Conducted since 1993, the connect mobile network test with its neutral, customer-oriented testing has become an industry standard by which big corporations choose their operator. Who's leading in Germany, Austria and Switzerland in 2014?





Fotos: © Sebastian Berger (13)

# THE GREAT
# MOBILE
# NETWORK
# TEST



**A**s Rudolf Augstein, founder of Germanys biggest news magazine „Der Spiegel", said as guidance to young journalists: „Just being straight". This motto should also hold true for a mobile network test, but it is not always so.

One German magazine simply focuses on easy to sell sensations and presents their benchmark as "Germany's hardest network test" – despite the fact that two of the four German operators ended up third for the second year in a row and with minimal distance to the winner.

Another big publication completely lost track of their benchmark data, rating an operator with less than 3% 4G market share higher than one with more than 30% of the LTE market but slightly less throughput.

### The proven Standard – since 1993

Connect refrains from superlatives and sends the proven test team of P3 communications on a trip through Germany, Austria and Switzerland. Two measurement cars per country, equipped with two measurement smartphones per operator, analyzing voice and data services in big cities, small cities and on the connecting highways.

In addition, two walk test systems per country, one for voice and one for data, are used for the same tests as in the measurement cars, with focus on indoor locations and railway connections. A third measurement car is used as counterpart station for the walk test voice system. The detailed methodology description can be found on page 28. The results of the German tests can be found on the following pages. How the Austrian and Swiss operators perform this year, and whether they outperform the Germans again, can be found on page 22. And the total results are summarized on page 29.

**BERND THEISS**

# GERMANY

## Voice Telephony

*An almost perfect voice service should be mandatory. Nevertheless, some operators showed some weaknesses last year. Will that happen again, this year?*

LTE was a perfect technology to help the operators to off-load some data traffic from their heavily used 3G networks in last year's network test. But it put a lot of challenge on the voice telephony. Since LTE did not support voice calls, as a workaround all smartphones had to switch to UMTS- or GSM-networks – so- called "circuit switched fall back" (CSFB). This complex handover took time and reliability and especially Vodafone, with its large LTE area coverage and incomplete optimization, suffered from this effect.

Voice over LTE (VoLTE) is currently being trialed by all operators (Connect 12/14), but not yet implemented. So normal voice calls are still using UMTS and GSM networks.

### Voice in Cities

In big cities, Telekom, Vodafone and O2 have an LTE share between 80% and up to more than 90%, leading to many of those CSFB handovers.. E-Plus needs less CSFB due to an LTE share below 50%.

It is exciting to see how Vodafone has improved compared to last year, and what impacts we will identify from O2's increased LTE share.

The outdoor drive test results show Vodafone on the same level as Deutsche Telekom with exactly the same performance figures and a reliability improvement of 4.4% points compared to last year. Their speech quality MOS value (mean opinion score) of 3.4 is even slightly better.



To ensure nothing can go wrong, engineers and technicans prepare the measurement setup painstakinngly.

The success rates of those two operators are again on a good level of 98.5%, which is sufficient to fulfill the requirements of demanding users.

O2 and E-Plus are dropping back, by only achieving success rates around 96%, plus O2 has additional weaknesses in call set up times. O2's CSFB still needs some optimization. Missing HD voice features lead to worse speech quality in the O2 network.

E-Plus' indoor voice reliability, with its smaller LTE share, comes very close to Telekom and to the even better performing Vodafone. O2 remains distant..

### Voice on Highways and Railways

Telekom has increased the distance on highways and delivers an excellent 98% success ratio. Vodafone caught up by 4% points against last year and ends up 2% behind. O2 and E-Plus lost additional roughly 3%. O2 shows the same problems with call setup times and speech quality as in the cities.

All operators have problems with railway coverage. Telekom has 13% unsuccessful calls, closely followed by O2 and Vodafone, while E-Plus lost up to 21% of their calls.

In addition, 2 – 3% of the calls suffer from interruptions or noise. All this leads to the impression that all operators have significant improvement potential on railways.

## Summary

Telekom achieved 175 of 210 points in voice telephony and is the best German operator in this category. Vodafone caught up tremendously and is able to beat Telekom in big cities with a slightly better score, improvement potential can be found on highways and in trains.
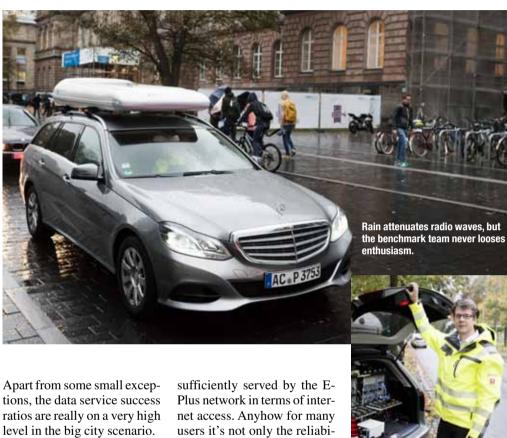
In big cities, E-Plus is not far away from the leaders and delivers a satisfactory result. Whereas O2 seems to be suffering from the fast LTE roll-out and related challenges in reliability and call setup times. >>

## TELEPHONY

| GERMANY OPERATOR | Deutsche Telekom | Vodafone | O2 | E-Plus |
|---|---|---|---|---|
| **TELEPHONY (BIG CITIES OUTDOOR)** | | | | |
| Call Success Ratio (%) | 98,5 | 98,5 | 95,7 | 96,0 |
| Call Setup Time (s) | 6,3 | 6,3 | 9,1 | 6,3 |
| Speech Quality (MOS-LQO) | 3,3 | 3,4 | 2,6 | 3,3 |
| Call Sustainability (%) | 99,6 | 99,6 | 99,2 | 98,8 |
| **TELEPHONY (BIG CITIES INDOOR)** | | | | |
| Call Success Ratio (%) | 98,0 | 98,3 | 96,1 | 97,4 |
| Call Setup Time (s) | 6,3 | 6,0 | 9,2 | 5,9 |
| Speech Quality (MOS-LQO) | 3,4 | 3,4 | 2,6 | 3,4 |
| Call Sustainability (%) | 99,7 | 99,6 | 99,8 | 98,7 |
| **TELEPHONY (HIGHWAYS)** | | | | |
| Call Success Ratio (%) | 97,6 | 95,4 | 93,1 | 92,5 |
| Call Setup Time (s) | 7,1 | 7,1 | 10,2 | 6,9 |
| Speech Quality (MOS-LQO) | 3,1 | 3,0 | 2,6 | 3,0 |
| Call Sustainability (%) | 98,9 | 99,2 | 98,9 | 98,1 |
| **TELEPHONY (TRAINS)** | | | | |
| Call Success Ratio (%) | 86,7 | 83,9 | 85,5 | 78,6 |
| Call Setup Time (s) | 7,6 | 7,3 | 9,7 | 8,0 |
| Speech Quality (MOS-LQO) | 2,7 | 2,7 | 2,5 | 2,6 |
| Call Sustainability (%) | 96,5 | 97,9 | 96,5 | 96,5 |

# Smartphone Data usage in Cities

*The LTE roll out has been driven quite far by three German network operators in the big cities. The questions is: will this provide top performance as regards data service usage?*



Rain attenuates radio waves, but the benchmark team never looses enthusiasm.



Apart from some small exceptions, the data service success ratios are really on a very high level in the big city scenario.

### Data service in big cities:

For example regarding drive testing the success ratios are in the range above 99%. Only E-Plus showed some weaker results for the static web browsing with 98,4 % and for the HTTP file download with 98,6 %.

Regarding the YouTube HD video assessment some minor (O2 and Vodafone) and some increased failure ratios (E-Plus) have been observed.

Nevertheless the reliability of all operators is at a really high level in the city outdoor scenario. For anybody not interested in HD but just SD, video streaming service is sufficiently served by the E-Plus network in terms of internet access. Anyhow for many users it's not only the reliability that counts but also the transfer speed. Apart from some rare scenarios the order in terms of speed is always Telekom, Vodafone, O2 and E-Plus. The live web browsing and the frequently used file upload performance of Vodafone is quite close to the leader Telekom, followed by O2 and E-Plus again.

The difference between Telekom and the other network is increased as regards file downloads. Telekom network is up to 3 times faster than E-Plus. This operator achieves average speeds around 40 Mbit/s and speeds higher than 11 Mbit/s in 90% of all samples. Telkom achieves a similar good level as last year taking into account an increase in traffic volume. The additional indoor measurements confirm the outdoor results with very high accuracy. Only the upload results show a slightly weaker performance indoors. Telefonica shows in general slightly weaker results indoor and regarding YouTube HD Vodafone and O2 show weaker results indoor and end up behind E-Plus.

In general one could say that all operators in Germany provide stable conditions in big cities. Telekom takes the lead here due to its sufficient LTE 1800 MHz coverage.

### Data service in small cities:

Compared to the well deployed big cities, the smaller towns don't show sufficient coverage in most cases. Nevertheless the Telekom network shows an impressive performance in this scenario. Based on the same good overall reliability observed in the big cities, web browsing performance at a similar level and a slightly decreased file transfer performance the Telekom network is the first choice for this scenario. Vodafone is placed behind Telekom and shows a decreased performance in terms of reliability and speed. Anyhow the Vodafone network is still able to satisfy user expectations. O2 and E-Plus show at least adequate performance for the web browsing service. However transfer of files or watching YouTube videos in HD quality is demanding for users.

## Summary

Regarding data performance in urban areas Telekom leads the field again in 2014. Vodafone and O2 offer good performance and high reliability with minor degradations in this scenario. Looking at small towns, O2 suffers from the as yet unfinished LTE expansion. This network is placed behind Vodafone in this category. But the Reds cannot manage to outdo the speed of Telekom with their wide-area broadband LTE-1800 expansion. E-Plus on the other hand clearly suffers from the delayed LTE rollout. The reliability is top, the speed a flop.

## DATA IN BIG AND SMALL CITIES

| DEUTSCHLAND | | | | |
|---|---|---|---|---|
| **ANBIETER** | **Deutsche Telekom** | **Vodafone** | **O2** | **E-Plus** |
| **DATA (BIG CITIES OUTDOOR)** | | | | |
| **WEB-PAGE DOWNLOAD (LIVE/STATIC)** | | | | |
| Success Ratio (%/%) | 99,8 / 99,9 | 99,9 / 99,7 | 99,7 / 99,0 | 99,4 / 98,4 |
| Avg. Session Time (s/s) | 3,2 / 0,8 | 3,8 / 1,0 | 4,0 / 1,1 | 5,1 / 2,8 |
| **FILE-DOWNLOAD (3 MB)** | | | | |
| Success Ratio/Avg. Session Time (%/s) | 99,8 / 1,6 | 99,8 / 2,5 | 99,9 / 2,6 | 98,6 / 4,5 |
| 90 % faster than (kbit/s) | 11734 | 5475 | 5428 | 3340 |
| **FILE-UPLOAD (1 MB)** | | | | |
| Success Ratio/Avg. Session Time (%/s) | 99,9 / 1,8 | 99,8 / 2,4 | 99,9 / 3,4 | 99,4 / 7,0 |
| 90 % faster than (kbit/s) | 1864 | 1822 | 1129 | 471 |
| **FILE-DOWNLOAD (10 SECONDS)** | | | | |
| Avg. Throughput (kbit/s) | 37314 | 19707 | 17565 | 17432 |
| 90 % faster than (kbit/s) | 11525 | 5411 | 5963 | 3710 |
| **FILE-UPLOAD (10 SECONDS)** | | | | |
| Avg. Throughput (kbit/s) | 21134 | 12815 | 8875 | 6296 |
| 90 % faster than (kbit/s) | 1579 | 1868 | 1291 | 382 |
| **YOUTUBE SD** | | | | |
| Success Ratio / Start Time (%/s) | 99,9 / 0,7 | 99,9 / 1 | 100 / 1,1 | 99,3 / 1,5 |
| Video playouts without interruptions (%) | 99,8 | 99,8 | 99,9 | 98,8 |
| **YOUTUBE HD** | | | | |
| Success Ratio / Start Time (%/s) | 99,5 / 0,9 | 98,7 / 1,4 | 98,9 / 1,5 | 96,8 / 2,1 |
| Video playouts without interruptions (%) | 98,9 | 97,0 | 98,2 | 94,3 |
| **DATA (BIG CITIES INDOOR)** | | | | |
| **WEB-PAGE DOWNLOAD (LIVE/STATIC)** | | | | |
| Success Ratio (%/%) | 99,4 / 99,6 | 99,4 / 99,7 | 99,2 / 99,5 | 98,9 / 98,8 |
| Avg. Session Time (s/s) | 3,5 / 0,8 | 4,4 / 1,1 | 5,3 / 1,3 | 5,5 / 1,7 |
| **FILE-DOWNLOAD (3 MB)** | | | | |
| Success Ratio/Avg. Session Time (%/s) | 99,6 / 2,1 | 99,7 / 4,3 | 99,2 / 4,5 | 98,0 / 3,9 |
| 90 % faster than (kbit/s) | 10729 | 4006 | 3023 | 3450 |
| **FILE-UPLOAD (1 MB)** | | | | |
| Success Ratio/Avg. Session Time (%/s) | 99,7 / 2,5 | 99,5 / 3,6 | 99,6 / 6,1 | 99,4 / 8,3 |
| 90 % faster than (kbit/s) | 1558 | 1236 | 715 | 449 |
| **FILE-DOWNLOAD (10 SECONDS)** | | | | |
| Avg. Throughput (kbit/s) | 38570 | 23388 | 14233 | 16079 |
| 90 % faster than (kbit/s) | 10930 | 4464 | 3199 | 3761 |
| **FILE-UPLOAD (10 SECONDS)** | | | | |
| Avg. Throughput (kbit/s) | 19299 | 12135 | 6260 | 4351 |
| 90 % faster than (kbit/s) | 1441 | 1251 | 736 | 363 |
| **YOUTUBE SD** | | | | |
| Success Ratio / Start Time (%/s) | 100 / 0,7 | 99,9 / 1,1 | 99,6 / 1,6 | 99,6 / 1,6 |
| Video playouts without interruptions (%) | 100 | 99,6 | 99,6 | 99,1 |
| **YOUTUBE HD** | | | | |
| Success Ratio / Start Time (%/s) | 99,7 / 0,9 | 97,3 / 1,5 | 96,2 / 2,1 | 96,9 / 2,1 |
| Video playouts without interruptions (%) | 99,3 | 93,9 | 91,4 | 94,4 |
| **DATA (SMALL CITIES OUTDOOR)** | | | | |
| **WEB-PAGE DOWNLOAD (LIVE/STATIC)** | | | | |
| Success Ratio (%/%) | 99,6 / 99,7 | 98,9 / 96,8 | 98,6 / 98,0 | 99,3 / 97,8 |
| Avg. Session Time (s/s) | 3,4 / 0,9 | 4,6 / 1,9 | 5,5 / 2,2 | 6,1 / 3,3 |
| **FILE-DOWNLOAD (3 MB)** | | | | |
| Success Ratio/Avg. Session Time (%/s) | 99,5 / 4,1 | 98,4 / 4,8 | 99,4 / 8,2 | 98,9 / 6,3 |
| 90 % faster than (kbit/s) | 8386 | 2975 | 1956 | 2626 |
| **FILE-UPLOAD (1 MB)** | | | | |
| Success Ratio/Avg. Session Time (%/s) | 100 / 2,6 | 100 / 6,7 | 100 / 7,9 | 98,3 / 8,9 |
| 90 % faster than (kbit/s) | 1611 | 541 | 700 | 431 |
| **FILE-DOWNLOAD (10 SECONDS)** | | | | |
| Avg. Throughput (kbit/s) | 29782 | 11311 | 17519 | 8870 |
| 90 % faster than (kbit/s) | 7255 | 2739 | 2253 | 2152 |
| **FILE-UPLOAD (10 SECONDS)** | | | | |
| Avg. Throughput (kbit/s) | 13695 | 5031 | 6109 | 1980 |
| 90 % faster than (kbit/s) | 1302 | 529 | 600 | 322 |
| **YOUTUBE SD** | | | | |
| Success Ratio / Start Time (%/s) | 100 / 0,8 | 100 / 1,5 | 100 / 1,5 | 96,7 / 2,3 |
| Video playouts without interruptions (%) | 99,4 | 99,5 | 98,3 | 96,7 |
| **YOUTUBE HD** | | | | |
| Success Ratio / Start Time (%/s) | 99,4 / 1,1 | 97,2 / 2,1 | 91,3 / 2,6 | 95,5 / 3,0 |
| Video playouts without interruptions (%) | 97,7 | 90,9 | 88,4 | 89,8 |

# Rules of Connect Test:

*In order to assure fair competition, high transparency is essential.*

The first meeting to setup the test for 2014 was held on the 24th of January this year, involving experts form P3 communication and Connect magazine. This meeting aimed to review the 2013 connect test, introducing LTE for the first time, and also to discuss the framework for 2014. The goal was to establish a high level schedule, choosing the smartphones and to define the test locations for the three countries under test.

### Transparency for Equal Opportunities

After the basic alignment of the test framework detailed information was sent to all CTOs of the participating network operators. This information contained a specific time schedule and defined the concept in terms of logistics, locations and services under test. After sharing this information all CTOs were asked to provide their feedback. This approach was established to avoid any situation whereby major network changes were scheduled during the test period. Furthermore the technical experts of the mobile communication providers had the chance to provide their feedback and to challenge the test methodology. This feedback was introduced into a second and final version of the information presentation, which was shared with the technical management at the beginning of August. This document is available via this link: www.connect.de/netz-testplanung.

These beneficial discussions are really appreciated by Connect magazine and also P3 communications. Nevertheless Connect magazine always has the last word regarding the measurement and scoring methodology.

Further Information shared with the operators contains start and end dates and pre-shared data about the results before the official release. This additional information avoids major network changes during the test period and gives sufficient preparation time for the post connect test public communication of each operator.

## DATA ON HIGHWAYS

| GERMANY | | | | |
|---|---|---|---|---|
| OPERATOR | Deutsche Telekom | Vodafone | O2 | E-Plus |
| **WEB-PAGE DOWNLOAD (LIVE/STATIC)** | | | | |
| Success Ratio (%/%) | 99,1 / 99,4 | 98,3 / 98,0 | 93,3 / 91,3 | 94,5 / 91,4 |
| Avg. Session Time (s/s) | 3,8 / 1,5 | 4,4 / 1,5 | 5,8 / 2,4 | 6,8 / 4,1 |
| **FILE-DOWNLOAD (3 MB)** | | | | |
| Succ. Rat./Avg. Ses. Time (%/s) | 98,4 / 3,5 | 98,2 / 4,6 | 91 / 12,2 | 92,1 / 13,1 |
| 90 % faster than (kbit/s) | 5572 | 3836 | 269 | 593 |
| **DATEI-UPLOAD (1 MB)** | | | | |
| Succ. Rat./Avg. Ses. Time (%/s) | 99,9 / 3,9 | 98,6 / 4,1 | 93,5 / 11 | 94,1 / 14,1 |
| 90 % faster than (kbit/s) | 979 | 941 | 298 | 271 |
| **DATEI-DOWNLOAD (10 SECONDS)** | | | | |
| Avg. Throughput (kbit/s) | 21741 | 15213 | 14793 | 8347 |
| 90 % faster than (kbit/s) | 5264 | 3461 | 1291 | 383 |
| **DATEI-UPLOAD (10 SECONDS)** | | | | |
| Avg. Throughput (kbit/s) | 10685 | 9790 | 6950 | 1909 |
| 90 % faster than (kbit/s) | 1047 | 577 | 79 | 77 |
| **YOUTUBE SD** | | | | |
| Success Ratio / Start Time (%/s) | 99,2 / 0,9 | 99,4 / 1,2 | 99,1 / 1,5 | 98,2 / 1,9 |
| Interruption free (%) | 98,9 | 98,8 | 98,6 | 97,4 |
| **YOUTUBE HD** | | | | |
| Success Ratio / Start Time (%/s) | 98,1 / 1,4 | 96,1 / 1,8 | 94,6 / 2,1 | 89,9 / 3,1 |
| Interruption free (%) | 96,8 | 92,4 | 91,8 | 85,1 |

# Transfer Routes:

*The mobile communication deployment on German highways is supposed to be quite good. Which network offers the best service?*

The mobile communication deployment on German highways is supposed to be quite good. Which network offers the best service?

Transfer routes between the cities are a challenge for all network operators under test. This was already revealed during past years' tests, with success ration around 80% and below.

This year increased reliability was observed for all participating network operators, represented by a success level around 90% for most services. Regarding the live web browsing activity success ratios are located between 93.3% for Telefonica and 99.4% for Telekom. Vodafone shows values around the leading Telekom and E-Plus even better than Blue (O2).

A huge step forward was also observed for the speeds. The results show 81% LTE share for Telekom, 84% for Vodafone and O2 showed up with 72% LTE coverage. Only E-plus was observed behind with 7% less than O2. This dense deployment results in high throughputs, especially for Vodafone and Telekom, showing significantly increased data rates compared to 2013. Only O2 could not clearly benefit from the LTE share. 10% of all measure samples show less than 1.3 Mbit/s. Regarding E-plus performance, 10% of the downloaded samples show less than 384kbit/s. In terms of uplink speed both, O2 and e-plus show weak results.

With a measurement setup in a trolley, the complete test routine can also be performed in trains.



# Data in Trains:

*Customers frequently facing low quality of service in trains may ask themselves: Could a change improve my service level?*

The train scenario in general is a nightmare for mobile communication companies. Most of the time the base stations along the tracks don't serve any customer and just consume power. But then for a few minutes they have to server a hundred or more customers passing by at high speeds. And additionally these customers are shielded by a case of metal and aluminized glass. Only some repeaters which amplify GSM and LTE 1800 indoor improve this situation.

This scenario is clearly reflected by the results observed on train routes. Telekom offers the lowest failure ratios with up to 11% but suffers from low speeds regarding all data services. But this is still the good case. E-Plus, Vodafone and O2 show huge gaps with 38% in terms of success ratios and really low throughputs. Based on these results normal Internet usage is not possible. As a result of this overall low service level the Telkom network is in this case the one-eyed man among the blind.

The network operators and Deutsche Bahn have to improve this situation jointly in the future.     >>

## DATA ON TRAINS

| GERMANY | | | | |
|---|---|---|---|---|
| OPERATOR | Deutsche Telekom | Vodafone | O2 | E-Plus |
| **WEB-PAGE DOWNLOAD (LIVE/STATIC)** | | | | |
| Success Ratio (%/%) | 89,0 / 90,6 | 83,6 / 82,1 | 80,9 / 72,7 | 87,6 / 83,9 |
| Avg. Session Time (s/s) | 5,7 / 1,1 | 7,4 / 2,2 | 8,1 / 2,6 | 7,9 / 2,4 |
| **FILE-DOWNLOAD (3 MB)** | | | | |
| Succ. Rat./Avg. Ses. Time (%/s) | 86,1 / 7,1 | 72,8 / 18,9 | 61,9 / 23,9 | 77,6 / 12,8 |
| 90 % faster than (kbit/s) | 320 | 111 | 100 | 144 |
| **FILE-UPLOAD (1 MB)** | | | | |
| Succ. Rat./Avg. Ses. Time (%/s) | 90,2 / 7,3 | 76,9 / 11,8 | 69,8 / 12,1 | 82,3 / 12,8 |
| 90 % faster than (kbit/s) | 706 | 229 | 301 | 250 |
| **FILE-DOWNLOAD (10 SECONDS)** | | | | |
| Avg. Throughput (kbit/s) | 17937 | 6426 | 5836 | 5190 |
| 90 % faster than (kbit/s) | 97 | 40 | 27 | 59 |
| **FILE-UPLOAD (10 SECONDS)** | | | | |
| Avg. Throughput (kbit/s) | 12172 | 2854 | 2134 | 1985 |
| 90 % faster than (kbit/s) | 45 | 16 | 7 | 12 |
| **YOUTUBE SD** | | | | |
| Success Ratio / Start Time (%/s) | 96,5 / 1,3 | 98,4 / 2,7 | 95,9 / 2,7 | 95,7 / 2,4 |
| Interruption free (%) | 95,3 | 97,6 | 93,8 | 94,9 |
| **YOUTUBE HD** | | | | |
| Success Ratio / Start Time (%/s) | 93,4 / 1,4 | 87,5 / 3,6 | 90,2 / 4,4 | 85,3 / 4,0 |
| Interruption free (%) | 92,7 | 76,8 | 74,4 | 78,9 |

# Individual reviews

*Overview of strengths and weaknesses for German network operators.*

## DEUTSCHE TELEKOM

**Deutsche Telekom sets the benchmark in Germany for the fourth time in a row.**

Deutsche Telekom outperforms the other operators with regards to railway service, however their performance is still is not considered good. This is especially clear when looking at the direct comparison with international competitors in neighbouring countries.

For voice telephony Telekom shows highest success ratios and is on the same high level with Vodafone for speech quality and call setup times.

In terms of data services Telekom achieves average download data rates between 8,4 and 30 Mbit/s, which is significantly higher than the competitors. Also in the other disciplines the operator from Bonn defines the performance that customers can expect. Due to this it is an excellent choice for customers that intend to use mobile Internet beyond just in the big cities.

For anyone looking for very good voice telephony and excellent data service quality in big cities, small cities and transfer routes, Deutsche Telekom is a good fit. After a dip to third rank in 2010 Deutsche Telekom now achieved 1st place for the fourth time in a row. Congratulations to Bonn!

**connect-Score**
**very good (436 points)**

## VODAFONE

**Despite harder test procedures Vodafone is back as premium network operator.**

As with the other network operators, covering the railways is challenging for Vodafone. For voice Vodafone has made a big step ahead after suffering from high failure ratios and long call setup times last year due to complex Circuit Switched Fallback (CSFB) that is needed in LTE. Success ratios of more than 98% in cities at best speech quality and fast call setup times show that the company from Düsseldorf is back on track.

This is also confirmed by data service measurements where Vodafone does not show gaps to Telekom with regards to reliability in big cities. The throughput levels are not always as high as for Telekom, however this only impacts very challenging data-intensive activities. In small cities there are specific measurement spots with improvement potential. The transfer routes show a high quality service.

With a good overall performance Vodafone made a comeback in fighting for demanding customers and achieved an indisputable 2nd rank.
.

**connect-Score**
**good (400 points)**

## O2

**O2 has progressed well in its LTE rollout, now is the time to follow-up with optimizations**

Due to the acquisition of E-Plus, the O2 network can be considered as work in progress. The merger of both operator's networks is expected soon. However this has not blocked the LTE rollout of O2 during the last year, and for the meantime the big cities in Germany are already covered. The ramp-up status of the O2 LTE network causes relatively weak voice telephony performance as seen for other operators before. CSFB is the reason behind reduced success ratios of around 96% and even lower outside big cities, as well as increased call setup times in the range of 9-10 seconds. Here O2 needs to quickly execute the respective optimization activities.

With respect to data connections in big cities O2 has significantly improved reliability compared to last year, and partly also data rates. In the case of railways O2 is dealing with coverage issues, while on transfer routes data services are perceived better. Overall O2 has a decent data performance.

**connect-Score**
**satisfactory (335 points)**

## E-PLUS

**With still lower LTE ratio the E-Plus data performance is showing gaps.**

After optimizing the UMTS network E-Plus started to build LTE in large cities. Just below 50% of the data measurements there are executed in the fast fourth generation network, in small cities and on transfer routes the ratio was below 10%.

Also reliability of the E-Plus voice service seems to suffer from the complexity associated with CSFB handover. The stability has reduced compared to last year. Despite this E-Plus managed to keep the call setup time at a low level and to improve speech quality. This is sufficient to achieve better voice performance than O2.

The reliability as well as speed of data connections on transfer routes and railways looks less promising. Also in cities E-Plus lacks throughput due to small LTE deployment. This is acceptable for inhabitants of the cities as long as large uploads or HD videos are not relevant, since the reliability is good and the speed is definitely enough for web browsing..  >>

**connect-Score**
**satisfactory (327 points)**

# AUSTRIA

*In recent years, Mobile Network Operators in Austria set the standards others tried to achieve. Can they repeat it this year?*

The mobile market in Austria is known among experts as particularly interesting. 8 million inhabitants use only 2.6 million landline connections but over 13 million SIM cards (as of 2013). Thus, communication is strongly focused on the mobile networks. This is proven by the steep increase in transferred data volume, which rose by 57% (equivalent to 112,000 Terabytes) between 2012 and 2013. Operators need to respond with continuous capacity expansion even to maintain the current standard.

The strong position of mobile radio in Austria must be credited to the Network Operators who have continuously offered high quality and performance levels. Ever since connect started testing all three countries in 2009, an Austrian Operator finished first in the international comparison, although the leading position changed twice between local competitors. And no Austrian operator ever scored lower than "good".

## Telephony

This year, the performance level of mobile telephony in Austria is high again. Where German operators are top, the performance range of Austrian operators only starts. In cities, T-Mobile offers very good telephony with success ratios between 98,4% and 98,7% and a Mean Opinion Score (MOS) of 3.6. Drei and A1 Telekom Austria are even better. This means Drei and T-Mobile managed the introduction of LTE well, overco-

ming the difficulties this brings about for the voice service. A1 and T-Mobile also showed remarkably short Call Setup Times in LTE.

Stability suffers slightly on the transfer roads between cities, leading to a success ratio of 95% for T-Mobile. Drei and A1 Telekom Austria end up with 97-98% success ratios and thus show better performance than other operators in big cities. A1 also improved compared to the previous year.

So is all now perfect in Austria? Not quite, as success ratios substantially drop during measurements on trains. Drei only achieves 82.6%, trailing T-Mobile with 85.9%. A1 manages to score best and loses slightly less then every tenth call (90.8%).

## Data in cities

Voice telephony is mandatory for network operators while data service gives the possibility to differentiate. The network operators in Austria also show an impressive reliability in this discipline in big cities. Success ratios beyond 99.5% for internet browsing and file

up-/download are visible and only for YouTube high-definition two out of three cross the 99% threshold due to slightly increased number of interruptions. The indoor measurements are even slightly more critical than the outdoor tests. A1 Telekom Austria also manages this challenge impressively and improves average download speeds from 13 to 52 Mbit/s. This is also related to the high throughput required by YouTube HD service and provided by the A1 network. Web browsing benefits less from this; there the difference between a loading time of 2.2 seconds on average for a popular web page with dynamic content for A1 and around 3 seconds for T-Mobile and Drei is not really significant. The differentiation is perceived for up- and download of larger files where A1 is up to 3 times faster than Drei, who increased average data rates compared to last year from 7- 30 Mbit/s. Also T-Mobile made a big step ahead from 13 to 28 Mbit/s. In smaller cities the network operators are getting closer to each other, however A1 still shows highest performance despite

partly higher reliability for Drei and T-Mobile.

## Data on transfer routes

The picture for transfer routes looks similar to that for cities. However Drei can outperform T-Mobile and catch up with A1. Both improved heavily compared to the previous year. For railways, the known ranking A1, T-Mobile und Drei is visible again, where only the number 1 provides a more or less acceptable performance.

## Conclusion

The overall performance level offered in Austria is very high, with some exceptions in the train and small city scenarios. Consequently, Drei and T-Mobile finish the test well inside the "good" range, although conditions and requirements got tougher this year. Particularly in the big cities, they provide plenty of power

## TELEPHONY

| OPERATOR | A1 Telekom Austria | T-Mobile | Drei |
|---|---|---|---|
| **AUSTRIA** | | | |
| **TELEPHONY(BIG CITIES OUTDOOR/INDOOR)** | | | |
| Call Success Ratio (% / %) | 98,7 / 99,1 | 98,4 / 98,7 | 98,7 / 99,8 |
| Call Setup Time (s / s) | 5,7 / 6 | 5,7 / 5,6 | 6,8 / 6,9 |
| Speech Quality (MOS-LQO / MOS-LQO) | 3,6 / 3,7 | 3,5 / 3,6 | 3,7 / 3,8 |
| Call Sustainability (% / %) | 99,9 / 99,7 | 99,6 / 99,7 | 99,8 / 99,7 |
| **TELEPHONY(HIGHWAYS/TRAINS)** | | | |
| Call Success Ratio (% / %) | 97,9 / 90,8 | 95,0 / 85,9 | 97,1 / 82,6 |
| Call Setup Time (s / s) | 5,7 / 5,5 | 6,5 / 6,3 | 7,4 / 7,7 |
| Speech Quality (MOS-LQO / MOS-LQO) | 3,6 / 3,4 | 3,3 / 3,2 | 3,5 / 3,4 |
| Call Sustainability (% / %) | 99,5 / 98,7 | 99,4 / 98,7 | 99,6 / 98,5 |

for everything but the most demanding tasks. Demanding customers who also expect to use telephony and mobile internet on the trains make the best choice with A1 Telekom Austria, deserving the mark "very good" for the 6th time in a row.
\>>

**Kufstein and Wörgl are among the 20 small cities that the test team visited in addition to the important big cities.**

**The large number of antennae are distributed across the roof box metal plate for homogeneous RF conditions.**



## DATA

| AUSTRIA | | | |
|---|---|---|---|
| **OPERATOR** | **A1 Telekom Austria** | **T-Mobile** | **Drei** |
| **DATA (BIG CITIES OUTDOOR)** | | | |
| **WEB-PAGE DOWNLOAD (LIVE/STATIC)** | | | |
| Success Ratio (%/%) | 99,7 / 99,6 | 99,8 / 99,7 | 99,8 / 99,5 |
| Avg. Session Time (s/s) | 2,2 / 0,6 | 2,8 / 1,2 | 3,0 / 1,6 |
| **FILE-DOWN-/UPLOAD (3 MB/1 MB)** | | | |
| Success Ratio (%/%) | 99,5 / 99,7 | 99,9 / 99,8 | 99,5 / 99,5 |
| 90 % faster than (kbps / kbps) | 2355 / 4379 | 7397 / 1136 | 4419 / 1207 |
| **FILE-DOWN-/UPLOAD (10 S/10 S)** | | | |
| Avg. Throughput (kbps / kbps) | 52033 / 30923 | 28124 / 16952 | 30433 / 15497 |
| 90 % faster than (kbps / kbps) | 23617 / 4274 | 7436 / 873 | 4435 / 729 |
| **YOUTUBE SD/HD** | | | |
| Success Ratio / Start Time (%/s) | 99,9 / 100 | 99,8 / 98,6 | 99,8 / 99 |
| Video playouts without interruptions (%/%) | 99,9 / 99,8 | 99,6 / 97,8 | 99,7 / 97,1 |
| **DATA (BIG CITIES INDOOR)** | | | |
| **WEB-PAGE DOWNLOAD (LIVE/STATIC)** | | | |
| Success Ratio (%/%) | 99,7 / 99,8 | 99,7 / 99,4 | 99,8 / 100 |
| Avg. Session Time (s/s) | 2,5 / 0,6 | 2,8 / 0,7 | 3,8 / 1,5 |
| **FILE-DOWN-/UPLOAD (3 MB/1 MB)** | | | |
| Success Ratio (%/%) | 99,8 / 99,8 | 99,8 / 99,6 | 99,2 / 100 |
| 90 % faster than (kbps / kbps) | 2132 / 2782 | 11452 / 1159 | 3266 / 634 |
| **FILE-DOWN-/UPLOAD (10 S/10 S)** | | | |
| Avg. Throughput (kbps / kbps) | 54518 / 28694 | 39943 / 19911 | 23252 / 9998 |
| 90 % faster than (kbps / kbps) | 19834 / 2784 | 11187 / 1171 | 3350 / 351 |
| **YOUTUBE SD/HD** | | | |
| Success Ratio / Start Time (%/s) | 100 / 99,8 | 99,8 / 98,8 | 99,6 / 96,0 |
| Video playouts without interruptions (%/%) | 100 / 99,6 | 99,8 / 98,6 | 99,2 / 91,8 |
| **DATA (SMALL CITIES OUTDOOR)** | | | |
| **WEB-PAGE DOWNLOAD (LIVE/STATIC)** | | | |
| Success Ratio (%/%) | 97,9 / 96,9 | 99,0 / 97,7 | 99,8 / 99,6 |
| Avg. Session Time (s/s) | 3,0 / 1,8 | 3,7 / 2,0 | 3,7 / 2,2 |
| **FILE-DOWN-/UPLOAD (3 MB/1 MB)** | | | |
| Success Ratio (%/%) | 99,2 / 98,4 | 100 / 99,2 | 98,5 / 99,3 |
| 90 % faster than (kbps / kbps) | 1085 / 890 | 5063 / 667 | 2421 / 1239 |
| **FILE-DOWN-/UPLOAD (10 S/10 S)** | | | |
| Avg. Throughput (kbps / kbps) | 26233 / 11151 | 14558 / 5468 | 18576 / 8263 |
| 90 % faster than (kbps / kbps) | 8243 / 649 | 5471 / 516 | 3428 / 473 |
| **YOUTUBE SD/HD** | | | |
| Success Ratio / Start Time (%/s) | 100 / 98,4 | 98,4 / 98,4 | 100 / 94,6 |
| Video playouts without interruptions (%/%) | 100 / 97,6 | 98,4 / 97,6 | 100 / 90,0 |
| **DATEN (TRANSFERROUTEN)** | | | |
| **WEB-PAGE DOWNLOAD (LIVE/STATIC)** | | | |
| Success Ratio (%/%) | 97,7 / 97,3 | 98,0 / 96,5 | 98,9 / 98,4 |
| Avg. Session Time (s/s) | 3,4 / 2,2 | 4,8 / 3,2 | 4,2 / 2,8 |
| **FILE-DOWN-/UPLOAD (3 MB/1 MB)** | | | |
| Erfolgsrate/Ladezeit (%) | 97,5 / 98,8 | 97,8 / 99,1 | 98,0 / 99,1 |
| 90 % schneller als (kbps) | 841 / 530 | 1207 / 318 | 2482 / 863 |
| **FILE-DOWN-/UPLOAD (10 S/10 S)** | | | |
| Avg. Throughput (kbps / kbps) | 24485 / 11290 | 12500 / 4164 | 16400 / 7109 |
| 90 % faster than (kbps / kbps) | 4458 / 354 | 1800 / 188 | 2974 / 241 |
| **YOUTUBE SD/HD** | | | |
| Success Ratio / Start Time (%/s) | 99,1 / 98,3 | 97,1 / 94,5 | 98,4 / 96,1 |
| Video playouts without interruptions (%/%) | 98,9 / 98,1 | 96,4 / 93,3 | 97,3 / 93,9 |
| **DATEN (BAHN)** | | | |
| **INTERNET-SEITENAUFRUF (LIVE/STATISCH)** | | | |
| Success Ratio (%/%) | 96,1 / 96,4 | 96,5 / 96,9 | 96,8 / 97,8 |
| Avg. Session Time (s/s) | 4,1 / 1,8 | 5,5 / 2,5 | 6,2 / 3,0 |
| **FILE-DOWN-/UPLOAD (3 MB/1 MB)** | | | |
| Success Ratio (%/%) | 91,4 / 95,8 | 95,3 / 98,4 | 91,6 / 97,2 |
| 90 % faster than (kbps / kbps) | 392 / 301 | 763 / 317 | 827 / 195 |
| **FILE-DOWN-/UPLOAD (10 S/10 S)** | | | |
| Avg. Throughput (kbps / kbps) | 14578 / 4311 | 11329 / 2818 | 5946 / 1710 |
| 90 % faster than (kbps / kbps) | 2702 / 168 | 1376 / 143 | 769 / 74 |
| **YOUTUBE SD/HD** | | | |
| Success Ratio / Start Time (%/s) | 98,3 / 94,6 | 93,9 / 84,1 | 97,1 / 80,7 |
| Video playouts without interruptions (%/%) | 97,8 / 90,4 | 91,7 / 81,8 | 91,9 / 69,3 |

# SWITZERLAND

*No Mobile Network Operator managed to win more times in a row than market-leading Swisscom. Are they also successful in 2014?*

The online-portion of well-known "Neue Züricher Zeitung" recently called Swisscom the "Sun King". This not only related to their biggest market share in post-paid contracts of 63.8% in the first half of 2014, but also to the biggest share of new contracts (more than 50% in the same period). The other two operators Sunrise and Orange have very similar shares with 19.1 and 17.1% postpaid contracts respectively.

It is interesting to note that while data tariffs in Germany apply Fair Use Policies with price-dependent monthly limits of included data volume and subsequent throttling of data speeds, Swisscom takes a different approach. In their Infinity tariffs, the maximum high-speed data volume is not limited and not dependent on the monthly fee paid, but only the maximum speed offered is. Hence, no customer has to worry about data consumption, hence further increasing the traffic in the network, which is already highly with the large number of customers. Having access to unlimited data volume for a fixed price seems to appeal to many Swiss customers, since Orange has also offered an unlimited data plan for a while now.

## Telephony:

Before testing the mobile Internet, telephony comes under scrutiny. All three Network Operators showed success ratios around 99%, however Sunrise is slightly out in front. Swisscom and Sunrise tie on speech quality while Orange trails them by only

0,15 points on the MOS scale (range 1-5) still showing a very high quality level. Looking at the Call Setup Time, Sunrise scores the best value with 4,4 to 4,5 seconds. No other network with a similarly high share of LTE has ever connected calls faster than that.

On the transfer roads between cities, the reliability naturally goes down, but stays at a remarkably high level for all. One reason for this is that Orange has managed to improve by 6.5% compared to last year. The quality of calls made on trains is even more impressive. It may not come as a surprise that even in a country with extremely high railway usage such as Switzerland there is a visible performance gap between highways and railways. But only the best non-Swiss operator A1 Telekom Austria comes anywhere close to third-placed Sunrise. Orange takes the lead in the train telephony scenario while Swisscom finishes somewhat behind, still way ahead of the other competitors in the international comparison.

## Data in cities:

In the Swiss cities, usage of

mobile Internet is a dream. Success Ratios usually range between 99 and 100 percent for all Network Operators. Accessing a popular web page typically takes no longer than 3 seconds irrespective of the Operator. Swisscom still manages to raise the bar over the very good competition, impressing with average download speeds of 35Mbit/s and uploads of 27Mbit/s. Average speeds have improved by more than 50% since last year, showing how hard the operators work on their networks. With such high data speeds, it does not come as a surprise that YouTube videos play almost perfectly in Switzerland. Only Sunrise still shows some problems with HD videos in small cities.

## Data on transfer roads:

The high level of reliability of Swisscom and Sunrise only drops marginally on the transfer roads, while only the critical YouTube HD suffers slightly more. Orange falls behind but stays at a very good level. Swisscom once again scores the highest average data rates. On the trains, performance is affected more, but again the Swiss number 3

ends up level pegging with the Austrian number 1, let alone the German networks. Switzerland confirms its reputation as a railroad country.

## Conclusion:

The big "Netztest" leads to the conclusion that Swiss customers deserve our envy as they only have the choice between "very good" networks in both the voice and the data domain. Roughly quoting Oscar Wilde: "One who is always satisfied with the best" when it comes to mobile service in Switzerland will end up with Swisscom. Owing to the very good coverage of the rural areas Swisscom achieves the advantage that earns test victory in Switzerland. In addition, they score more points than the best networks in Germany and Austria and – for the first time in the 7-year existence of the connect-DACH-Netztest – finish ahead of A1 Telekom Austria.

## TELEPHONY

| SWITZERLAND | | | |
|---|---|---|---|
| **OPERATOR** | **Swisscom** | **Sunrise** | **Orange** |
| **TELEPHONY(BIG CITIES OUTDOOR/INDOOR)** | | | |
| Call Success Ratio (% / %) | 98,6 / 99,4 | 98,9 / 99,4 | 98,4 / 99,6 |
| Call Setup Time (s / s) | 7,5 / 7,2 | 4,5 / 4,4 | 5,9 / 5,8 |
| Speech Quality (MOS-LQO / MOS-LQO) | 3,4 / 3,5 | 3,4 / 3,5 | 3,2 / 3,4 |
| Call Sustainability (% / %) | 99,7 / 99,5 | 99,4 / 99,8 | 99,5 / 99,9 |
| **TELEPHONY(HIGHWAYS/TRAINS)** | | | |
| Call Success Ratio (% / %) | 97,8 / 93,7 | 97,7 / 91,6 | 97,2 / 96,5 |
| Call Setup Time (s / s) | 7,5 / 7,9 | 4,6 / 4,9 | 5,8 / 5,9 |
| Speech Quality (MOS-LQO / MOS-LQO) | 3,4 / 3,3 | 3,3 / 3,2 | 3,1 / 3,1 |
| Call Sustainability (% / %) | 99,7 / 98,8 | 98,8 / 97,2 | 99,6 / 99,5 |

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In addition to metropolitan areas and big cities, the route in Switzerland also included 22 small cities, such as the famous Montreux.

Continuous supervision of the measurements by a controller in the passenger seat ensures the quality of the measurements.



## DATA

| SWITZERLAND | | | |
|---|---|---|---|
| **OPERATOR** | **Swisscom** | **Sunrise** | **Orange** |
| **DATA (BIG CITIES OUTDOOR)** | | | |
| **WEB-PAGE DOWNLOAD (LIVE/STATIC)** | | | |
| Success Ratio (%/%) | 99,4 / 99,6 | 99,5 / 99,6 | 99,4 / 99,2 |
| Avg. Session Time (s/s) | 2,7 / 1,1 | 2,6 / 1,1 | 3,0 / 1,1 |
| **FILE-DOWN-/UPLOAD (3 MB/1 MB)** | | | |
| Success Ratio (%/%) | 99,8 / 99,9 | 99,8 / 99,8 | 99,5 / 99,9 |
| 90 % faster than (kbps / kbps) | 11619 / 4613 | 4908 / 1871 | 7221 / 2497 |
| **FILE-DOWN-/UPLOAD (10 S/10 S)** | | | |
| Avg. Throughput (kbps / kbps) | 31245 / 26906 | 25357 / 19331 | 22155 / 16118 |
| 90 % faster than (kbps / kbps) | 13573 / 5847 | 5683 / 2211 | 9812 / 3053 |
| **YOUTUBE SD/HD** | | | |
| Success Ratio / Start Time (%/s) | 99,9 / 99,3 | 99,7 / 98,7 | 99,8 / 99,0 |
| Video playouts without interruptions  (%/%) | 99,8 / 98,9 | 99,5 / 97,3 | 99,7 / 98,4 |
| **DATA (BIG CITIES INDOOR)** | | | |
| **WEB-PAGE DOWNLOAD (LIVE/STATIC)** | | | |
| Success Ratio (%/%) | 99,5 / 100 | 99,5 / 99,8 | 99,6 / 100 |
| Avg. Session Time (s/s) | 2,8 / 0,9 | 2,6 / 1,0 | 3,0 / 0,9 |
| **FILE-DOWN-/UPLOAD (3 MB/1 MB)** | | | |
| Success Ratio (%/%) | 99,8 / 99,7 | 99,8 / 99,5 | 99,8 / 100 |
| 90 % faster than (kbps / kbps) | 10774 / 3023 | 8742 / 2700 | 10150 / 3963 |
| **FILE-DOWN-/UPLOAD (10 S/10 S)** | | | |
| Avg. Throughput (kbps / kbps) | 34639 / 27285 | 29782 / 21128 | 23945 / 16701 |
| 90 % faster than (kbps / kbps) | 13411 / 3083 | 8590 / 2338 | 11614 / 4946 |
| **YOUTUBE SD/HD** | | | |
| Success Ratio / Start Time (%/s) | 100 / 99,8 | 100 / 99,3 | 100 / 99,8 |
| Video playouts without interruptions  (%/%) | 100 / 99,8 | 100 / 99,3 | 100 / 99,6 |
| **DATA (SMALL CITIES OUTDOOR)** | | | |
| **WEB-PAGE DOWNLOAD (LIVE/STATIC)** | | | |
| Success Ratio (%/%) | 99,9 / 100 | 99,8 / 99,7 | 99,9 / 99,7 |
| Avg. Session Time (s/s) | 2,7 / 1,1 | 2,7 / 1,4 | 2,9 / 1,1 |
| **FILE-DOWN-/UPLOAD (3 MB/1 MB)** | | | |
| Success Ratio (%/%) | 100 / 100 | 100 / 100 | 100 / 100 |
| 90 % faster than (kbps / kbps) | 13296 / 6182 | 4286 / 1399 | 6289 / 1254 |
| **FILE-DOWN-/UPLOAD (10 S/10 S)** | | | |
| Avg. Throughput (kbps / kbps) | 31029 / 26828 | 17733 / 12744 | 20904 / 15524 |
| 90 % faster than (kbps / kbps) | 14045 / 7954 | 4355 / 1551 | 6414 / 1613 |
| **YOUTUBE SD/HD** | | | |
| Success Ratio / Start Time (%/s) | 100 / 100 | 100 / 96,1 | 100 / 99,3 |
| Video playouts without interruptions  (%/%) | 100 / 98,7 | 100 / 94,8 | 100 / 98,0 |
| **DATEN (TRANSFERROUTEN)** | | | |
| **WEB-PAGE DOWNLOAD (LIVE/STATIC)** | | | |
| Success Ratio (%/%) | 99,1 / 98,9 | 98,7 / 99,3 | 97,9 / 96,3 |
| Avg. Session Time (s/s) | 3,1 / 1,6 | 3,2 / 1,9 | 3,6 / 1,8 |
| **FILE-DOWN-/UPLOAD (3 MB/1 MB)** | | | |
| Success Ratio (%/%) | 99,3 / 99,5 | 98,0 / 99,0 | 96,8 / 97,4 |
| 90 % faster than (kbps / kbps) | 6379 / 2059 | 2535 / 1094 | 2537 / 1376 |
| **FILE-DOWN-/UPLOAD (10 S/10 S)** | | | |
| Avg. Throughput (kbps / kbps) | 28271 / 22778 | 17270 / 10976 | 20672 / 14364 |
| 90 % faster than (kbps / kbps) | 7301 / 1849 | 2706 / 949 | 3848 / 693 |
| **YOUTUBE SD/HD** | | | |
| Success Ratio / Start Time (%/s) | 99,7 / 98,2 | 98,8 / 96,1 | 99,1 / 96,2 |
| Video playouts without interruptions  (%/%) | 99,7 / 97,2 | 98,2 / 94,2 | 98,8 / 95,4 |
| **DATEN (BAHN)** | | | |
| **WEB-PAGE DOWNLOAD (LIVE/STATIC)** | | | |
| Success Ratio (%/%) | 98,2 / 98,1 | 97,9 / 98,0 | 97,6 / 98,0 |
| Avg. Session Time (s/s) | 3,8 / 1,3 | 4,4 / 1,9 | 4,0 / 1,5 |
| **FILE-DOWN-/UPLOAD (3 MB/1 MB)** | | | |
| Success Ratio (%/%) | 98,6 / 97,6 | 95,6 / 96,6 | 97,0 / 99,0 |
| 90 % faster than (kbps / kbps) | 2685 / 692 | 1622 / 928 | 2352 / 1165 |
| **FILE-DOWN-/UPLOAD (10 S/10 S)** | | | |
| Avg. Throughput (kbps / kbps) | 20919 / 17797 | 10983 / 7178 | 18297 / 14797 |
| 90 % faster than (kbps / kbps) | 3883 / 530 | 1226 / 205 | 3290 / 1005 |
| **YOUTUBE SD/HD** | | | |
| Success Ratio / Start Time (%/s) | 98,5 / 96,4 | 97,0 / 89,3 | 98,0 / 96,4 |
| Video playouts without interruptions  (%/%) | 98,5 / 93,8 | 95,5 / 82,7 | 97,5 / 93,8 |

# AUSTRIA

## A1 TELEKOM AUSTRIA

**With the best telephony service as well as fast and solid data transfers A1 forges ahead in Austria.**

A1 Telekom Austria wins eight out of nine categories owing to the stable and high quality speech transmission as well as the almost area-wide and extremely fast data network. In big cities, the average throughput was about 55 Mbit/s in downlink and about 29 Mbit/s in uplink direction. Even on the hard to cover railway tracks A1 is one step ahead of the competition and wins the undisputed sole lead in Austria.

**connect**-scoring
**very good** (453 points)

## T-MOBILE

**T-Mobile Austria provides voice and data services with an out-and-out good performance.**

Despite of the even more ambitious test conditions this year, T-Mobile shows a boost in its network performance. Within the last 12 months the average download throughput rose from 13 Mbit/s to 28 Mbit/s. At the most, T-Mobile lost some points with telephony on railway tracks, data upload and high definition videos in small cities. However, this might go unnoticed by the end user as these deficiencies are marginal. Instead, T-Mobile can cope with the more relevant disciplines like data transfers in the metropolitan areas and thus serves very well those customers who attach importance to a sound data performance in the city centres.

**connect**-scoring
**good** (417 points)

## DREI

**Drei satisfies with excellent telephony. And Austria's smallest network operator provides even more.**

With respect to telephony Drei outperforms T-Mobile by far despite weaknesses on railway tracks. However, in cities and on the interconnecting routes the success ratio is high and the audio quality is strong. Drei suffers the loss of some points with its data services. Here, the upload speed and the stability of high definition YouTube videos take their toll again. This happened in particular for indoor coverage in big as well as small cities. As a matter of fact, the provisioning of voice and data services in trains is also problematic. The bottom line is that the good performance in the most relevant areas attests Drei as giving a sound data service.

**connect**-scoring
**good** (413 points)

# SWITZERLAND

## SWISSCOM

**In this year's test Swisscom sets the benchmark. No need to add anything more.**

Swisscom almost made a clean sweep. The performance of the telephony service is at the highest level with respect to reliability and audio quality. Only the call setup duration blurs the results and allows the competition to catch up. For its market share of 60 percent Swisscom passes the tests of its data services with flying colours. Even the coverage of rural areas is at the highest level. For these reasons Swisscom has the best network in Switzerland and in the Germany-Austria-Switzerland benchmark.

**connect**-scoring
**very good** (456 points)

## SUNRISE

**For telephony Sunrise is a step ahead due to fast call setup. For data services, Sunrise scores "very good".**

For telephony Sunrise runs a close race against Swisscom and Orange in terms of reliability and audio quality at an overall very high level. In the big cities Sunrise wins this race but loses on the rural routes. However, due to the fastest call setup Sunrise finally wins the telephony competition even in the Germany-Austria-Switzerland contest. On top of that, Sunrise shows consistently high reliability and speed levels leading to a final rating of "very good".

**connect**-scoring
**very good** (442 points)

## ORANGE

**Orange shows very good performance for both voice and data services and shines on railway tracks.**

Like the competition, Orange also provides telephony services with literal Swiss clockwork precision in all aspects, including the audio quality. The smallest network operator in Switzerland even reached the top ranking in trains, not only for telephony but also — with a slight advance over Swisscom — for data services. Despite minor weaknesses for data upload and high definition YouTube on the transfer routes, Orange provides data services at a very high level.     >>

**connect**-scoring
**very good** (441 points)

# TEST METHODOLOGY
# CONNECT

As in previous years P3 communications, Connect's partner for executing network benchmarks, sent out two measurement cars to perform the tests. The cars were equipped with ten Samsung Galaxy S4 LTE+ smartphones each – six to eight of them used for testing depending on the country. As far as possible, the smartphone's firmware matched the network operator's genuine ones. In cases when no operator specific firmware was available the most recent Samsung firmware was used. In addition to the cars a separate test team executed walk tests indoors or in trains using a portable battery powered measurement system.

## Smartphone-Telephony

Data and voice services were executed with separate smartphones. Telephony was tested mobile-to-mobile from one car to the other. In order to ensure realistic testing conditions background data traffic was generated on the smartphones during a voice call.

The audio quality of the transmitted speech samples was evaluated using the HD-voice capable and ITU standardized so-called POL-QA wideband algorithm.

This year, all network operators offer LTE capable subscriptions. Therefore all smartphones were set to "LTE preferred" mode. As a consequence, the phones needed to switch ("fall back") to 2G or 3G when they camped on the LTE service and a phone call was initiated. This procedure is known as circuit-switched fall back (CSFB).

## Smartphone-Data

The testing of data services was done with three to four separate Samsung smartphones in the cars. As a first measurement task several popular live web pages were browsed using the built-in smartphone browser. The web pages had been selected previously according to the Alexa ranking. In addition, the artificial (static) "Kepler" test web page as specified by ETSI (European Telecommunications Standards Institute) for such testing purposes was used.

In order to test the data service performance, files of 3MB and 1MB for download and upload respectively were transferred from or to a test server located in the Internet. In addition, the peak data performance was tested in up- and downlink direction by assessing the amount of data that could be transferred within a 10 seconds time period.

While 10 seconds peak throughput test focuses on network capability the YouTube tests add a more end user centric view to the test curriculum. Here, videos with standard definition (SD, 360p, 2.7MB, 30s) and high definition (HD, 720p, 11.9MB, 30s) were played using the YouTube player on the smartphones.

In order to simulate in-car or indoor coverage a 12dB attenuation was inserted in the path between the smartphones in the car and the antennae mounted on the car's roof top. Due to the usage of MIMO technology (Multiple Input Multiple Output) in LTE two antennas were used per each smartphone.

## Walk tests indoors and in trains

The same test program executed for voice and data services in the measurement cars was also executed by the walk test teams.

*Four smartphones on the left-hand side are used for testing telephony while the phones on the right serve for testing the data services*

## FINAL CONCLUSION
**Bernd Theiss,**
**connect-Redakteur**

The 2014 network benchmark reveals that building and engineering an LTE-network for data combined with a reliable 2G/3G network for voice is not a trivial exercise. In Germany, Telekom was successful in doing so. The network operator provides telephony services of the highest performance in both small and big cities. But Telekon is also ahead of the competition on rural routes despite some weaknesses in trains. .However Vodafone has made a great leap ahead and is now – in contrast to previous years – on Telekom's heels and showed the best indoor coverage in the city centres during the test. Furthermore, Vodafone provides reliable and fast data services though Telekom is still ahead in terms of speed. Therefore, Telekom remains the test winner in Germany. O2 having introduced LTE late shows signs of weakness in voice service quality while E-Plus falls behind in data service performance due to a lack of LTE coverage. It will be exciting to see whether there will be a performance boost in the future after last year's merger of the two operators seemed to have slowed down the development of their networks.

The Swiss networks Sunrise and Orange show how to exploit room for improvement and outpoint Germany's number one Telekom this year. A1 Telekom Austria scored even slightly better but had to make way for the winner of the three country test: Swisscom.

The measurements took place on public transport and in particular in publicly accessible buildings like cafés, museums, train stations or airport terminal buildings. As far as possible the testers took regional trains to travel between cities and for taking measurements during the journey.

## Logistics

During the measurements, the two cars were in the same city, but not at the same location. This was to avoid disturbances from one car to the other. Both cars visited defined destinations. For stationary measurements they stopped at selected "areas of interest", typically crowded locations such as airports, train stations, recreation areas or densely populated residential areas.

Especially at those locations, the measurement systems have to share the available networks capacities with other normal users. This is according to the usual competition between users for the more or less scarce bandwidth.

The selected cities should be representative for a large proportion of the population. Therefore the measurements were executed in 21 of the bigger cities in Germany, from Osnabrück with 156,000 inhabitants up to Berlin with 3,4 million inhabitants. Smaller cities were visited by one measurement car during the transfers from one large city to the next one, along the routes. 27 smaller cities were visited, covering sizes from 20,000 inhabitants, like Witten or Nauen, up to almost 90,000 inhabitants in cities like Esslingen. In Switzerland and Austria 16 of the biggest 25 cities were covered, including approximately 20 smaller cities in each country. Between the cities highways were mainly used by the measurement cars.

## Effort and output

During 45,000 measurement kilometers - a circumnavigation of the world - 150,000 measurement samples were collected, almost half of them in Germany. This effort is necessary to provide statistically relevant network quality statements.

The smartphones in the measurement trolley record the same key performance indicators as those in the cars.

| COUNTRY | | GERMANY | | | | AUSTRIA | | | SWITZERLAND | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Netzbetreiber | | Deutsche Telekom | Vodafone | O2 | E-Plus | A1 Telekom Austria | T-Mobile | Drei | Swisscom | Sunrise | Orange | |
| **Telephony** | max. 210 | **175** | **171** | **128** | **145** | **188** | **175** | **183** | **181** | **189** | **182** | |
| Big Cities (outdoor) | 95 | 85% | 85% | 58% | 69% | 90% | 86% | 87% | 84% | 91% | 84% | |
| Big Cities (indoor) | 35 | 82% | 84% | 62% | 78% | 91% | 89% | 94% | 89% | 95% | 93% | |
| Highways | 70 | 85% | 79% | 66% | 68% | 91% | 80% | 87% | 88% | 89% | 87% | |
| Trains | 10 | 61% | 57% | 54% | 43% | 78% | 66% | 59% | 82% | 77% | 89% | |
| **Data** | max. 290 | **261** | **229** | **207** | **182** | **265** | **242** | **230** | **275** | **253** | **259** | |
| Big Cities (Outdoor) | 135 | 91% | 83% | 80% | 68% | 96% | 87% | 83% | 94% | 87% | 88% | |
| Big Cities (Indoor) | 50 | 90% | 78% | 67% | 65% | 94% | 91% | 74% | 94% | 90% | 92% | |
| Small Cities | 35 | 86% | 65% | 59% | 53% | 77% | 72% | 71% | 96% | 81% | 86% | |
| Highways | 50 | 95% | 88% | 70% | 58% | 90% | 77% | 85% | 97% | 91% | 90% | |
| Trains | 20 | 76% | 54% | 46% | 55% | 86% | 77% | 68% | 95% | 85% | 96% | |
| **connect** Rating | max. 500 | **436** very good | **400** good | **335** satisfactory | **327** satisfactory | **453** very good | **417** good | **413** good | **456** very good | **442** very good | **441** very good | |