



commsquare

Proximus Mobile Network Benchmark
June 2019
KPI Validated Results

Drive-test

Setup

Drive-test



2019-Q2 Test setup

Drive-test

- » 3 mobile networks tested
 - Proximus, Orange and Telenet
- » Drive tests with 2 cars
 - Voice calls between phones in 2 different cars
- » Phones mounted in ski-box
 - Attenuation simulating “indoor coverage” conditions



| Test mode | 2019 Q2 – Test phone model |
|-------------------|----------------------------|
| Voice CSFB-CSFB | Sony Z5 |
| Voice VoLTE-VoLTE | Samsung S8 |
| Data LTE | Sony XZ2 & Sony XZ Premium |
| Coverage | Scanner TSME |





Campaign description

Drive-test

5

- » 26/March to 28/April/2019
- » 250h of measurements
- » ~10,000km driven
- » ~80,000 coverage bins
- » 7,400 calls per mode and operator
- » 4,100 data tests per mode and operator

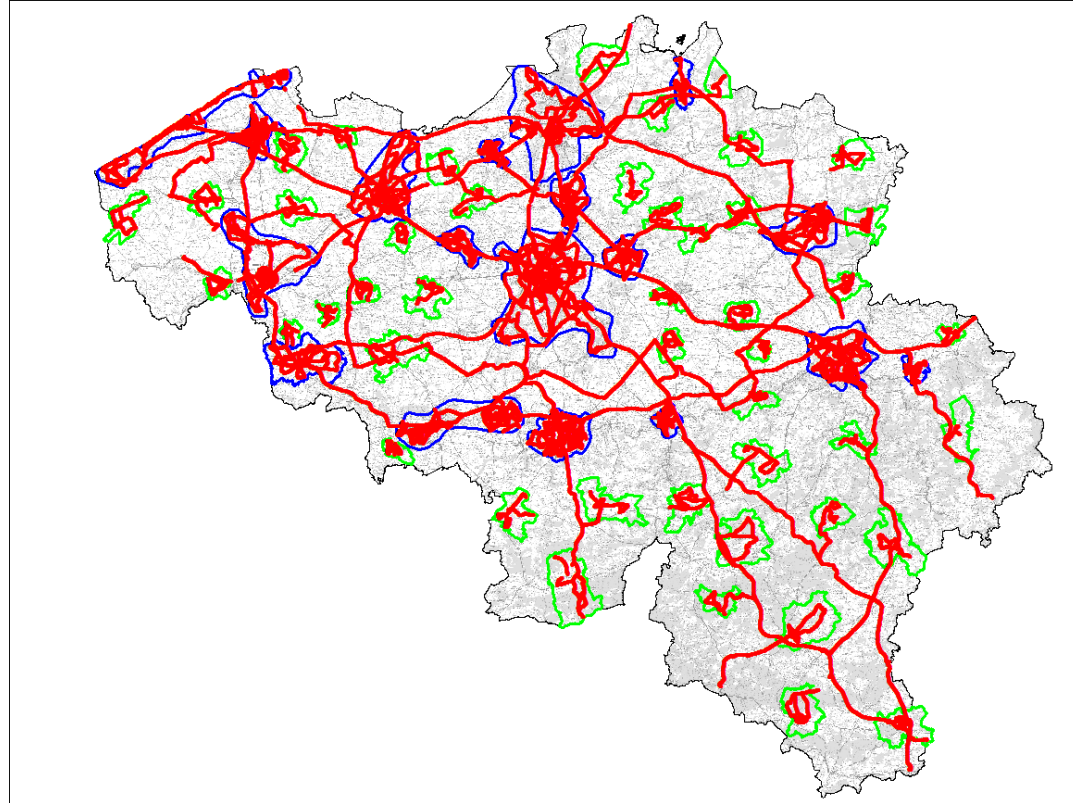
"Golden" Big Cities

Antwerp
Brussels
Charleroi
Gent
Liege

"Silver" Medium-size Cities

| | |
|--------------|-----------------|
| Aalst | Mons-Lalouviere |
| Brugge | Namur |
| Coast | Sint-Niklaas |
| Hasselt-Genk | Tournai |
| Kortrijk | Turnhout |
| Leuven | Verviers |
| Mechelen | |

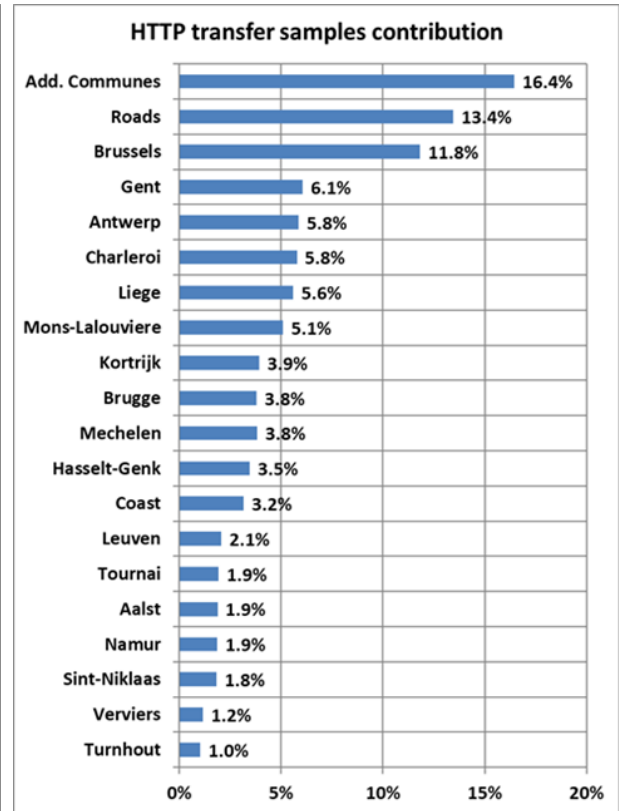
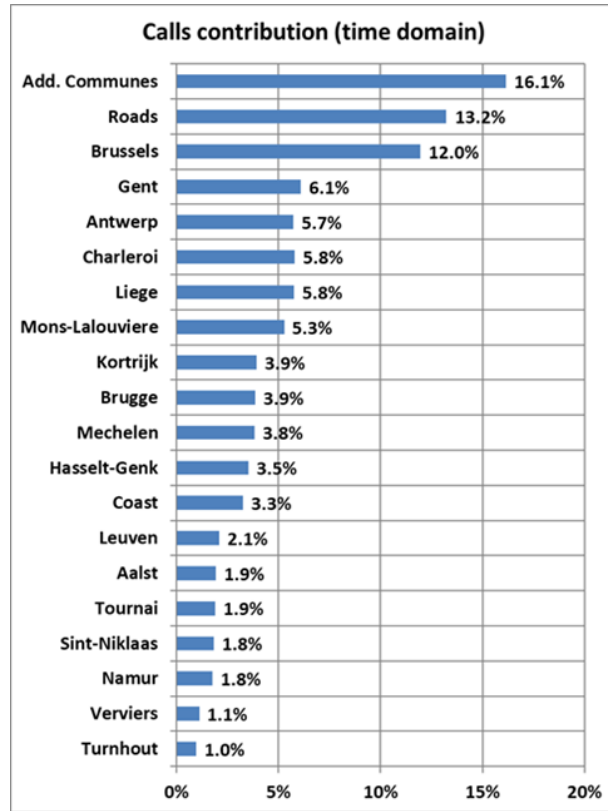
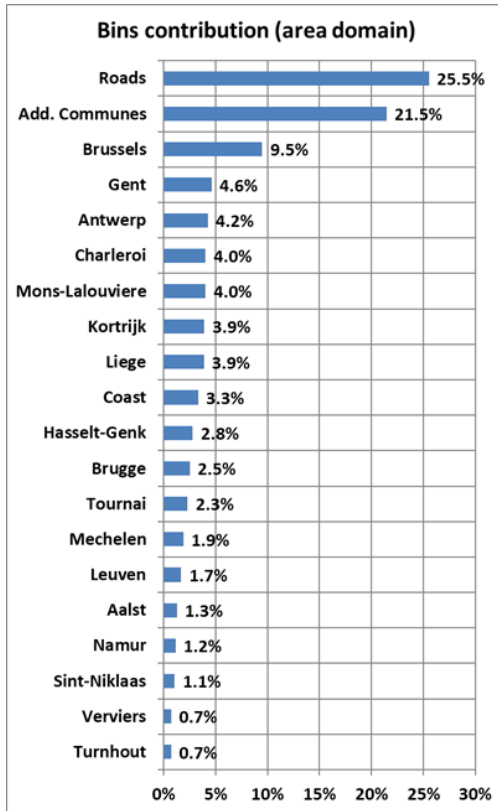
46 Communes





Polygon contribution

Drive-test



Validated KPIs

Drive-test



Voice (CSFB-to-CSFB)

Drive-test

| Voice Summary | | Proximus | Orange | Telenet |
|----------------------------------|-------------|--------------|--------------|--------------|
| Success Rates | | | | |
| Call setup success rate | % | 99.3% | 99.2% | 99.4% |
| Call completion rate | % | 99.1% | 98.8% | 99.2% |
| Uninterrupted call rate | % | 98.6% | 98.3% | 99.1% |
| Voice Speech Quality | | | | |
| Voice Quality Score | Average | 3.81 | 3.83 | 3.93 |
| Voice Quality Score low samples | 10% lowest | 3.10 | 3.18 | 3.44 |
| Call Setup Time | | | | |
| Call Setup Time (s) | Average | 4.4 | 4.0 | 4.8 |
| Call Setup Time (s) long samples | 10% longest | 6.2 | 5.1 | 5.4 |

Test setup:
 Sony Z5 calling
 Sony Z5
 4G preferred to
 4G preferred

Call setup success rate: calls with ringing tone, i.e. considered a "successful call setup"

Call completion rate: calls reaching the call end, configured as 90s call time (includes calls with and without interruption)

Uninterrupted call rate: calls reaching the call end without an interruption (technically: without a call re-establishment)

Voice quality based on Super-wideband POLQA algorithm

Call setup time is the time between pressing the Dial button and the ringing tone at the caller side ("to Alerting")



LTE voice (VoLTE)

Drive-test

| Voice Summary | | Proximus VoLTE | Orange VoLTE |
|----------------------------------|-------------|----------------|--------------|
| Success Rates | | | |
| Call setup success rate | % | 99.1% | 99.0% |
| Call completion rate | % | 98.8% | 98.7% |
| Voice Speech Quality | | | |
| Voice Quality Score | Average | 3.99 | 3.96 |
| Voice Quality Score low samples | 10% lowest | 3.47 | 3.39 |
| Call Setup Time | | | |
| Call Setup Time (s) | Average | 2.9 | 2.6 |
| Call Setup Time (s) long samples | 10% longest | 3.6 | 3.9 |

Test setup: Samsung S8 calling Samsung S8; VoLTE preferred to VoLTE preferred

- SIMs for Telenet activated VoLTE during the campaign
- "Uninterrupted calls" are not relevant for VoLTE: interruptions much shorter as for CSFB, typically <1s for VoLTE



LTE data

Drive-test

| Data Summary | | | Proximus | Orange | Telenet |
|------------------------------|--|-------------|----------|--------|---------|
| Throughput | | | | | |
| HTTP DL fixed duration | DL throughput (Mbps) | Average | 67 | 56 | 71 |
| | | Slowest 10% | 10.0 | 9.9 | 12.9 |
| HTTP UL fixed duration | UL throughput (Mbps) | Average | 19.4 | 20.2 | 29.6 |
| | | Slowest 10% | 3.4 | 3.2 | 2.8 |
| File Transfer | | | | | |
| HTTPS DL fixed size 10MB | DL time (s) | Median | 1.8 | 2.7 | 2.6 |
| | Success rate | % | 98.2% | 98.4% | 97.4% |
| HTTPS UL fixed size 5MB | UL time (s) | Median | 2.7 | 2.3 | 2.0 |
| | Success rate | % | 97.5% | 96.2% | 95.4% |
| Web Browsing | | | | | |
| All pages (blended KPI) | Web browsing time (s) | Median | 2.0 | 2.2 | 2.2 |
| | Success rate | % | 99.0% | 98.5% | 97.6% |
| Video | | | | | |
| YouTube – buffered streaming | Success Rate | % | 98.9% | 98.7% | 98.8% |
| | Success Rate without interruption & min 720p | % | 96.5% | 57.0% | 97.1% |
| | Time to 1 st picture (s) | Average | 1.6 | 1.9 | 1.6 |
| | Video Quality | Average | 4.41 | 4.30 | 4.41 |
| Social media | | | | | |
| Facebook | Success Rate | % | 99.3% | 99.4% | 98.9% |
| | Total time (s) | Average | 1.6 | 1.7 | 1.8 |
| Instagram | Success Rate | % | 98.2% | 97.1% | 95.7% |
| | Total time (s) | Average | 12.3 | 13.0 | 12.7 |



LTE coverage

Based on drive tests

- » Coverage results based on drive test
 - KPI indicates the percentage of 100x100m coverage bins exceeding the coverage threshold
 - Results based on a scanner measuring the downlink Reference Signal Received Power (RSRP)
 - KPI doesn't indicate population coverage

| LTE Coverage Summary | | Proximus | Orange | Telenet |
|----------------------|-----------------|----------|--------|---------|
| Coverage level | RSRP threshold | | | |
| Deep Indoor | ≥ -86 dBm | 82.9% | 71.0% | 69.3% |
| Indoor | ≥ -100 dBm | 97.4% | 97.0% | 96.4% |
| Outdoor | ≥ -112 dBm | 98.9% | 98.9% | 98.9% |

Trains

Setup

Trains



2019-Q2 Test setup

Trains

- » 3 mobile networks tested
 - Proximus, Orange and Telenet
- » Train tests with mobile – to – mobile calls
 - Voice calls between phones in the train and static phones in Commsquare premises in Mechelen
- » Testing is performed with Swissqual Freerider
- » UE equipment placed inside a backpack; the system is controlled remotely by a Samsung tablet



| Test mode | 2019 Q2 – Test phone model |
|-------------------|----------------------------|
| Voice CSFB-CSFB | Sony Z5 |
| Voice VoLTE-VoLTE | Samsung S8 |
| Data LTE | Sony XZ2 & Sony XZ Premium |
| Coverage | Scanner TSME |



Campaign description

Trains

» The results correspond to measurements conducted on the following train lines:

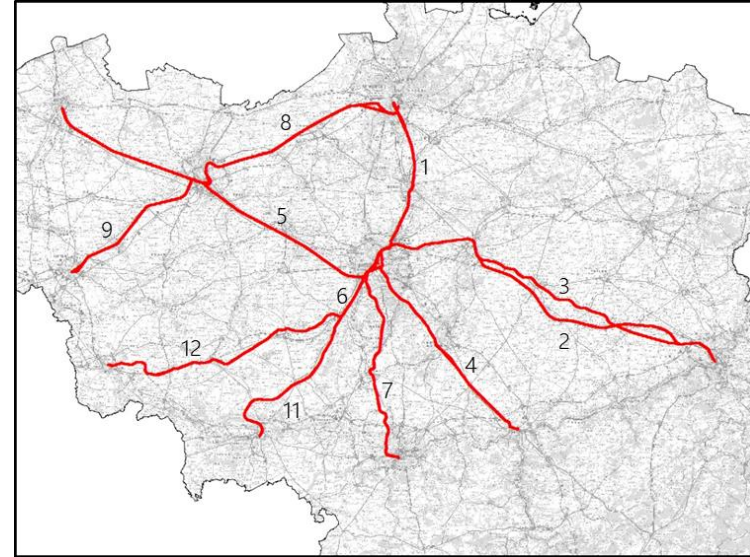
1. Brussels-Midi – Antwerpen-Centraal
2. Brussels-Midi – Liège-Guillemins (fast line)
3. Brussels-Midi – Liège-Guillemins (slow line)
4. Brussels-Midi – Namur
5. Brussels-Midi – Gent-Sint-Pieters
6. Brussels-Midi – Halle
7. Brussels-Midi – Charleroi
8. Antwerpen-Centraal – Gent-Sint-Pieters
9. Gent-Sint-Pieters – Kortrijk
10. Gent-Sint-Pieters – Brugge
11. Mons – Halle
12. Tournai – Halle

» Measurement dates:

→ Data: 2/April - 07/May/2019

→ Voice: 8 - 21/May/2019

» Measurement window: 06:00h – 18:30h (On peak: 06:00h – 9:30h and 15:00h – 18:30h)



Validated KPIs

Trains



Voice (CSFB-to-CSFB)

Trains

| Voice Summary - Trains | | Proximus | Orange | Telenet |
|--------------------------------------|-------------|--------------|--------------|--------------|
| Success Rates | | | | |
| Call setup success rate | % | 98.7% | 97.9% | 96.1% |
| Call completion rate | % | 98.3% | 95.6% | 92.2% |
| Uninterrupted call rate | % | 95.5% | 94.7% | 90.9% |
| Voice Speech Quality | | | | |
| Voice Quality Score | Average | 3.88 | 3.78 | 3.70 |
| Voice Quality Score low samples | 10% lowest | 3.36 | 3.03 | 2.76 |
| Call Setup Time | | | | |
| Call Setup Time moving to static (s) | Average | 4.2 | 4.3 | 4.9 |
| Call Setup Time (s) long samples | 10% longest | 5.6 | 5.4 | 5.5 |

*Note: Static mobile always performing CSFB for all operators
 Call failures and drops are considered only when they occur on the moving side (Static-side related failures and drops are ignored)
 Call setup success rate: calls with ringing tone, i.e. considered a "successful call setup"
 Call completion rate: calls reaching the call end, configured as 90s call time (includes calls with and without interruption)
 Uninterrupted call rate: calls reaching the call end without an interruption (technically: without a call re-establishment)
 Voice quality based on Super-wideband POLQA algorithm
 Call setup time is the time between pressing the Dial button and the ringing tone at the caller side ("to Alerting")
 Call setup time "to Alerting" for moving to static mobile*

Moving Mobile: 2G/3G/LTE
Static Mobile: 2G/3G/LTE

Test setup: Sony Z5, 4G preferred to 4G preferred



LTE voice (VoLTE)

Trains

| Voice Summary - Trains | | Proximus VoLTE | Orange VoLTE | Telenet VoLTE |
|--------------------------------------|-------------|----------------|--------------|---------------|
| Success Rates | | | | |
| Call setup success rate | % | 99.0% | 98.3% | 95.8% |
| Call completion rate | % | 98.3% | 96.3% | 90.7% |
| Voice Speech Quality | | | | |
| Voice Quality Score | Average | 3.98 | 3.94 | 3.94 |
| Voice Quality Score low samples | 10% lowest | 3.46 | 3.32 | 3.34 |
| Call Setup Time | | | | |
| Call Setup Time moving to static (s) | Average | 2.7 | 2.4 | 4.4 |
| Call Setup Time (s) long samples | 10% longest | 2.9 | 2.9 | 5.4 |

Test setup: Samsung S8, VoLTE preferred to VoLTE locked

Call failures and drops are considered only when they occur on the moving side (Static-side related failures and drops are ignored)

Moving Mobile: 2G/3G/LTE
Static Mobile: LTE locked

| Data Summary - Trains | | | Proximus | Orange | Telenet |
|------------------------------|--|--------------|----------|--------|---------|
| Throughput | | | | | |
| HTTP DL fixed duration | DL throughput (Mbps) | Average | 57 | 43 | 50 |
| | | Slowest 10% | 4.8 | 4.6 | 3.5 |
| HTTP UL fixed duration | UL throughput (Mbps) | Average | 19 | 15 | 18 |
| | | Slowest 10% | 2.4 | 2.0 | 1.1 |
| File Transfer | | | | | |
| HTTPS DL fixed size 10MB | DL time (s) | Median | 2.1 | 3.2 | 3.4 |
| | | Success rate | 96.8% | 95.1% | 91.6% |
| HTTPS UL fixed size 5MB | UL time (s) | Median | 2.6 | 3.2 | 3.1 |
| | | Success rate | 97.3% | 94.5% | 88.4% |
| Web Browsing | | | | | |
| All pages (blended KPI) | Web browsing time (s) | Median | 2.2 | 2.6 | 2.4 |
| | | Success rate | 98.9% | 97.7% | 94.2% |
| YouTube Video | | | | | |
| YouTube – buffered streaming | Success Rate | % | 99.4% | 97.2% | 95.7% |
| | Success Rate without interruption & min 720p | % | 93.8% | 44.6% | 88.6% |
| | Time to 1 st picture (s) | Average | 1.6 | 2.1 | 1.8 |
| | Video Quality | Average | 4.40 | 4.25 | 4.36 |
| Social media | | | | | |
| Facebook | Success Rate | % | 99.7% | 99.3% | 96.3% |
| | Total time (s) | Average | 1.7 | 1.8 | 1.9 |
| Instagram | Success Rate | % | 99.3% | 98.5% | 96.3% |
| | Total time (s) | Average | 2.4 | 2.6 | 3.1 |

Blended KPI for 5 web pages

Note: Instagram testing consists of 1 action in trains and 2 actions in the drive-test



LTE coverage

Based on train tests

- » Coverage results based on train test
 - KPI indicates the percentage of 100x100m coverage bins exceeding the coverage threshold
 - Results based on a scanner measuring the downlink Reference Signal Received Power (RSRP)
 - KPI doesn't indicate population coverage

| LTE Coverage Summary | | Proximus | Orange | Telenet |
|----------------------|-----------------|----------|--------|---------|
| Coverage level | RSRP threshold | | | |
| 'In train' coverage | ≥ -115 dBm | 98.5% | 97.4% | 95.4% |

- » Results & conclusions in this report are valid for the measurement period
- » Results are considered statistically relevant at the level of Belgium
 - Results are not relevant per commune or 100x100m bin