

Italian Operators' Response to the COVID-19 Pandemic

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ABSTRACT

Since the beginning of the COVID-19 pandemic, governments introduced several social restrictions. As of 18 March 2020, more than 250 million people were in lockdown in Europe. This drastically increased the number of online activities. Due to this unprecedented situation, some concerns arose about the suitability of the Internet network to sustain the increased usage.

Italy was severely hit by the first wave of the pandemic and various regions underwent a lockdown before the main country-wide one. The Italian network operators started sharing information about improvements carried out on the network and new measures adopted to support the increase in Internet usage. In this report, by means of a questionnaire, we collect information and provide a quantitative overview of the actions undertaken by network operators in Italy. The attitude of Italian operators was synergic and proactive in supporting the changed market conditions caused by the public health emergency.

CCS CONCEPTS

• **Networks** → *Network management*.

KEYWORDS

Internet operations, Internet performance, COVID-19

1 INTRODUCTION

The corona virus pandemic (COVID-19) is an ongoing pandemic caused by the virus SARS-CoV-2. The virus started spreading in December 2019 and soon cases of infection started appearing worldwide. The World Health Organization (WHO) declared the virus spreading of international concern on 30 January 2020. The WHO later announced the virus to be classified as a pandemic on 10 March and Europe to be the active center of the COVID-19 pandemic as of 13 March 2020. Since the virus is mostly spread via small droplets produced by coughing, sneezing, and talking [5, 8], European governments started introducing more and more social restrictions. As of 18 March, more than 250 million people were in lockdown in Europe [19].

As the number of activities carried out online increased, such as remote working and distance learning, some concerns arose about the suitability of the Internet network to sustain the increased usage [6, 20, 23]. While most of these concerns revealed to be unfounded, network operators worldwide proactively acted on improving their networks and services in order to keep the users connected during the pandemic. At the same time, content providers were asked by the European Union to reduce their footprint on the

network, for this reason major streaming platforms reduced the quality of their streamed content [21, 22].

In a recent study published in [4], the authors highlight the impact of the lockdowns on the latency of the European region by collecting more than 12 billion latency measurements, mostly issued from domestic connections. In particular, results for Italy show possible hints on how the action implemented by network operators did not only mitigate the increased usage, but in fact improved the latencies countrywide at night, when the network was not loaded.

In this report we address the topic directly from the point of view of the Italian network operators. In particular, by means of a questionnaire, we aim to collect information and to summarize a quantitative overview of the actions undertaken by network operators to support the proper functioning of the Italian Internet during the pandemic.

2 RELATED WORK

Various reports were released by Internet players about the increased usage of their infrastructure, which we review in the following. Firstly, a cloud computing provider and content delivery network, reported traffic and download speeds towards their servers [2]. In their report, Italy had a 109.3% increase in traffic and a 35.4% decrease in average download speed. Similarly, Cloudflare, a content delivery network, reported numbers about the increase of traffic towards their servers [12]. In particular, they report a traffic increase of 30% in Northern Italy. DE-CIX, an Internet eXchange Point, reported a traffic record of 9.1 Tbps [14], as well as a 50% increase in video conferencing traffic and 25% increase of social media traffic. Finally, the Organisation for Economic Co-operation and Development (OECD) released an article that summarizes the various traffic information shared by Internet operators in a single document [15]. Such report highlights some important numbers, among which a traffic increase up to 60% at IXPs and ISPs, and a 24-times increase of video conferencing traffic.

From a scientific literature point of view, the work in [4] analyzes network measurements and shows the impact of the lockdown in terms of increased latency and increased variability of latency. Various end-points are measured before and during the lockdown. During the lockdown, the additional delay with respect to the minimum delay towards the end-points is measured to be $\sim 3 - 4$ times as much as the value before the pandemic. Similarly, packet loss is $\sim 2 - 3$ times as much as before the pandemic. Besides latency and packet loss, the impact is evaluated in different times of the day and on different versions of the IP protocol.

Another paper focusing on this topic is the one in [9], where the impact of the COVID-19 pandemic is observed from the campus

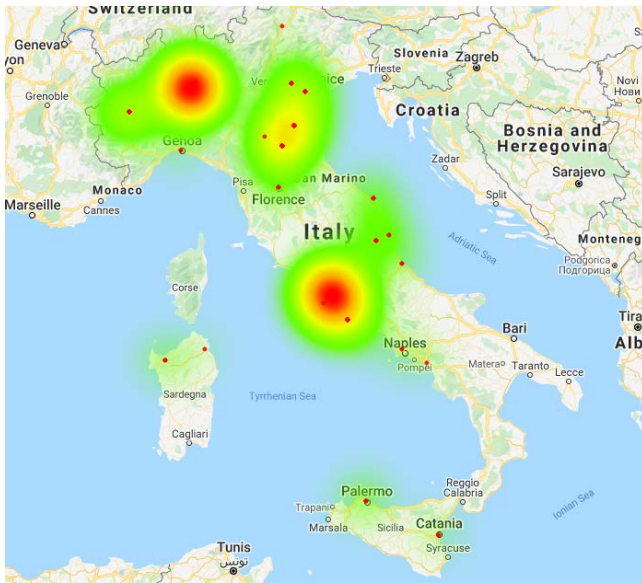


Figure 1: Approximation of the geographical distribution of the network infrastructure belonging to the organizations contributing to the questionnaire (map from Google maps).

network of an Italian University. The authors report a decrease of 10 times in incoming traffic and an increase of 2.5 times in outgoing traffic, as a consequence of remote learning activities. Moreover, using passive measurements and application logs, they study the fruition and performance of their distance learning platform.

Following these two researches, other articles appeared: in [13], the authors evaluate the effect of the pandemic on the traffic experienced by a UK mobile network operator, which reflects the changes in the mobility of the users. In [3], the surge in Facebook’s traffic is analyzed, changes in user behavior and user experience are reported. The authors also describe how different regions of the world saw different magnitudes of impact. In [10], the authors use traffic data from some vantage points, mostly located in IXPs, and analyze the effects of the lockdowns on traffic shifts. They report increases in traffic of about 20%.

3 QUESTIONNAIRE

3.1 Participants

We proposed to the Italian network operators a multiple choice questionnaire online. We shared the questionnaire in the Italian Network Operators Group mailing list. The questionnaire was divided into two parts: one part dedicated to Internet Service Providers (ISPs) providing connectivity to end users, transit providers, content providers, and content distribution networks (for brevity, we will refer to this part simply as the ISP part); another part dedicated to Internet eXchange Points (IXPs). The questionnaire has been available to the community from 6 May 2020 to 16 June 2020. In total 51 operators participated, each of them responsible for a different Autonomous System (AS). The 51 participants are 46 in the first group (ISPs) and 5 in the second (IXPs).

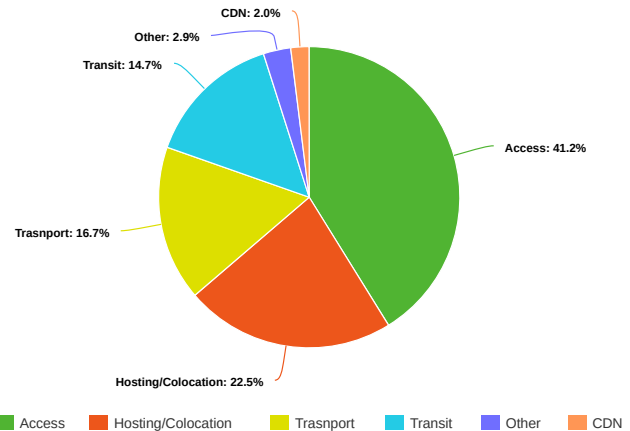


Figure 2: Declared business type by the participants in the ISP part of the questionnaire.

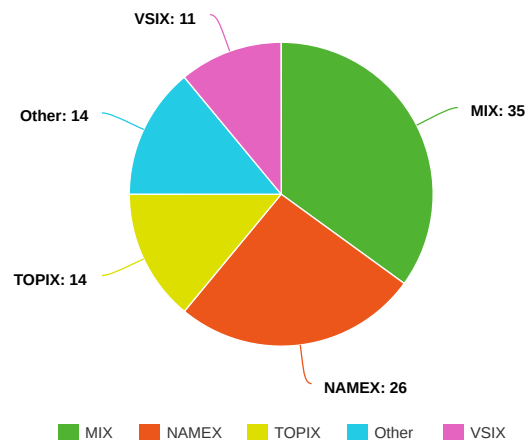


Figure 3: Italian IXPs used by the ISPs before the pandemic, number of answers.

According to RIPE NCC, the number of Local Internet Registries (LIRs) having headquarter in Italy is 1 218 [18], of which only 943 are announcing any prefix at BGP [16] level, as visible from the RIPE Routing Information Service (RIS) [17]. According to the previous numbers, the participants in our questionnaire are the 5.4% of the total amount of operating networks in Italy. The number of IPv4 prefixes announced by the participants in this study is 1 034, which is the 15% of the total amount of prefixes announced by the 943 Italian LIRs (6 851 prefixes). For the IXP part, the participants cover more than 71% of the IXPs active inside the national border, including the major ones in terms of number of members.

Figure 1 depicts an approximation of the coverage of the network infrastructure operated by the participants. The heatmap has been produced by obtaining the announced prefixes of each AS operated by the participants, according to [17]. For each prefix, several IP addresses able to answer ping measurements have been selected. Finally, the IP addresses have been geolocated by

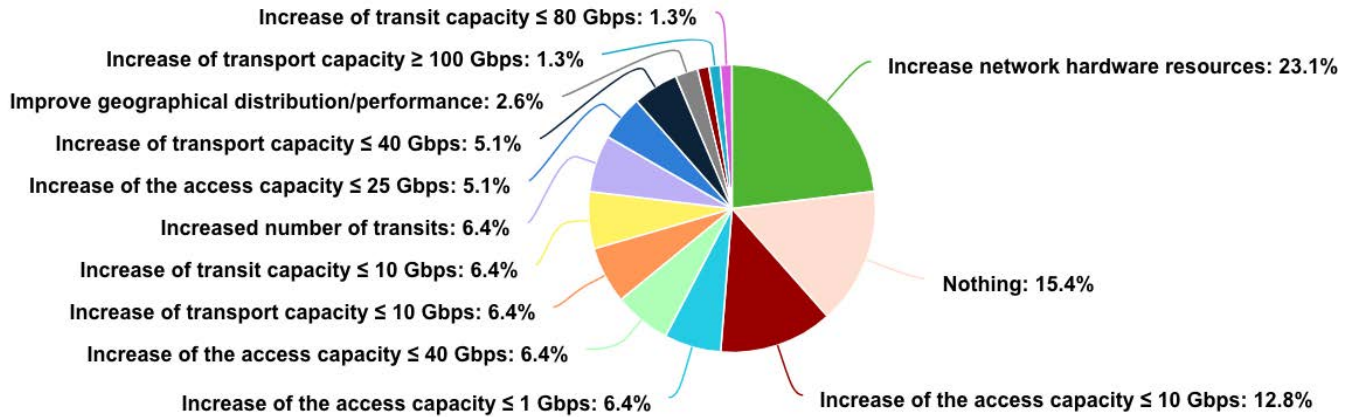


Figure 4: Measures adopted by the ISPs during the pandemic.

using RIPE IPmap [7] (80.3% accuracy at city-level). Naturally, IP addresses belonging to the same prefix could be geolocated far away, while geolocating all the IP addresses in such prefixes may not scale in practice, for these reasons the map must be considered a lower bound of the real coverage of the participants.

Most of the participants declared to serve both businesses and consumers. Figure 2 shows a summary of the type of services performed by the participants to the ISP part of the questionnaire, according to their answers.

3.2 Questions for ISPs

The first question for the part of the questionnaire dedicated to ISPs was about assessing to which IXPs the ISPs used to peer in Italy before the pandemic. Figure 3 shows the answers of the participants: 35 (76%) peer at the Milan Internet eXchange (MIX), 26 (56.5%) peer at the Nautilus Mediterranean eXchange (NAMEX), 15 (30.4%) at the Torino Piemonte Internet Exchange (TOPIX), 11 (24%) at the Veneto System Internet Exchange (VSIX), and other IXPs are adopted by 11 (30.4%) participants.

The second question wanted to assess if the ISPs were subject to a variation in the amount of traffic during the lockdown period. In particular, 38 ISPs (82.6%) declared an increase in the traffic, 3 ISPs (6.5%) declared a decrease in traffic, and 5 ISPs (10.8%) did not perceive any variation.

The third question aimed to assess the measures adopted by the ISPs to respond to the increase in traffic due to the lockdown and other operational difficulties. The options for this question are reported in Table 1, while Figure 4 summarizes the answers. The most common adopted measure was an increase in network hardware resources and an increase in the overall access capacity between 1 and 10 Gbps. Independently of the amount, the increase in access capacity was the most reported measure. If we consider all the answers together, Italian ISPs overall increased their access capacity between 260 Gbps and 500+ Gbps. Notable is also the increase of the number of transits, increasing for 10.8% of the participants. We preferred ranges to exact numbers during the collection of the capacity data since we are interested only in a global view, while

Table 1: Measures adopted by the ISPs during the pandemic and number of answers.

Measures adopted by ISPs during the pandemic	#	
Overall increase in access capacity	≤ 1 Gbps	5
	≤ 10 Gbps	10
	≤ 25 Gbps	4
	≤ 40 Gbps	5
	≤ 80 Gbps	0
	≤ 100 Gbps	1
≥ 100 Gbps	0	
Overall increase in transport capacity	≤ 1 Gbps	0
	≤ 10 Gbps	5
	≤ 25 Gbps	0
	≤ 40 Gbps	4
	≤ 80 Gbps	0
	≤ 100 Gbps	0
≥ 100 Gbps	1	
Overall increase in transit capacity	≤ 1 Gbps	0
	≤ 10 Gbps	5
	≤ 25 Gbps	0
	≤ 40 Gbps	0
	≤ 80 Gbps	1
	≤ 100 Gbps	0
≥ 100 Gbps	0	
Improve geographical distribution/performance	2	
Increase of transits	5	
Increase in network hardware resources	18	
Nothing	12	

exact numbers would have perhaps discouraged the participation in the questionnaire.

The fourth question inquired about the possible increase in capacity (not traffic) on the switching infrastructure where ISPs are doing peering at IXPs. The answers are summarized in Figure 5. As

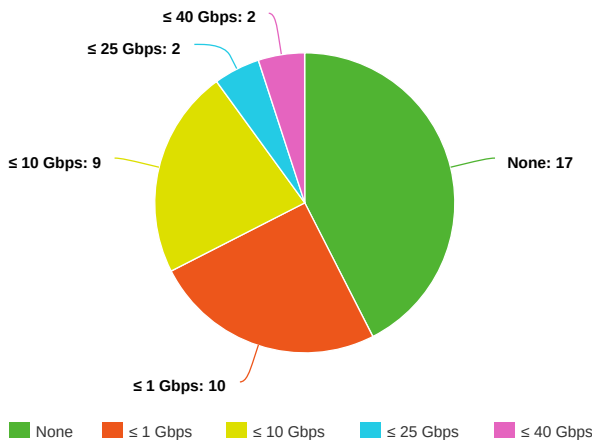


Figure 5: Overall capacity increase at IXPs performed by the participant ISPs, number of answers.

can be observed, 17 (37%) participants did not adopt any measure to increase the capacity, 10 (21.7%) increased the capacity ≤ 1 Gbps, and 9 (19.5%) increased the capacity ≤ 10 Gbps.

The fifth question is similar to the previous one, but it was inquiring about the increase in the overall capacity of private peerings. Figure 6 summarizes the results. In this case, 33 (71.7%) of the participants declare no increase in capacity, 6 (13%) increased the capacity ≤ 1 Gbps, and 4 (8.7%) increased the capacity ≤ 10 Gbps.

The sixth question aimed to quantify the number of new BGP peerings established with other ASes at IXPs. To this question, summarized in Figure 7, 12 ISPs declared they did not establish any new peering, 21 ISPs established less than 5 new peerings, and 4 ISPs declared more than 20 new peerings.

During the pandemic, TIM (the Italian incumbent) started peering again in public peering LANs of Italian IXPs for the first time since the end of 2012 [1]. We then asked the participants if they started free peering relations with TIM (AS3269) during the pandemic; 45.7% answered positively. We also asked for the date since when they started peering. Almost all the participants started peering with TIM in April, in particular around 6 April. The earliest date reported was mid March and the latest was the beginning of August.

3.3 Questions for IXPs

The first question in the part of the questionnaire dedicated to IXPs was about the quantification of the increase in members. Out of the five IXPs participating in the questionnaire, 2 reported an increase between 1 and 3 new members, 2 reported an increase between 7 and 10 new members, and 1 reported no new members from the beginning of the pandemic.

The second question was about the quantification of the overall capacity increase of the ports customer-side of the IXPs peering LANs. The five IXPs this time reported really different values in their answers. One IXP reported an increase between 10 Gbps and 50 Gbps, one IXP an increase between 100 Gbps and 150 Gbps,

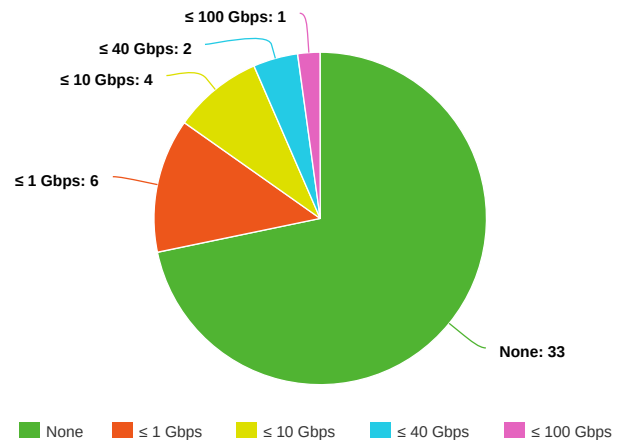


Figure 6: Overall capacity increase of ISPs private peerings, number of answers.

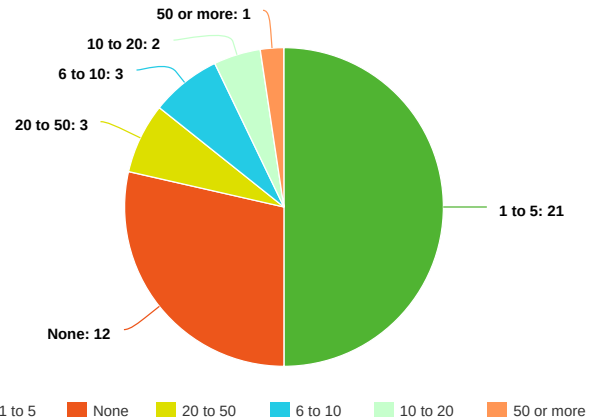


Figure 7: Number of new peerings with other ASes established by the ISPs, number of answers.

another one between 200 Gbps and 400 Gbps, and one reporting increases above 500 Gbps.

The third question aimed to quantify the increase in capacity operated for private network interconnections (PNI). Two out of five IXPs reported no increase, two reported only a modest increase, and only one reported a more than double increase in capacity.

The fourth question was inquiring if TIM was doing peering on the public peering LAN. Out of the 5 IXPs, 3 responded positively. These IXPs answered a sub-question as well about the date: the earliest date reported is also in this case the beginning of April, the latest is the beginning of June.

The fifth question was asking if the IXPs introduced any economical advantage to the customers during the pandemic. The answers are summarized in Table 2. The most common economical advantage introduced is the removal of the costs for increasing capacity on the switching infrastructure, introduced by 3 out of the 5 IXPs.

Following, the removal of the remote hands costs, introduced by 2 out of the 5 IXPs.

Another major problem during the pandemic was for sure the access to the data centers. Since this is part of the IXPs business we asked the participants how they adapted to the new situation. In addition to the economical advantages previously mentioned, the IXPs adopted since February 2020 several procedural improvements, among which: expanded offers of remote hands (free of charge) to reduce or completely remove the need for the customers to access the data center, and created new rules for hygiene procedures and shifts of the personnel working in the data centers.

Finally, we asked if they were contacted by the Government or any other regulator about actions or guidance to follow for the resilience of the Italian Internet during the pandemic and the lockdown. All the IXPs answered negatively to this question.

Nonetheless, it is worthwhile to mention that the Italian Government has also played a role, by recognizing telecommunications as an essential service and by introducing, during the emergency, new rules for operators and new assurances for users.

Table 2: Economical advantages introduced by IXPs.

Economical advantage	#
No remote hands costs	2
No costs for increasing capacity on the switching infrastructure (peering)	3
No installation costs for a new POP	1
None	2

4 CONCLUSIONS

Proactivity is the key word that characterized the attitude of Italian telecommunications operators in support to the changed market conditions caused by the public health emergency. This is what comes out from our survey, previously explained in detail. In particular, we would like to point out how ISPs have readily adapted the capacities aimed at improving user access, data transport, and Internet transit. These are three categories of measures which go hand in hand, that are combined with each other to provide a good Internet experience to users.

It should be noted that the Italian Government, by a decree dated 17 March 2020 [11], in order to cope with the growth in consumption of services and traffic on communications networks, established that telecommunications operators take measures and perform any useful initiative aimed to strengthen infrastructures, guarantee the functioning of the networks, and the operability and continuity of services. This decree also required ISPs to take all necessary measures to enhance and guarantee uninterrupted access to emergency services and to satisfy any reasonable request by users for improvement of network capacity and quality of service.

From a geographical point of view, the areas that benefited most from the adjustments carried out by the operators participating in the questionnaire were the regions of Northern Italy, those of the center, especially on the Tyrrhenian side, and the major Sicilian provinces (see Figure 1). In other words, a large part of the Italian population has enjoyed, if not an improvement, at least a service not penalized by the increased traffic circulating on the Italian network during the pandemic. As the heatmap shows, a reduced

infrastructure or a scarce participation in the questionnaire could be detected in the regions of southern Italy, whose motivations go beyond the scope of this document.

Decisive was also the contribution of the Internet eXchange Points operating on the national territory which have well interpreted the role of facilitators for interconnections among ISPs. The increase in the number of peering relationships, the increase in the total capacity of the ports available to members on the peering LAN, and the facilitated economic conditions for remote-hands services have contributed to support the work, distance learning, and entertainment needs of the entire Italian population.

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