# The 2018 Mobile Network Test in the Netherlands

Groningen

Hoorn

Zaanstad
Haarlem
Almere
Amsterdam

Hengelo

Den Haag
Leiden
Utrecht
Amersfoort

Leidschendam-
Voorburg
Rotterdam
Gouda
Arnhem

Nissewaard
Nijmegen

s-Hertogenbosch

Breda
Tilburg

Eindhoven

Maastricht

- ● Drivetest
- ○ Walktest
- — Roads
- ---- Railways

The benchmarking expert P3 has been testing the Dutch mobile networks since 2015, showing always excellent and continuously increasing network performance in the Netherlands.

With significant changes in the market due to recent mergers, our fourth mobile network test once more promises an exciting race. How did the four independent candidates perform this time?

*The P3 connect Mobile Benchmark in the Netherlands has always shown very strong results. This year, the three strongest contenders have once again improved on their results, with only Tele2 falling a little behind last year's score.*
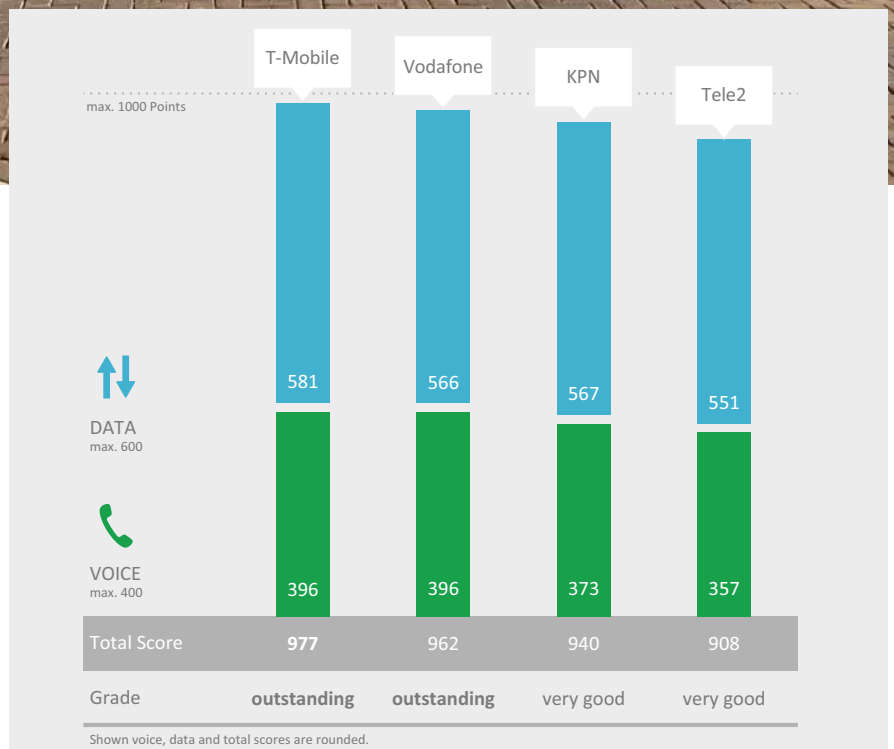
# Results in a nutshell

P3's network benchmarks are widely accepted as the de-facto industry standard and for being highly objective. The carefully designed methodology of our 2018 benchmark in the Netherlands combines two cars conducting drivetests in 21 Dutch cities and on the connecting roads between them with walktests in seven larger cities and tests on Dutch railways. The areas in which we have tested account for more than 5.7 million people, or for about 34 per cent of the Dutch population.

P3's measurement included the use of up-to-date LTE Cat 9 as well as VoLTE-capable smartphones for the tests. Also, we constantly readjust the thresholds of our evaluation with steps like these we take the latest technical developments of the mobile networks into account. The scope of our benchmark is to show how the mobile networks perform at the edge of what is technically feasible – and to what extent do customers benefit from these capabilities? In order to provide valid assessments, we have also used the most comprehensive mobile plans available from each operator.

### T-Mobile, Vodafone and KPN have improved compared to their 2017 scores

As in the two previous years, the overall winner is T-Mobile. This time, the winner even achieves an impressive 977 points – the highest score which has ever been achieved in a P3 connect Mobile Benchmark – and the grade „outstanding". Vodafone follows closely behind achieving the same grade. KPN ranks third with the overall grade "very good". All three operators were able to improve clearly compared to their 2017 results, with Vodafone making the biggest leap (+31 points), followed by T-Mobile (+21 points) and KPN (+10 points). Only Tele2 has lost some ground (-11 points) compared to its 2017 score.

T-Mobile maintains the lead in almost every service and category. However, all in all T-Mobile, Vodafone and KPN show excellent results. KPN has lost points because of slightly inferior speech quality and longer call setup times. All Dutch operators show a strong performance for all data services on connecting roads as well as in trains.

| max. 1000 Points | T-Mobile | Vodafone | KPN | Tele2 |
|---|---|---|---|---|
| DATA max. 600 | 581 | 566 | 567 | 551 |
| VOICE max. 400 | 396 | 396 | 373 | 357 |
| Total Score | **977** | 962 | 940 | 908 |
| Grade | **outstanding** | **outstanding** | very good | very good |

Shown voice, data and total scores are rounded.

| Overall Results Voice and Data | | T-Mobile | Vodafone | KPN | Tele2 |
|---|---|---|---|---|---|
| **Voice** | max. 400 | 396 | 396 | 373 | 357 |
| Cities (Drivetest) | 180 | 99 % | 100 % | 92 % | 90 % |
| Cities (Walktest) | 60 | 100 % | 99 % | 99 % | 92 % |
| Towns (Drivetest) | 80 | 99 % | 99 % | 92 % | 90 % |
| Roads (Drivetest) | 50 | 100 % | 99 % | 91 % | 88 % |
| Trains (Walktest) | 30 | 93 % | 93 % | 94 % | 81 % |
| **Data** | max. 600 | 581 | 566 | 567 | 551 |
| Cities (Drivetest) | 270 | 97 % | 95 % | 95 % | 93 % |
| Cities (Walktest) | 90 | 95 % | 95 % | 93 % | 88 % |
| Towns (Drivetest) | 120 | 97 % | 93 % | 94 % | 92 % |
| Roads (Drivetest) | 75 | 99 % | 97 % | 98 % | 97 % |
| Trains (Walktest) | 45 | 94 % | 87 % | 90 % | 85 % |
| **Connect Rating** | max. 1000 | 977 | 962 | 940 | 908 |

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

*The mobile networks in the Netherlands are famous for their high performance level. In recent years, the smaller Dutch operators conducted various mergers and acquisitions in order to attack the market leader KPN.*

# THE DUTCH OPERATORS

## kpn

The **K**oninklijke **P**TT **N**ederland N.V. emerged from the privatisation of the formerly state-owned PTT in 1998. With about 8 million mobile customers, KPN had a market share of about 44 per cent in the Netherlands at the end of 2017. With these numbers, the company is by far the largest Dutch mobile operator. For the fiscal year 2017, the company reported a total revenue of 6.5 billion Euros.

The company focuses on marketing its KPN brand, however with Simyo, Telfort and Ortel it also has offerings in the "no-frills" segment.

KPN operates 2G/GSM at 900 and 1800 MHz, 3G/UMTS at 900 and 2100 MHz and 4G/LTE at 800, 1800, 2100 and 2600 MHz. The company claims a 99 per cent 4G availability all over the country. Where KPN already offers carrier aggregation, the theoretical maximum speed of its LTE network is 225 Mbit/s. KPN markets this configuration as "4G+". KPN has offered VoLTE since October 2016.

## vodafone

The Dutch subsidiary of the international Vodafone Group acquired the formerly independent 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. VodafoneZiggo is the second largest mobile operator in the Netherlands with around 5 million mobile customers equalling a mobile market share of about 28 per cent. The company also specifies nearly 4 million video, over 3 million fixed broadband and about 2.5 million fixed telephony subscribers. For the calendar year 2017, VodafoneZiggo announced a mobile revenue of 4 billion Euros.

The company operates 2G networks at 900 and 1800 MHz, 3G at 2100 MHz and 4G/LTE at 800, 1800, 2100 and 2600 MHz. Vodafone claims to offer more than 98 per cent coverage with 4G (up to 150 Mbit/s). In many Dutch regions the company offers "4G+" up to 250 Mbit/s. VoLTE was introduced in November 2016.

## T · ·

In 2000, the German Deutsche Telekom bought a minority of the Dutch mobile network operator Ben, which two years later was 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 Netherlands additionally acquired the operator Orange. At the end of its fiscal year 2017, T-Mobile Netherlands reported 3.85 million customers and a revenue of 1.4 billion Euros which equals a mobile market share of about 21 per cent. In December 2017, the company announced to acquire Tele 2 (see next column).

T-Mobile Netherlands operates 2G mostly at 1800 MHz, 3G at 900 and 2100 MHz and 4G/LTE at 900, 1800, 2100 and 2600 MHz. The company claims a 4G coverage of more than 99 per cent of the Dutch population. With 4G+, T-Mobile network offers a maximum download speed of 300 Mbit/s. VoLTE was introduced in October 2017.

## TELE2

The Swedish telecommunications operator Tele2 acquired the former Versatel N.V. in 2005 and merged it with its existing Dutch operations. Originally acting as a MVNO (mobile virtual network operator), Tele2 nowadays operates its own infrastructure and has a portfolio of fixed telephony, data, internet and mobile telephony products.

At the end of its fiscal year 2017, Tele2 reported more than 1.2 million mobile customers which equals a market share of about 5 per cent. As a result of the announced merger with T-Mobile NL, Tele2 will hold a minority stake of 25 per cent in the combined company. At the time of writing this report, Tele2 operated its own network and T-Mobile NL announced to continue to use the Tele2 brand in the market.

Tele2 operates its own LTE network at 800 and 2600 MHz and offers roaming in the T-Mobile 2G and 3G networks to its customers. Tele2's 4G network claims a coverage of 97 per cent of the country and offers carrier aggregation ("4G+") up to 225 Mbit/s as well as VoLTE.

# A close look at the Dutch networks

*P3 and connect have conducted a mobile network test in the Netherlands for the fourth time. How have the recent mergers and acquisitions affected the traditionally powerful Dutch networks in 2018?*

P3 communications GmbH, based in Aachen, Germany, is a world leader in mobile network testing. It is part of the P3 group, with over 3,500 employees worldwide and a turnover of more than 350 million Euros. P3 is partnering with the international telecommunications magazine connect, which has more than 20 years of editorial expertise and is one of the leading test authorities in Europe for telecommunications products and services.
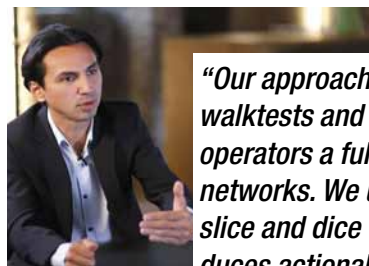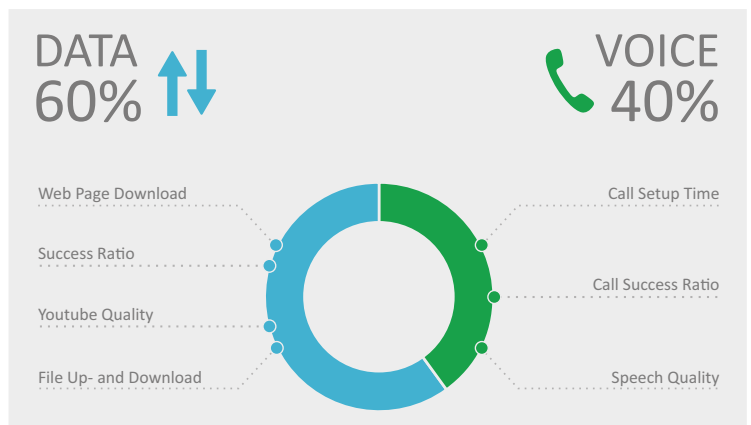
Together, P3 and connect have been conducting the most important network benchmark test in Germany for 15 years, extending it to Austria and Switzerland in 2009 and to other countries in the following years. Currently, we are publishing public benchmarks in eight countries. In the Netherlands, the P3 connect Mobile Benchmark has been conducted since 2015.

In 2017 alone, P3 compiled more than 60,000 measurement hours in 70 countries across five continents, with its test vehicles covering almost one million kilometres. As the de-facto industry standard, the P3 benchmarking methodology focuses on customer-perceived network quality. P3's network benchmarks are widely accepted as a completely objective authority.

**Carrier Aggregation (4G+) and VoLTE in all Dutch networks**
In 2017, the test winner T-Mobile received the grade "outstanding", and the three other candidates were evaluated as "very good". The results clearly reflected the high performance level of the mobile networks in the Netherlands. Since then, the joint venture of Vodafone and Ziggo has advanced, T-Mobile announced to acquire Tele2. Also, all four Dutch operators support carrier aggregation ("4G+") as well as Voice over LTE (VoLTE) in their networks. So, the testing team was curious how these changes had affected the 2018 results.



DATA 60%   VOICE 40%

Web Page Download
Success Ratio
Youtube Quality
File Up- and Download

Call Setup Time
Call Success Ratio
Speech Quality



Hakan Ekmen, CEO of P3 communications GmbH.

*"Our approach combines drivetests, walktests and also crowdsourcing, giving operators a full 360-degree view of their networks. We use our analytical skills to slice and dice the data in a way that produces actionable insights into network performance and user experience, helping operators optimise service delivery and make better investment decisions."*

# Voice

*Voice services may be less important today – however, customers expect reliable connections when talking on the phone. How do the Dutch networks fulfil these expectations?*

As the last Dutch operator, T-Mobile introduced Voice over LTE (VoLTE) in October 2017. So, today all four contenders support this useful technology. VoLTE transmits voice calls as data packets over the 4G connection. This way, the formerly necessary "circuit-switched fallback", which forced smartphones to switch back to 3G or 2G in order to take or place a phone call, can be avoided. Also, VoLTE codecs potentially support a wider audio bandwidth providing operators with the opportunity to deliver higher speech quality to their customers.

On their tour through the Netherlands, P3's two test cars visited 21 cities, of which 16 are counting over 100 000 inhabitants, as well as 31 towns. Also, the cars covered about 3 600 km of connecting roads. Additionally, a walktest team conducted tests in seven cities. For the voice rating, each car carried a total of eight Samsung Galaxy S7 smartphones (two per operator). The walktest team carried a total of four Galaxy S7 – one per operator. The phones in the cars always called a counterpart in the other car. The phones carried by the walktest teams called a stationary counterpart. The connected testing equipment registered success ratios, setup times and speech quality. In order to simulate normal smartphone usage, data transfers took place in the background of the test calls.

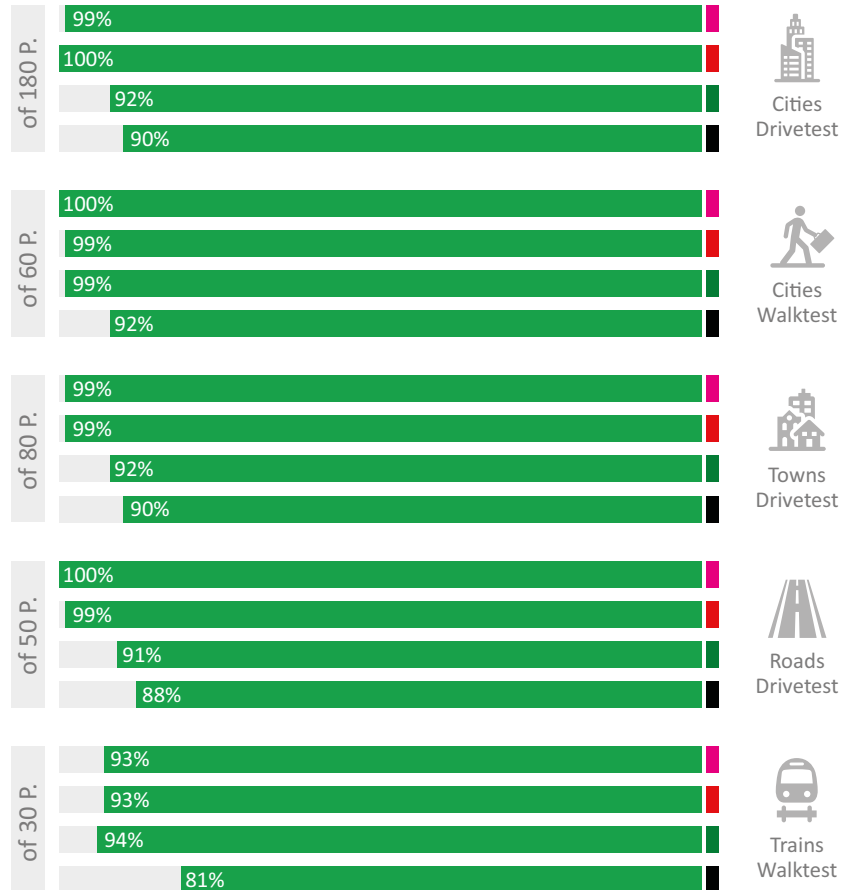### T-Mobile and Vodafone on par in voice, KPN and Tele2 a little behind

In the voice tests conducted in cities, towns and on connecting roads, it was a neck-and-neck race between T-Mobile and Vodafone. In the drivetests executed in the larger Dutch cities Vodafone scored slightly ahead of T-Mobile. For the KPIs call setup time and speech quality, both contenders achieve the maximum number of available point, so the race in this sector is decided by the call success ratios. With exactly 99.91 per cent, Vodafone scores slightly higher than T-Mobile with 99.88 per cent. In the smaller towns, their scores are on a par. On the connecting roads, T-Mobile scored slightly ahead of Vodafone. So, in the intermediate result of the voice discipline T-Mobile and Vodafone are on a par, both scoring 396 points.

Compared to the top two, the drive test results of KPN and Tele2 in cities, towns and on connecting roads falls a little behind due to slightly lower call success ratios and speech quality values as well as longer call setup times. >>

**of 180 P.** — Cities Drivetest
- 99%
- 100%
- 92%
- 90%

**of 60 P.** — Cities Walktest
- 100%
- 99%
- 99%
- 92%

**of 80 P.** — Towns Drivetest
- 99%
- 99%
- 92%
- 90%

**of 50 P.** — Roads Drivetest
- 100%
- 99%
- 91%
- 88%

**of 30 P.** — Trains Walktest
- 93%
- 93%
- 94%
- 81%

Legend: ■ T-Mobile  ■ Vodafone  ■ KPN  ■ Tele2

| Voice - Drivetest | T-Mobile | Vodafone | KPN | Tele2 |
|---|---|---|---|---|
| **Cities** | | | | |
| Call Success Ratio (%) | 99.9 | 99.9 | 99.8 | 99.5 |
| Call Setup Time (s) | 2.2 | 2.4 | 4.4 | 3.9 |
| Speech Quality (MOS-LQO) | 4.1 | 4.0 | 3.7 | 3.4 |
| **Towns** | | | | |
| Call Success Ratio (%) | 99.8 | 99.9 | 99.8 | 99.4 |
| Call Setup Time (s) | 2.3 | 2.4 | 4.3 | 3.9 |
| Speech Quality (MOS-LQO) | 4.1 | 4.0 | 3.7 | 3.4 |
| **Roads** | | | | |
| Call Success Ratio (%) | 99.9 | 99.7 | 99.5 | 98.8 |
| Call Setup Time (s) | 2.4 | 2.5 | 4.5 | 4.1 |
| Speech Quality (MOS-LQO) | 4.0 | 4.0 | 3.7 | 3.4 |

## Walktests conducted in seven cities show excellent results of all networks

For the first time, a walktest has been conducted as part of the P3 connect Mobile Benchmark in the Netherlands. The walktest team visited Almere, Amsterdam, Den Haag, Nijmegen, Rotterdam, Tilburg and Utrecht. The results of their measurements show high success ratios and short call setup times for T-Mobile, Vodafone and KPN. In this discipline, KPN joined the top two contenders – with T-Mobile scoring 100 per cent of the available points in the category, while Vodafone and KPN scored 99 per cent. Tele2 follows at a little distance, but still achieves 92 per cent of the possible points.

Examining the speech quality observed in our test calls, there is a more distinct ranking order: T-Mobile scores highest, followed closely by Vodafone. Then, there is a little gap with KPN reaching the third and Tele2 reaching the fourth rank. Still, our results point out that smartphone users walking in the large Dutch cities can expect an excellent voice performance from any of their mobile operators.

## Voice results in Dutch trains among the best in Europe

In 2018, P3 connect Mobile Benchmark in the Netherlands for the first time also includes tests conducted in railways. In order to perform them, the walktest team took trains to travel between the seven cities listed above. Additionally, they took trains to the very north and the very south of the country (see map on the right-hand side). It is no surprise that the measurement values gathered in the challenging railway scenario fall a little behind compared to the drivetests and the walktests in the cities. Still, the Dutch networks achieve very good results in this discipline. Here, KPN is slightly ahead, while Vodafone and T-Mobile follow at close distance and Tele2 with a little wider gap. The overall results of the train tests however rank the voice connectivity in Dutch trains among the European top group. Similar ratings were achieved in Switzerland. Compared to Germany and Austria, the performance in Dutch trains is by far better.



The walktest team took trains to travel between the seven walktest cities. Additionally, they made train trips to the very north and the very south of the Netherlands.



© Ad Meskens / Wikimedia Commons

## VOICE RESULTS AT A GLANCE

T-Mobile and Vodafone share the win in the voice discipline. KPN also achieves very good results and was clearly able to improve over its 2017 voice score. Slightly inferior speech quality and longer call setup times prevent an even better score for KPN. Tele2 falls a little behind but still achieves decent voice results.

| Voice - Walktest | T-Mobile | Vodafone | KPN | Tele2 |
|---|---|---|---|---|
| Cities | | | | |
| Call Success Ratio (%) | 99.9 | 99.9 | 99.9 | 98.8 |
| Call Setup Time (s) | 1.5 | 1.5 | 1.5 | 2.2 |
| Speech Quality (MOS-LQO) | 4.4 | 4.3 | 3.9 | 3.7 |

| Voice - Walktest | T-Mobile | Vodafone | KPN | Tele2 |
|---|---|---|---|---|
| Trains | | | | |
| Call Success Ratio (%) | 98.1 | 97.9 | 98.7 | 95.2 |
| Call Setup Time (s) | 1.7 | 1.7 | 1.6 | 2.4 |
| Speech Quality (MOS-LQO) | 4.3 | 4.3 | 3.8 | 3.6 |

# Data

In order to assess the performance and reliability of data connections, our two drivetest cars carried two smartphones per operator for the data tests: One Samsung Galaxy S7 and one Sony Xperia XZ. This choice was made in order to take the variations into account that result from the interaction of different smartphone types with the different networks. The walktest team carried one Samsung Galaxy S7 per operator. Supporting the LTE category 9, both smartphone types were able to benefit from the so-called aggregation of three LTE carrier frequencies which the Dutch operators offer under the name of 4G+ and which could theoretically transmit up to 450 Mbps. P3's testing considers fast throughputs as well as the networks' availability and stability. Web page and file downloads or file uploads reward fast speeds, while recording success ratios and assessing YouTube playouts concentrate on reliability aspects. As YouTube streams videos at adaptive bitrates, the average value of the received video resolution is another important performance indicator.

**Overall high data performance in large Dutch cities**
In the drivetests conducted in the cities, T-Mobile is ahead with 97 per cent of the achievable points, but its competitors follow closely. Vodafone and KPN both score 95 per cent, while Tele2 scores 93 per cent of possible points in this category.                >>
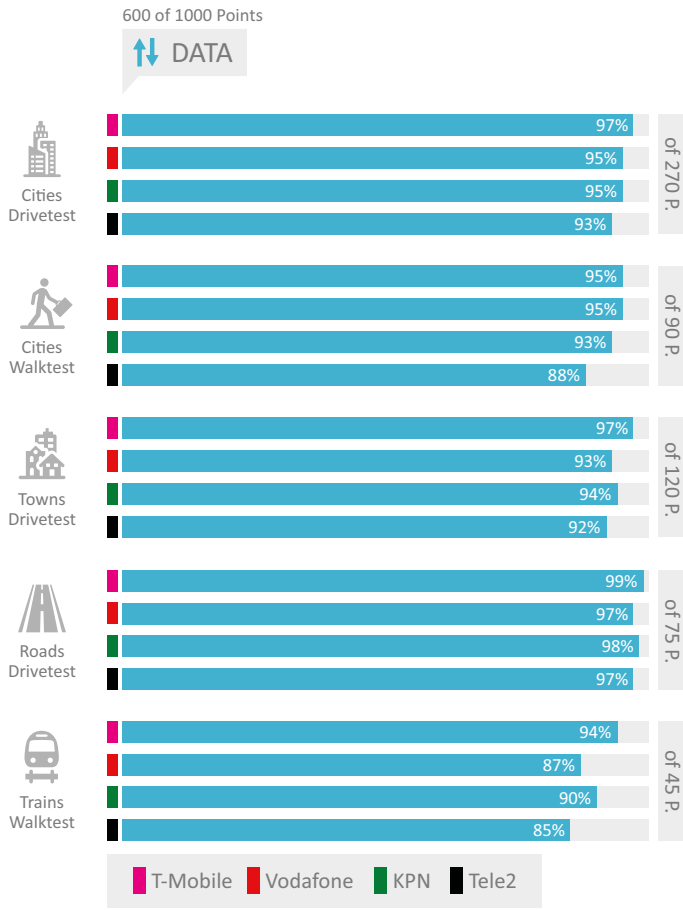
| Data in Cities - Drivetest | T-Mobile | Vodafone | KPN | Tele2 |
|---|---|---|---|---|
| Web-Page Download (Live/Static) | | | | |
| Success Ratio (%/%) | 100.0/100.0 | 99.7/100.0 | 99.5/100.0 | 99.7/100.0 |
| Static: Avg. Session Time (s) | 1.1 | 1.1 | 1.0 | 1.0 |
| Live: Reaction Time (ms) | 562 | 547 | 595 | 593 |
| Live: Initial DL Speed 1st second (kB/s) | 873 | 846 | 825 | 833 |
| File Download (3 MB) | | | | |
| Success Ratio/Avg. Session Time (%/s) | 100.0/0.8 | 100.0/1.0 | 99.9/0.9 | 100.0/1.0 |
| 90%/10% faster than (kbit/s) | 21946/76506 | 16436/72727 | 17754/77170 | 17122/70796 |
| File Upload (1 MB) | | | | |
| Success Ratio/Avg. Session Time (%/s) | 100.0/0.5 | 100.0/0.7 | 99.9/0.7 | 99.6/1.0 |
| 90%/10% faster than (kbit/s) | 13221/27682 | 8576/25890 | 8595/26316 | 4128/23952 |
| File Download (7 Seconds) | | | | |
| Success Ratio (%) | 99.8 | 100.0 | 100.0 | 100.0 |
| Avg. Throughput (kbit/s) | 86913 | 57810 | 65222 | 66170 |
| 90%/10% faster than (kbit/s) | 32200/156810 | 19469/108641 | 20466/124793 | 20894/121535 |
| File Upload (7 Seconds) | | | | |
| Success Ratio (%) | 99.9 | 99.8 | 99.9 | 99.6 |
| Avg. Throughput (kbit/s) | 34600 | 27272 | 27088 | 23910 |
| 90%/10% faster than (kbit/s) | 18048/43527 | 8871/43455 | 10132/42489 | 5002/42655 |
| Youtube Video | | | | |
| Success Ratio/Start Time (%/s) | 99.9/1.8 | 99.8/1.9 | 100.0/2.0 | 99.7/1.8 |
| Playouts without Interruptions (%) | 100.0 | 100.0 | 99.9 | 99.8 |
| Average Video Resolution (p) | 1080 | 1079 | 1079 | 1078 |

| Data in Cities - Walktest | T-Mobile | Vodafone | KPN | Tele2 |
|---|---|---|---|---|
| Web-Page Download (Live/Static) | | | | |
| Success Ratio (%/%) | 99.8/100.0 | 99.8/100.0 | 99.4/100.0 | 98.9/99.0 |
| Static: Session Time (s) | 1.1 | 1.0 | 1.1 | 1.2 |
| Live: Reaction Time (ms) | 561 | 520 | 573 | 594 |
| Live: Initial Download speed (Kbyte/s) | 819 | 860 | 794 | 775 |
| File Download (3 MB) | | | | |
| Success Ratio/Avg. Session Time (%/s) | 99.8/1.0 | 100.0/1.0 | 100.0/1.3 | 99.4/1.5 |
| 10% faster than (kbit/s) | 64516 | 70589 | 65058 | 66482 |
| 90% faster than (kbit/s) | 17133 | 14147 | 11000 | 12217 |
| File Upload (1 MB) | | | | |
| Success Ratio/Avg. Session Time (%/s) | 100.0/0.6 | 100.0/0.6 | 100.0/0.9 | 99.0/1.3 |
| 10% faster than (kbit/s) | 27491 | 26152 | 26230 | 24024 |
| 90% faster than (kbit/s) | 11364 | 10183 | 7809 | 3723 |
| File Download (7 Seconds) | | | | |
| Success Ratio (%) | 100.0 | 99.8 | 99.4 | 99.8 |
| Avg. Throughput (kbit/s) | 68184 | 61655 | 51096 | 59435 |
| 10% faster than (kbit/s) | 125393 | 113373 | 110519 | 117570 |
| 90% faster than (kbit/s) | 22956 | 14490 | 11160 | 15702 |
| File Upload (7 Seconds) | | | | |
| Success Ratio (%) | 99.6 | 99.4 | 99.2 | 98.2 |
| Avg. Throughput (kbit/s) | 32225 | 28639 | 25107 | 25151 |
| 10% faster than (kbit/s) | 43175 | 43361 | 41439 | 42465 |
| 90% faster than (kbit/s) | 15993 | 12004 | 10055 | 3828 |
| Youtube Video | | | | |
| Success Ratio/Start Time (%/s) | 99.6/1.6 | 100.0/1.6 | 99.8/1.8 | 98.6/1.6 |
| Video playouts without interruptions (%) | 100.0 | 100.0 | 99.6 | 100.0 |
| Average Video Resolution (p) | 1080 | 1078 | 1076 | 1077 |

**600 of 1000 Points**

⇅ DATA

**Cities Drivetest** (of 270 P.)
- T-Mobile: 97%
- Vodafone: 95%
- KPN: 95%
- Tele2: 93%

**Cities Walktest** (of 90 P.)
- T-Mobile: 95%
- Vodafone: 95%
- KPN: 93%
- Tele2: 88%

**Towns Drivetest** (of 120 P.)
- T-Mobile: 97%
- Vodafone: 93%
- KPN: 94%
- Tele2: 92%

**Roads Drivetest** (of 75 P.)
- T-Mobile: 99%
- Vodafone: 97%
- KPN: 98%
- Tele2: 97%

**Trains Walktest** (of 45 P.)
- T-Mobile: 94%
- Vodafone: 87%
- KPN: 90%
- Tele2: 85%

Legend: ■ T-Mobile ■ Vodafone ■ KPN ■ Tele2

| OPERATOR | T-Mobile | Vodafone | KPN | Tele2 |
|---|---|---|---|---|
| **DATA (Towns; Drivetest)** | | | | |
| **Web-Page Download (Live/Static)** | | | | |
| Success Ratio (%/%) | 99.9/100.0 | 99.9/100.0 | 99.2/99.9 | 99.7/100.0 |
| Static: Avg. Session Time (s) | 1.1 | 1.1 | 1.0 | 1.1 |
| Live: Reaction Time (ms) | 574 | 566 | 600 | 603 |
| Live: Initial DL Speed 1st sec (kB/s) | 881 | 796 | 824 | 824 |
| **File Download (3 MB)** | | | | |
| Success Ratio/Ø Session Time (%/s) | 100.0/0.8 | 100.0/1.3 | 99.7/1.0 | 100.0/1.1 |
| 90%/10% faster than (kbit/s) | 25424/75472 | 9625/66427 | 18375/74627 | 14325/72772 |
| **File Upload (1 MB)** | | | | |
| Success Ratio/Ø Session Time (%/s) | 100.0/0.6 | 100.0/1.0 | 100.0/0.9 | 99.2/1.4 |
| 90%/10% faster than (kbit/s) | 8909/26846 | 4861/23324 | 7285/25333 | 3190/23297 |
| **File Download (7 Seconds)** | | | | |
| Success Ratio (%) | 100.0 | 100.0 | 100.0 | 100.0 |
| Ø Throughput (kbit/s) | 94334 | 49482 | 66315 | 69690 |
| 90%/10% faster than (kbit/s) | 34584/169501 | 9820/106526 | 22792/122037 | 18474/131543 |
| **File Upload (7 Seconds)** | | | | |
| Success Ratio (%) | 100.0 | 100.0 | 100.0 | 99.1 |
| Ø Throughput (kbit/s) | 31215 | 20658 | 24587 | 20557 |
| 90%/10% faster than (kbit/s) | 9631/43943 | 5610/40961 | 7256/41093 | 3355/42269 |
| **Youtube Videos** | | | | |
| Success Ratio/Start Time (%/s) | 100.0/1.8 | 100.0/1.9 | 100.0/1.9 | 100.0/1.8 |
| Playouts without Interruptions (%) | 99.7 | 100.0 | 100.0 | 100.0 |
| Ø Video Resolution (p) | 1080 | 1076 | 1080 | 1077 |
| **DATA (Roads; Drivetest)** | | | | |
| **Web-Page Download (Live/Static)** | | | | |
| Success Ratio (%/%) | 100.0/100.0 | 99.7/99.8 | 99.4/99.5 | 99.8/99.9 |
| Static: Avg. Session Time (s) | 1.1 | 1.1 | 1.1 | 1.1 |
| Live: Reaction Time (ms) | 568 | 563 | 605 | 606 |
| Live: Initial DL Speed 1st sec (kB/s) | 855 | 769 | 807 | 817 |
| **File Download (3 MB)** | | | | |
| Success Ratio/Ø Session Time (%/s) | 100.0/0.7 | 100.0/1.3 | 99.8/1.0 | 100.0/1.1 |
| 90%/10% faster than (kbit/s) | 21843/78689 | 10540/57692 | 13485/75949 | 11569/69767 |
| **File Upload (1 MB)** | | | | |
| Success Ratio/Ø Session Time (%/s) | 100.0/0.8 | 100.0/0.9 | 100.0/0.9 | 100.0/1.1 |
| 90%/10% faster than (kbit/s) | 8183/26936 | 5040/23121 | 7960/25974 | 4020/22923 |
| **File Download (7 Seconds)** | | | | |
| Success Ratio (%) | 100.0 | 100.0 | 99.8 | 100.0 |
| Ø Throughput (kbit/s) | 91258 | 40904 | 63999 | 60945 |
| 90%/10% faster than (kbit/s) | 33817/164997 | 9426/87872 | 14838/120675 | 16604/115764 |
| **File Upload (7 Seconds)** | | | | |
| Success Ratio (%) | 100.0 | 100.0 | 99.5 | 99.8 |
| Ø Throughput (kbit/s) | 32045 | 19427 | 24804 | 20532 |
| 90%/10% faster than (kbit/s) | 12664/43898 | 5422/39547 | 8962/42266 | 4723/41220 |
| **Youtube Videos** | | | | |
| Success Ratio/Start Time (%/s) | 100.0/1.8 | 100.0/2.0 | 99.8/2.0 | 99.8/1.8 |
| Playouts without Interruptions (%) | 100.0 | 100.0 | 99.8 | 99.5 |
| Ø Video Resolution (p) | 1080 | 1080 | 1077 | 1076 |
| **DATA (Trains; Walktest)** | | | | |
| **Web-Page Download (Live/Static)** | | | | |
| Success Ratio (%/%) | 98.7/99.1 | 97.3/98.3 | 98.3/98.0 | 97.9/98.1 |
| Static: Avg. Session Time (s) | 1.2 | 1.3 | 1.3 | 1.3 |
| Live: Reaction Time (ms) | 626 | 611 | 634 | 665 |
| Live: Initial DL Speed 1st sec (kB/s) | 789 | 712 | 721 | 722 |
| **File Download (3 MB)** | | | | |
| Success Ratio/Ø Session Time (%/s) | 99.6/1.3 | 98.9/1.9 | 99.3/2.2 | 100.0/2.0 |
| 90%/10% faster than (kbit/s) | 12013/63796 | 7097/57116 | 6366/63208 | 5543/59885 |
| **File Upload (1 MB)** | | | | |
| Success Ratio/Ø Session Time (%/s) | 97.5/1.0 | 98.1/1.3 | 98.2/1.5 | 96.1/2.1 |
| 90%/10% faster than (kbit/s) | 5765/24845 | 3614/21092 | 2991/22002 | 1831/17878 |
| **File Download (7 Seconds)** | | | | |
| Success Ratio (%) | 99.6 | 98.5 | 99.6 | 97.3 |
| Ø Throughput (kbit/s) | 59705 | 34499 | 47584 | 46361 |
| 90%/10% faster than (kbit/s) | 15976/119348 | 5346/78138 | 7138/101044 | 8410/90524 |
| **File Upload (7 Seconds)** | | | | |
| Success Ratio (%) | 97.8 | 95.2 | 98.1 | 95.4 |
| Ø Throughput (kbit/s) | 22152 | 17824 | 15761 | 13060 |
| 90%/10% faster than (kbit/s) | 7099/37412 | 3997/34473 | 3443/29483 | 1681/28752 |
| **Youtube Videos** | | | | |
| Success Ratio/Start Time (%/s) | 98.9/1.8 | 96.3/2.0 | 98.5/2.1 | 96.6/1.8 |
| Playouts without Interruptions (%) | 98.5 | 100.0 | 99.6 | 98.0 |
| Ø Video Resolution (p) | 1072 | 1073 | 1064 | 1066 |

## T-Mobile and Vodafone ahead in data walktests

The data walktests conducted in seven large Dutch cities (see page 6 for the complete list) yield very similar results. In this category, however, T-Mobile and Vodafone share the top position, and KPN falls marginally behind. Tele2 scores weaker in this discipline, due to slightly lower success ratios. But even the smallest Dutch network still achieves 88 per cent of the possible points.

## T-Mobile leads in drivetests in smaller towns, KPN, Vodafone and Tele2 follow closely

In the drivetests performed in the smaller Dutch towns, T-Mobile achieves the highest score and KPN ranks second, while Vodafone and Tele2 follow closely behind. This ranking order can be seen in measurement values like the speeds of file downloads and uploads. All four operators achieve excellent results when it comes to accessing YouTube while driving in smaller towns.

## All Dutch operators share very strong results on connecting roads

A similar ranking can be observed on the connecting roads. T-Mobile also leads in this discipline with 99 per cent of the possible points. KPN ranks second with 98 per cent, while Vodafone and Tele2 share the third rank with 97 per cent of the achievable points. These results are rather sensational, attesting that Dutch drivers can expect top mobile connectivity on the roads of their country.

## T-Mobile and KPN achieve highest scores for data connectivity on Dutch railways

Our test of data connections in Dutch trains again demonstrates the high quality of mobile coverage in the Netherlands. T-Mobile leads the field and even scores higher than in the voice discipline. KPN ranks second but scores a little lower than with its voice connections on trains. Vodafone achieves the third and Tele2 the fourth rank in this discipline. Again, compared to the results in other European trains, the Dutch operators show excellent performances for data connections in trains.

## DATA RESULTS AT A GLANCE

T-Mobile also leads the data discipline of this test. Although KPN has lost some points in comparison to its 2017 data results, the largest Dutch operator still ranks second in the discipline. Vodafone achieves the third rank but shows the biggest improvement compared to last year's data results. Tele2 scores last in this discipline and falls some points behind its 2017 data results, still achieving a very good overall performance in the data discipline.

*The methodology of the P3 connect Mobile Benchmark is the result of more than 15 years of testing mobile networks. Today, tests are conducted in 70 countries. It was carefully designed to evaluate and objectively compare the performance and service quality of The Netherlands' mobile networks from the users' perspective.*

# Testing Methodology

The P3 connect Mobile Benchmark in the Netherlands took place from February 16th until March 10th, 2018. All samples were collected between 8am and 10pm. The network tests covered 21 cities, of which 16 are counting more than 100 000 inhabitants, and 31 smaller towns. Furthermore, our test routes included 3,600 kilometres of connecting roads. Additionally, a walk-test team visited seven larger cities. The team took the trains between the cities and also into more rural areas of the country, performing voice and data tests on the railways as well.

This combination of test areas has been carefully selected to provide a significant series of test results covering the Dutch population. The areas chosen for the 2018 test account for about 5.8 million people, or 34 per cent of the total Dutch population.

P3 conducted the tests with two drive-test cars, equipped with arrays of Samsung Galaxy S7 Cat 9 smartphones (voice) as well as a mixed allocation of Samsung Galaxy S7 and Sony Xperia XZ Cat 9 smartphones (data) for the simultaneous measurement of voice and data services.

### Voice testing

Two smartphones per operator in each car were used for the voice tests, setting up test calls from one car to another. The walktest team carried one smartphone per operator for the voice tests. In this case, the smartphones called a stationary 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 Dutch operators offer 4G capable subscriptions. In total, two voice channels were in operation. Both smartphones establishing the first voice test channel were set to 4G preferred mode forcing the network to perform a fallback to UMTS in LTE areas. On the second channel, both smartphones were set to VoLTE-preferred to simulate customer behaviour with the latest technology. The smartphones used in the walktests were all set to VoLTE-preferred.

In order to account for typical smartphone-use scenarios during the voice tests, background data traffic was generated in a controlled way through random injection of small amounts of HTTP traffic. The voice test scores account for 40 per cent of the total benchmark results.
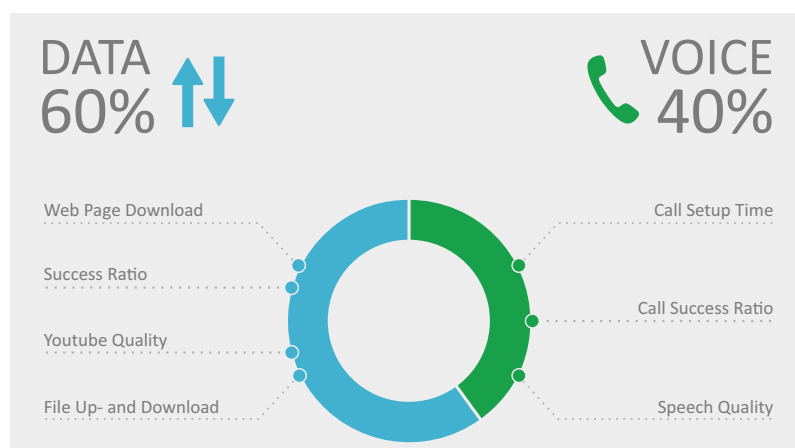
### Data testing

Data performance was measured by using four smartphones in each car – one per operator. One car was equipped with four Samsung Galaxy S7 while the other car was carrying four Sony Xperia XZ in order to respect the variable data performance >>



**Three boxes were mounted into the back and into the side windows of each measurement car in order to support twelve smartphones per car.**



**Each box housed four smartphones allowing the simultaneous testing of four mobile operators.**

**DATA 60%** ⬆⬇   📞 **VOICE 40%**

- Web Page Download
- Success Ratio
- Youtube Quality
- File Up- and Download
- Call Setup Time
- Call Success Ratio
- Speech Quality

of different smart phones in different networks. In order to further reflect the customer experience, the radio access technology was set to LTE preferred mode. The web tests 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 performance, files of 3 MB and 1 MB for download and upload were transferred from or to a test server located on the Internet. 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. Another discipline was the playback of YouTube videos. It took into account that YouTube dynamically adapts the video resolution to the available bandwidth. So, in addition to success ratios, start times and playouts without interruptions, YouTube measurements also determined the average video resolution.

All the tests were conducted with the best-performing mobile plan available from each operator. Data scores account for 60 per cent of the total results.

## Routes and samples

The test routes are shown on page 1 of this report. In the selected 21 cities and 31 smaller towns, the cars had to follow predefined routes. Altogether, the two test cars covered more than 6,420 kilometres, of which approximately 2,820 km led through the cities and towns, while 3,600 km covered connecting roads.

## Performance indicators and rating

The score weighting reflects both the geographical distribution of the Dutch population and the ranking of usage scenarios. Therefore, 600 of the total of 1000 maximum points were assigned to the cities – 450 maximum points for the drivetest results (voice: max. 180 p., data: max. 270 p.) and 150 for walktests results (voice: max. 60 p., data: max. 90 p.). For the towns, a maximum of 200 points is available (voice: max. 80 p., data: max. 120 p.) and for the connecting roads a maximum of 125 points (voice: max. 50 p., data: max. 75 p.). The tests conducted in trains account for another 75 points (voice: max. 30 p., data: max. 45 p.) The tables on page 2 and page 11 of this report show the percentage of maximum points that each operator has achieved in each discipline.



| DRIVETEST | SCORE BREAKDOWN | |
|---|---|---|
| | Cities - Drivetest | 450 |
| | Cities - Walktest | 150 |
| WALKTEST | Towns - Drivetest | 200 |
| | Roads - Drivetest | 125 |
| | Train - Walktest | 75 |
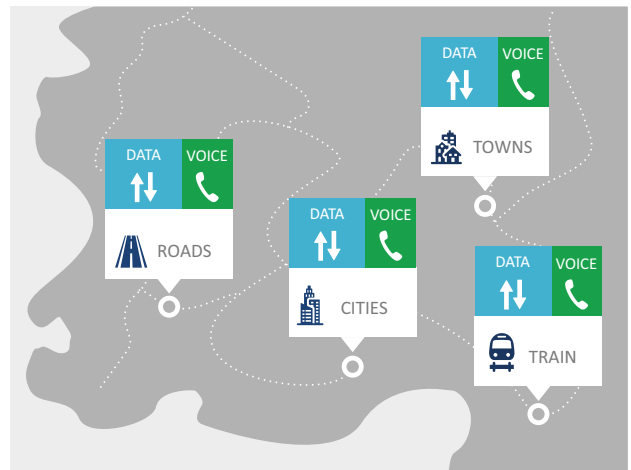
# Additional Analysis of Four Carrier Aggregation

All decisions concerning the setup and methodology of the test are jointly made by P3 and connect. However, we do this in close consultation with the operators about to be tested. This way, we can ensure that all procedures of the test are fair and none of the candidates suffers any disadvantages.

This principle also applies to the smartphones that we use for the measurements. The two LTE Cat 9 smartphones that we chose fulfilled each operator's requirements regarding software stability and network settings as well as supporting three carrier aggregation (3CA) – the combination of three LTE/4G carrier frequencies which the Dutch mobile operators market under the term „4G+".

As KPN, Vodafone and T-Mobile already use four different LTE/4G carrier frequencies in the Netherlands (800, 1800, 2100 and 2600 MHz), there have been discussions whether the data tests should be performed with a Cat 16 smartphone that already supports "4CA" – such as the Samsung Galaxy S8. But as the integration of the Galaxy S8 was completed too late for our regular preparation and adjustment timeline, we decided to stick with the Galaxy S7 and Sony Xperia XZ devices for the current benchmark season.

Another reason was that this decision facilitated that all network tests of the current season were based on the same setup. However, as we wanted to make sure that this decision does not cause an unfair disadvantage to any of the candidates, we equipped a third drivetest car with Samsung Galaxy S8 instead of the Galaxy S7 devices. Subsequently, we had this car drive on the same routes and perform the same series of tests as our actual drivetest cars.

The results of these comparison measurements verified the validity of our methodology: Interestingly, the measurement values delivered by the control devices in the data category would have resulted in slightly higher data scores for all four candidates – an addition of between two and five points to the actual results. But the overall ranking would not have changed had we used the Galaxy S8 instead of the Galaxy S7.

| Results of confirmatory data measurements with Samsung S8 | | T-Mobile | Vodafone | KPN | Tele2 |
|---|---|---|---|---|---|
| Data | max. 600 | 583 | 571 | 570 | 555 |
| Cities (Drivetest) | 270 | 98% | 96% | 96% | 94% |
| Towns (Drivetest) | 120 | 98% | 94% | 95% | 93% |
| Roads (Drivetest) | 75 | 99% | 98% | 98% | 97% |

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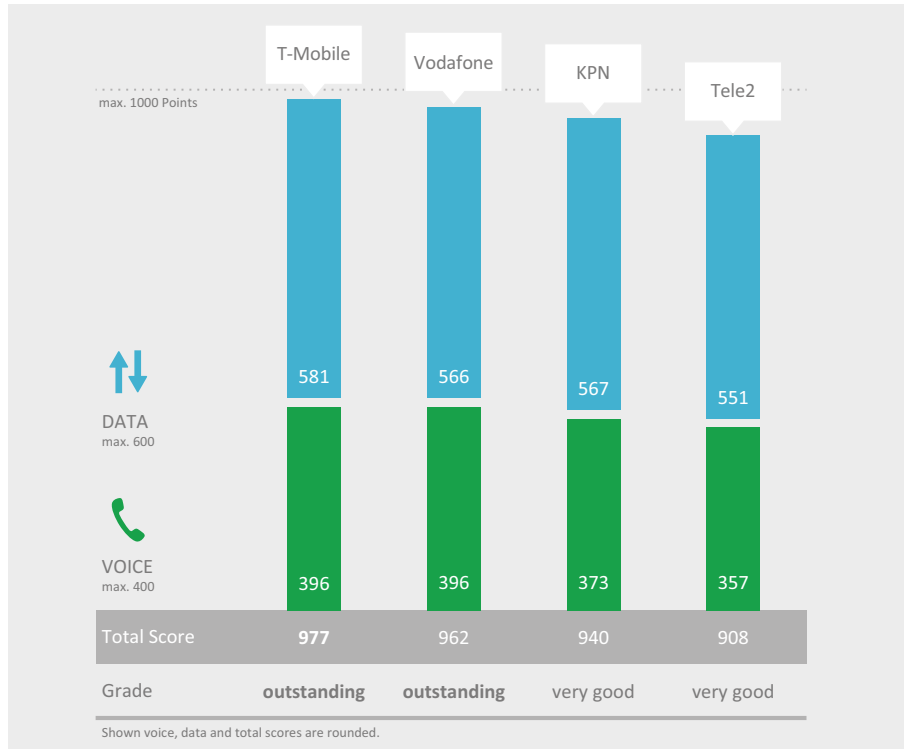
# Conclusion

*T-Mobile wins again. Vodafone shows also "outstanding" results. A very good KPN ranks third, and Tele2 fourth – but still with a "very good" score.*

For the third time in a row, T-Mobile is the clear winner of the P3 connect Mobile Benchmark in the Netherlands. Its impressive 977 total points is the highest score ever achieved in any P3 connect benchmark. As the distinct leader in the data category and being on par with Vodafone in the voice discipline, T-Mobile's grade "outstanding" is well deserved. If this operator succeeds in integrating the frequencies and base stations of its projected subsidiary Tele2, it will be excellently positioned for the future.

The pursuer Vodafone also shows an "outstanding" performance in this year's benchmark. It achieves the second rank especially due to excellent voice results which are the same a those of test winner T-Mobile, while in the data discipline, Vodafone is almost at the same level as the third-ranking KPN.

KPN is strong in the data discipline, where it ranks second behind test winner T-Mobile. But the Dutch market leader loses some points in the voice category due to slightly lower speech quality and longer call setup times. However, all in all KPN still achieves a very good result.

Tele2, the smallest Dutch operator and destined to be owned by T-Mobile, achieves the fourth rank. Due to its concentration on LTE/4G, it achieves a decent score in the data discipline. Its score for data connectivity on the roads is particularly strong. However, Tele2's voice score shows some room for improvement. It will be interesting to see how the merger with T-Mobile will affect this operator's future results.

| | T-Mobile | Vodafone | KPN | Tele2 |
|---|---|---|---|---|
| max. 1000 Points | | | | |
| DATA max. 600 | 581 | 566 | 567 | 551 |
| VOICE max. 400 | 396 | 396 | 373 | 357 |
| Total Score | **977** | 962 | 940 | 908 |
| Grade | **outstanding** | **outstanding** | very good | very good |

Shown voice, data and total scores are rounded.

| Overall Results Voice and Data | | T-Mobile | Vodafone | KPN | Tele2 |
|---|---|---|---|---|---|
| Voice | max. 400 | 396 | 396 | 373 | 357 |
| Cities (Drivetest) | 180 | 99 % | 100 % | 92 % | 90 % |
| Cities (Walktest) | 60 | 100 % | 99 % | 99 % | 92 % |
| Towns (Drivetest) | 80 | 99 % | 99 % | 92 % | 90 % |
| Roads (Drivetest) | 50 | 100 % | 99 % | 91 % | 88 % |
| Trains (Walktest) | 30 | 93 % | 93 % | 94 % | 81 % |
| Data | max. 600 | 581 | 566 | 567 | 551 |
| Cities (Drivetest) | 270 | 97 % | 95 % | 95 % | 93 % |
| Cities (Walktest) | 90 | 95 % | 95 % | 93 % | 88 % |
| Towns (Drivetest) | 120 | 97 % | 93 % | 94 % | 92 % |
| Roads (Drivetest) | 75 | 99 % | 97 % | 98 % | 97 % |
| Trains (Walktest) | 45 | 94 % | 87 % | 90 % | 85 % |
| Connect Rating | max. 1000 | 977 | 962 | 940 | 908 |

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

**1**
The third largest Dutch operator wins the 2018 benchmark with a distinct lead in the data category and a voice result on a par with second ranking Vodafone. The operator earns the grade "outstanding". Above that, T-Mobile was able to improve on last year's results both in the voice and in the data discipline.

**2**
With an "outstanding" overall performance, Vodafone well earns the second rank. In the voice discipline it is on a par with T-Mobile, in the data category it scores similar to KPN. In both disciplines, Vodafone shows a distinct improvement over its scores from last year's benchmark.

**3**
With strong data results and a still very good voice score, the largest Dutch operator ranks third. Compared to its 2017 scores, KPN has improved in the voice discipline, but loses some points in the data category. However, all in all this operator again achieves a very good result.

**4**
The Netherlands' smallest operator scores last and loses points compared to its score in our 2017 benchmark both in the voice and data categories. However, Tele2's results are still very competitive and deserve the overall grade "very good". In the future, this operator will be part of T-Mobile.
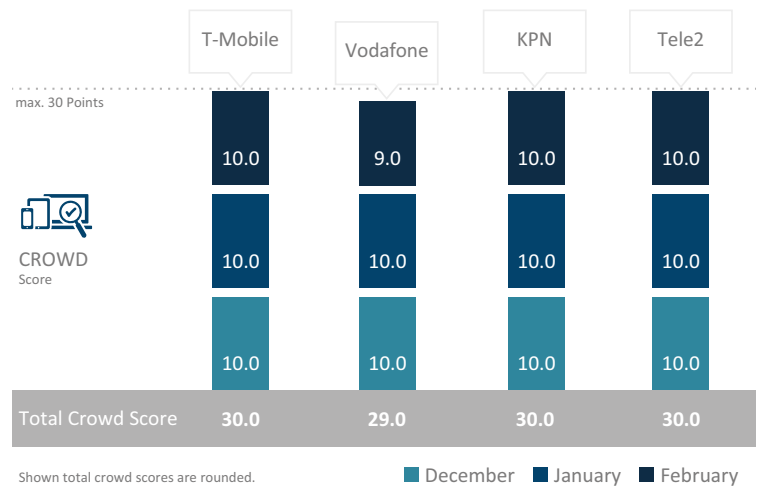
# Operational Excellence



*In the near future, we plan to complement our measurements with an additional assessment of service availability. For the Netherlands, we present this crowdsourced approach as a case study this year – it will become part of the overall scoring next year.*

An additional important aspect of mobile service quality – above performance and measured values – is the actual availability of the mobile networks. Obviously, even the best performing network is only of limited benefit to its users, if it is frequently impaired by outages or disruptions.

Therefore, P3 has been looking into additional methods for the quantitative determination of network availability, collecting data via crowdsourcing. This method must however not be confused with the drivetests described on the previous pages. We are convinced that crowdsourcing will further enhance our benchmarks. Drivetesting has advantages as a very controlled environment. Crowdsourcing enables statements about network availability on a larger scale in terms of time and geography.

However, when it comes to diagnose the sheer availability of the respective mobile networks, a crowdsourcing approach can provide additional insights. Therefore, P3 has developed an app-based crowdsourcing mechanism in order to assess how a large number of mobile customers experience the availability of their mobile network. We call this aspect "operational excellence".

In the future, we envision this consideration to become part of the overall scoring of our mobile network tests. But as we have been conducting this method in the Netherlands only for a couple of months and have not yet reached statistically firm numbers of users for all tested networks within the months considered, we have decided to present the results as a case study this year.          >>

| | T-Mobile | Vodafone | KPN | Tele2 |
|---|---|---|---|---|
| max. 30 Points (February) | 10.0 | 9.0 | 10.0 | 10.0 |
| CROWD Score (January) | 10.0 | 10.0 | 10.0 | 10.0 |
| (December) | 10.0 | 10.0 | 10.0 | 10.0 |
| Total Crowd Score | 30.0 | 29.0 | 30.0 | 30.0 |

Shown total crowd scores are rounded. ■ December ■ January ■ February

## OPERATIONAL EXCELLENCE AT A GLANCE

Considering December 2017, January 2018 and February 2018, we could only observe one degradation of one hour in the Vodafone network in February 2018 (see chart below). According to our planned crowdsourcing methodology and evaluation (see page 13), this would have resulted in a loss of one (rounded) point for the February score of Vodafone, while the three other candidates would have remained unaffected.

**CROWD SOURCING**
Network availability



22/02/18 (1 hr)

T-Mobile / Vodafone / KPN / Tele2
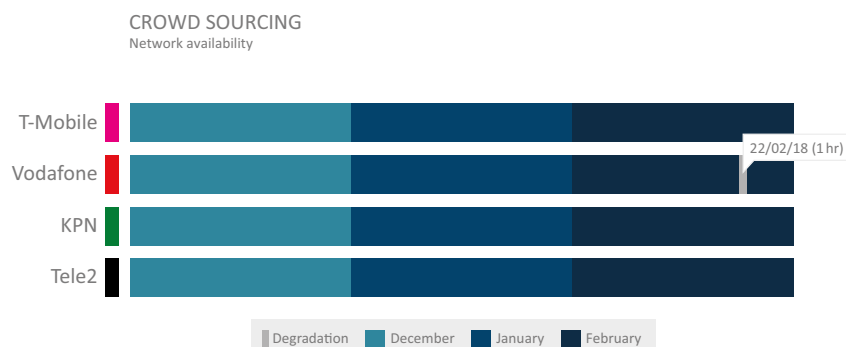
■ Degradation ■ December ■ January ■ February

So, the resulting observations are not yet included in the score of our network test. Nonetheless, in next year's P3 connect Mobile Benchmark in the Netherlands, we expect our crowdsourcing results to become a part of the overall test score. The P3 connect Mobile Benchmark will then be the only mobile network test which combine drivetesting and crowdsourcing, thus delivering the most comprehensive view on network performance.

As a matter of fact, we envision to even extend the scope of our crowdsourcing results. In addition to reliability, also coverage reach and quality as well as users' best throughput (average and top values) will become part of the crowd score.

**Crowdsourcing shows: Dutch networks very reliable**
For this case study, we have taken a closer look at the data network availability in the Netherlands for the months preceding and including our measurement tours – specifically December 2017, January 2018 and February 2018. The underlying methodology is described in detail on the right-hand side.

An in-depth analysis of our crowdsourcing data shows that the Dutch networks are all in all very stable and reliable. The only degradation that we could actually observe, happened on February 22nd at 13:00 h in the Vodafone network. This operator suffered an observable service degradation on this day that lasted no more than one hour.

This one hour of limited availability costs Vodafone one point in the simulated crowd score for February. KPN, T-Mobile und Tele2 did not suffer any observable degradations in the period under consideration.

This minor reduction of service availability would have had only a limited impact to the overall result even if we already had included them into our scoring. Even when taking into account the conversion of maximum achievable points to a lower total in order to "make room" for the crowdsourcing points, the overall ranking would not have changed and Vodafone would have only suffered a loss of one point.

However, with close point distances between the winning contenders as they are typical in highly competitive markets with extremely high performance levels such as the Netherlands, multiple or prolonged degradations clearly would have the potential to alter the final ranking order of our benchmark. We are already excited to put this new component of our testing procedures officially into effect starting with the P3 connect Mobile Benchmark in the Netherlands next year.

# Crowdsourcing Methodology

*The mechanisms of our crowdsourcing analyses carefully distinguish actual service degradations from simple losses of network coverage. Also, the planned scoring model considers large-scale network availability as well as a fine-grained measurement of operational excellence.*

For the crowdsourcing of operational excellence, P3 considers connectivity reports that are gathered by background diagnosis processes included in a number of popular smartphone apps. While the customer uses one of these apps, a diagnosis report is generated daily and is evaluated per hour. As such reports only contain information about the current network availability, it generates just a small number of bytes per message and does not include any personal user data.

Additionally, interested parties can deliberately take part in the data gathering with the specific "U get" app (see below).

In order to differentiate network glitches from normal variations in network coverage, we apply a precise definition of "service degradation": A degradation is an event where data connectivity is impacted by a number of cases that significantly exceeds the expectation level. To judge whether an hour of interest is an hour with degraded service, the algorithm looks at a sliding window of 168 hours before the hour of interest. This ensures that we only consider actual network service degradations differentiating them from a simple loss of network coverage of the respective smartphone due to prolonged indoor stays or similar reasons.

In order to ensure the statistical relevance of this approach, a valid assessment month must fulfil clearly designated prerequisites: A valid assessment hour consists of a predefined number of samples per hour and per operator. The exact number depends on factors like market size and number of operators.

A valid assessment month must be comprised of at least 90 per cent of valid assessment hours (again per month and per operator). As these requirements were only partly met for the period of this report, we publish the Dutch crowdsourcing as a case study.

**Sophisticated scoring model**
The relevant KPIs are then based on the number of days when degradations occurred as well as the total count of hours affected by service degradations. In the scoring model that we plan to apply to the gathered crowdsourcing data, 60 per cent of the available points will consider the number of days affected by service degradations – thus representing the larger-scale network availability. An additional 40 per cent of the total score is derived from the total count of hours affected by degradations, thus representing a finer-grained measurement of operational excellence.

Each considered month is then represented by a maximum of ten achievable points. The maximum of six points (60 per cent) for the number of affected days is diminished by one point for each day affected by a service degradation. One affected day will cost one point and so on until six affected days out of a month will reduce this part of a score to zero.

The remaining four points are awarded based on the total number of hours affected by degradations. Here, we apply increments of six hours: Six hours with degradations will cost one point, twelve hours will cost two points etc., until a total number of 24 affected hours will lead to zero points in this part of the score.

---

## PARTICIPATE IN OUR CROWDSOURCING

Everybody interested in being a part of our "operational excellence" global panel and obtaining insights into the reliability of the mobile network that her or his smartphone is logged into, can most easily participate by installing and using the "U get" app. This app exclusively concentrates on network analyses and is available under **uget-app.com** or via the adjoint QR code. "U get" checks and visualises the current mobile network performance and contributes the results to our crowdsourcing platform. **Join the global community of users who understand their personal wireless performance, while contributing to the world's most comprehensive picture of the mobile customer experience.**