



# ARCEP experience on QoS for Mobile Systems

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# Agenda



- **Introduction**
- **Mobile QoS obligations**
- **Mobile QoS surveys**
- **Voice survey**
- **Data survey**
- **Geographical perimeter**
- **Results**

# Introduction (1/2)

- **Authorization for the deployment of mobile network were allotted to the operators :**
  - **For 2G networks :**
    - In 1991 to Orange France and SFR
    - In 1994 to Bouygues Telecom
  - **For 3G networks :**
    - In 2001 to Orange France and SFR
    - In 2004 to Bouygues telecom
    - In 2009 to Free Mobile
- **Commercial opening of those networks were done in :**
  - **For 2G networks :**
    - In 1993 for Orange France and SFR
    - In 1996 for Bouygues Telecom
  - **For 3G networks :**
    - In 2004 for Orange France and SFR
    - In 2007 for Bouygues Telecom
    - Planned in 2012 for Free Mobile

# Introduction (2/2)

- **Actual population coverage is :**
  - **Above 98% in 2G for each operator**
  - **In 3G :**
    - **Around 88% for Orange France**
    - **Around 84% for SFR**
    - **Around 80% for Bouygues Telecom**
    - **Planned to be 98% for each operator at the end of 2011**
    - **Planned to be 90% in 2018 for Free Mobile**
- **Spectrum quantity :**

Opérateurs	900 MHz	1800 MHz	2,1 GHz	TOTAL
Orange France	10 MHz duplex	25 MHz duplex	19,6 MHz duplex	54,6 MHz duplex
SFR	10 MHz duplex	25 MHz duplex	19,8 MHz duplex	54,8 MHz duplex
Bouygues Telecom	10 MHz duplex	25 MHz duplex	14,8 MHz duplex	49,8 MHz duplex
Free Mobile	5 MHz duplex	-	5 MHz duplex	10 MHz duplex

# Mobile network operator QoS obligations

- **Mobile network operators (MNO) have some QoS obligations in their 2G and 3G authorizations about :**
  - \_ **Call success rate over 90%**
  - \_ **SMS success rate over 90%**
  - \_ **Internet access success rate over 90%**
  - \_ **File transfer success rate over a specific upload and download speed over 90% (different for each operator)**
- **In 2G those obligations were imposed to the MNO when they were given their authorization**
- **In 3G those obligations were taken by the operators during a beauty contest with QoS criteria**

# Mobile network operator QoS surveys (1/3)

- **Annual QoS surveys are planned in their authorizations :**
  - The first goal of those surveys is to compare the quality and availability of 2G and 3G voice and data services
  - The second goal of those surveys is to verify the MNO obligations
- **A 2G voice service survey is conducted since 1998**
- **In 2006, 3G voice and data services tests were introduced**
- **Since 2006 there is two different survey :**
  - One for voice service
  - One for data services (SMS, MMS, WAP, Visio and FTP)

# Mobile network operator QoS surveys (2/3)

- Each survey is conceived by us, in cooperation with the operators
- Each operator has to pay for the measurement done on its network
- Each survey is conducted by an independent consultant (one for each or one for both)
- Each survey has different phases :
  1. Preparation phase during which all the materials and protocols are being tested by the consultant, that last around 1 month
  2. Field tests made by the consultant, that last around 4 months
  3. Analysis phase during which MNO analyze all the tests and can make comments, that last around 1 month
- At the end, the results are published on the ARCEP website and are relayed in all the media

# Mobile network operator QoS surveys (3/3)

- The total cost of both surveys is around 390 000 €
- Most of this cost, 90%, is paid by the operators
- Rest is paid by ARCEP
- Consultants are usually organize with :
  - One project manager
  - Field test technicians (one or two teams) :
    - A pair : one fix and one mobile, for each network for voice service
    - A single : mobile, for each network for data services
    - Drivers
  - All the tests equipments (mobiles, laptops, GPS, cars, ...)
- One person at ARCEP pilots the survey and is the link between operators and consultants



# Voice service survey (1/4)

- This survey consist of evaluating the audio quality and availability of 2G and 3G voice service on each network
- Tests are conducted on 2G and 3G phones (proportion is given by the MNO based on their voice traffic)
- Tests have to be done manually, meaning the audio quality is evaluated by the investigators
- Length of the calls are 2 or 5 minutes (same number of calls)
- Audio quality is evaluated from the mobile and fix investigator on the following scale :
  - \_ Perfect : Same quality has a fix call (non VoIP)
  - \_ Acceptable : A few imperfections that doesn't bother the understanding
  - \_ Poor : Frequent imperfections that slightly bother the understanding
  - \_ Bad : Many imperfections, no understanding
- Worse of both evaluation is retained

# Voice service survey (2/4)

- **Published indicators are the following :**
  - **Communication success rate : Number of communications that lasted 2 (or 5) minutes on the number total of communication**
  - **Perfect quality communication success rate : Number of communication that lasted 2 (or 5) minutes and that were evaluated “Perfect” on the number total of communication**
  - **Correct quality communication success rate : Number of communication that lasted 2 (or 5) minutes and that were evaluated “Perfect or Acceptable” on the number total of communication**

# Voice service survey (3/4)

- **The geographical perimeter of the survey is :**
  - \_ The 12 most populated cities (Paris, Lyon, Marseille Aix-en-Provence, Toulouse, Bordeaux, Strasbourg, Nantes, Lille, Lens-Douai, Grenoble, Nice-Cannes-Antibes, Toulon)
  - \_ 20 cities among the cities of 50 000 to 400 000 citizens (around 100 in France) pick by ARCEP and the consultant and not given to the operators
  - \_ 20 cities among the cities 10 000 to 50 000 citizens (around 300 in France) pick by ARCEP and the consultant and not given to the operators
- **The 40 cities under 400 000 citizens are pick in order to be distributed in an homogeneous way**
- **On each city, the tests are conducted in several environments :**
  - \_ Pedestrian : indoor and outdoor
  - \_ Incar in the cities
  - \_ Incar on the highways
  - \_ Train (TGV and suburban train in appropriate cities)
- **The tests are conducted on weekdays from 9 am to 9 pm**

# Voice service survey (4/4)

2 or 5 minutes calls	Incar	Pedestrian	
		Outdoor	Indoor
TOP 12	200	400	575
50 00 to 400 000 citizens	150	300	425
10 000 to 50 000 citizens	75	150	225

	TGV	Highways	Suburban trains
2 minutes calls	1500	1000	1000

# Data services survey (1/6)

- This survey consist of evaluating the quality and availability of 2G and 3G data service on each network
- Services tested are : SMS, MMS, WAP, FTP and Visio
- For SMS, MMS and WAP, tests are conducted on 2G and 3G phones (proportion is given by the MNO based on their voice traffic for SMS and data traffic for MMS and WAP)
- For FTP, tests are conducted on 3G key or 3G notebook along with the best internet access plan
- For Visio, tests are naturally conducted on 3G phone
- SMS, MMS and WAP tests have to be done manually, meaning the investigator is sending and receiving SMS and MMR or surfing on a WAP site
- Visio tests have to be done manually, meaning the communication is evaluated by the investigators
- FTP tests have can be done with a specific software

# Data services survey (2/6)

- Tests are conducted on a static way, usually inside a car (except for Visio)
- Each service has it's own protocol :
  - SMS
    - A test consist of sending and receiving a SMS
    - Investigator has the sending and receiving phones
    - Timeout = 2 minutes
    - Sending + receiving delay is measured and published
      - Success rate less than 30 seconds, based on all tests
      - Success rate less than 2 minutes, based on all tests
  - SMS / MMS
    - A test consist of sending and receiving a MMS
    - Investigator has the sending and receiving phones
    - Timeout = 5 minutes
    - Sending + receiving (including downloading) delay is measured and published
      - Success rate less than 30 seconds, based on all tests
      - Success rate less than 2 minutes, based on all tests

# Data services survey (3/6)

## – WAP

- A test consist of a 5 minutes surf on specific WAP sites
- 10 different client path are tested for each operator
- Homepage timeout = 30 seconds
- Interpage timeout = 30 seconds
- Failure when the homepage is on timeout, when the interpage is on timeout and the back feature didn't work or when the surf is block
- Published indicators are :
  - Homepage access success rate, based on all tests
  - 5 minutes surfing success rate, based on all tests

## – Visio

- A test consist of maintaining a communication during 2 minutes
- Audio and video quality are no longer evaluated
- Failure (less than 5 seconds) or cut (during the 2 minutes) are registered
- As well as voice test, they are conducted indoor and outdoor
- Published indicators are :
  - Communication success rate, based on all tests
  - Communication failure rate, based on all tests

# Data services survey (4/6)

## – FTP

- A test consist of a network connection and then the download of a 5 Mo file or the upload of a 1 Mo file from a dedicated server
- Network connection timeout = 1 minute
- Downloading timeout = 5 minutes
- Uploading timeout = 2 minutes
- 1 500 download and 1 500 upload for each operator
- Published indicators are :
  - Network connection success rate in less than 1 minute, based on all tests
  - Network connection success rate in less than 10 seconds, based on all tests
  - Upload and download success rate, based on successful network connection
  - Throughput of the 10%, 50% and 90% download and received files
  - Throughput plots



# Data services survey (5/6)

- **The geographical perimeter of the survey is :**
  - **The 12 most populated cities (Paris, Lyon, Marseille Aix-en-Provence, Toulouse, Bordeaux, Strasbourg, Nantes, Lille, Lens-Douai, Grenoble, Nice-Cannes-Antibes, Toulon)**
  - **20 cities among the cities of 50 000 to 400 000 citizens (around 100 in France) pick by ARCEP and the consultant and not given to the operators**
- **The 20 cities under 400 000 citizens are pick in order to be distributed in an homogeneous way**
- **Those 20 cities won't be the same as the one pick for the voice survey**
- **The tests are conducted on weekdays from 9 am to 9 pm**

# Data services survey (6/6)

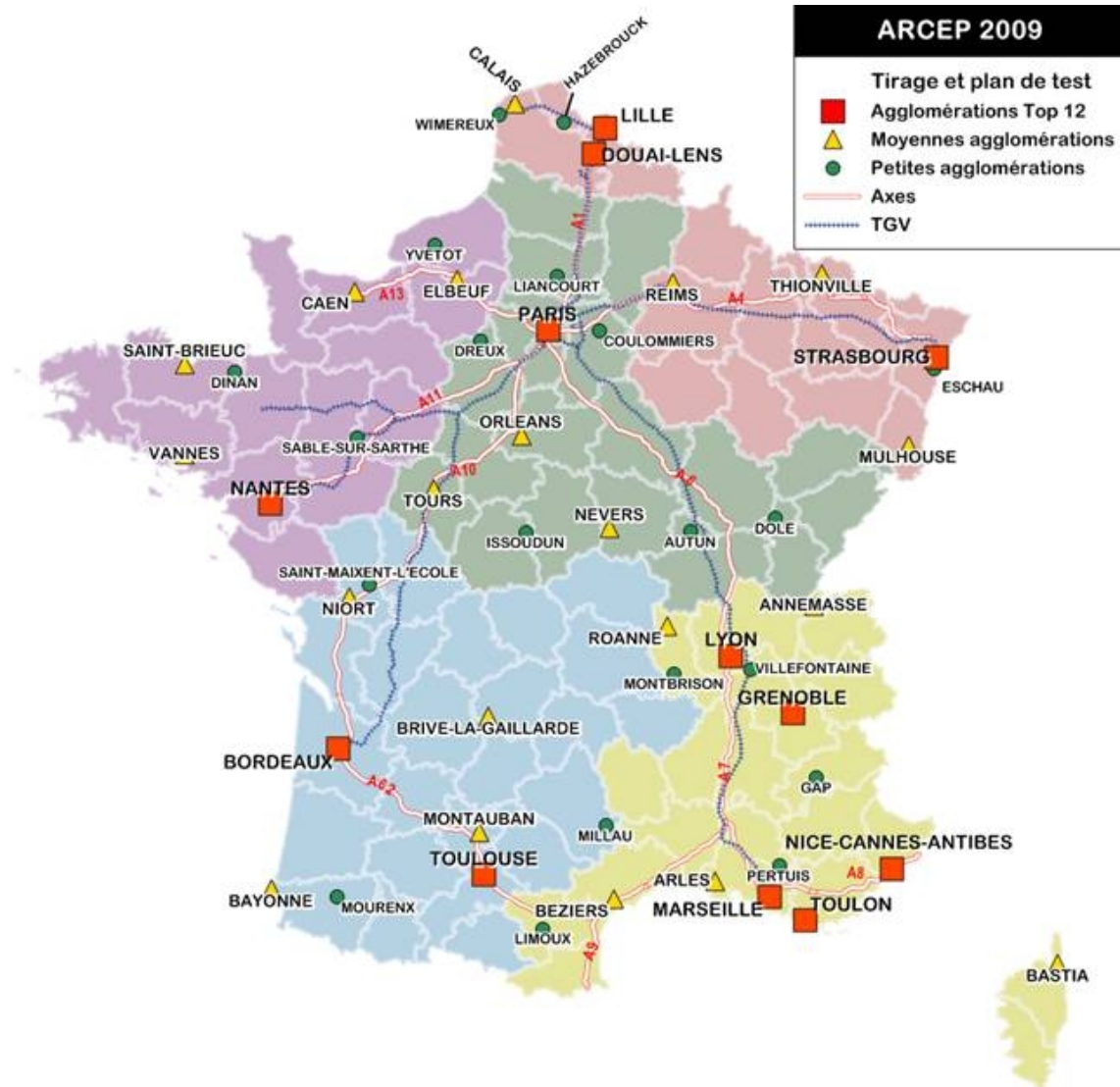
- Number of tests are the following :

Number of tests	SMS	MMS	WAP	FTP	Visio
TOP 12	400	400	800	800 DL 800 UL	250 indoor 250 outdoor
50 000 to 400 000 citizens	350	350	700	700 DL 700 UL	

- In each city, the number of tests is based on the population
- A total of 6 500 calls for each operator
- Terminals used for SMS, MMS, WAP and Visio the survey :
  - \_ Each operator give the 3 most 2G and 2G sold terminals in the last 6 months
  - \_ During the preparation phase, the consultant is testing on laboratory and on the field, each terminals on its technical and ergonomic performances
  - \_ Based on those tests, ARCEP choose the 2G and 3G (only one compatible with every service) terminal that will be used for each operator (most of the time the most sold)
- Terminal used for FTP is the most sold in the last 6 months along with the best internet access plan

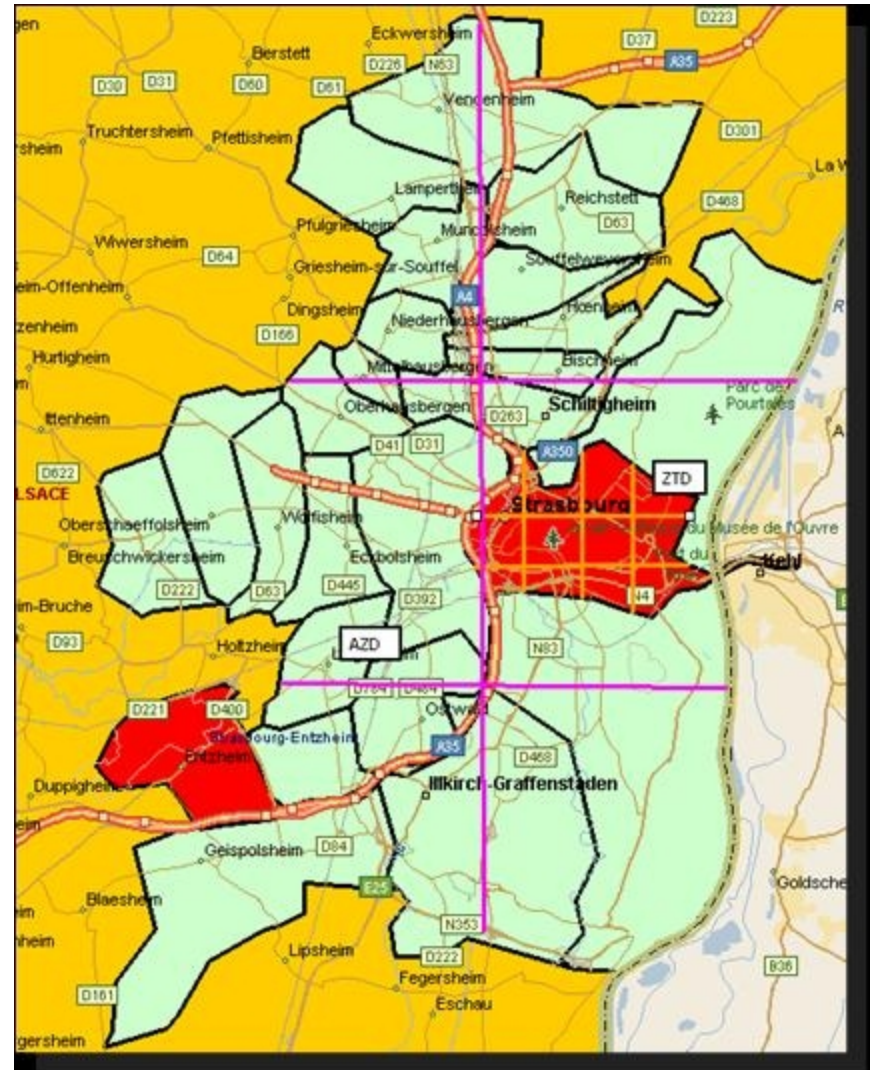
# Geographical perimeter (1/2)

- Map of the cities of the Voice service survey 2009



# Geographical perimeter (2/2)

- Repartition of the measurement points in each city
- Two zone for each city :
  - Very dense zones (red zone)
  - Other dense zones (green zone)
- Squaring in each city is made in order to have one measurement point by square
- This able to have an homogeneous repartition of the measurement points inside each city



# Results

- The methodology and results are published every year on the ARCEP website
- Published results are based on the indicators described above
- For each indicator voice or data, except FTP, the mean of the rate of the 3 operators is published and each operator is compared to this mean. His grade will range from “--” (less than 4% under the mean) to “++”(more than 4% above the mean)
- For FTP, individual results are still published
- For each indicator the results are compared with the year before and if the difference is significant an up or down arrow will be noted. The determination of “significant” is based on a specific formula

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# Voice 2008 results

- All cities (above 20 000 citizens)

Ensemble des agglomérations de plus de 20 000 habitants 6237 mesures par réseau	Moyenne mesurée	Orange France	SFR	Bouygues Telecom
Taux de communications réussies et maintenues 2 minutes <i>Précision statistique</i>	98% ± 0.22%	=	=	=
Taux de communications réussies, maintenues 2 minutes et de qualité parfaite <i>Précision statistique</i>	95% ± 0.30% (↗)	= (↗)	= (↗)	= (↗)
Taux de communications réussies, maintenues 2 minutes et de qualité correcte <i>Précision statistique</i>	97% ± 0.25%	=	=	=
Ecart heure pleine / heure creuse (taux de communications réussies et maintenues) <i>Précision statistique</i>	0.3% ± 0.13%	=	=	=

# Voice 2008 results

- **TOP 12 (above 400 000 citizens)**

Les 12 plus grandes agglomérations 3076 mesures par réseau	Moyenne mesurée	Orange France	SFR	Bouygues Telecom
Taux de communications réussies et maintenues 2 minutes  <i>Précision statistique</i>	<b>98%</b>  ± 0.28%	=	=	=
Taux de communications réussies, maintenues 2 minutes et de qualité parfaite  <i>Précision statistique</i>	<b>96%</b>  ± 0.42% (↗)	=	+  (↗)	=  (↗)
Taux de communications réussies, maintenues 2 minutes et de qualité correcte  <i>Précision statistique</i>	<b>97%</b>  ± 0.33%	=	=	=  (↗)
Ecart heure pleine / heure creuse (taux de communications réussies et maintenues)  <i>Précision statistique</i>	<b>0.2%</b>  ± 0.17%	=	=	=



# Voice 2008 results

- TGV :**

TGV 1674 mesures par réseau	Moyenne mesurée	Orange France	SFR	Bouygues Telecom
Taux de communications réussies et maintenues 2 minutes  <i>Précision statistique</i>	<b>72%</b>  ± 1.24%	++ (↗)	=	--
Taux de communications réussies, maintenues 2 minutes et de qualité parfaite  <i>Précision statistique</i>	<b>66%</b> (↗) ± 1.31%	+ (↗)	=	- (↗)
Taux de communications réussies, maintenues 2 minutes et de qualité correcte  <i>Précision statistique</i>	<b>69%</b> ± 1.28%	++ (↗)	= (↘)	- (↗)

# Data 2008 results

- FTP connection and DL :

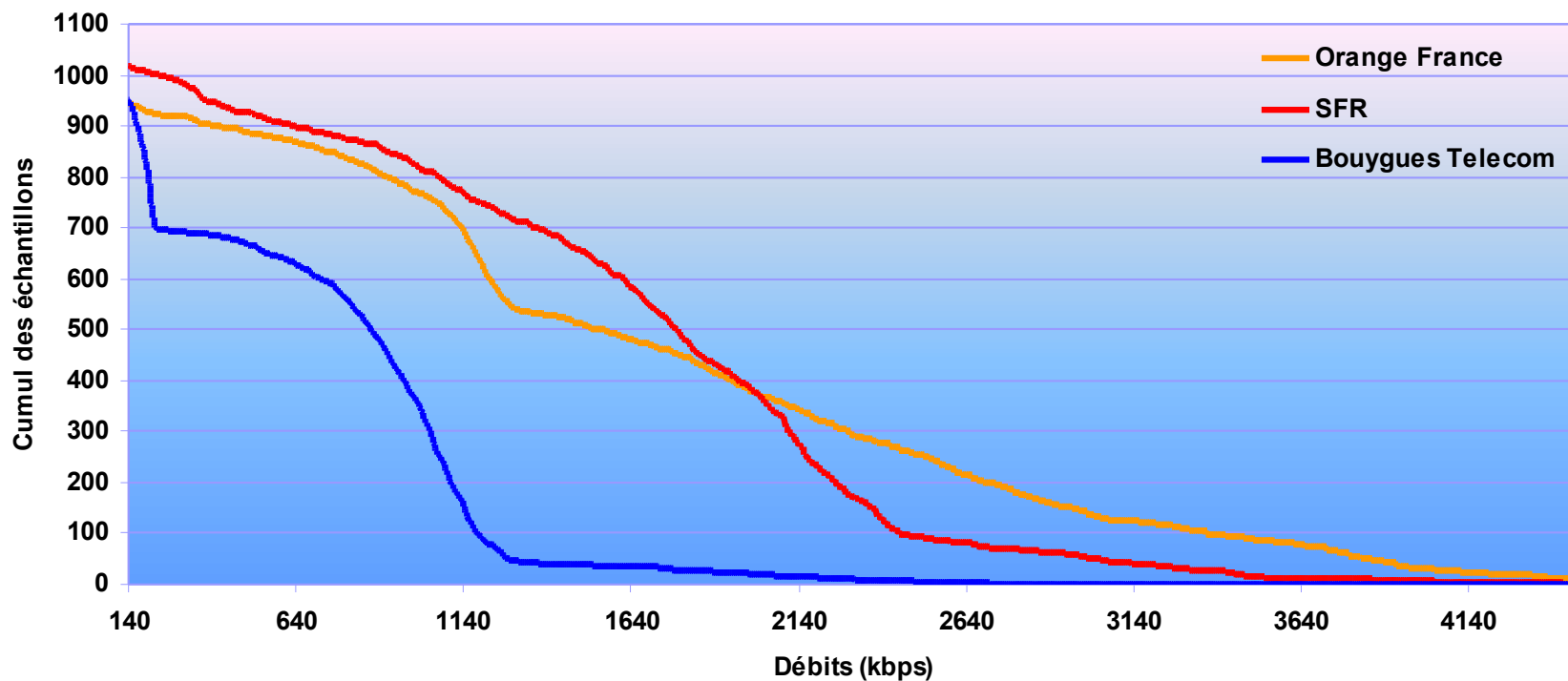
Connexion 2103 mesures par réseau	Moyenne mesurée	Orange France*	SFR**	Bouygues Telecom***
Taux de connexions réussies	99.9% ↗	= ↗	=	= ↗
<i>Précision statistique</i>	± 0.08%			
Taux de connexions réussies dans un délai de 10 secondes	99.5% ↗	= ↗	= ↗	= ↗
<i>Précision statistique</i>	± 0.18%			

Téléchargement de fichiers de 5 Mo 1044 mesures par réseau	Orange France	SFR	Bouygues Telecom
Taux de fichiers de 5 Mo reçus	90.6% ↘	97.3% ↗	91.1% ↗
<i>Précision statistique</i>	± 1.77%	± 0.98%	± 1.73%
Débit de données atteint pour 90% des fichiers reçus*	720 Kbps ± 37.8	549 Kbps ± 20.7	184 Kbps ± 2.9
Débit de données atteint pour 50% des fichiers reçus*	1682 Kbps ± 32.6	1756 Kbps ± 43.0	891 Kbps ± 24.9
Débit de données atteint pour 10% des fichiers reçus*	3398 Kbps ± 53.4	2426 Kbps ± 41.4	1186 Kbps ± 25.0

# Data 2008 results

- FTP DL :

Répartition des débits en sens descendant (download)



# Data 2008 results

- **FTP UL :**

Envoi de fichiers de 1 Mo 1059 mesures par réseau	Orange France	SFR	Bouygues Telecom
Taux de fichiers de 1 Mo reçus	<b>93.8%</b>	<b>98.1%</b>	<b>86.9%</b>
<i>Précision statistique</i>	± 1.46%	± 0.82% ↗	± 2.03% ↗
Débit de données atteint pour 90% des fichiers reçus*	<b>181 Kbps</b>	<b>287 Kbps</b>	<b>86 Kbps</b>
<i>Précision statistique</i>	± 6.5	± 12.6	± 1.3
Débit de données atteint pour 50% des fichiers reçus*	<b>454 Kbps</b>	<b>485 Kbps</b>	<b>315 Kbps</b>
<i>Précision statistique</i>	± 8.8	± 8.8	± 7.0
Débit de données atteint pour 10% des fichiers reçus*	<b>691 Kbps</b>	<b>650 Kbps</b>	<b>464 Kbps</b>
<i>Précision statistique</i>	± 11.8	± 8.5	± 10.2

# Data 2008 results

- FTP UL :

Répartition des débits en sens montant (upload)

