



DRIVE TEST  
CAMPAIGN  
RESULTS  
**2020**



Belgian Institute for Postal Services  
and Telecommunications



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## 1 Introduction

For the third consecutive year, BIPT and Commsquare have measured customer experience of the three mobile networks in Belgium. This publication on mobile network quality increases transparency and helps customers to make better informed decisions. It also helps BIPT to understand and monitor mobile network performance in Belgium. Besides, operators can rely on this information to prioritize their investment and provide an even better service.

This report contains the results, explains the methodology and gives an overview of the BIPT 2020 measurement campaign on customer experience. The aim is to understand what customers experience when they watch a video, visit a website, download a file or make a phone call on a mobile network.

## 2 Campaign methodology

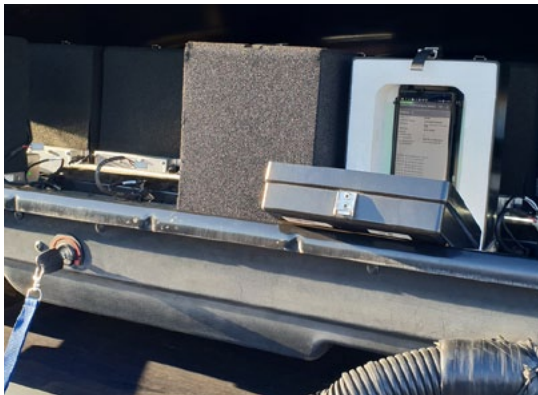
The objective of the campaign was to measure customer experience for a user using a 4G/LTE capable smartphone in indoor conditions.

Measurements were conducted by driving 2 cars with a Rohde & Schwarz equipment across Belgium. Smartphones were installed in a ski-box, such that the measurements represent in-car and indoor performance (i.e. as experienced by a user in a building or house, close to a window).

The campaign was conducted between 17/Sep and 10/Oct/2020. A total



of 250 hours of drive tests were made (i.e. 125 hours of measurements for each car).



The measurement methodology has slightly evolved compared to the campaign conducted in 2019. The differences in setup between 2020 and 2019 reflect advancements in technology or are deliberate choices that only lead to small statistical variations in the results (see sidebar for more details).

## Differences between the 2020 and 2019 measurements

Measurements in 2020 use more recent smartphone models, typically supporting newer technologies and resulting in better customer experience.

- The VoLTE voice tests were conducted using a Samsung Galaxy S10 phone (S8 in 2019), with a better speech codec, called EVS. As all operators support EVS in their network, all 3 operators show a major improvement in speech quality.

- In the data tests, the LG V50 ThinQ supports the latest network features in download resulting in higher download throughput (compared to the Sony XZ2 used in 2019).

The web pages selected in the test are popular pages in Belgium, and the size of these pages varies as their content is dynamic (e.g. for news sites). As a result, the 'web browsing time' in the 2020 measurements is not comparable with the 2019 results.

The measurement locations are slightly different between campaigns conducted in different years, but this has no impact on the results (except for pure statistical variation).

- The same major and medium cities are tested. The actual roads driven in each city might slightly differ.

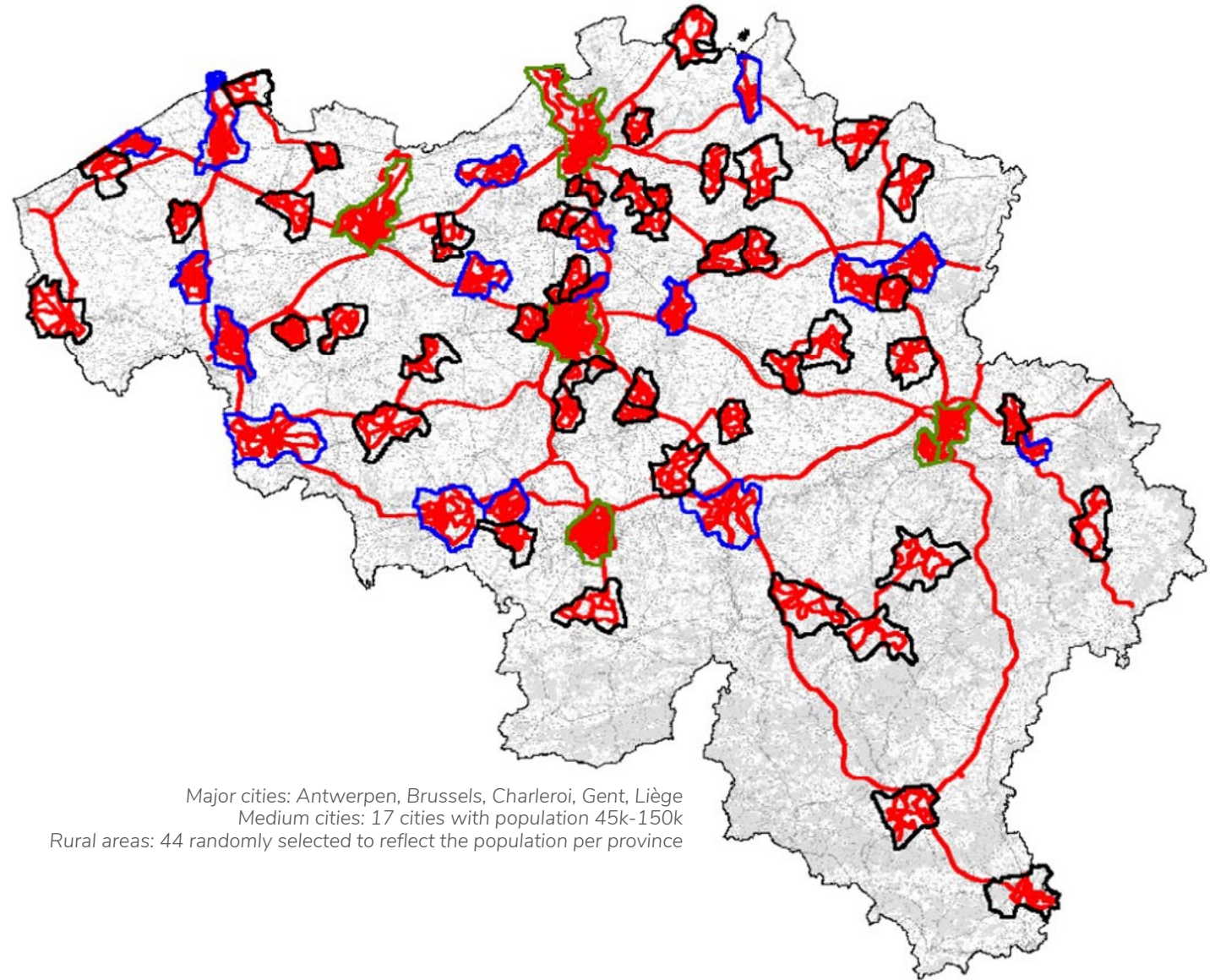
- The 44 rural areas are randomly selected within each province. As a result, we have tested different rural areas, as well as different N-roads connecting the rural areas.



## 2.1. Measurements location

BIPT and Commsquare selected the cities and villages to be measured, based on their importance and population (see map). The choice of medium cities and rural areas reflects the population per province. The operators did not receive upfront information about the specific cities and areas in the test.

A total distance of roughly 11,000 km was driven during the tests; over 7,800 voice calls were made on each network; and over 60,000 data tests were conducted per network.



## 2.2. Voice telephony tests

The Samsung Galaxy S10 is an Android smartphone and supports VoLTE calls with the best speech codec, called EVS.

Voice calls were made between phones placed in both cars, i.e. a phone in the first car calling the phone in the second car. A new VoLTE call was made every 2 minutes: the call holding time (or duration) was 90s, with 30s pause between test calls. During the call, the phones could make unrestricted and non-user-initiated data activity, as is typically the case for a smartphone.

## 2.3. Data tests

The LG V50 ThinQ was used for tests in 4G-preferred-mode. This means the phone tries to use the 4G/LTE network, but in its absence, continues service on the 3G or 2G data network.

The data tests included a series of different tests: throughput speed tests in downlink and uplink (conducted as a down- or upload during 10s); a file transfer of 10MB in download and 5MB in upload; a selection of 6 popular web pages in the web browsing tests; a YouTube buffered streaming video during 60s; and a Dropbox upload test.

## 2.4. Known limitations

The approach is a valid approach but has some inherent known limitations.

The results in this report are a snapshot of mobile network performance measured in Belgium in September-October 2020. Mobile networks evolve and undergo changes and improvements, which might lead to different performance in the future.

All tests are conducted whilst driving. This is a best-practice approach to make tests across an entire country. However, most mobile users use their phone in static conditions, i.e. when not moving. It is generally assumed the average static user experiences better performance than the moving user in our tests.

Tests were conducted using relatively high-end smartphones running on the Android operating system. As mobile phones themselves impact user experience, users with older or less-capable phone models or with a different operating system might experience a different performance.

We conducted the tests with 4G-capable phones which is representative for the typical user in Belgium. There are some early 5G technology deployments in Belgium, but 5G is not the mainstream technology in Belgium yet.

The test setup measures customer experience in indoor conditions, e.g. for a user in a building close to the window. When using a mobile phone in deep-indoor locations (e.g. in basements, far away from a window, in highly insulated houses, or concrete buildings), performance will be worse.



### 3 Voice results

Voice performance is summarised in 3 categories of service indicators.

Voice Summary		Orange	Proximus	Telenet
<b>Success Rates</b>				
Call setup success rate	%	99.6	99.7	99.5
Successfully established calls completion rate	%	99.8	99.8	99.9
<b>Call Setup Time</b>				
Call Setup Time (s)	Average	2.7	2.2	2.9
Call Setup Time (s) long samples	10% longest	3.0	2.6	3.9
<b>Voice Quality</b>				
Voice Quality Score	Average	4.4	4.3	4.4
Voice Quality Score low samples	10% lowest	3.9	3.6	3.7

This is a description of the voice service indicators:

- **Success rates** answer the questions “Can I make a call?” (setup success) and “Can I complete a call without a drop?” (completion rate).
  - The **call setup success rate** denotes the proportion of success call setups, i.e. “Can I make a call”, in other words, do I receive ringing tone after I pressed the dial button. All operators demonstrate a high call setup success rate, with Proximus (99.7%) ahead of Orange (99.6%) and Telenet (99.5%).

- The **successfully established calls completion rate** measures the proportion of successfully established calls that reach the end of the conversation, i.e. “Can I complete a call without a drop?”, in other words calls that successfully started and didn’t prematurely terminate or drop. All networks score very high, with Telenet (99.9%) ahead of Orange (99.8%) and Proximus (99.8%). Note the completion rate depends on call duration, which is 90s in our tests. It is generally known that users making longer phone calls would experience more call drops.

- **Call Setup Time** measures the time that is needed to set up a call, i.e. from pressing the dial button until hearing ringing tone.
  - For the average **call setup time**, Proximus (2.2s) is fastest, followed by Orange (2.7s)<sup>1</sup> and Telenet (2.9s).
  - **Call setup time long samples** indicates the minimum time it takes to set up the 10% slowest calls. Proximus (2.6s) is faster than Orange (3.0s) and Telenet (3.9s).
- **Voice Quality** measures the quality of the conversation on a scale from 5 (excellent) to 1 (poor). Good speech quality means clarity of the call, i.e. the speech clearness, fidelity, intelligibility and absence of distortion (such as metallic voice).
  - All operators demonstrate a high average **voice quality score**, with Orange (4.4) and Telenet (4.4) ahead of Proximus (4.3).
  - **Voice quality score low samples** indicates voice quality for the 10% worst speech samples. Orange (3.9) scores better than Telenet (3.7) and Proximus (3.6).

1. The Orange Call Setup Time is affected, because of the specific test setup with call repetitions every 2 minutes.

## 4 Data results

The performance of data services is expressed in 5 categories of service indicators.

Data Summary			Orange	Proximus	Telenet
<b>Throughput</b>					
HTTP DL fixed duration	DL throughput	Average (Mbps)	68.3	74.1	99.5
		Slowest 10% (Mbps)	10.0	10.3	16.3
HTTP UL fixed duration	UL throughput	Average (Mbps)	28.9	26.3	24.1
		Slowest 10% (Mbps)	7.0	6.1	5.0
<b>File Transfer</b>					
HTTPS DL fixed size 10MB	File download	Median time (s)	1.8	1.6	1.3
		Success rate (%)	98.5	98.7	99.1
HTTPS UL fixed size 5MB	File upload	Median time (s)	1.8	2.0	2.5
		Success rate (%)	98.5	99.1	98.2
<b>Web Browsing</b>					
All web pages (blended KPI)	Web page browsing	Median time (s)	2.7	2.8	2.8
		Success rate (%)	99.5	99.6	99.5
<b>Video</b>					
YouTube – buffered streaming	Success Rate	Success rate (%)	99.3	99.4	99.2
	Time to 1 <sup>st</sup> picture	Average time (s)	1.5	1.6	1.6
	Video Quality	Average MOS	4.4	4.4	4.4
<b>Cloud storage</b>					
Dropbox UL 1MB	Upload	Median time (s)	1.6	1.5	1.6
		Success rate (%)	99.0	99.4	98.7



This is a description of the data quality indicators:

- **Throughput** (expressed in Mbit/sec) measures the speed the network can offer to a single user. An individual user will benefit from high throughput in case he/she wants to download big amounts of data.
  - Telenet has the highest average **download throughput** (99.5Mbps), followed by Proximus (74.1Mbps) and Orange (68.3Mbps). Telenet has also the highest download throughput performance (16.3Mbps) when considering the 10% of slowest test cases, followed by Proximus (10.3Mbps) and Orange (10.0Mbps).
  - Orange has the highest average **upload throughput** (28.9Mbps), followed by Proximus (26.3Mbps) and Telenet (24.1Mbps)<sup>2</sup>. Orange has also the highest upload throughput performance (7.0Mbps) when considering the 10% of slowest test cases, followed by Proximus (6.1Mbps) and Telenet (5.0Mbps).
- **File transfer** tests measure the performance of downloading a 10MB file or uploading a 5MB file (e.g. for uploading or downloading a picture). The performance of file transfers is measured by 2 service indicators: (1) the **time to complete the transfer**, i.e. an indicator of speed, and (2) the **success rate**, an indicator of the reliability of the service.
  - For a **download** of a 10MB file, Telenet has the fastest download time (1.3s), followed by Proximus (1.6s) and Orange (1.8s). Telenet has the highest success rate (99.1%), followed by Proximus (98.7%) and Orange (98.5%).
  - For an **upload** of a 5MB file, Orange has the fastest upload time

2. Telenet upload throughput is affected because of the selection of the LG V50 ThinQ smartphone (it does not support carrier aggregation in LTE uplink).

(1.8s) followed by Proximus (2.0s) and Telenet (2.5s). Proximus has the highest success rate (99.1%), followed by Orange (98.5%) and Telenet (98.2%).

- **Web browsing** or surfing to web pages is a popular activity of mobile phone users. A selection of 6 popular web pages in Belgium was used for the aggregated results. Web browsing results are summarised into 2 service indicators: (1) the time to view the web page (web page browsing time) and (2) the success rate.
  - For **web page browsing time** Orange (2.7s) is ahead of Proximus (2.8s) and Telenet (2.8s).
  - **Web success rate** denotes the percentage of web pages that is completely downloaded within 20s. Proximus (99.6%) is ahead of Orange (99.5%) and Telenet (99.5%).
- **Video streaming**, and YouTube in particular, is amongst the most popular mobile apps. Buffered video streaming was tested, as opposed to live streaming. YouTube performance is measured as (1) a success rate, i.e. the proportion of tests that had a complete play-out of the video; (2) the time-to-first-picture, i.e. how long it takes for the play-out to start; and (3) the video quality during the entire play-out.
  - Proximus (99.4%) offers the highest **success rate**, followed by Orange (99.3%) and Telenet (99.2%).
  - Orange has the fastest **“time to 1<sup>st</sup> picture”** (1.5s), followed by Proximus (1.6s) and Telenet (1.6s).
  - **Video quality** is the same on all networks (4.4). It captures the effect of low video resolution, freezing of the play-out, etc. When the networks offer sufficient throughput and capacity (5-10Mbps on average), and



coverage is present, video quality is expected to be the same in all networks.

- **Cloud storage service** (Dropbox) performance is measured as (1) the time to upload a 1MB file and (2) the success rate to complete the transfer.
  - For **time to complete** the 1MB file upload Proximus (1.5s) is ahead of

Orange (1.6s) and Telenet (1.6s).

- Proximus has the highest **success rate** (99.4%) for Dropbox performance, followed by Orange (99.0%) and Telenet (98.7%).

## 5 Performance per area

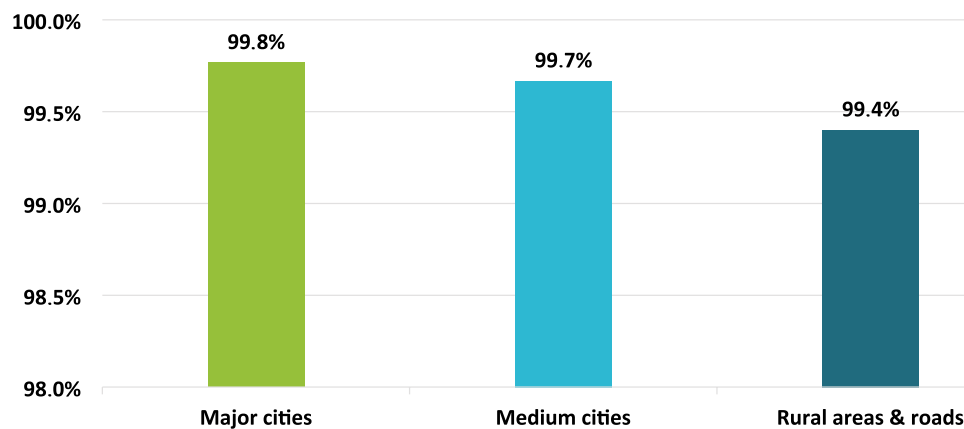
We compare the user experience of the 3 mobile networks in major cities, medium cities, and rural areas & roads.

We want to assess whether a user experiences similar or good quality in different geographical areas.

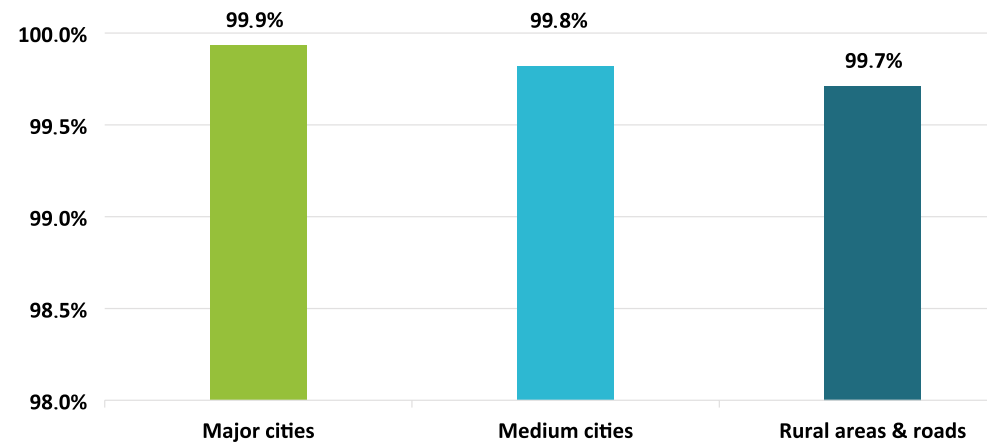
### 5.1. Voice

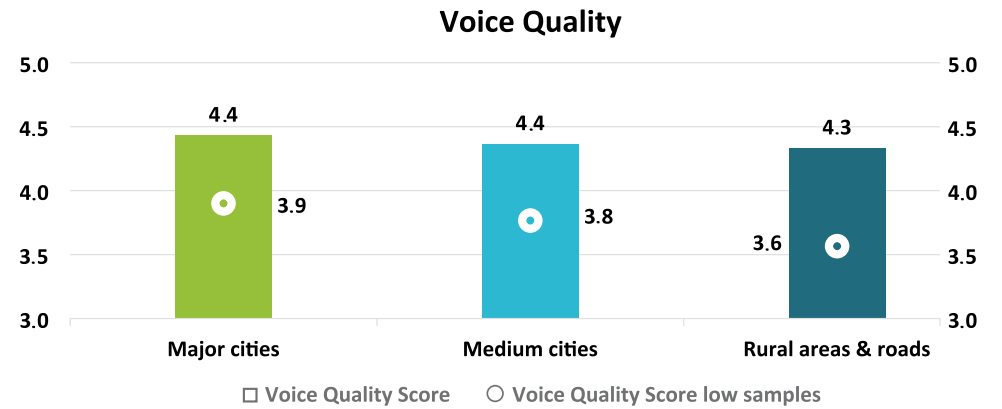
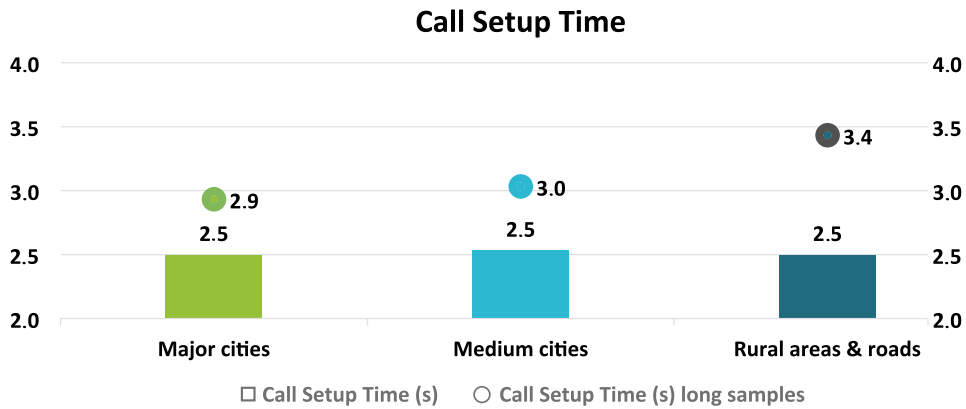
Voice performance on all indicators is better in major and medium size cities compared to rural areas & roads.

**Call Setup success rate**



**Successfully established calls completion rate**

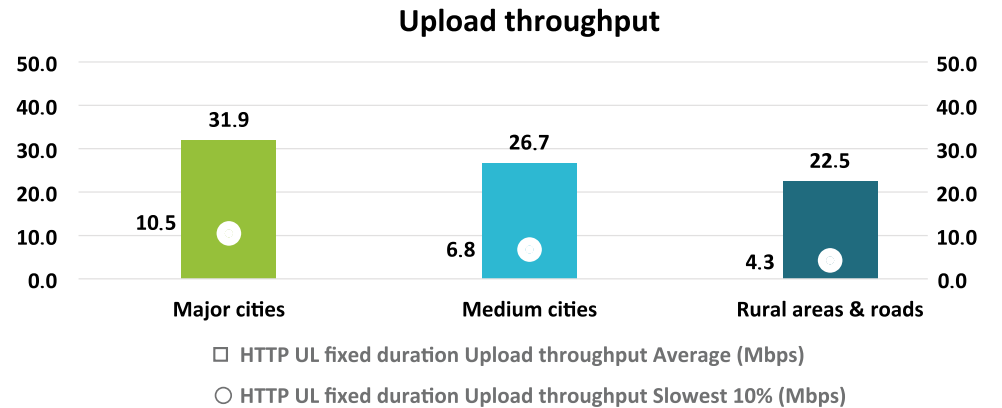
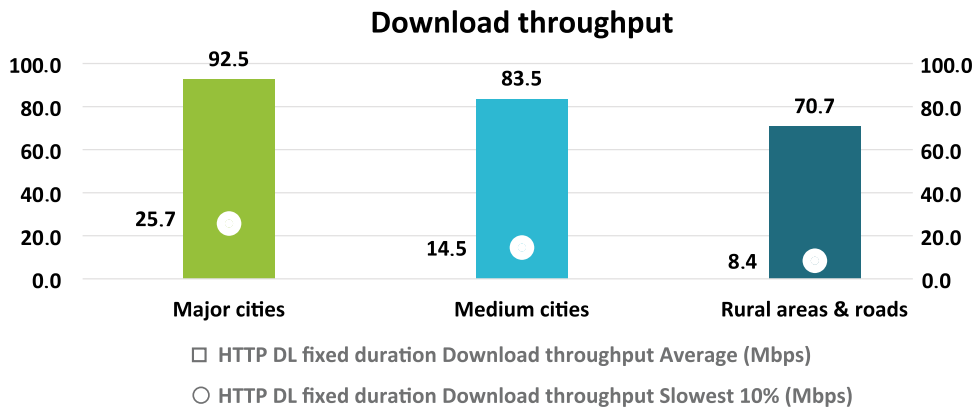




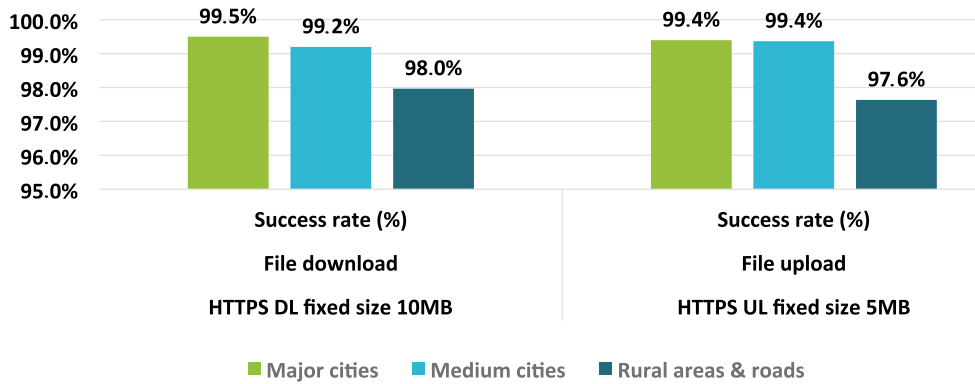
In rural areas & roads, call setup success rate is lower but still at a good level, and there are more voice calls with a long call setup time as well as more calls with low voice quality compared to major and medium size cities.

## 5.2. Data

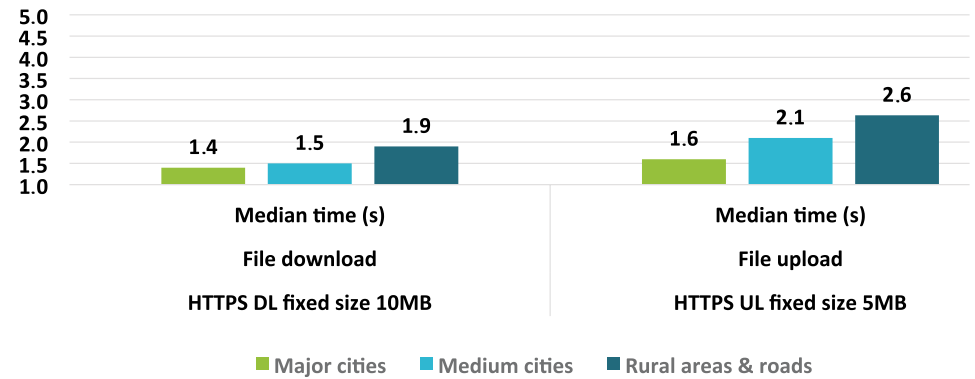
Pure network speed, i.e. download and upload throughput, is highest in major cities, and lowest in rural areas & roads. Success rate indicators indicate the reliability of the data service, and these are similar in major and medium cities..



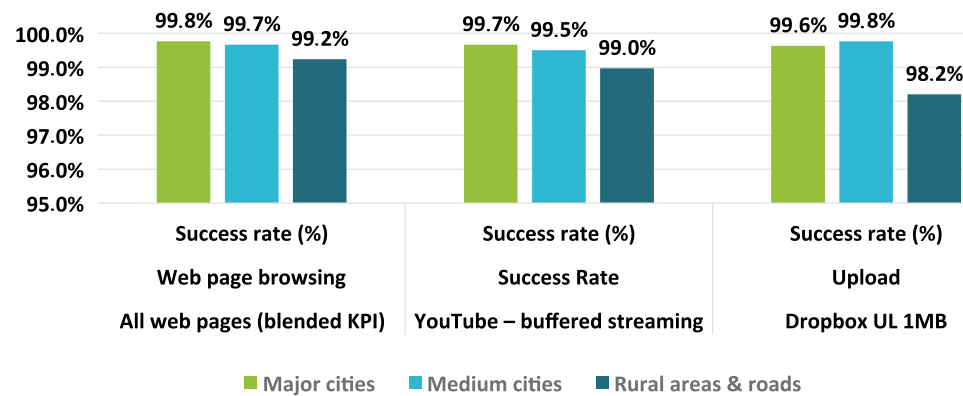
### File transfers success rate (download & upload)



### File transfers duration (download & upload)



### Data services success rate (web, video, cloud storage)



Data performance indicators are lowest in rural areas & roads.

Throughput is lower and success rate indicators are lower but still at good to acceptable levels, typically in the range 98%-99%.



## 6 Trending vs. previous years

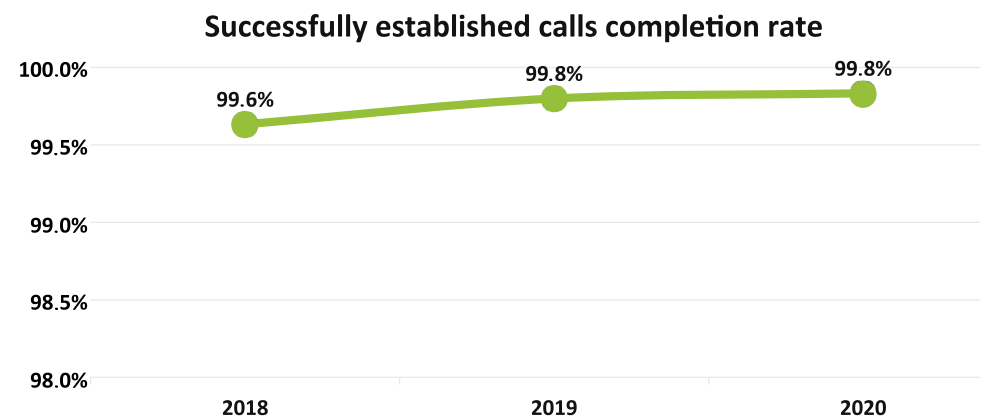
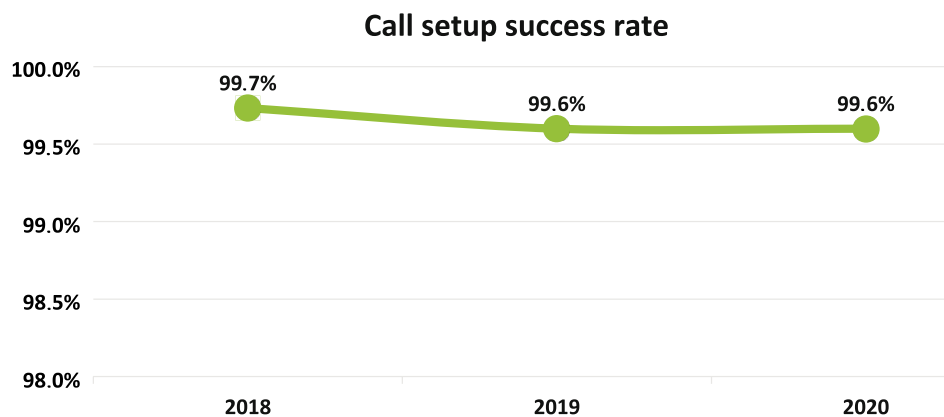
We have conducted benchmarking campaigns of the mobile networks since 2018. We compare performance of the 3 campaigns to assess the evolution of customer experience in Belgium.

### 6.1. Voice

Success rate indicators (“Can I set up a call?” and “Can I complete the call without a drop?”) are high and stable since 2018.

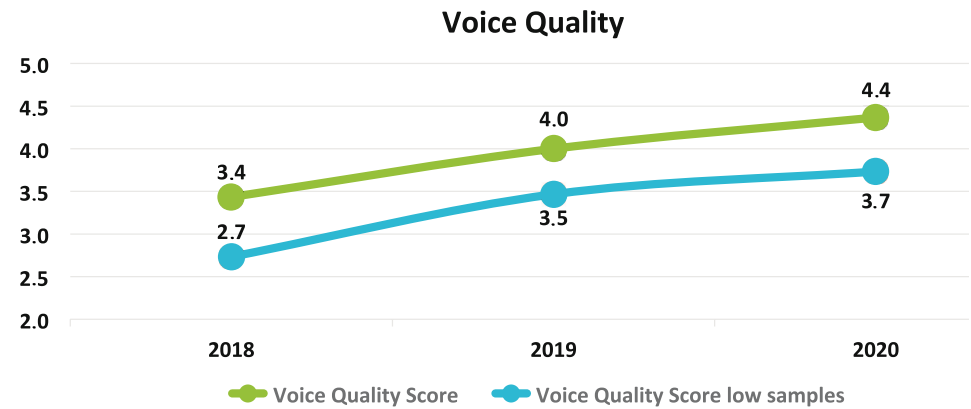
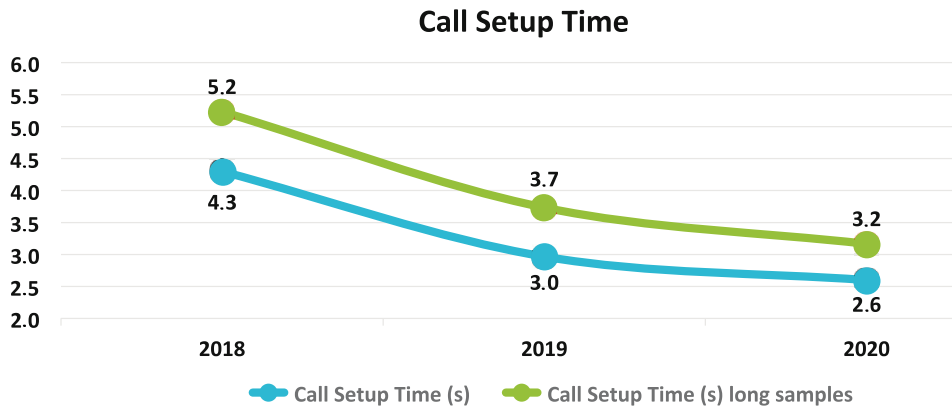
Call setup time (i.e. the time to hear ringing tone) has significantly improved, thanks to the introduction of VoLTE as the voice technology in all networks.

Voice quality has also substantially improved, thanks to the introduction of the EVS<sup>3</sup> (Enhanced Voice Services) codec in all networks. This improvement has a major impact on customer perception of mobile voice calls.



3. EVS is an algorithm which provides better voice quality thanks to higher maximum audio bandwidth and robustness compared to older algorithms.

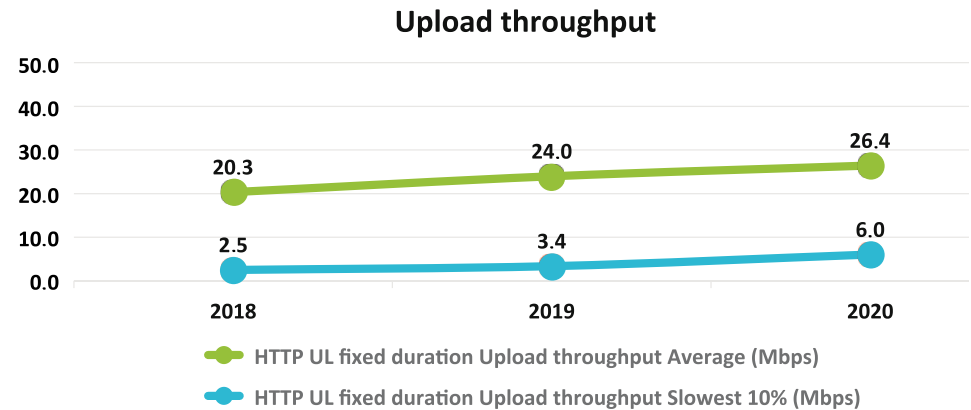
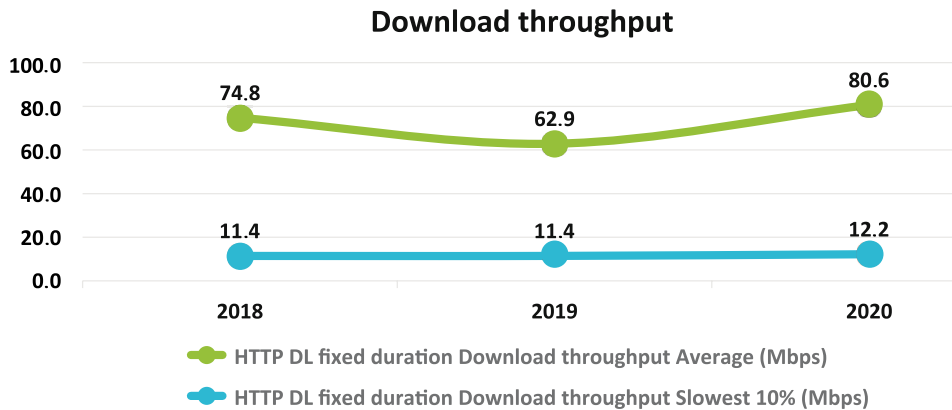




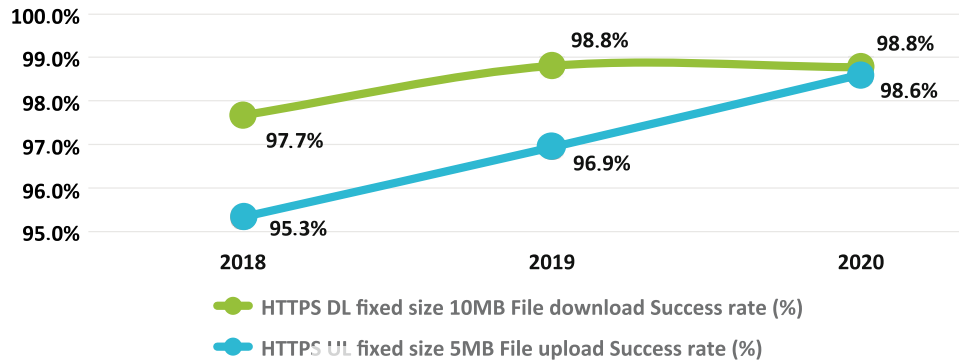
The improved customer experience is realized thanks to investments in new technologies, such as the introduction of VoLTE and the EVS codec by all operators, and network optimization.

## 6.2. Data

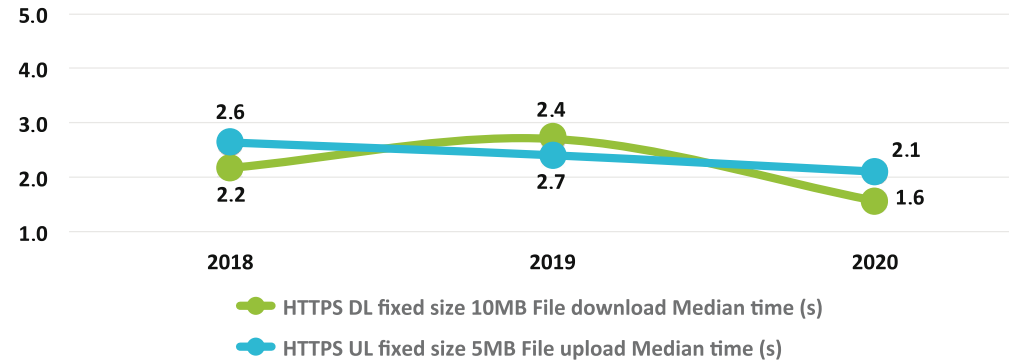
All performance indicators related to throughput or network speed have improved compared to measurements last year. We observed operators have made investments in network capacity and performance, such as reallocation of spectrum from 3G to 4G, which leads to increased throughput values. In addition, recent phone models have better capabilities, also leading to an increase in measured throughput.



### File transfers success rate (download & upload)

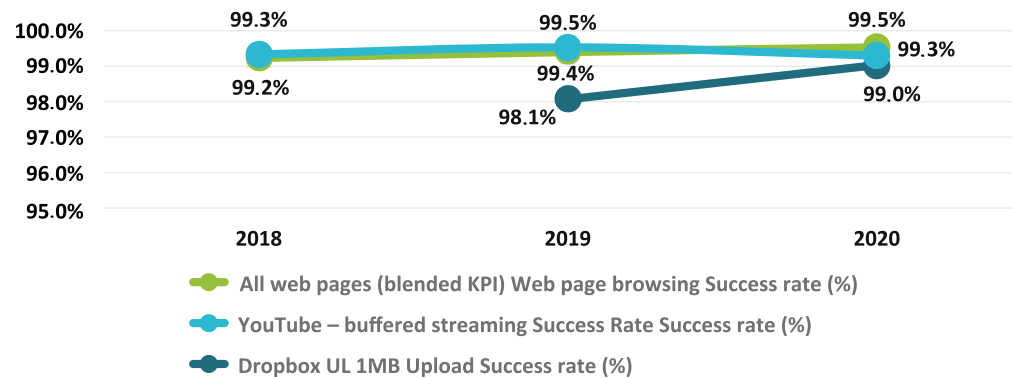


### File transfers duration (download & upload)



Success rate indicators, or the reliability of data services, show a stable to slightly increasing trend.

### Data services success rate (web, video, cloud storage)



In all data indicators there is stable or improved performance compared to previous years. The throughput increase is a reflection of the increase in the available bandwidth and the further LTE deployment of the mobile networks in Belgium.

Data services remain very reliable and throughput is further increasing thanks to the improvements made in the 4G networks.



## 5 Conclusions



The performance of the mobile networks in Belgium was assessed in September-October 2020. The measurements were configured such that these are representative of customer experience in indoor conditions. Mobile networks were measured by driving 2 cars in all major cities and highways, as well as in a selection of medium size cities, villages and roads.

### For **voice performance**:

- Setting up a call works well in all networks (**call setup success rate**), with Proximus (99.7%) ahead of Orange (99.6%) and Telenet (99.5%).
- The probability to complete a call without a drop is very high (**successfully established calls completion rate**), with Telenet (99.9%) ahead of Orange (99.8%) and Proximus (99.8%).
- Setting up a call is fast, with Proximus (2.2s) the fastest **average call setup time**, followed by Orange (2.7s) and Telenet (2.9s). For the 10% slowest call setups, Proximus (2.6s) is faster than Orange (3.0s) and Telenet (3.9s).
- Conversational quality is very high (**voice quality score** on average), with Orange (4.4) and Telenet (4.4) ahead of Proximus (4.3). For the 10% worst samples of voice quality, Orange (3.9) scores higher than Telenet (3.7) and Proximus (3.6).

### For **data performance**:

- Telenet has the highest average **download throughput** (99.5Mbps),



followed by Proximus (74.1Mbps) and Orange (68.3Mbps).

- Orange has the highest average **upload throughput** (28.9Mbps), followed by Proximus (26.3Mbps) and Telenet (24.1Mbps).

- For the **download of a file**, Telenet has the fastest download time (1.3s), followed by Proximus (1.6s) and Orange (1.8s). Telenet has the highest success rate (99.1%), followed by Proximus (98.7%) and Orange (98.5%).  
- For the **upload of a file**, Orange (1.8s) is faster than Proximus (2.0s) and Telenet (2.5s); and Proximus (99.1%) has the highest success rate followed by Orange (98.5%) and Telenet (98.2%).
- For **web page browsing** time Orange (2.7s) is ahead of Proximus (2.8s) and Telenet (2.8s). For the success loading of a web page (web success rate), Proximus (99.6%) is ahead of Orange (99.5%) and Telenet (99.5%).
- For **video streaming**, Proximus (99.4%) offers the highest success rate, closely followed by Orange (99.3%) and Telenet (99.2%). Orange has the fastest “time to 1st picture” (1.5s), followed by Proximus (1.6s) and Telenet (1.6s). All operators present identical average video quality (4.4).
- For **Dropbox performance**, Proximus has the highest success rate (99.4%), followed by Orange (99.0%) and Telenet (98.7%). For time to complete the 1MB file upload Proximus (1.5s) is ahead of Orange (1.6s) and Telenet (1.6s).

We observed performance differences between the different networks, but the differences are often small. There is not a single network outperforming the other networks on all service indicators we have measured and consider relevant for customer experience. The performance in major and medium size cities is better than the rural areas and roads. Comparing to previous years, the performance of mobile networks in Belgium has been stable or improved on all performance indicators, both for voice and data. The improvements are the result of advancements in technology as well as investments and optimisation work by the operators.

These conclusions are valid based on the measurements made in September-October 2020, simulating indoor coverage conditions. Customer experience deep into buildings will be different.

Based on our international experience and considering the combination of all service indicators we have measured, we can conclude that all mobile networks in Belgium demonstrate a very good performance for users with a recent 4G mobile phone.





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