Covid 19 Impact on China ISP's Network Traffic Pattern and Solution Discussion

Yunan Gu*, Zhenbin Li**
Huawei
Beijing, China
*guyunan@huawei.com
**lizhenbin@huawei.com

***Abstract*— The COVID-19 has brought big changes to both life and work since the early 2020. Among these changes, the Internet service has been playing a significant role, which is relevant to many perspectives, such as medical care, education, governing, remote office, entertaining and so on. This paper provides the Internet traffic change analysis in China during COVID-19, i.e., the traffic change pattern as well as new network requirements incurred. In addition, solutions to cope with these new challenges are also discussed.**

Keywords—COVID-19, Traffic steering

I. INTRODUCTION

Covid-19 has brought life and work from offline to online. It brings the emergence of services like remote office, online education, remote medical care and so on.

New network pain points have arisen.

- Online education quality assurance: For example, an online English teaching platform has experienced 19% class failure, and thus receives complain from parents[1].
- Remote office quality assurance: For example, service drop, video lag and asynchronization.
- Population mobility impact on traffic pattern: during/after the Spring Festival, population dynamic contributes to the network traffic pattern change, such as local traffic burst.

In the meanwhile, new network opportunities come along with challenges.

- 2C services: The emergence of online education, remote office, and home entertainment during COVID-19 have made home the new center of network economy. Certain services require SLA assurance, such as online education and remote office.
- 2B services: Trailer style or newly built hospitals specialized for COVID-19 patients require quick network service launches with SLA assurance, such as fast cloud service deployment with tunnel quality assurance, real-time SLA monitoring.
- 2B services: E-government and online health care has accelerated the network transformation. It attracts more investment in network coverage extension, 5G/video private network, big data analysis platform, network security and so on.
- 2B services: Flexible network adaptable to new 5G 2B services, e.g., real-time remote medication, 5G ultra-sound robot, drones for surveillance.

II. NETWORK TRAFFIC PATTERN CHANGES

A. Increase of Internet Traffic

According the statistics during January to February 2020, there have been an skyrocket increase regarding certain Internet services in China.

- **Remote office services** in China after the Chinese Spring Festival (2020/01/24 ~ 2020/01/30) have been experiencing an exponential increase. An rough estimation of the total user number shows that the Enterprise user reaches 18 Million, and the individual user reaches 300 Million. For example, the daily user of a video meeting APP x has increased by 100%.
- **Online course services** in China is also witnessing an explosion increase. There have been about 22 online course platforms, 24K online courses, with 270 Million students users. The total online course user has increased during 2020 January and February by about 128 times.
- **Medical care services** expand thanks to not only online doctor APPs, but also new network construction for newly built hospitals specialized for COVID-19. The online user of an online doctor APP x reaches 1.11 Billion. Trailer style hospitals are built within 10 days covering 12 provinces nation-wide. New base stations are built within 30 hours, and new 5G services are launched within 3 days.
- **E-Government services** have been utilized as important guarantees of the Chinese government in defending against COVID-19. More networks are built to cover rural areas, and new data analysis platforms are constructed to enable digitalization.

The above mentioned changes have led to essential traffic increase in the network. According to statistics of major ISPs in China during Jan. to Feb. 2020, there have been a general traffic increase in Backbone, Metro, BRAS, OLT, IDC, CDN

[1] Please note, statistics used in this paper here and thereafter is mostly not public. They are used in this paper purely for better understanding of network related trend during the COVID-19. Please don't cite or reuse anywhere else.

networks. Figure 1 depicts an nation-wide average traffic change of different networks of China during 2020 Jan. to Feb.[2].

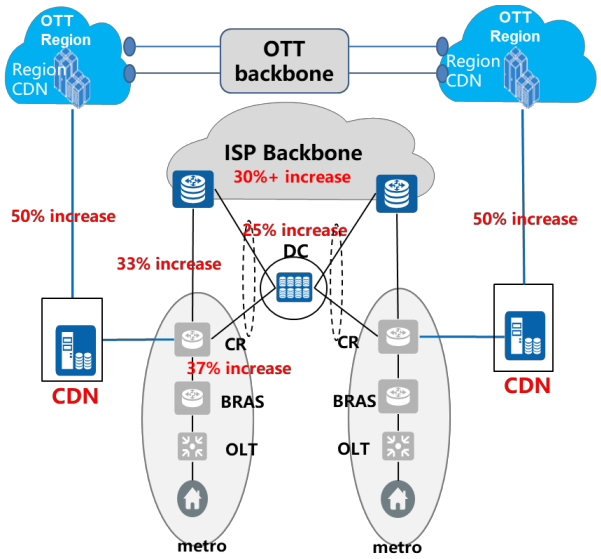

Figure 1 Traffic Change during COVID-19

B. *Traffic Distribution Change and Inccurred Network Requirements*

Although the overall network traffic increases due to various service emergence, different networks still exhibits different traffic patterns, considering the service types, network geolocation, population mobility and so on.

- **Backbone:** The backbone network, in general, is seen a traffic increase of over 30% nation-wide, during the Spring Festival period of 2020/01/24 to 2020/02/04. In addition, the traffic distribution has gone through non-trivial changes due to population distribution change. Both the traffic increase and distribution change in the backbone network have resulted in local traffic burst and unbalanced traffic loads. This further leads to ingress and intra-domain traffic steering needs in the backbone network.
- **Metro:** The metro network have seen an average outgoing traffic increase of over 33% nation-wide from 2020/01/12 to 2020/02/14. Also affected by population distribution change, some provinces with more coming population during the Spring Festival, like Shandong, Henan and so on, have significant traffic increase of over 50%, while provinces and cities with more population going out, like Shanghai and Zhejiang, have seen traffic decreases of around 2% ~ 15%. In the meanwhile, the metro traffic pattern is also related to service types. For online course services, the traffic travels within the province, without going through the backbone, while for remote office services, traffic typically traverses through from metro to backbone. This leads to the egress traffic steering need at the metro network, and/or ingress traffic steering need at the backbone network, and/or network capacity upgrade. What's more, different services require different levels of SLA assurance. For example, online course service and remote office service require low transmission latency, while 5G mobile remote medical care service requires low latency as well as low packet loss. Again, traffic steering for specific service flows to guarantee SLA is needed.
- **IDC:** the nation-wide IDC traffic increases about 25% during from 2020/01/12 to 2020/02/14. Again, IDC in different provinces and cities exhibit unbalanced increase. Provinces with more incoming population, reach over 50% of traffic increase, while places with more outgoing population see traffic drops. What's more, the outgoing traffic of an IDC x in Beijing has had a short-time burst at the Chinese New Year's Eve, reaching 105G; and increases slowly by 5% per day after that; and then increases rapidly at 2020/02/01 and stays at around 170G until 2020/02/18. The network operator had to take an emergency network capacity upgrade.
- **CDN:** As pointed out in the Metro traffic pattern part, the online course traffic is majorly within the province. Such traffic is mainly carried by CDN. Besides from the online course traffic, part of the medical care and E-government traffic is also offloaded from backbone to CDN. CDN providers have had special promotion towards COVID-19 related services, and some have upgraded their network capacities during this period.
- **Mobile:** Mobile traffic distribution have similar pattern as the fixed band traffic distribution regarding population change. However, due to the Spring Festival and the quarantine, people spent more time at home, thus leading to about 7% of mobile traffic offloaded to fixed band WiFi. This further adds burden to the backbone and metro network.

C. *Challenges Brought by Traffic Pattern Changes*

The first step to either network capacity upgrade or traffic steering is the link status and flow visibility. Manual blind adjustment can lead to waste and even affect existing services at the worst case.

The second step is automated adjustment. Regarding frequent network traffic during COVID-19, manual configurations are always error-prone, and the adjustment period could be as long as 15 days.

III. Solution Discussion

As discussed in the previous section, traffic full visibility is a necessity. In addition, Top N or elephant flow analysis and visualization is also beneficial for making better traffic optimization decisions. If traffic steering is sufficient to meet the demands, i.e., without the need to upgrade network capacity, then traffic steering actions are taken based on the link status and flow analysis.

In the following sections, we discuss some typical traffic steering cases. We introduce three scenarios, i.e., intra-

[2] Note that Figure 1 is not a topology to any specific network but an illustration of composed network with different network roles.

domain traffic steering, ingress traffic steering, and egress traffic steering. The latter two are actual cases from our customers.

A. Intra-domain Traffic Steering

The SDN controller collects the flow and link status, by means of SNMP, IPFIX and BGP-LS (TWAMP data), and provide link and flow visualization. The SDN controller, by analyzing the Top N/elephant flow from the data, can support traffic optimization decisions, which is also an essential step for automated traffic optimization. The analysis can be based on flow aggregation at IP/AS/community levels.

The SDN controller may utilize BGP FlowSpec [1] [2] to indicate R1 to steer specific data flow to be redirected to R2 instead of R3 to avoid the congested link between R1 and R3. The FlowSpec routes would generate ACLs at the devices to take actions on mapped data flow. A data flow can be indicated based on source and destination IP, source and destination port number, QoS and other values. Further, to indicate an aggregated flow, e.g., aggregated by source and destination ASN, [3] can be used to save ACL resources at the device side.

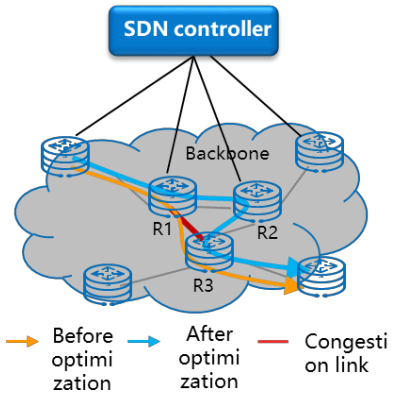

Figure 2 Intra-domain traffic steering

B. Ingress Traffic Steering

The R2 and R3 may utilize BGP RPD (Route Policy Distribution) [4] to indicate R1 to steer data flow to select R3 as the next hop instead of R2. BGP RPD is realized through revising BGP attributes, e.g., MED, AS-Path and Community, when advertising BGP routes to affect the receiver BGP speaker's route selection decision.

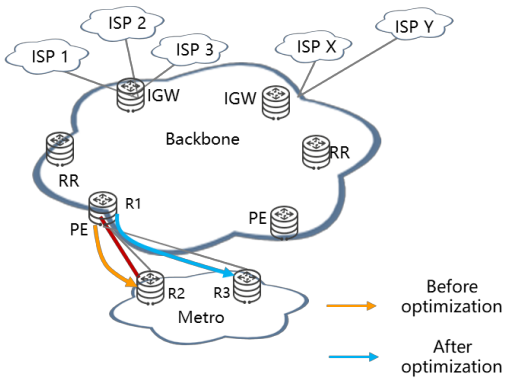

Figure 3 Ingress Traffic Steering

C. Egress Traffic Steering

The SDN controller may utilize BGP FlowSpec [1][2] to indicate R1 to steer data flow 1 (e.g., online course service traffic) to be redirected to R2 for traffic localization, and to indicate R1 to steer data flow 2 to be redirected to R3 (e.g., links between R1-R3 and between R3 and backbone are light loaded) for VIP services, and to in indicate R1 to steer data flow 3 to be redirected to R4 to avoid congestion with VIP services.

Similarly, one can adopt [3] to indicate elephant flow to be redirected while saving ACL resources.

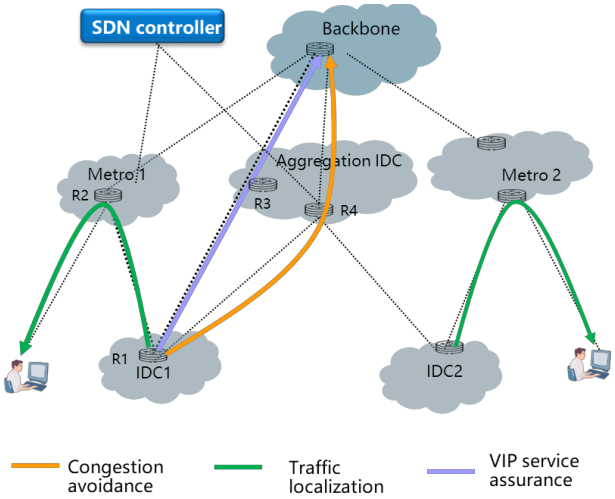

Figure 4 Egress traffic steering

IV. CONCLUSIONS

This paper discusses the network traffic pattern changes during the COVID-19 in China. We see new network services emerging, such as online course, remote office, remote medical care and so on. Some services require high SLA assurance. In addition, the Spring Festival and the COVID-19 quarantine have led to traffic distribution changes due to population distribution changes. These factors have resulted in the need for traffic steering or network capacity upgrade. Utilizing BGP FlowSpec and BGP RPD to cope with frequent traffic steering requirement is also discussed.

REFERENCES

[1] Marques, P., Sheth, N., Raszuk, R., Greene, B., Mauch, J., and D. McPherson, "Dissemination of Flow Specification Rules", RFC 5575, DOI 10.17487/RFC5575, August 2009, <https://www.rfc-editor.org/info/rfc5575>.

[2] J. Uttaro, J. Alcaide, C. Filsfils, D. Smith, P. Mohapatra, "Revised Validation Procedure for BGP Flow Specifications.", draft-ietf-idr-bgp-flowspec-oid-12, Jul. 8, 2020

[3] H. Wang, A. Wang, S. Zhuang, "Destination-IP-Origin-AS Filter for BGP Flow Specification.", draft-wang-idr-flowspec-dip-origin-as-filter-03, Sep. 10, 2020

[4] Z. Li, L. Ou, Y. Luo, S. Lu, H. Chen, S. Zhuang, H. Wang, "BGP Extensions for Routing Policy Distribution (RPD).", draft-li-idr-flowspec-rpd-05, Jul. 7, 2019