



2021



4G/5G Internet Mobile Barometer

9 Metropolitan Areas
In France

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METHODOLOGY

Context & Goals



CONTEXT & GOALS

5G has generated as much excitement as questions about its real contribution. In this context, QoS by MOZARK has launched a field measurement campaign at the national level:

- to clarify the quality of service offered by operators to customers who have subscribed to their 5G offers,
- to objectify 5G's first differences with 4G technology.

To measure the quality of services perceived by the end user on the various target services of internet mobile (4G and 5G), we selected a set of points distributed within each agglomerations deemed deployed, subjected to a scenario of service tests in customer vision.

Operators' services are evaluated under similar circumstances according to two profiles: one equipped with a 4G offer and the other with a 4G/5G one (terminal + subscription).

It is important to consider 5G's youth and its deployment, now in its very first phase. The results obtained illustrate only a first objectivation of average service levels, in rapid evolution: evidence is the instantaneous performances reached, sometimes exceeding 2Gbps.

Scope of the Survey

SCOPE OF THE SURVEY

To evaluate the quality of 4G and 5G data services, the survey is based on a field measurement campaign enabling us to verify the quality of services offered to end customers from the 4 national operators.

- ✓ On a **panel of 40 to 50 measure points per agglomeration, i.e. between 350 and 400 tested addresses**
- ✓ In **living and residential areas** outside buildings, in agglomeration
- ✓ In each point, **1 cycle of 4G measures + 1 cycle in 5G**

TESTED SERVICES

The study was mainly focused on a protocol testing the following 6 main services:

- downstream data transfer (download),
- upload data transfer (upload),
- file transfer in the downstream direction (download),
- file transfer in the upward direction (upload),
- web browsing.

The tests are performed in **auto mode** on a Samsung Galaxy S20 5G:

- the switchover is automatic from 4G to 5G when the 5G network is available and hooked;
- same from 5G to 4G when 5G is not hooked anymore;
- these switches can reduce the observed performance and should disappear as the deployment progresses.

MEASURES PERIOD AND VOLUME

This study presents all the data collected by QoS by MOZARK teams (from March 10th to April 2nd, 2021) on a selection of 9 cities located in metropolitan France, in which 5G is deemed deployed and accessible to customers equipped with compatible terminals.

The 4 cellular network operators: Bouygues Telecom, Free, Orange and SFR are accessed in automatic 4G and 5G mode.

More than 55,000 tests have been performed on the 4 operators by our teams in the following cities:

Cities / Agglos	Start date	End date	<i>Nb of tests</i>
LENS	03/10/2021	03/12/2021	5 900 tests
MONTPELLIER	03/10/2021	03/13/2021	6 141 tests
MARSEILLE	03/15/2021	03/17/2021	6 272 tests
TOULOUSE	03/15/2021	03/18/2021	6 012 tests
CLERMONT-FERRAND	03/22/2021	03/25/2021	6 397 tests
NICE	03/22/2021	03/26/2021	6 396 tests
ILE DE FRANCE (92)	02/23/2021	03/08/2021	5 116 tests
PARIS	03/29/2021	04/02/2021	6 654 tests
STRASBOURG	03/30/2021	04/01/2021	6 395 tests

Material Aspects

4G PACKAGES (NOT 5G COMPATIBLE) & 5G PACKAGES

	Abonnements 5G	Abonnements 4G
<i>Opérateurs</i>	<i>Forfaits 5G</i>	<i>Forfaits 4G</i>
Orange	Go illimités 5G	Sosh 70Go
SFR	Forfait illimité 5G	Red 100 Go (ou plus)
Bouygues	Sensation 150 Go	B&You
Free	Free 5G 150 Go	Free 80 Go

USED TERMINALS

- Targeted operating systems: OS Android
- Samsung Galaxy S20 5G compatible
- Commercially available cell phones compatible with ALL 2G/3G/4G/5G technologies



MEASUREMENT TOOLS :

- Xcal M (tracing tools) : radio track collection

Intervention scope

TESTS COURSES

Tests were performed in static outdoor conditions (i.e. like a pedestrian at a standstill). For each operator, and in the same measurement point, a test scenario is executed according to 2 configurations reflecting 2 customer profiles:


"4G Profile": Customer profile with access to 2G, 3G and 4G networks

⇒ tests carried out from a SIM with a 4G package for the general public
(not 5G compatible)

"5G Profile": Customer profile with access to 2G, 3G, 4G and 5G networks.


=> tests performed with a SIM with a 5G compatible consumer package

The tests are performed for the 2 profiles on the same measurement point in 2 successive cycles.

Profile  : 4 operators tested in automatic mode with 4G compatible sims (and not 5G compatible)

Outdoor

2G/3G/4G

Profile  : 4 operators tested in automatic mode with 5G compatible sims

Outdoor

2G/3G/4G/5G

Measurement protocols

IMPLEMENTED PROTOCOL: MOBILE DATA QUALITY OF SERVICE MEASURES (according to ARCEP 2021 regulatory protocol)

File transfers: A test consists in sending and receiving a file at each measure point. Measures will be carried out, in mono-thread, from and to a dedicated server.

- 1 DL transfer measure of a 5 Mb file in 30s
- 1 measure of loading a 1 MB file in 30s

Downstream and upstream speeds: A test consists in transferring, in the upstream and downstream directions, a file of 50 Mb upstream and 250 Mb downstream for a maximum duration of 10 seconds. This test is performed in mono-thread from and to a dedicated server.

- 1 DL throughput measurement from the download of a 250 MB file in 10s
- 1 UL throughput measurement from the upload of a 50 MB file in 10s

Web browsing: The web browsing measurement corresponds to the loading of a page within 10s.

- In living areas, 10 web pages on a panel of 30 pages at each location
- In transport measurements, the tests are performed simultaneously on the same page for the 4 operators; 30 web pages tested continuously

Video streaming: The streaming measurement corresponds to the viewing of a one-minute video, with 10s of initialization delay, and for which the quality of the viewing is calculated/measured (notably number and duration of buffering type defects)

- Choice of encoding quality: 720px
- Mix of popular videos (high audience) and content selected by QoS (low audience)



RESULTS & INDICATORS

4G/5G DATA

Hook rate by city

CLERMONT-FERRAND	BYT	Free	ORF	SFR	AVERAGE
4G/4G+	46%	43%	30%	87%	52%
5G - Low band frequency 700 MHz-2100 MHz	53%	39%	0%	13%	26%
5G - High band frequency 3.5 GHz	1%	18%	70%	0%	22%

HAUTS-DE-SEINE (IdF 92)	BYT	Free	ORF	SFR	AVERAGE
4G/4G+	61%	83%	38%	74%	64%
5G - Low band frequency 700 MHz-2100 MHz	11%	16%	0%	0%	7%
5G - High band frequency 3.5 GHz	28%	1%	62%	26%	29%

LENS	BYT	Free	ORF	SFR	AVERAGE
4G/4G+	72%	36%	18%	100%	56%
5G - Low band frequency 700 MHz-2100 MHz	4%	44%	1%	0%	12%
5G - High band frequency 3.5 GHz	24%	20%	81%	0%	31%

MARSEILLE	BYT	Free	ORF	SFR	AVERAGE
4G/4G+	44%	57%	32%	74%	52%
5G - Low band frequency 700 MHz-2100 MHz	28%	35%	2%	1%	16%
5G - High band frequency 3.5 GHz	28%	8%	66%	25%	32%

MONTPELLIER	BYT	Free	ORF	SFR	AVERAGE
4G/4G+	64%	71%	28%	74%	59%
5G - Low band frequency 700 MHz-2100 MHz	5%	29%	0%	0%	9%
5G - High band frequency 3.5 GHz	31%	0%	71%	26%	32%

NICE	BYT	Free	ORF	SFR	AVERAGE
4G/4G+	39%	43%	52%	72%	51%
5G - Low band frequency 700 MHz-2100 MHz	19%	47%	0%	1%	17%
5G - High band frequency 3.5 GHz	42%	10%	48%	28%	32%

PARIS	BYT	Free	ORF	SFR	AVERAGE
4G/4G+	65%	100%	51%	84%	75%
5G - Low band frequency 700 MHz-2100 MHz	0%	0%	0%	0%	0%
5G - High band frequency 3.5 GHz	34%	0%	49%	16%	25%

STRASBOURG	BYT	Free	ORF	SFR	AVERAGE
4G/4G+	100%	78%	52%	100%	82%
5G - Low band frequency 700 MHz-2100 MHz	0%	23%	6%	0%	7%
5G - High band frequency 3.5 GHz	0%	0%	42%	0%	10%

TOULOUSE	BYT	Free	ORF	SFR	AVERAGE
4G/4G+	100%	72%	41%	100%	79%
5G - Low band frequency 700 MHz-2100 MHz	0%	22%	4%	0%	7%
5G - High band frequency 3.5 GHz	0%	6%	55%	0%	14%

DATA Results - Downlink Rates

AVERAGE DOWNSTREAM RATES (DL) :

Definition:

Average throughput observed when transferring a 250mo file for 10s.

Observation:

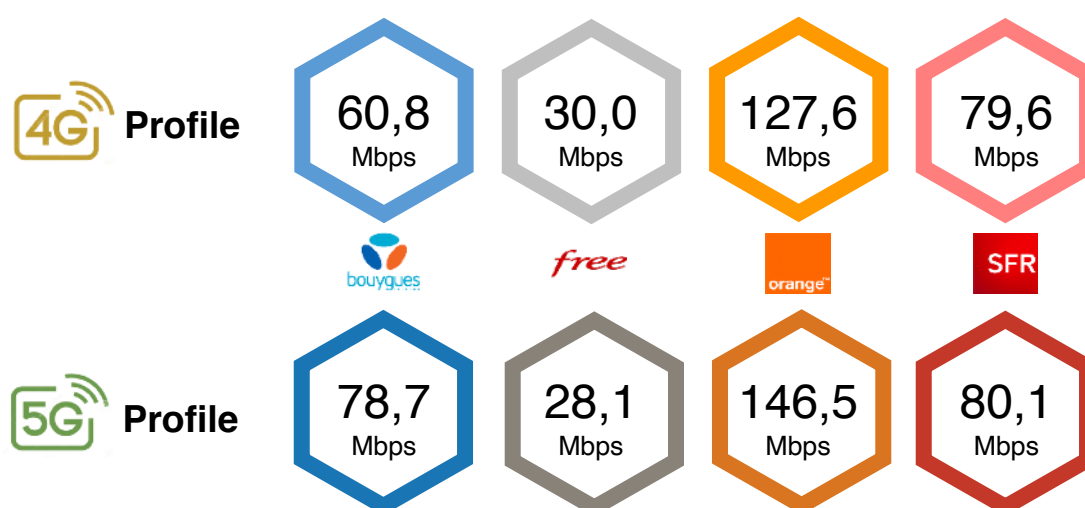
Within each city, the performance gaps between the 4G and 5G profiles tested are not significant, with a slight advantage to the 5G profile.

The differences in performance between operators are found in both profiles.











- **Orange** has the best average downlink speeds in the 9 cities tested, for both profiles.
- **SFR** and **Bouygues** are very close with 80.1 Mbps and 78.7 Mbps in profile 2.

Free shows average speeds behind its competitors.

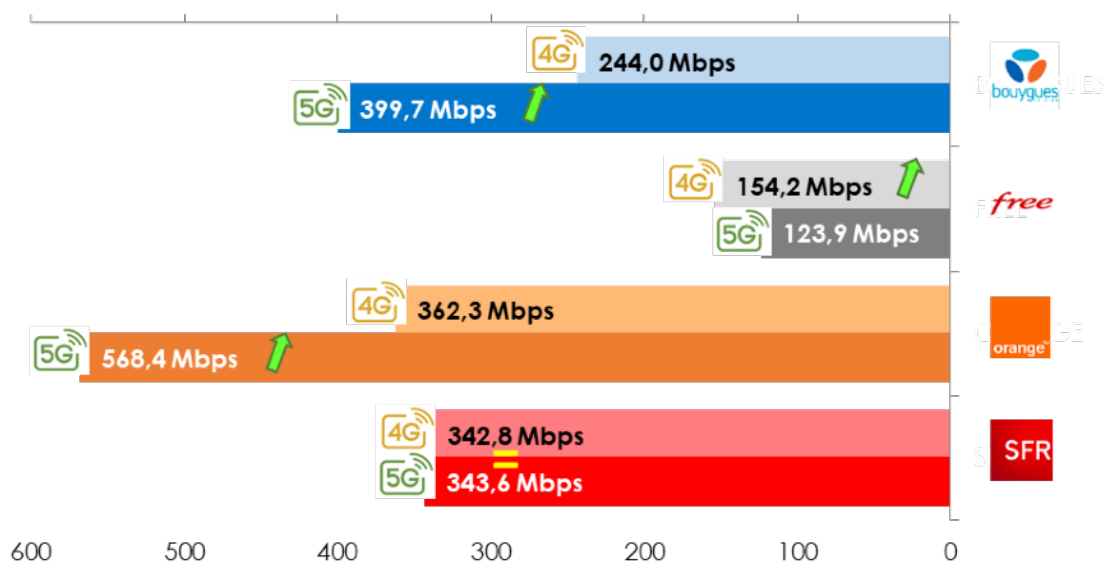
AVERAGE DOWNSTREAM RATES (DL) :



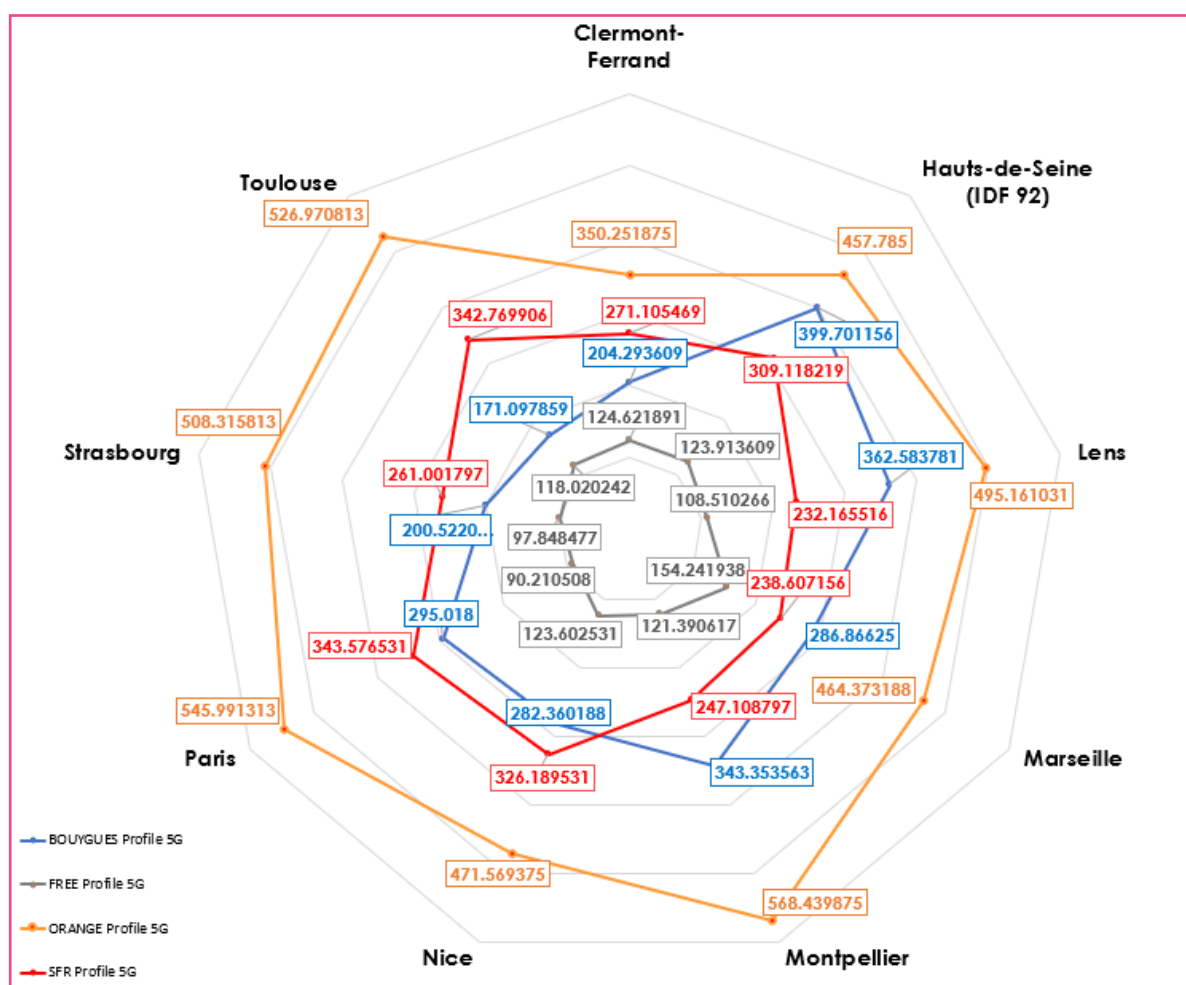
DISTRIBUTION OF AVERAGE DOWNFLOWS BY PROFILE:

Average flow thresholds DL	Les than 50 Mbps	From 50 to 100 Mbps	From 100 to 200 Mbps	More than 200 Mbps
4G_Profile 				
	52.3%	28.0%	17.6%	2.1%
	87.5%	11.1%	1.4%	0.0%
	15.5%	25.9%	41.2%	17.4%
	41.4%	28.9%	22.2%	7.4%
5G_Profile 				
	45.8%	25.7%	19.4%	9.0%
	84.0%	13.9%	2.1%	0.0%
	33.9%	13.0%	22.5%	30.6%
	42.6%	29.2%	20.1%	8.1%

BEST AVERAGE DOWNFLOWS ACHIEVED PER PROFILE:



BEST AVERAGE DOWNSTREAM SPEEDS BY CITY:



Figures are in Mbps

In all tested major cities, **Orange** achieves the best average speeds, exceeding 500Mbps in 4 cities.

At the time of the study, **Bouygues** offers a 5G connection in high and low frequency, allowing in some cities to reach up to 400 Mbps.

SFR presents very homogeneous performances in all cities.

Free is behind with DL speeds below 150 Mbps. Its deployment mainly in 700Mhz band allows it nevertheless to offer 5G coverage in 30% of the tests conducted.

DATA Results - 5G Frequency Band



AVERAGE DOWNSTREAM RATES PER 5G FREQUENCY :

In 5G profile, the observed variation in speeds is strongly linked to the frequency bands used by operators.

The speeds observed in high band (3.5 GHz) are always higher than those obtained on other frequencies.

This illustrates the sensitivity of the results to the strategies and deployment schedules of each operator.

Best average downstream data rates comparison by profile and frequencies

	BOUYGUES	FREE	ORANGE	SFR
4G Profile 				
4G - LTE	60.8 Mbps	30.0 Mbps	127.6 Mbps	79.8 Mbps
5G Profile 				
4G - LTE	42.3 Mbps	11.2 Mbps	22.9 Mbps	29.6 Mbps
5G - Low band frequency 700 MHz-2100 MHz	54.2 Mbps	22.3 Mbps	53.1 Mbps	77.6 Mbps
5G - High band frequency 3.5 GHz	166.2 Mbps	57.3 Mbps	203.6 Mbps	166.5 Mbps

* 4G - LTE: all frequencies included

DATA Results - Downlink Rates

MAXIMUM DOWNSTREAM SPEEDS BY CITY:

Definition:

Maximum throughput peak observed during the transfer of a 250mo file. According to the protocol, this test is performed in mono-thread. A multi-threaded test could show even better results.

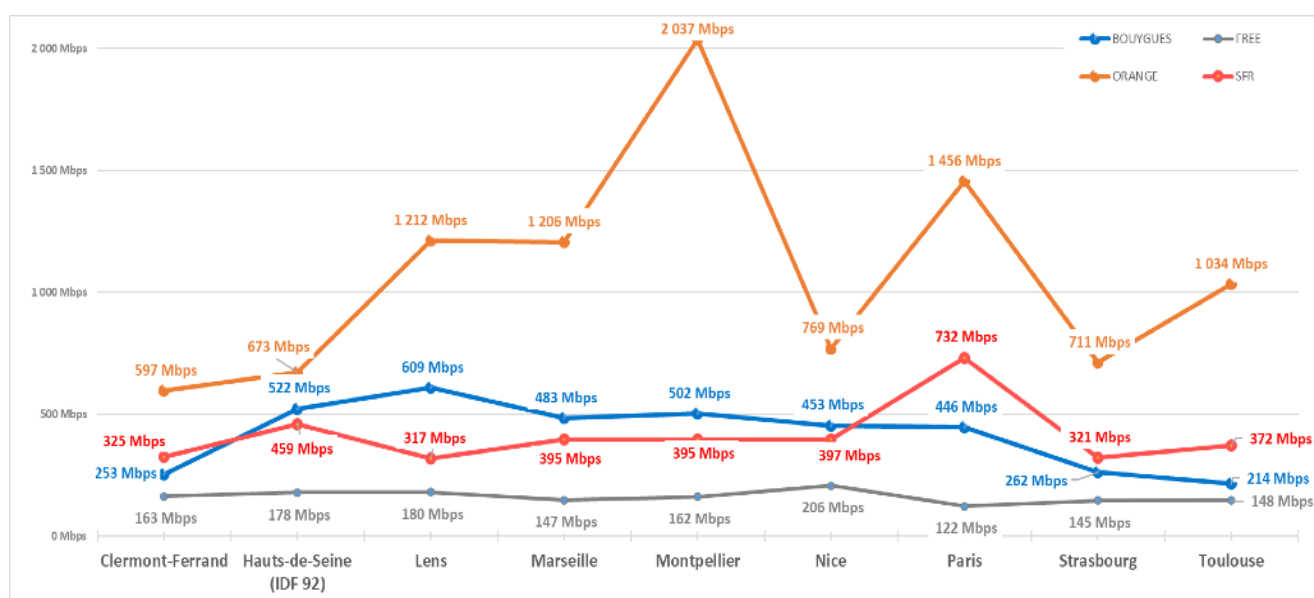
Finding:





Maximum downstream speed reached, if not directly representative of the customer experience, informs about the raw performance and the possible progress of future average speeds.

Orange regularly exceeds 1Gbps, reaching 2Gbps in Montpellier.

SFR reaches 732 Mbps in Paris, **Bouygues** 609 Mbps in Lens and

Free 206 Mbps in Nice.



				
Clermont-Ferrand	253 Mbps	163 Mbps	597 Mbps	325 Mbps
Hauts-de-Seine (IDF 92)	522 Mbps	178 Mbps	673 Mbps	459 Mbps
Lens	609 Mbps	180 Mbps	1 212 Mbps	317 Mbps
Marseille	483 Mbps	147 Mbps	1 206 Mbps	395 Mbps
Montpellier	502 Mbps	162 Mbps	2 037 Mbps	395 Mbps
Nice	453 Mbps	206 Mbps	769 Mbps	397 Mbps
Paris	446 Mbps	122 Mbps	1 456 Mbps	732 Mbps
Strasbourg	262 Mbps	145 Mbps	711 Mbps	321 Mbps
Toulouse	214 Mbps	148 Mbps	1 034 Mbps	372 Mbps

DATA Results - 5G Hook

5G CATCH RATE PER PROFILE AND FREQUENCY :

Definition:

The 5G hookup rate is the number of handoffs performed in 5G for more than 50% of the time divided by the total number of handoffs performed (4G+5G).

Finding:

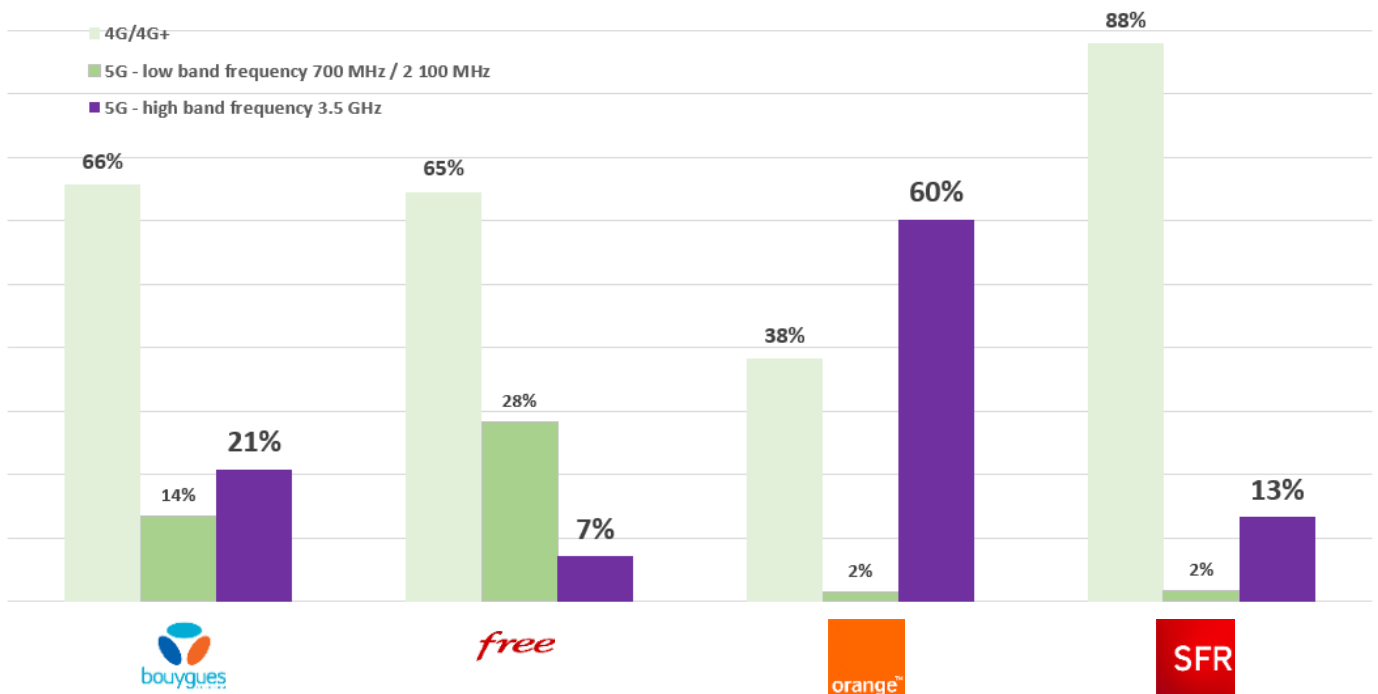
With 61% of the tests performed in 5G on high frequency band, **Orange** provides a 5G grip rate - all frequencies combined - 2 times higher than the other 3 operators. At the time of the tests, it provided a customer experience mostly in 5G in areas deemed deployed.

On **Bouygues** and **Free** networks, 1 out of 3 tests was performed in 5G. While **Bouygues** uses a balanced mix of high and low 5G frequencies, Free favors mostly low 700 MHz band.

SFR allows a 5G connection in only 12% of cases but systematically favors high frequencies.

These indicators reflect very different deployment strategies.

5G reach rate by operator and frequency band



DATA Results - Uplink Rates

AVERAGE FLOW RATES (UL) :

Definition:

Average rate observed during the sending of a 50mb file during 10s from the mobile to the server.

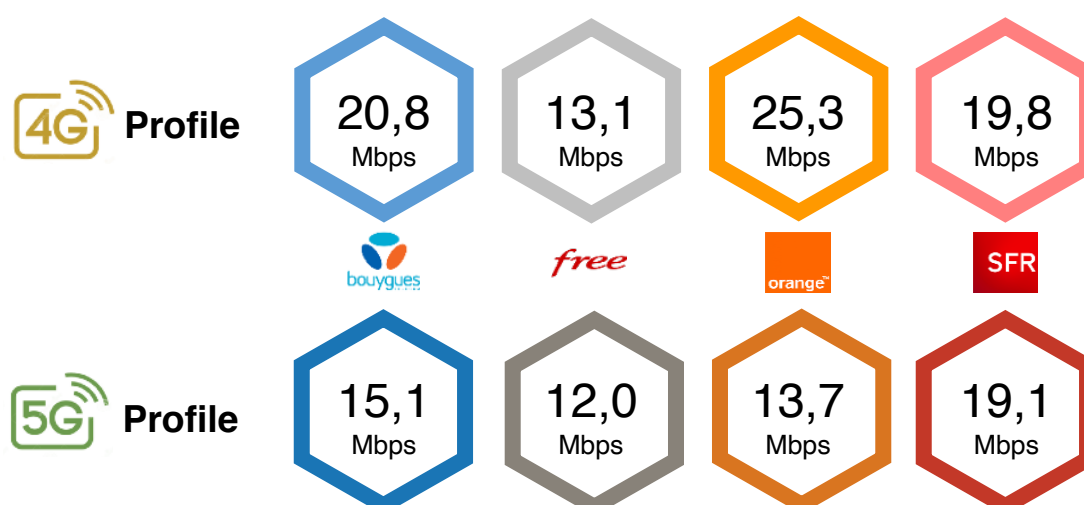
Finding:

Overall, levels of upload speeds measured in the field do not allow a customer to feel the contribution of 5G. The 4G profile even has higher average upload speeds.

Of the 4 operators, **SFR** provides the best average upload speed in 5G. **Free** and **SFR** offer steady performances between 4G and 5G.

- **Bouygues** shows a degradation in average upload speed in 5G.
- **Orange** obtains the best average upload speed in 4G profile (up to 74 Mbps in Nice). In 5G profile, the average UL throughput is up to two times lower than 4G (with an average dropping from 25.3 Mbps to 13.7 Mbps, i.e. half).

Average downlink rates by operator and customer profile



MAXIMUM UPLINK RATES

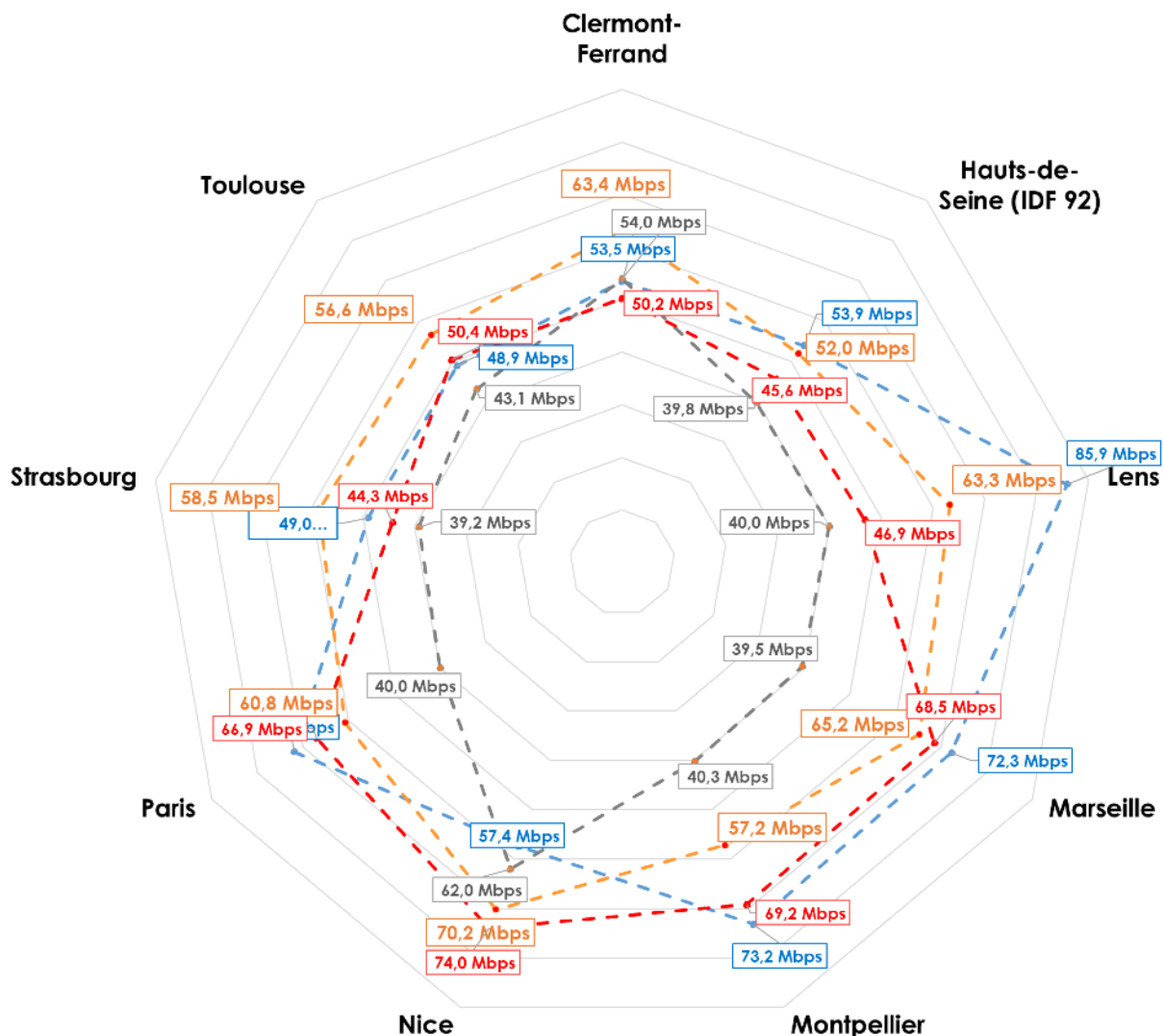
Definition:

Maximum throughput peak observed during the sending of a 50mo file for 10s from the mobile to the server.

Observation:

The maximum upload speed, while not directly representative of the customer experience, provides information on the raw performance achievable today and informs on future progress.

Bouygues has a maximum upload speed of 85.9 Mbps, followed by **SFR** (74Mbps) then **Orange** (70.2Mbps) and finally **Free** (62Mbps).



DATA Results - Web Navigation

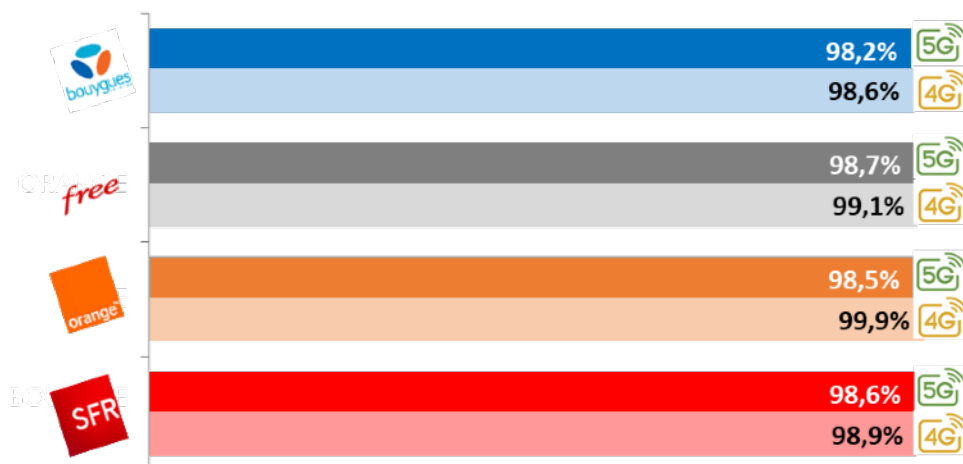
Definition:

Rate of success in displaying a web page within a given time frame.

Finding:

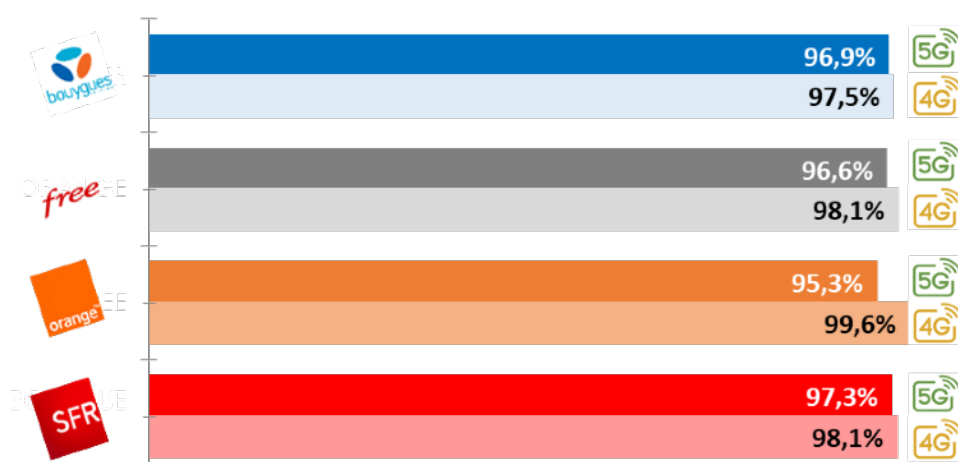
99% of the pages are displayed in less than 10s for the 4 operators in 5G profile.

In 5G option, we detect a slight increase in the rate of failed pages:
 -1.5% of success for Orange against -0.3% for the 3 other operators.



QOS NAVIGATION: WEB PAGES IN < 5 SEC

Overall, and for the 4G customer profile, we note a rate of 98.3% of successful display of web pages in less than 5s, all operators included.
 In 5G profile, the rate increases to 96.5% (+2% of failures on average).



DATA Results - VIDEO Streaming

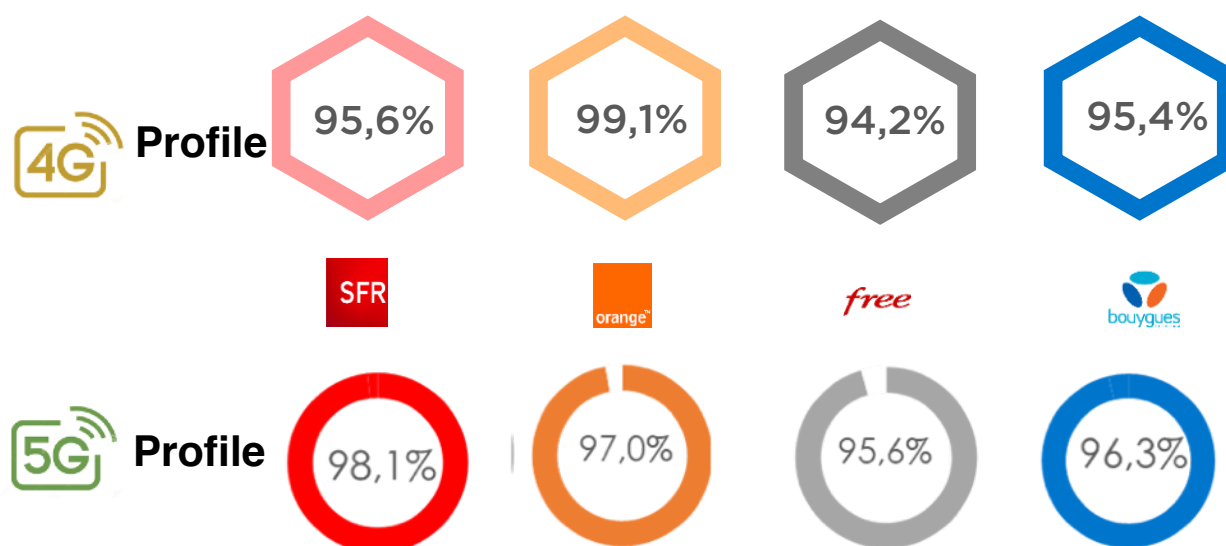
VIDEO STREAMING : QUALITY INDICATORS

Definition:

Viewing at each measurement point of a 2-minute YouTube video, with a qualification of the audio and video quality.

Viewings are considered perfect when no video/audio disturbance is

Successful and perfect Quality Broadcast Rate



Apart from **Orange**, the quality indicator is slightly improved in 5G conditions for all operators.

SFR improves its broadcast rate by 2.5%. **Free** and **Bouygues** gain respectively +1.4%, and +0.9%.

The video resolution in 720px does not allow to effectively discriminate the performance according to the 4G or 5G profile.

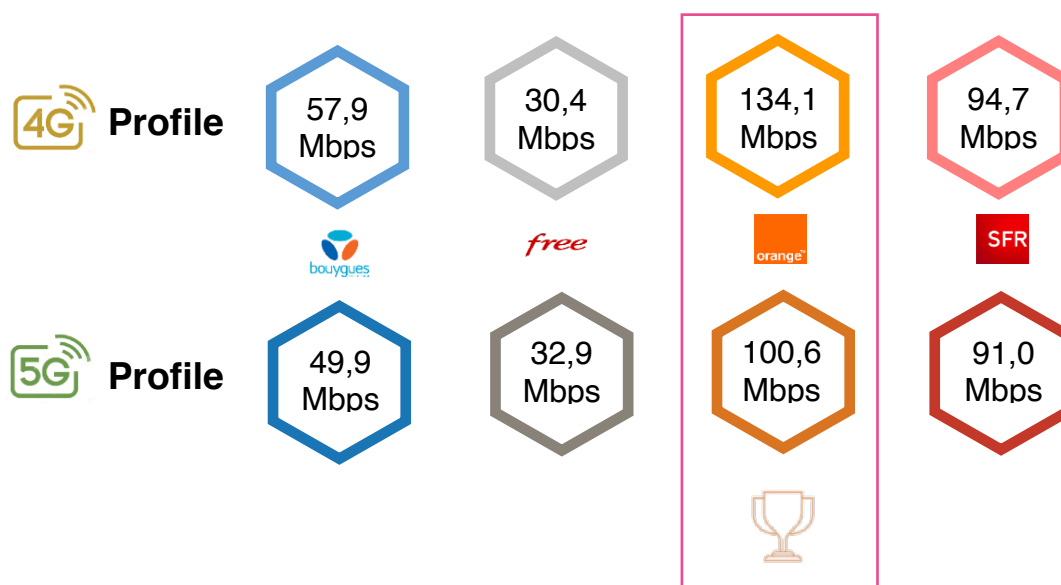


To Go Further

FOCUS BY AGGLOMERATIONS

Clermont Ferrand

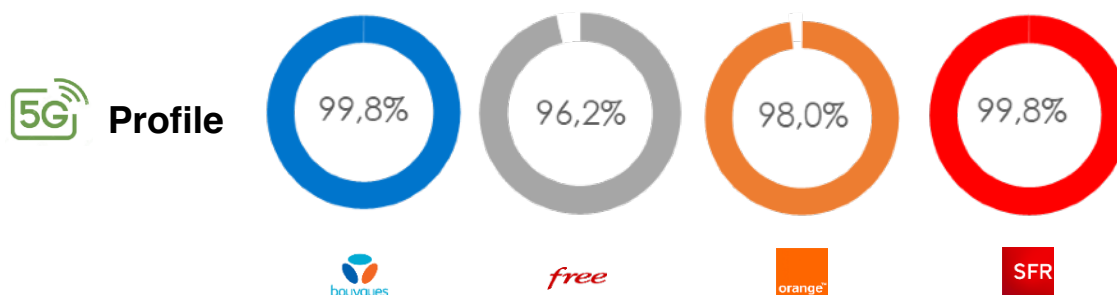
Average downlink rates (DL):



Top débit moyen :

en 4G : 350,3 Mbps
 en 5G : 347,0 Mbps

Web navigation web QoS : page display < 10 seconds

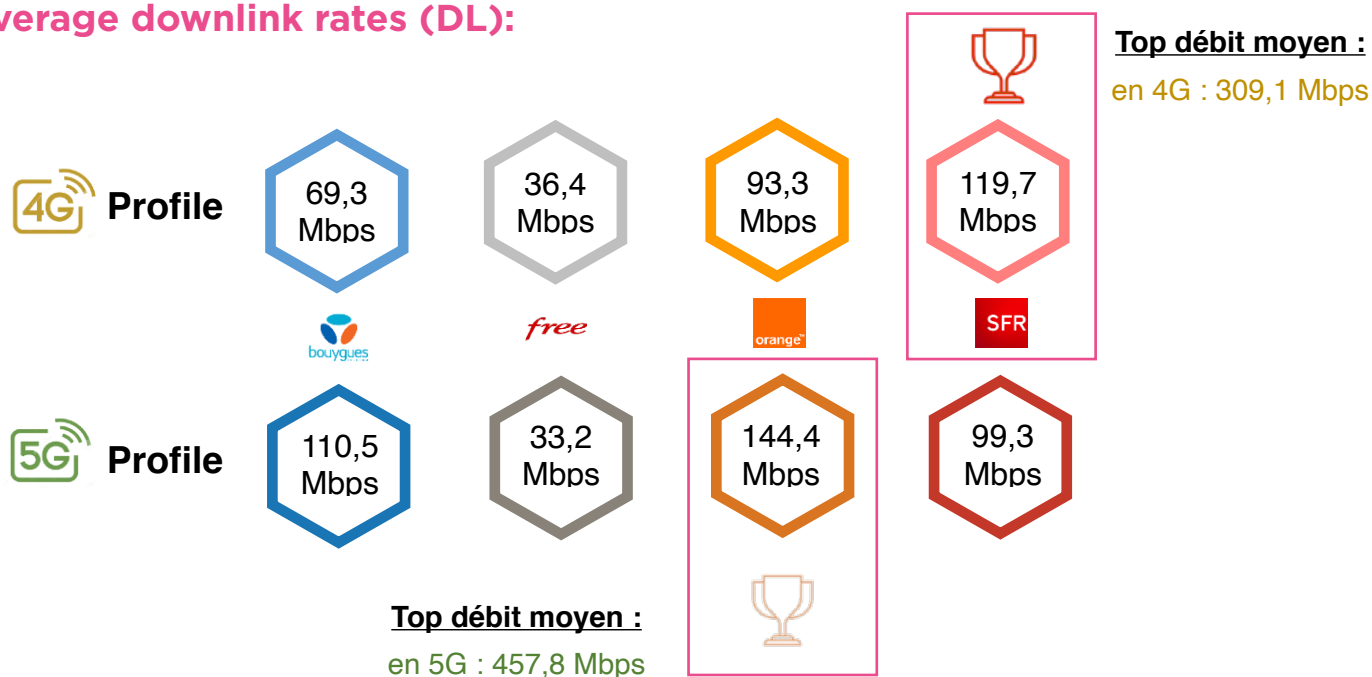


Video streaming QoS: successful and perfect quality broadcasts rate

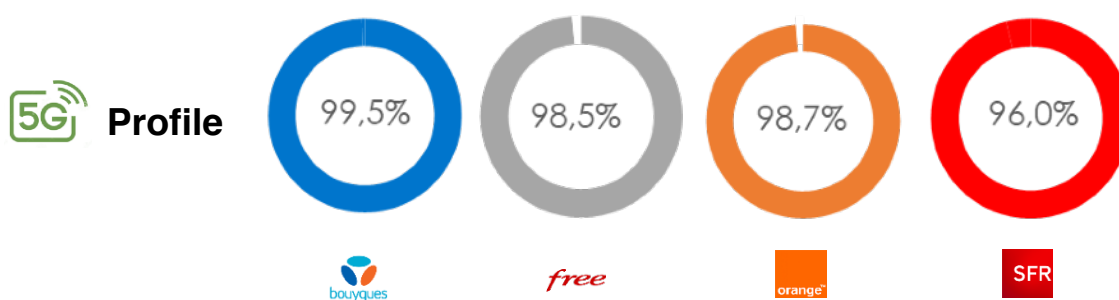


HAUTS-DE-SEINE (IDF 92)

Average downlink rates (DL):



Web navigation web QoS : page display < 10 seconds



Video streaming QoS: successful and perfect quality broadcasts rate

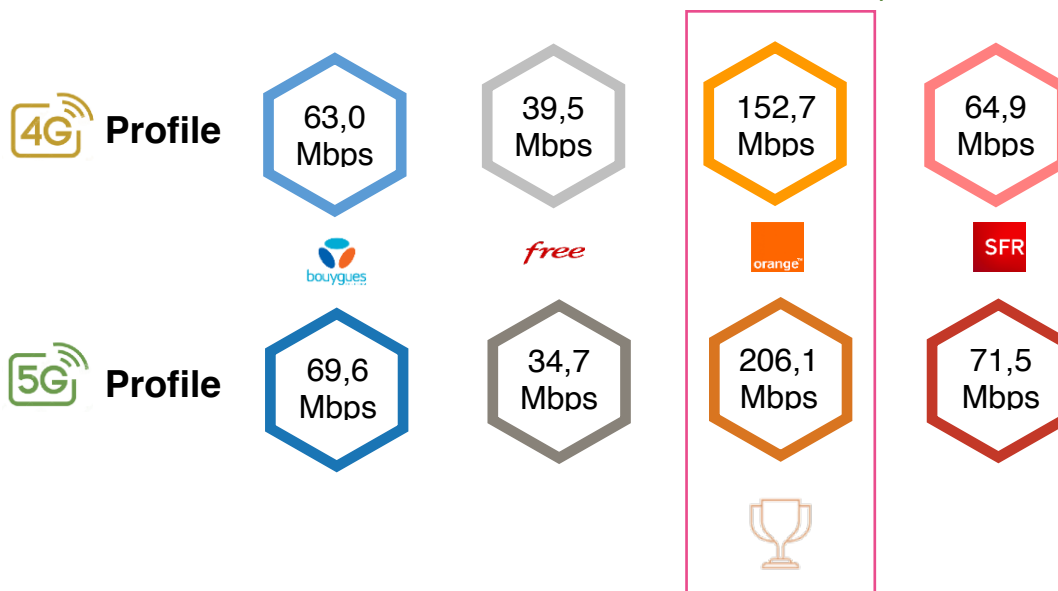


LENS

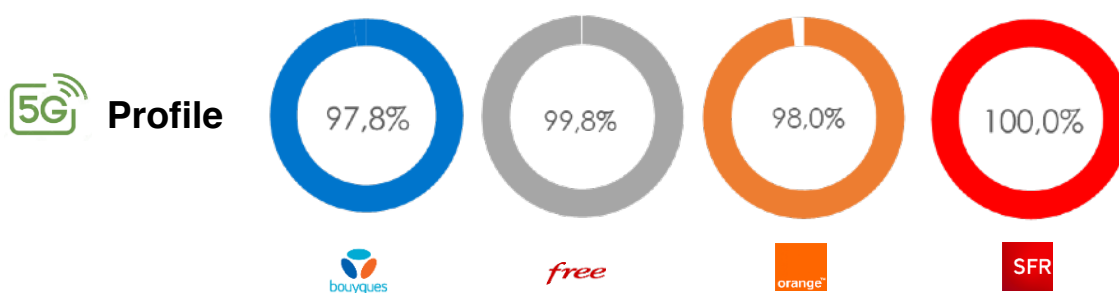
Average downlink rates (DL):

Top débit moyen :

en 4G : 362,6 Mbps
 en 5G : 495,7 Mbps



Web navigation web QoS : page display < 10 seconds



Video streaming QoS: successful and perfect quality broadcasts rate



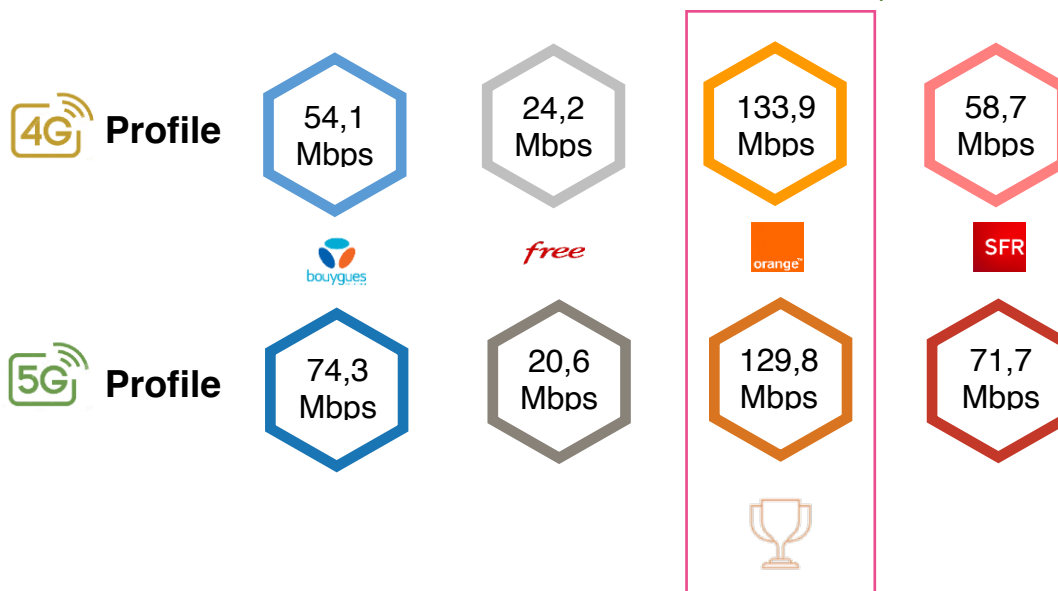
MARSEILLE

Average downlink rates (DL):

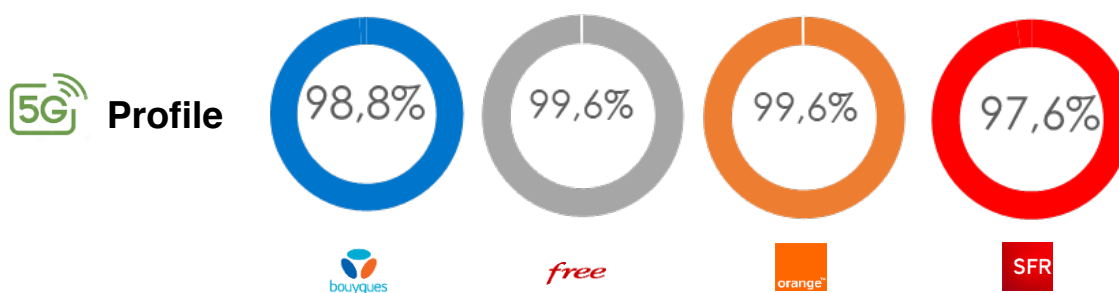
Top débit moyen :

en 4G : 340,4 Mbps

en 5G : 464,4 Mbps



Web navigation web QoS : page display < 10 seconds



Video streaming QoS: successful and perfect quality broadcasts rate



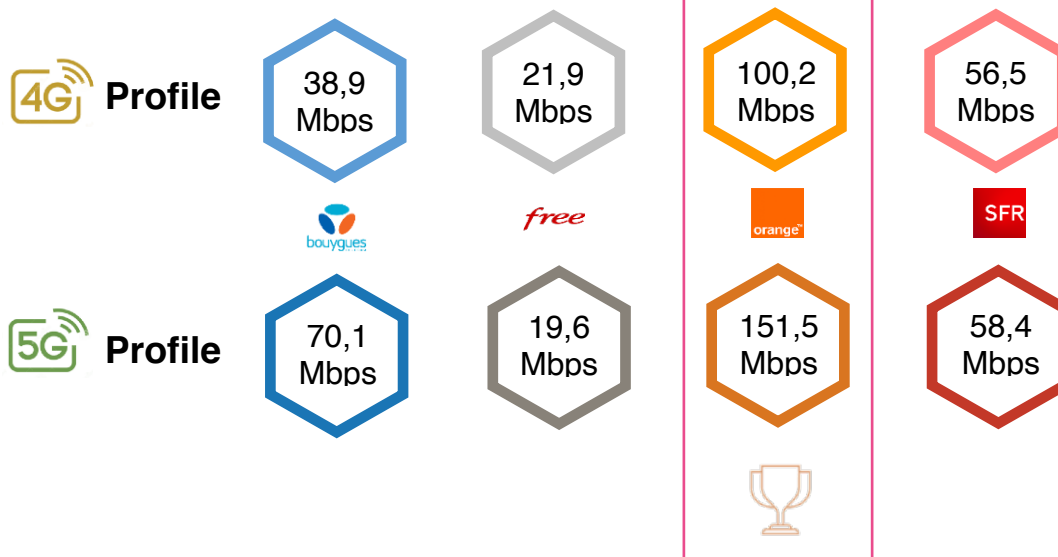
MONTPELLIER

Average downlink rates (DL):

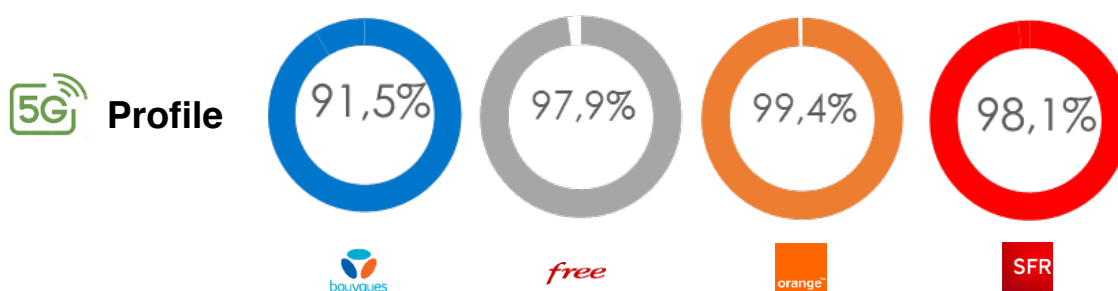
Top débit moyen :

en 4G : 272,9 Mbps

en 5G : 568,4 Mbps



Web navigation web QoS : page display < 10 seconds



Video streaming QoS: successful and perfect quality broadcasts rate

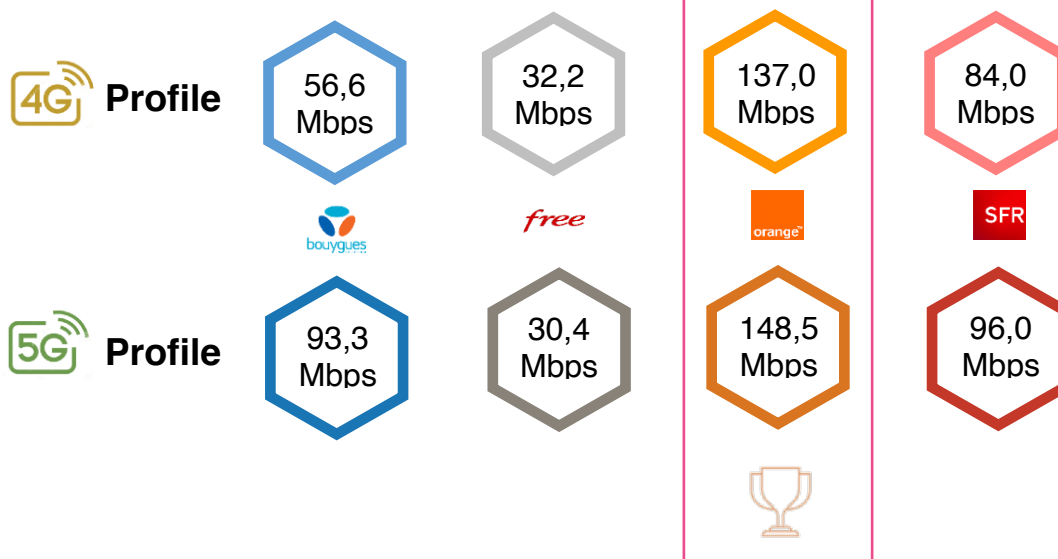


NICE

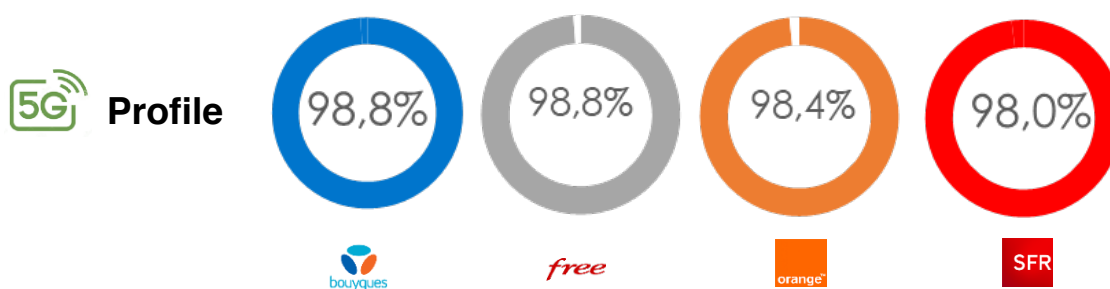
Average downlink rates (DL):

Top débit moyen :

4G : 362,3 Mbps
 5G : 471,6 Mbps



Web navigation web QoS : page display < 10 seconds



Video streaming QoS: successful and perfect quality broadcasts rate



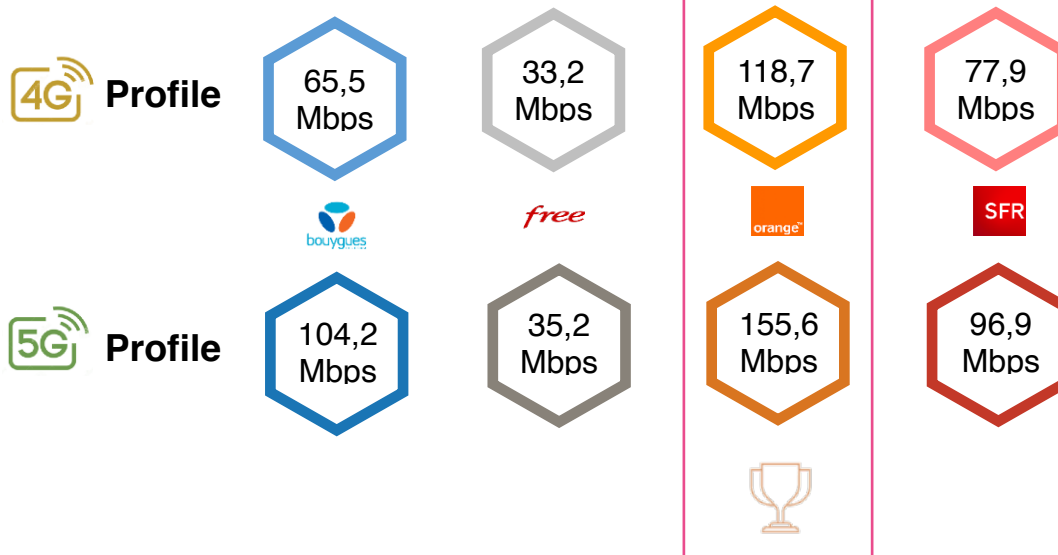
PARIS

Average downlink rates (DL):

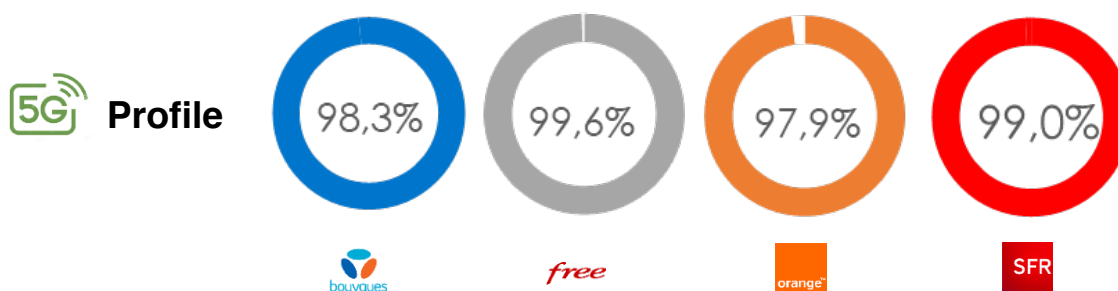
Top débit moyen :

4G : 310,7 Mbps

5G : 546,0 Mbps



Web navigation web QoS : page display < 10 seconds



Video streaming QoS: successful and perfect quality broadcasts rate



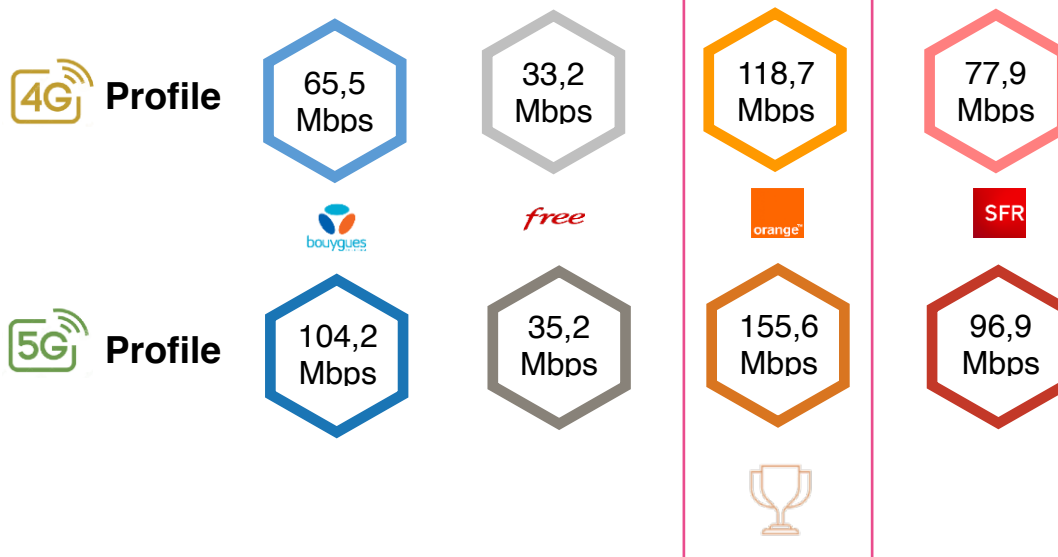
STRASBOURG

Average downlink rates (DL):

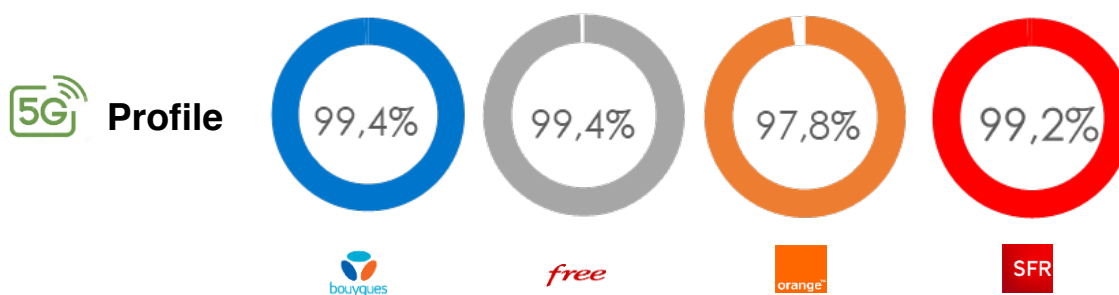
Top débit moyen :

4G : 308,6 Mbps

5G : 508,3 Mbps



Web navigation web QoS : page display < 10 seconds



Video streaming QoS: successful and perfect quality broadcasts rate



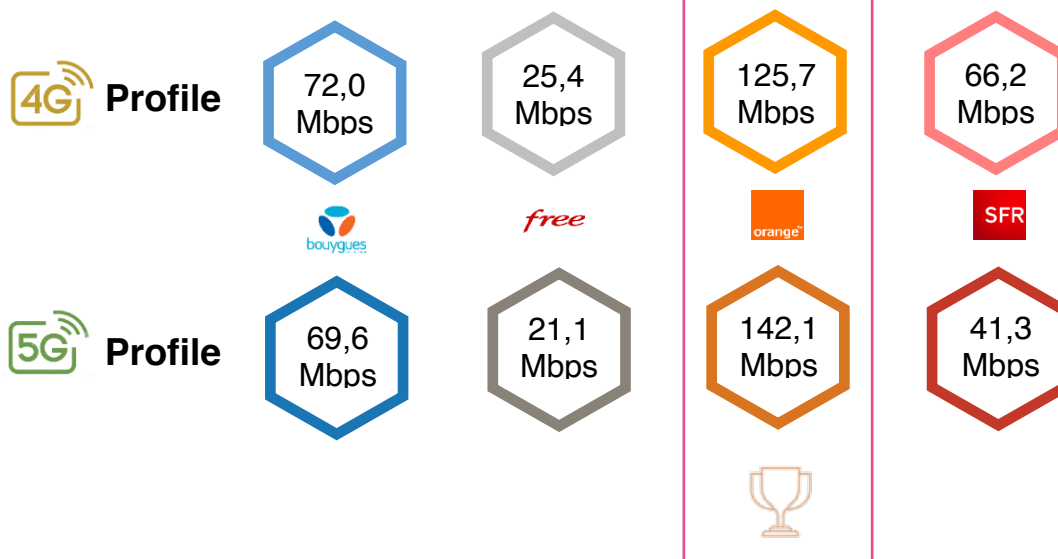
TOULOUSE

Average downlink rates (DL):

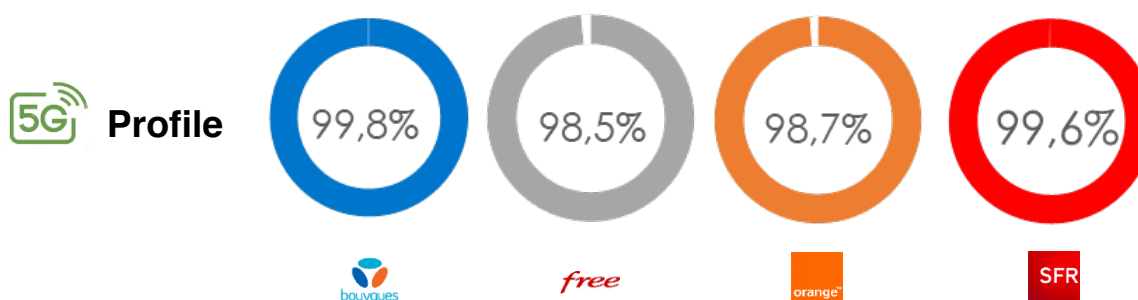
Top débit moyen :

4G : 342,8 Mbps

5G : 527,0 Mbps



Web navigation web QoS : page display < 10 seconds



Video streaming QoS: successful and perfect quality broadcasts rate





MOZARK
EXPERIENCE IS ALL

QoSi by MOZARK is the specialist in QoE/QoS measurement of telecom networks, leader in mobile customer knowledge and crowdsourcing. We capitalize on more than 15 years of expertise and work with numerous operators, equipment manufacturers, regulators and media around the world.

As methods, measurement tools, equipment and uses evolve considerably, we have oriented our development strategy by integrating innovative and disruptive solutions into our offers.

We offer our clients a complete set of solutions for a perfect mastery of the customer experience, with the only global offer on the market:

- ✓ Drive tests
- ✓ Analysis and expertise
- ✓ Measurement tools
- ✓ Crowdsourcing

Our business is changing. With 5Gmark, we are starting its revolution!

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