

Audit Report.

Mobile Performance Italy, Q4 2020





Measurement Overview

umlaut has tested and measured the performance of its voice and data services on smartphones in comparison to other LTE/UMTS/GSM mobile radio networks in metropoli-
tan and rural areas of Italy.
The audit was done as a performance benchmark performed by umlaut between 07.11.2020 and 14.12.2020 in cities and towns as well as on connection roads. Dedicated measurements have been executed as drive tests outdoors using a Samsung Galaxy S10 Cat20 2000/150 Mbps and Samsung Galaxy S20+ Cat20 2000/200 Mbps; 5G (5+ Gbps DL) Smartphone.

All data measurements have been performed in 4G pre-ferred mode and 5G preferred mode. Voice measurements have been done in 4G/4G preferred mode on both sides, while call origin has been alternated.
The following pages provide a comparative overview about the performance results observed for the different tested service types.



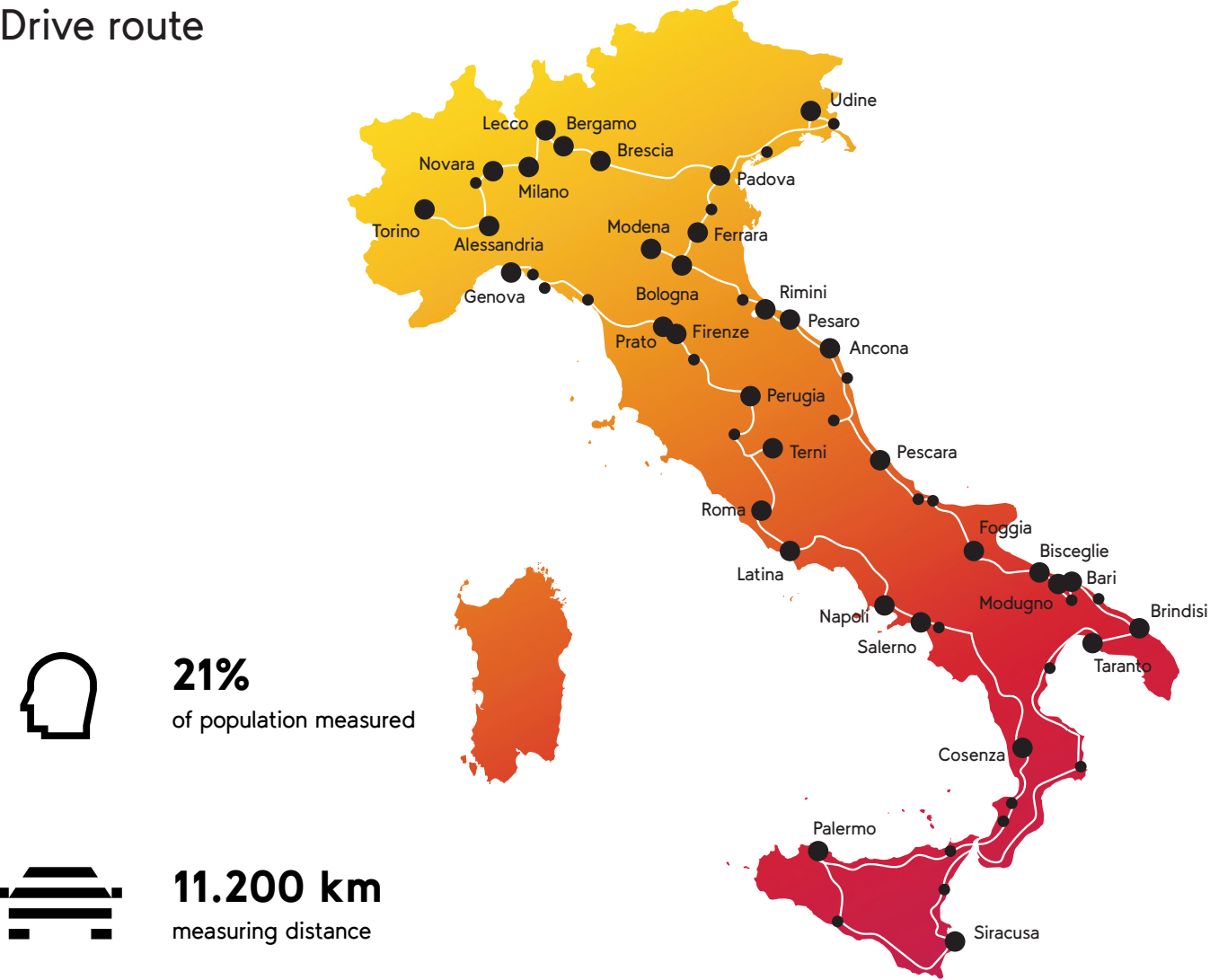
Measurement setup

Drivetest	Voice	Data
Device	Samsung Galaxy S10	System 1 in 4G pref. — S10 G973F (4G) System 2 in 5G pref. — S20+ G986B (5G)
Test Cases	Mobile-to-Mobile (M2M) Channel1: Side1 (VoLTE) to Side2 (VoLTE) 115 sec call window 70 sec call duration 15 sec call setup timeout Multi-RAB traffic injection on both sides	Data 4G preferred CA, Data 5G preferred HTTP DL datastream 7s HTTP UL datastream 7s HTTP 5MB DL fixed file transfer HTTP 2.5MB UL fixed file transfer Web Browsing 10 Live web pages 3 YouTube HD video ~ 45s
Mobility and Route Types	Drivetest 58% in Cities, 12% in Towns and 30% on Roads	
Samples	~7000 per Operator	~ 74,000 per Operator
Dates	31 drive test measurement days 07.11.2020 – 14.12.2020	



Testing area

Drive route



21%
of population measured



11.200 km
measuring distance



Methodology

The leader in mobile benchmarking, umlaut, has analyzed the mobile networks of Italy with regards to mobile network performance. We measure smartphone voice and data performance based on extensive drivetests – from major metropolitan areas to smaller cities and connection roads.

We objectively define the routes and test methodology and publish the results through certificates or public benchmark reports.

As the de-facto industry standard, our benchmarking methodology focuses on customer-perceived network quality and covers a wide range of mobile services.

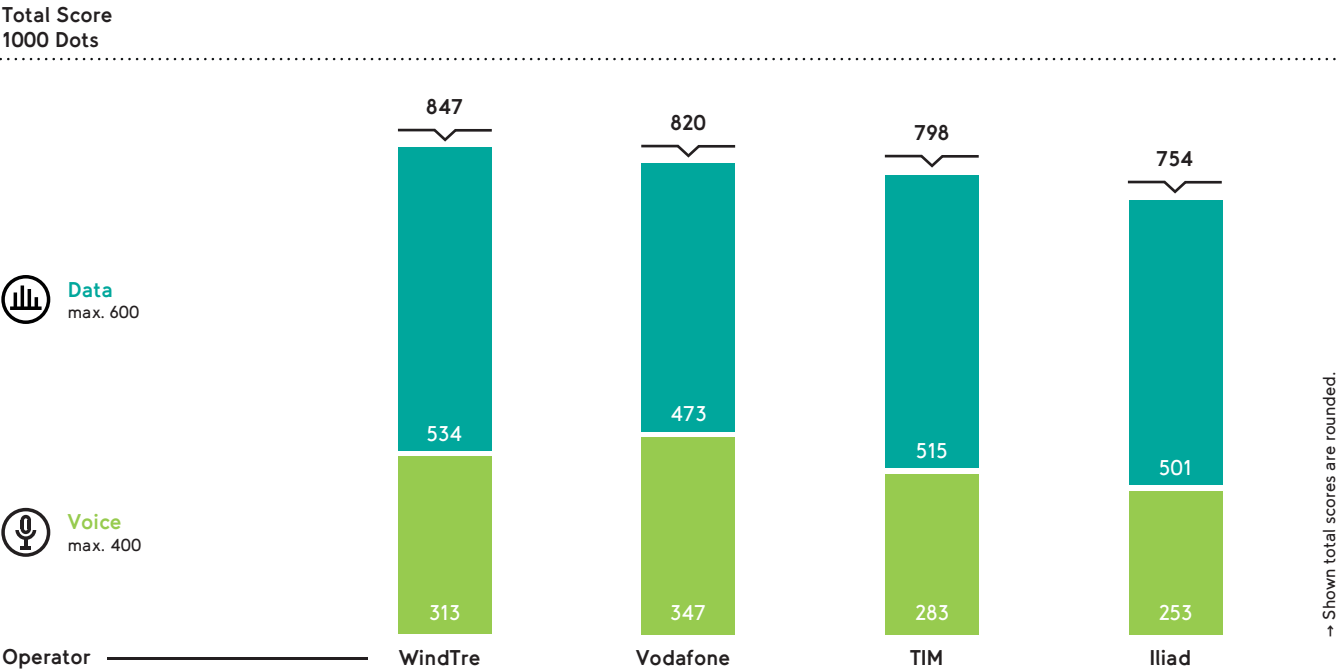
Today, more than 200 mobile networks in more than 120 countries are being evaluated by our unique scoring methodology. It allows a technical analysis that is unpre-

cedented in its level of detail and enables comparisons between the network performance and capability of each mobile network. Our public benchmarks as well as the certificate benchmarks help network operators to demonstrate how well they are delivering wireless connections to consumers, business users and enterprises and reveals the areas of improvement.



Score and breakdown

WindTre achieved the highest overall score among competitors with 847 dots out of 1000.



Overall score considering Voice and Data.



Total score

		WindTre	Vodafone	TIM	Iliad
Voice	max. 400	313	347	283	253
Cities Drivetest	240	82%	89%	72%	65%
Towns Drivetest	80	81%	91%	81%	63%
Roads Drivetest	80	64%	76%	57%	59%
Data	max. 600	534	473	515	501
Cities Drivetest	360	90%	79%	87%	83%
Towns Drivetest	120	88%	76%	87%	84%
Roads Drivetest	120	87%	82%	82%	84%
Total	1000	847	820	798	754

Shown scores are rounded.



Achieved percentage of the maximum score in each of the different data services.

Data	Service Group	max	WindTre	Vodafone	TIM	Iliad
Cities	Web Browsing	90,0	95%	95%	95%	92%
	File Download	90,0	89%	80%	83%	80%
	File Upload	90,0	87%	84%	83%	74%
	YouTube	90,0	89%	55%	86%	87%
Towns	Web Browsing	30,0	92%	95%	96%	90%
	File Download	30,0	87%	79%	78%	80%
	File Upload	30,0	86%	83%	84%	75%
	YouTube	30,0	85%	47%	89%	89%
Roads	Web Browsing	30,0	90%	92%	90%	88%
	File Download	30,0	91%	85%	80%	88%
	File Upload	30,0	85%	83%	80%	77%
	YouTube	30,0	82%	68%	79%	84%



KPI overview

Voice

The following table indicates the achieved values of all networks under test in each of the relevant Voice Key Performance Indicators (KPIs) for the geographical categories "Cities", "Towns" and "Roads".

Voice	Service Group	Unit	WindTre	Vodafone	TIM	Iliad
Cities	Qualifier	[%]	98,2	99,3	98,1	98,6
	Call Setup Time	[s]	3,4	3,2	3,7	6,3
	Call Setup Time (P90)	[s]	3,8	3,7	6,7	8,1
	Speech Quality (AVG)	[MOS–LQO]	4,3	4,4	4,2	3,8
	Speech Quality (P10)	[MOS–LQO]	3,5	3,7	3,4	3,2
	Multirab connectivity	[%]	100,0	100,0	99,1	94,9
Towns	Qualifier	[%]	98,0	99,6	99,6	98,1
	Call Setup Time	[s]	3,4	3,2	3,7	5,8
	Call Setup Time (P90)	[s]	3,8	3,7	6,6	7,8
	Speech Quality (AVG)	[MOS–LQO]	4,3	4,4	4,2	3,8
	Speech Quality (P10)	[MOS–LQO]	3,5	3,6	3,5	3,3
	Multirab connectivity	[%]	99,6	99,0	99,7	95,0
Roads	Qualifier	[%]	92,3	95,4	92,8	95,1
	Call Setup Time	[s]	3,7	3,4	3,8	5,9
	Call Setup Time (P90)	[s]	4,3	4,0	6,8	8,0
	Speech Quality (AVG)	[MOS–LQO]	4,1	4,2	4,1	3,8
	Speech Quality (P10)	[MOS–LQO]	3,1	3,3	3,1	3,3
	Multirab connectivity	[%]	99,3	97,9	97,9	94,9



Data

The following table indicates the achieved values of all networks under test in each of the relevant Data Key Performance Indicators (KPIs) for the geographical category "Cities".

Data Cities	KPI Name	Unit	WindTre	Vodafone	TIM	Iliad
HTTP Live Page DL Smartphone	Qualifier	[%]	99,7	99,8	99,7	99,8
	Overall Session Time	[s]	1,1	1,1	1,1	1,4
HTTP Static Page DL Smartphone	Qualifier	[%]	99,8	99,5	99,8	98,6
	Overall Session Time	[s]	1,3	1,4	1,3	1,6
HTTP 5MB DL Smartphone	Qualifier	[%]	99,9	98,5	99,6	100,0
	Average Session Time	[s]	1,8	2,5	2,4	3,2
	90% faster than	[Mbit/s]	14,3	10,4	10,2	8,3
	10% faster than	[Mbit/s]	111,0	85,5	94,8	51,3
HTTP 2500KB UL Smartphone	Qualifier	[%]	99,8	99,7	99,7	99,8
	Average Session Time	[s]	1,7	1,9	2,1	3,1
	90% faster than	[Mbit/s]	9,2	6,9	5,7	3,9
	10% faster than	[Mbit/s]	30,3	35,0	36,3	18,6
HTTP DL FDTT	Qualifier	[%]	99,8	99,8	99,6	99,8
	Average Data Rate	[Mbit/s]	85,1	75,5	75,9	44,3
	90% faster than	[Mbit/s]	19,5	9,8	10,2	15,1
	10% faster than	[Mbit/s]	174,3	172,1	156,0	75,6
HTTP UL FDTT	Qualifier	[%]	99,7	99,7	99,6	99,4
	Average Data Rate	[Mbit/s]	32,3	27,4	26,9	14,3
	90% faster than	[Mbit/s]	10,6	7,5	6,0	3,5
	10% faster than	[Mbit/s]	52,3	50,9	49,2	24,2
YouTube	Qualifier	[%]	99,1	93,3	98,6	98,9
	Start Time	[s]	1,3	1,8	1,2	1,5
	AVG Resolution	[p]	918	815	913	916
YouTube Live Smartphone	Qualifier	[%]	98,9	95,3	98,3	98,7
	Start Time	[s]	1,5	1,7	1,4	1,6
	AVG Resolution	[p]	1036	880	1032	1033



Data

The following table indicates the achieved values of all networks under test in each of the relevant Data Key Performance Indicators (KPIs) for the geographical category “Towns”.

Data Towns	KPI Name	Unit	WindTre	Vodafone	TIM	Iliad
HTTP Live Page DL Smartphone	Qualifier	[%]	99,2	99,8	99,9	99,6
	Overall Session Time	[s]	1,2	1,2	1,2	1,4
HTTP Static Page DL Smartphone	Qualifier	[%]	99,3	99,9	99,8	98,6
	Overall Session Time	[s]	1,4	1,4	1,3	1,7
HTTP 5MB DL Smartphone	Qualifier	[%]	99,8	100,0	99,2	99,7
	Average Session Time	[s]	1,9	3,0	2,6	3,0
	90% faster than	[Mbit/s]	12,9	7,6	9,2	9,0
	10% faster than	[Mbit/s]	107,8	72,7	70,1	60,5
HTTP 2500KB UL Smartphone	Qualifier	[%]	99,7	99,8	100,0	99,8
	Average Session Time	[s]	1,7	2,2	2,0	3,2
	90% faster than	[Mbit/s]	9,4	6,2	6,0	3,6
	10% faster than	[Mbit/s]	29,8	32,6	35,6	22,7
HTTP DL FDTT	Qualifier	[%]	99,7	99,6	99,7	99,4
	Average Data Rate	[Mbit/s]	85,5	45,8	46,1	51,9
	90% faster than	[Mbit/s]	18,4	8,1	9,6	18,1
	10% faster than	[Mbit/s]	175,8	105,4	95,3	96,4
HTTP UL FDTT	Qualifier	[%]	99,8	99,4	99,9	99,1
	Average Data Rate	[Mbit/s]	29,1	23,8	24,9	17,4
	90% faster than	[Mbit/s]	9,3	7,3	6,8	3,9
	10% faster than	[Mbit/s]	51,1	48,3	47,1	38,9
YouTube	Qualifier	[%]	98,6	92,9	99,3	99,2
	Start Time	[s]	1,3	1,7	1,3	1,5
	AVG Resolution	[p]	917	827	915	918
YouTube Live Smartphone	Qualifier	[%]	97,3	89,3	98,4	99,0
	Start Time	[s]	1,5	1,7	1,5	1,7
	AVG Resolution	[p]	1034	916	1034	1035



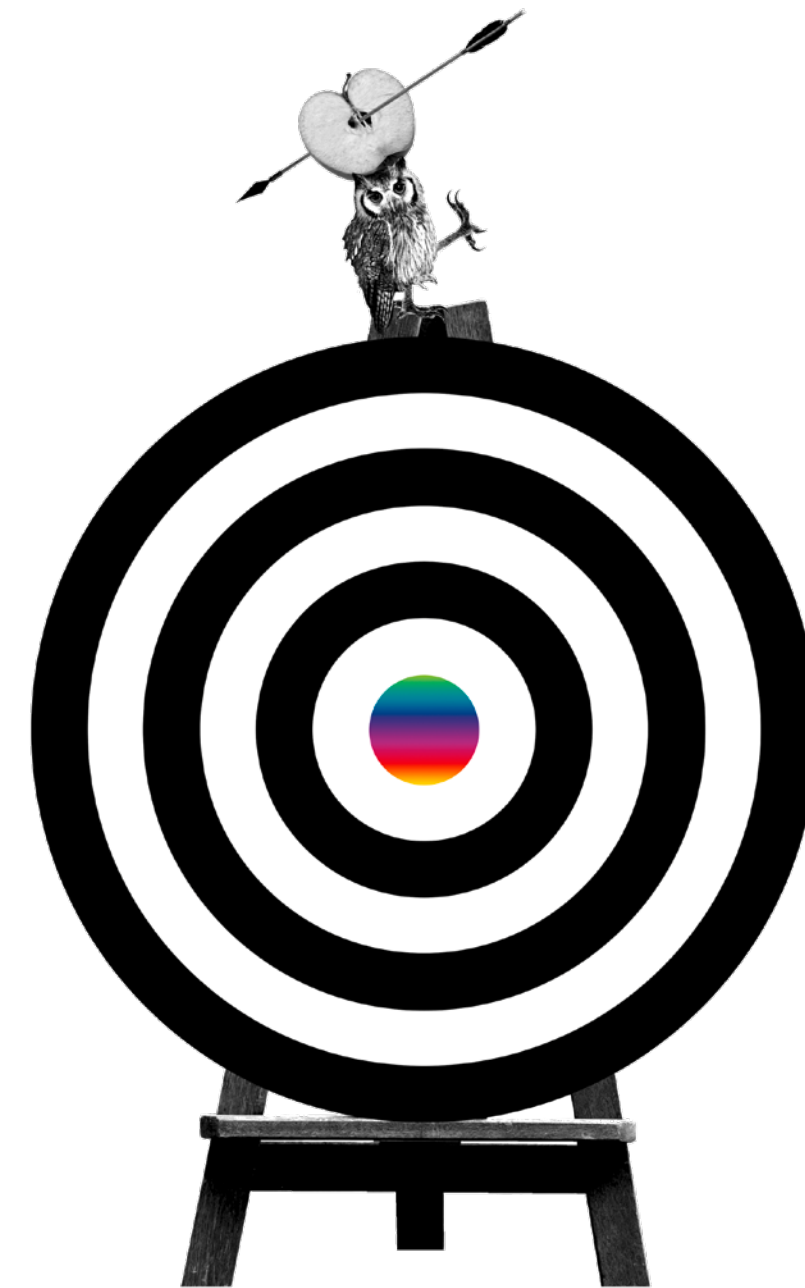
The following table indicates the achieved values of all networks under test in each of the relevant Data Key Performance Indicators (KPIs) for the geographical category “Roads”.

Data Roads	KPI Name	Unit	WindTre	Vodafone	TIM	Iliad
HTTP Live Page DL Smartphone	Qualifier	[%]	98,5	98,9	98,3	98,4
	Overall Session Time	[s]	1,4	1,3	1,3	1,5
HTTP Static Page DL Smartphone	Qualifier	[%]	98,2	98,6	98,3	97,5
	Overall Session Time	[s]	1,5	1,5	1,6	1,7
HTTP 5MB DL Smartphone	Qualifier	[%]	99,0	99,0	98,5	98,8
	Average Session Time	[s]	2,2	3,2	3,5	2,8
	90% faster than	[Mbit/s]	12,1	7,2	6,2	9,2
	10% faster than	[Mbit/s]	112,7	74,9	73,7	70,1
HTTP 2500KB UL Smartphone	Qualifier	[%]	98,6	99,0	97,8	98,1
	Average Session Time	[s]	2,5	2,7	2,9	3,1
	90% faster than	[Mbit/s]	5,4	4,1	3,7	3,6
	10% faster than	[Mbit/s]	28,4	32,2	32,9	24,4
HTTP DL FDTT	Qualifier	[%]	98,8	99,3	98,4	98,6
	Average Data Rate	[Mbit/s]	83,7	55,7	46,3	66,2
	90% faster than	[Mbit/s]	14,3	7,8	5,9	16,2
	10% faster than	[Mbit/s]	172,5	123,2	107,3	136,8
HTTP UL FDTT	Qualifier	[%]	97,7	97,6	97,2	96,5
	Average Data Rate	[Mbit/s]	27,3	21,7	22,4	19,4
	90% faster than	[Mbit/s]	5,3	4,3	4,0	3,4
	10% faster than	[Mbit/s]	50,7	45,7	47,3	45,2
YouTube	Qualifier	[%]	96,8	93,7	95,9	97,1
	Start Time	[s]	1,6	1,8	1,5	1,6
	AVG Resolution	[p]	913	837	907	916
YouTube Live Smartphone	Qualifier	[%]	95,3	91,4	94,5	96,7
	Start Time	[s]	1,7	1,7	1,6	1,7
	AVG Resolution	[p]	1031	924	1019	1033



Key takeaways

- WindTre shows the highest overall score with 847 out of 1000 points in the nationwide measurements.
- In mobile data performance, WindTre is ahead of competition as well in the geographical regions cities, towns and roads.
- WindTre with the widest VoLTE coverage in cities & towns.
- Nationwide, WindTre is providing the most reliable Data experience.





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