	99.6	99.6	98.1
10% faster than (Mbps)	98.6	102.3	76.2
Speed > 2Mbps / 5Mbps (%)	100.0/98.5	98.9/97.4	98.8/92.2
Youtube			
Success Ratio/Start Time (%/s)	100.0/2.1	100.0/2.1	98.5/2.3
Average Video Resolution (p)	978	975	977
Youtube live			
Success Ratio/Start Time (%/s)	99.3/1.1	100.0/1.3	99.2/1.3
Average Video Resolution (p)	1080	1080	1080
Youtube 4K Smartphone			
Success Ratio/Start Time (%/s)	98.6/2.1	100.0/2.2	97.9/2.2
Average Video Resolution (p)	1875	1746	1660

”

DATA RESULTS AT A GLANCE

In the Data discipline, KPN is on the top rank in all tested scenarios. In the drive tests performed on Dutch roads, T-Mobile scores on a par with KPN, in the other categories it ranks second at a very close gap. The high levels of performance even in smaller towns and on the connecting roads, are particularly convincing. Vodafone follows on the third rank with also very good results, but at a wider gap to the second-ranking T-Mobile. In terms of 5G coverage, KPN leads in the bigger cities, while T-Mobile provides the highest share of 5G coverage in the smaller towns and on the roads. In terms of the observed 5G data rates. KPN is ahead.



Data Railways (Walktest)	KPN	T-Mobile	Vodafone
Web-Page Download			
Success Ratio (%)	99.5	99.4	97.5
Overall Session Time (s)	1.1	1.3	1.6
File Download (10 MB)			
Success Ratio/Avg. Session Time (%/s)	99.7/1.6	99.7/2.1	99.2/3.1
90%/10% faster than (Mbps)	31.7/193.7	24.9/165.8	13.1/110.6
File Upload (5 MB)			
Success Ratio/Avg. Session Time (%/s)	100.0/3.5	99.7/3.6	97.5/4.8
90%/10% faster than (Mbps)	5.2/53.7	4.6/53.3	4.4/45.9
File Download (7 Seconds)			
Success Ratio (%)	99.7	99.2	99.7
10% faster than (Mbps)	279.2	238.7	187.1
Speed > 5Mbps / 20Mbps (%)	100.0/96.3	98.9/96.8	98.6/80.6
File Upload (7 Seconds)			
Success Ratio (%)	98.4	98.7	96.0
10% faster than (Mbps)	81.4	80.2	58.2
Speed > 2Mbps / 5Mbps (%)	97.9/93.0	97.9/90.9	92.9/86.5
Youtube			
Success Ratio/Start Time (%/s)	100.0/2.2	100.0/2.3	100.0/2.4
Average Video Resolution (p)	976	976	974
Youtube live			
Success Ratio/Start Time (%/s)	98.9/1.1	98.9/1.2	95.5/1.5
Average Video Resolution (p)	1080	1080	1080
Youtube 4K Smartphone			
Success Ratio/Start Time (%/s)	99.5/2.2	96.7/2.3	97.7/2.4
Average Video Resolution (p)	1841	1693	1733

RAILWAYS WALKTEST
KPN

KPN AHEAD IN TRAINS, CLOSELY FOLLOWED BY T-MOBILE AND AT A SOMEWHAT WIDER GAP BY VODAFONE
Mobile data connections in trains are particularly demanding. After already achieving very good results in the voice tests conducted on Dutch railways, the three operators also perform convincingly in the according data tests. Overall, KPN is ahead in this discipline, offering very good success ratios and performance KPIs. T-Mobile follows closely with also convincing results. Vodafone ranks third at a somewhat wider gap, but still reaches a high performance level which is not too far behind its own results in the smaller Dutch towns.

5G AT ALREADY VERY HIGH LEVEL IN THE NETHERLANDS

After the end of the 5G frequency auction in July 2020, the Dutch mobile operators started their 5G deployment very quickly. Vodafone had started 5G ahead of the competitors on already available frequencies even in April 2020. KPN and T-Mobile launched their 5G networks at the end of July 2020.

Based on the acquired spectrum, all three Dutch mobile networks operate 5G on 700 MHz, 1400 MHz and 2100 MHz. In difference to other European countries, the 3600 MHz band is not yet available for 5G in the Netherlands as at the time of writing as it is currently still being used by the country's defence satellite system. However, this will change, and a frequency auction for this part of the spectrum is scheduled for later in 2022.

KPN expects to cover 95 per cent of the Netherlands by the end of 2022. In early 2022, it claimed that its 5G network reaches 81 per cent of the population. T-Mobile claimed to already reach about 98 per cent of the Dutch population with 5G and plans to rise the number further in the near future. Vodafone claims to have already reached national coverage with 5G.

5G

KPN AHEAD IN 5G COVERAGE IN BIGGER CITIES, T-MOBILE LEADS IN 5G COVERAGE OF SMALLER TOWNS, ROADS AND RAILWAYS. VODAFONE PREFERABLY USES 5G-DSS.

In all tested scenarios, all three Dutch operators achieved a high amount of 5G coverage. KPN leads in terms of 5G coverage in the bigger cities, while T-Mobile provides the highest share of 5G coverage in the smaller towns, on the roads and on railways. The obtained data samples indicate that Vodafone preferably uses 5G DSS (dynamic spectrum sharing – switching between 4G and 5G on the same frequency band as needed).

As a representative example, below we look at the results of samples with 5G in the 7 second Download tests. Here, KPN achieves the highest data rates, followed by T-Mobile and then Vodafone. The slower data rates in Vodafone's 5G network are a consequence of the 5G DSS chosen by this operator. In all three Dutch networks, the 5G shares seen in this and the other aggregations are already considerable.

Data rates 7s Download	KPN			T-Mobile			Vodafone		
	Share	Average (Mbps)	10% faster than (Mbps)	Share	Average (Mbps)	10% faster than (Mbps)	Share	Average (Mbps)	10% faster than (Mbps)
Samples with 5G									
Cities – Drivetest	94.0%	199.7	335.3	92.5%	150.2	251.0	–	–	–
Cities – Walktest	90.0%	213.1	329.3	83.3%	169.7	283.7	–	–	–
Towns – Drivetest	81.7%	218.8	350.8	90.1%	158.8	261.3	–	–	–
Roads – Drivetest	69.3%	203.0	355.4	85.1%	172.7	297.2	–	–	–
Trains – Walktest	75.5%	173.0	289.5	82.4%	138.3	235.9	–	–	–
Samples with 5G-DSS									
Cities – Drivetest	–	–	–	–	–	–	86.8%	100.5	219.0
Cities – Walktest	–	–	–	–	–	–	81.3%	136.9	256.0
Towns – Drivetest	–	–	–	–	–	–	78.7%	86.1	181.1
Roads – Drivetest	–	–	–	–	–	–	63.2%	87.4	185.1
Trains – Walktest	–	–	–	–	–	–	76.4%	87.5	186.1

CROWD

112,509 users from the Netherlands have contributed around 399 million measurement samples between end of August 2021 and early February 2022. We have conducted a thorough analysis of this extensive data set, using an even more refined methodology compared to previous years.

VODAFONE AND T-MOBILE ARE CO-LEADING IN THE CROWD CATEGORY, WITH KPN FOLLOWING AT A VERY CLOSE GAP OF JUST ONE POINT.

While the drive tests and walk tests, which determine the network performance with traditional methods, are in place since more than two decades, crowdsourcing can add important dimensions such as time, geography or variety in devices and tariff plans – if done in the right way. A detailed description of our crowdsourcing methodology can be found on page 16. A total of 112,509 Dutch mobile phone users have provided relevant samples to our crowd data. The test area of our crowdsourcing represents 98.9 per cent of the built-up area of the Netherlands and 99.8 per cent of the country’s population.

- COVERAGE
- T-MOBILE

KPN LEADS IN COVERAGE REACH, WHILE T-MOBILE IS AHEAD IN COVERAGE QUALITY AND TIME ON BROADBAND – WITH VODAFONE FOLLOWING CLOSELY IN THE LATTER TWO KPIS

In terms of Coverage Reach (the recorded 3G, 4G or 5G coverage related to the overall summation of all coverage areas), KPN is ahead. T-Mobile offers the best Coverage Quality (the ratio of all Evaluation Areas to the “common footprint”) and also the best Time on Broadband (how often an average user had 4G or 5G reception), which makes it the leader in this sub-category. In both KPIs (Coverage Quality and Time on Broadband), Vodafone follows closely behind T-Mobile and ahead of KPN.

Operators	KPN	T-Mobile	Vodafone
Broadband Coverage			
Coverage Quality (%)	98.8	99.5	99.4
Coverage Reach (%)	98.3	97.3	96.9
Time on Broadband (%)	99.2	99.6	99.5
Download Speed			
Basic Internet Class (%)	95.8	94.9	95.5
HD Video Class (%)	87.5	86.9	88.9
UHD Video Class (%)	32.2	30.2	32.2
Latency			
Gaming Class (%)	97.2	97.8	96.2
OTT Voice Class (%)	99.0	99.3	99.0



DOWNLOAD SPEEDS

KPN

KPN SLIGHTLY AHEAD OF VODAFONE IN CROWDSOURCED ASSESSMENT OF DOWNLOAD SPEEDS, T-MOBILE FOLLOWS AT A NARROW GAP

In our crowdsourced assessment of Download Speeds, KPN is slightly leading in the consideration over all speed classes.

In the Basic Internet sub-category, 95.8 per cent of KPN's samples have throughputs above 2 Mbps, closely followed by Vodafone with 95.5 per cent, T-Mobile follows on third rank with 94.9 per cent.

In "HD Video" (above 5 Mbps), Vodafone is slightly ahead with 88.9 per cent of the samples fulfilling this requirement, followed by KPN with 87.5 per cent and T-Mobile with 86.9 per cent.

In the most demanding sub-category, "UHD Video", KPN and Vodafone are on a par with 32.2 per cent, T-Mobile follows closely with 30.2 per cent.

LATENCY

T-MOBILE

T-MOBILE AHEAD IN THE LATENCY METRIC, FOLLOWED BY KPN AND THEN VODAFONE

In our examinations of Latency, T-Mobile is the leader in the Gaming category by showing 99.3 per cent of the samples below 100 ms (OTT Voice class). KPN and Vodafone follow closely and on a par, each at 99.0 per cent.

T-Mobile is also ahead in the more demanding Gaming category with 97,8 per cent of the samples gathered below the threshold of 50 ms. Here, KPN follows on second place with 97.2 per cent and Vodafone on the third with 96.2 per cent.



CROWD RESULTS AT A GLANCE

In the crowdbased score, overall T-Mobile and Vodafone are on a par, with KPN following at a very close distance of just one point. KPN leads in Coverage Reach, while T-Mobile is ahead in Coverage Quality and Time on Broadband. In the assessment of download speeds, KPN is slightly ahead of Vodafone, with T-Mobile following at a narrow gap. In the Latency metric, T-Mobile is ahead in both subcategories "OTT Voice" and the more demanding "Gaming" – followed by KPN and then Vodafone.



RELIABILITY

The assessment of Reliability is another way to look at the results of our voice and data drivetests and walktests as well as at those of our crowd analyses. This approach concentrates on the compulsory basics instead of the highest peaks of a network's performance.

Reliability is not an additional category of our tests, but rather a different angle of viewing the results: For each KPI, our scoring distinguishes between “Qualifiers” (the expected basic performance) and “Differentiators” (the additional performance that exceeds the expected basics). Our look at Reliability limits itself to the Qualifiers – 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 – and thus a smaller maximum score can be achieved in this category. The resulting scores state the reliability with which an operator offers its network services. This assessment once again confirms the neck-and-neck race between KPN and T-Mobile, which score at a distance of only one point – while the gap of Vodafone to the two leading contenders is a little more distinct.

KPN CLOSELY LEADS IN THE RELIABILITY ASSESSEMENT, WITH T-MOBILE FOLLOWING AT A GAP OF JUST ONE POINT. THE DISTANCE OF VODAFONE'S RELIABILITY SCORE IS A LITTLE MORE DISTINCT.

RELIABILITY

KPN CLOSELY LEADS IN RELIABILITY ASSESSMENT, FOLLOWED BY T-MOBILE AT A GAP OF ONLY ONE POINT – BOTH ACHIEVING THE GRADE “OUTSTANDING”. VODAFONE FOLLOWS AT A MORE DISTINCT GAP.

KPN is closely ahead in our Reliability assessment, with T-Mobile following at a distance of only one point. Both contenders achieve the grade “outstanding” for the offered reliability. Vodafone follows a score gap which is a little more distinct – particularly due to the somewhat weaker results in the data drive and walk tests. In the Voice and Crowd categories, Vodafone scores on the same level as the other candidates. All in all, Vodafone achieves the grade “very good” in the Reliability category.



Operator		KPN	T-Mobile	Vodafone
Voice	max. 165 points	164	164	162
Drivetest	128	100%	99%	98%
Walktest	37	99%	100%	99%
Data	max. 227 points	225	225	206
Drivetest	176	99%	99%	91%
Walktest	51	99%	99%	91%
Crowd	max. 138 points	133	132	133
Crowd	138	96%	96%	96%
Total	max. 529 points	522	521	501
Grade		outstanding	outstanding	very good

THE NETHERLAND'S LARGEST CITIES



For the inhabitants of the larger cities in the Netherlands, it is interesting to see how the different operators perform in their areas. Therefore, we made additional analyses for the five Dutch cities with the most inhabitants.

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. These results provide valuable insights to their inhabitants, which if the three operators shows the highest performance in their regional environment.

SAME RANKING AS NATIONWIDE IN AMSTERDAM AS WELL AS THE HAGUE AND UTRECHT. KPN SCORES BEST IN FOUR OUT OF FIVE DUTCH CITIES

In the Dutch capital of Amsterdam as well as in the Hague and in Utrecht, the results are similar to the nationwide ranking: KPN is ahead, closely followed by T-Mobile and at a slightly wider gap by Vodafone. In the voice and crowd categories, all three

contenders score close together. In Amsterdam and Utrecht, Vodafone is slightly ahead in the crowd-based assessment. In the data category, the gaps are a little more distinct.

KPN MORE DISTINCTLY LEADING IN EINDHOVEN

In Eindhoven, the score gap between the locally leading KPN and the second-ranking T-Mobile is a little wider than nationwide or in the aforementioned cities. Again, all three contenders score almost on the same level in the voice and crowd categories. For the most part, the ranking is decided in the data discipline.

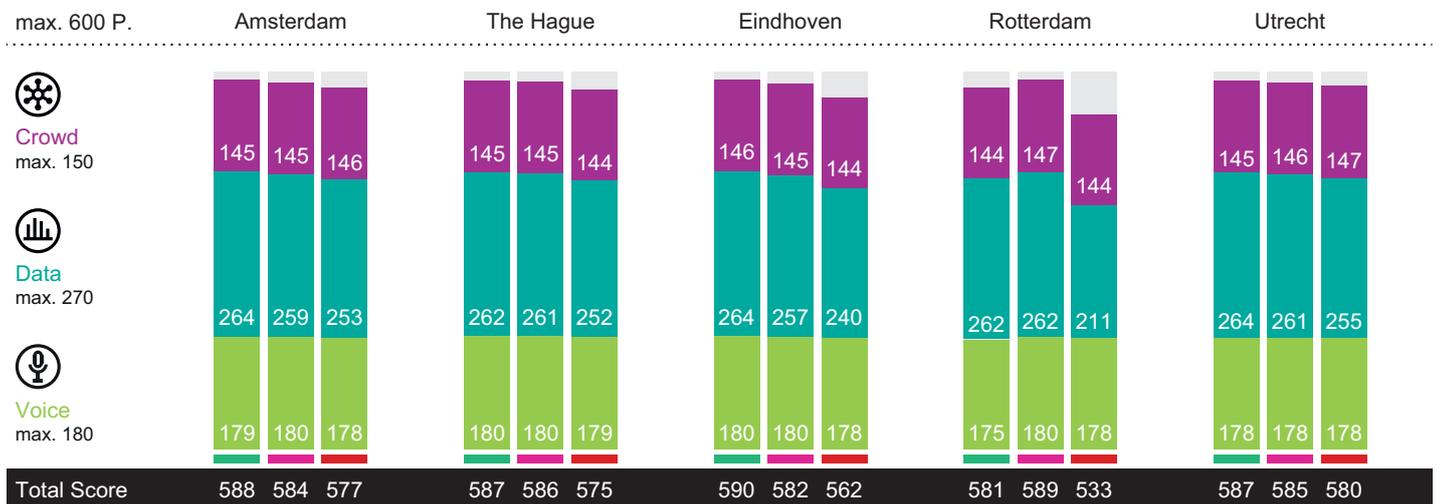
T-MOBILE LOCAL CHAMPION IN ROTTERDAM

While this year KPN wins the neck and neck race with T-Mobile

both nationwide as well as in most of the bigger Dutch cities, in Rotterdam T-Mobile leads the field with a clear score advantage. Here, KPN falls a little behind the other two contenders in the voice category. T-Mobile leads in voice, Vodafone follows at a distance of two point, while KPN is three points behind Vodafone.

In the data category, T-Mobile and KPN score on a par in Rotterdam, with Vodafone falling distinctly behind.

The win of T-Mobile in the harbour city is achieved both in the voice and in the crowd category. In the crowd category, T-Mobile scores three points ahead of both KPN and Vodafone, which are equally strong in the crowd-based analysis for this city.



Cities: Alkmaar, Amersfoort, Amsterdam (W), Deventer, Eindhoven (W), Enschede, Gouda, Groningen, Helmond, Hoorn, Leeuwarden, Leiden (W), Maastricht, Nijmegen, Oud-Beijerland, Ridderkerk, Rotterdam (W), The Hague (s-Gravenhage) (W), Tilburg (W), Utrecht (W), Zwolle; (W) designates walk test cities. A walk test has also been conducted in Dordrecht.

Towns: Bergen op Zoom, Boxtel, Den Helder, Doetinchem, Emmeloord, Emmen, Etten-Leur, Gorinchem, Middelburg, Nunspeet, Oldenzaal, Tiel, Venray

TESTING METHODOLOGY

The methodology of the umlaut connect Mobile Benchmark is the result of almost 20 years of testing mobile networks. Today, network tests are conducted in more than 120 countries. Our methodology was carefully designed to evaluate and objectively compare the performance and service quality of mobile networks from the users' perspective.

The umlaut connect Mobile Benchmark in the Netherlands comprises of the results of extensive voice and data drive tests and walk tests as well as a sophisticated crowd-sourcing approach.

DRIVE TESTS AND WALK TESTS

The drive tests and walk tests in the Netherlands took place between February 1st and February 11th, 2022. All samples were collected during the day, between 8.00 a.m. and 10.00 p.m. The network tests covered inner-city areas, outer metropolitan and suburban areas. Measurements were also taken in smaller towns and cities along connecting highways. Two cars conducted the drive tests in the Netherlands. The connecting routes between the cities and towns alone covered about 3362 kilometres in total. In addition, the cars covered 2180 km while driving through the cities and 440 km while driving through the smaller towns. Overall, the vehicles together covered about 6000 km.

The combination of test areas has been selected to provide

representative test results across the Dutch population. The areas selected for the 2022 test account for 5.83 million people, or roughly 34 per cent of the total population of the Netherlands. The test routes are shown on page 1 of this report, all visited cities and towns are listed in the box above.

The two drive-test cars were equipped with arrays of Samsung Galaxy S21+ smartphones for the simultaneous measurement of voice and data services.

VOICE TESTING

One smartphone per operator in each car was used for the voice tests, setting up test calls from one car to another („mobile-to-mobile“). The walk test teams also carried one smartphone per operator for the voice tests. In this case, the smartphones called a stationary (smartphone) counterpart. The audio quality of the transmitted speech samples was evaluated using the HD-voice capable and ITU standardised so-called POLQA wideband algorithm. All smartphones used for the voice

tests were set to “5G preferred” mode. In addition, they were set to “VoLTE preferred“. As Voice over 5G/Voice over New Radio is not yet supported in current 5G networks, this means that the devices would perform a fallback from 5G to 4G in order to establish voice calls.

In the assessment of call setup times we also rate the so-called P90 value. Such values specify the threshold in a statistical distribution, below which 90 per cent of the gathered values are ranging. For speech quality, we publish the P10 value (10 per cent of the values are lower than the specified threshold), because in this case higher values are better.

In order to account for typical smartphone use scenarios during the voice tests, background data traffic was generated in a controlled way through injection of data traffic (HTTP downloads). In the process, we also recorded Multi-RAB connectivity – the use of several “radio access bearers“ for the background data connections.

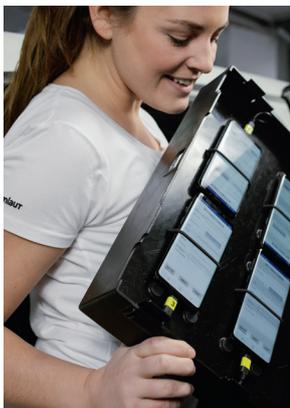
The voice scores account for 30 per cent of the total results.

DATA TESTING

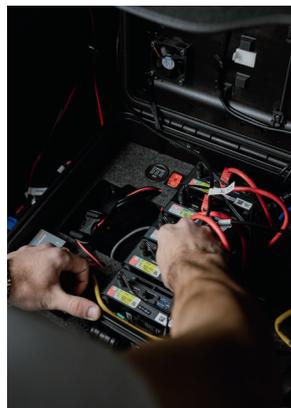
Data performance was measured by using three more Galaxy S21+ in each car – one per operator. Their radio access technology was also set to 5G preferred mode.

For the web tests, they accessed web pages according to the widely recognised Alexa ranking.

In addition, the static “Kepler” test web page as specified by ETSI (European Telecommunications Standards Institute) was used. In order to test the data service



Each drive test vehicle carried eight smartphones for conducting the voice and data tests.



A special control system monitors the smartphones and logs the measurement values they collect.



The walktest teams use trolleys in which powerful rechargeable batteries feed the test smartphones.

performance, files of 10 MB for download and 5 MB for upload were transferred from or to a test server located in the cloud. In addition, the peak data performance was tested in uplink and downlink directions by assessing the amount of data that was transferred within a seven seconds time period.

The Youtube measurements take into account the “adaptive resolution” of the video platform: Youtube dynamically adjusts the played resolution to the available bandwidth. The rating therefore considers the average image resolution or number of lines of the videos. In addition, the video rating is based on the success rate, the time until playback starts and the proportion of video playbacks that went through without interruption.

All the tests were conducted with the best-performing mobile plan available from each operator. Data scores account for 45 per cent of the total results.

CROWDSOURCING

Additionally, umlaut conducted crowd-based analyses of the Dutch networks which contribute 25 per cent to the end result. They are based on data gathered between calendar week 34 (end of August), 2021, until calendar week 5 (early February), 2022.

In the process, a total of 399 million samples from more than 112,509 users were evaluated. The area of the Netherlands covered by these crowdsourcing analyses counts approx. 36,7590 square km and 98.9 per cent of the country’s built-up areas, which correspond to approx. 99.8% of the population.

For the collection of crowd data, umlaut has integrated a background diagnosis process into more than 1000 diverse Android apps. If one of these applications is installed on the end-user’s phone and the user authorizes the background analysis, data collection takes place 24/7, 365 days a year. Reports are generated for every hour and sent daily to umlaut’s cloud servers. Such reports occupy just a small number of bytes per message and do

not include any personal user data.

This unique crowdsourcing technology allows umlaut to collect data about real-world experience wherever and whenever customers use their smartphones.

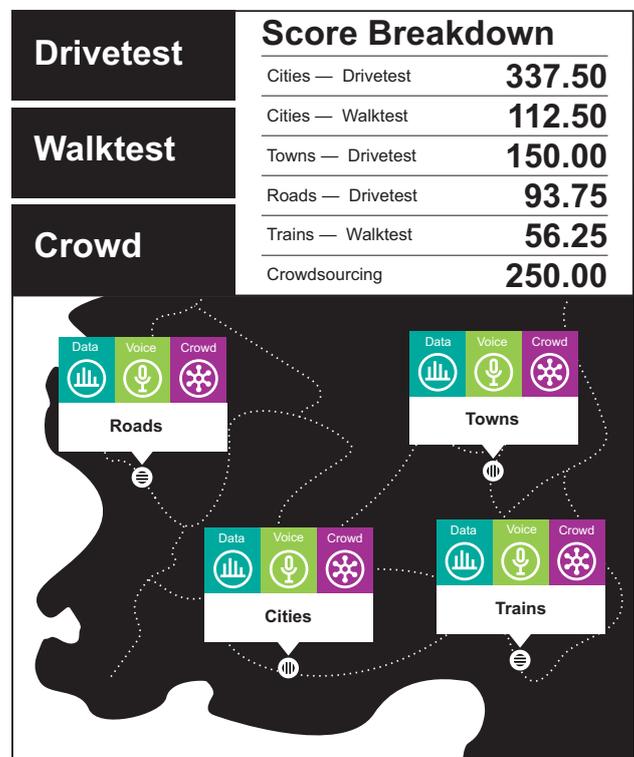
NETWORK COVERAGE

In order to assess the “Coverage Reach”, the test area is divided by a grid of 2x2 km tiles (“Evaluation Areas” or EAs for short). A minimum number of users and measured values must be available for an EA to be considered in the analysis.

For the evaluation, umlaut awards one point per EA if the network under consideration offers 3G coverage. Three points are awarded if 4G or 5G is available in the EA. The number of points achieved in this way is then divided by the total number of points that can be achieved (three points per EA in the “common footprint” – i.e. the area of the country covered by all tested operators).

In addition, we look at the “Coverage Quality”. It puts the percentage of EAs in which a user had 4G or 5G coverage in relation to all EAs in the common footprint.

A third KPI for broadband quality is “Time on Broadband”. It tells us how often an individual 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 and published for all three parameters reflect the respective degree of fulfilment – they do not correspond to the percentage of 4G/5G mobile coverage in an area or in relation to the overall population.



DATA RATES AND LATENCIES

The data rates determined are included in the crowd score at 30%, the latencies at 20%.

The investigation of these parameters is also carried out independently of the EAs and thus concentrates on the experience of each individual user. Samples that were recorded via WiFi or when flight mode was activated, for example, are filtered out before further analysis.

In order to take into account the fact that many mobile phone tariffs throttle the usable data throughput, umlaut has defined three application-related speed classes: “Basic internet” requires a minimum of 2 Mbps, “HD video” requires 5 Mbps and “UHD video” requires 20 Mbps. For a sample to be valid, a minimum amount of data must also have flowed in a 15-minute period.

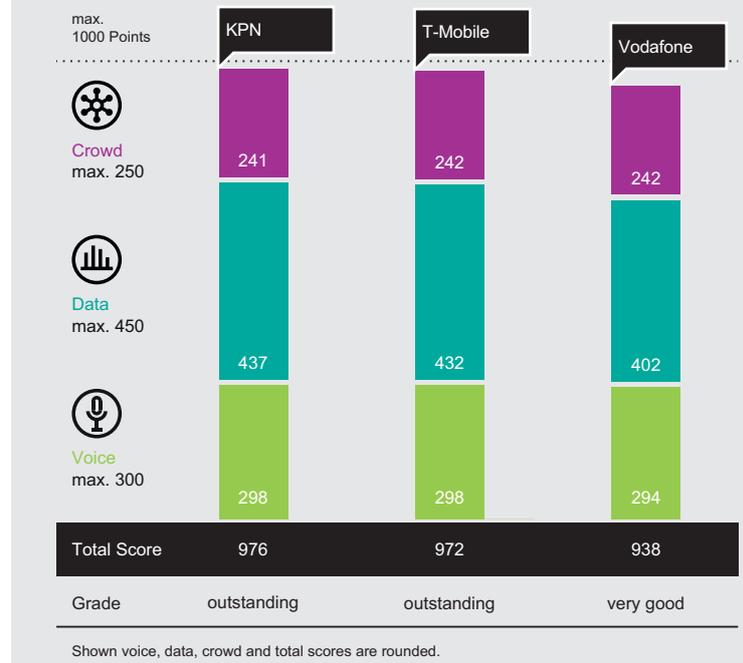
Similarly, the latency of the data packets is also assigned to an application-related class: Roundtrip times up to 100 ms are sufficient for “OTT voice services”, less than 50 ms qualify a sample for “gaming”.

In the evaluation, umlaut assigns the speeds and latencies determined in the samples to one of these classes. “Basic internet” then accounts for 55% of the data rate rating, “HD video” for 33.8% and “UHD video” for 11.3%. “OTT voice” services account for 55% of the latency rating and gaming for 45%.

CONCLUSION

KPN wins the umlaut connect Mobile Benchmark in the Netherlands for the first time and reaches the highest score achieved in our 2021/2022 benchmarking season. T-Mobile, who had won five times in a row before, ranks second this year at a narrow gap in a neck and neck race. Both KPN and T-Mobile achieve the impressive grade “outstanding”. As in our previous benchmark, Vodafone comes in third with the grade “very good”.

The overall winner of the 2022 umlaut connect Mobile Benchmark in the Netherlands is KPN. In a neck and neck race on a very high technological level, this year KPN manages to outscore the also extremely strong T-Mobile, which had won the previous umlaut connect Mobile Benchmarks in the Netherlands five times in a row. Both operators deservedly achieve the rare grade “outstanding”. In a comparison to the results of our previous Benchmark in the Netherlands, which was published at the end of 2020, KPN achieves the biggest score improvement by gaining another 22 points. Its overall lead is particularly won in the data category. As we regularly update our methodology and threshold values in order to keep pace with the technological advancements, KPN’s score gain is even more impressive. But also the second-ranking T-Mobile managed to improve its score over its previous results by an impressive 10 points. Vodafone achieves a very good result, but basically remains at its previous performance level, which results in losing 7 points due to the increased demands of our updated methodology.



Overall Results		KPN	T-Mobile	Vodafone
Voice (max. 300.00 P.)		298	298	294
Cities (Drivetest)	135.00	99%	100%	98%
Cities (Walktest)	45.00	100%	100%	99%
Towns (Drivetest)	60.00	100%	99%	98%
Roads (Drivetest)	37.50	98%	99%	96%
Railways (Walktest)	22.50	99%	99%	98%
Data (max. 450.00 P.)		437	432	402
Cities (Drivetest)	202.50	97%	96%	90%
Cities (Walktest)	67.50	98%	97%	91%
Towns (Drivetest)	90.00	97%	96%	88%
Roads (Drivetest)	56.25	97%	97%	92%
Railways (Walktest)	33.75	95%	93%	86%
Crowd (max. 250.00 P.)		241	242	242
Crowd	250.00	97%	97%	97%
Connect Rating (max. 1000 P.)		976	972	938

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



1 

For the first time, KPN is the winner of our Mobile Benchmark in the Netherlands. It deservedly achieves the rare grade “outstanding”, scored highest in the data category and also leads in the voice category, together with T-Mobile. KPN is also ahead in terms of 5G coverage in the bigger Dutch cities.

2 

The second-ranking T-Mobile scores four points behind the overall winner and also achieves the rare grade “outstanding”. The operator is ahead in the crowd category together with Vodafone and scores on a par with KPN in the voice discipline. T-Mobile also provides the highest share of 5G coverage in towns, on roads and on railways.

3 

Vodafone ranks third with a very good result. It scores relatively close to its competitors in the voice category and leads together with T-Mobile in the crowd category. The third place is obtained mainly due to a slight drop in performance in the data discipline. In 5G, Vodafone offers good coverage and performance KPIs.