Operation and Performance of the Games Data Network

KUROMIYA Takayuki SAITO Wataru SHIGECHIKA Noriyuki

Abstract

The data network for the Olympic and Paralympic Games Tokyo 2020 is one of the most critical infrastructures, and its stable operation is essential for the smooth conduct of the Games as the infrastructure supporting the Games. This article introduces the specific challenges and framework organized for the stability of the Games data network, analyzes the performance and operation outcomes, and discusses and summarizes the singularity and success factors of the Olympic and Paralympic Games Tokyo 2020 derived from these results.

Keywords : Data network, Operation, TOC, Operation framework, Incident

1. Introduction

For the smooth conduct of the Olympic and Paralympic Games Tokyo 2020 (hereinafter referred to as "Tokyo 2020 Games"), it is very significant not only to develop and provide an appropriate network but also to maintain and operate it stably at all times. The scoring systems and other systems for the competitions also work on this communications infrastructure, and any incidents could have a critical impact on the competitions themselves and the management of the Games. It was necessary to enhance availability by monitoring the normality of the network and responding quickly and accurately to any incidents to ensure the stable operation of the data network for the Games. And it was also required to have complete maintenance and operation framework that could flexibly change settings according to user conditions and requirements.

Furthermore, the characteristics of the Games, in which multiple events take place simultaneously in many venues, inevitably require a large-scale operation framework because the stable operation should be broad in geographical and temporal scope. But the growth of the framework must not decrease the quality of the operation performance.

To cope with this challenge, we prepared the maintenance and operation framework of the data network for the Games in anticipation of the actual Games for the test events more than a year before the Games and made the operation process and procedure mature through some training and knowledge sharing among the members.

Although some problems occurred during the Games time, there were no critical incidents, and the maintenance and operation team and the members involved secured stable operation. This section describes the maintenance and operation framework and analyzes it from the viewpoints of the actual performance and operation results of the data network for the Games.

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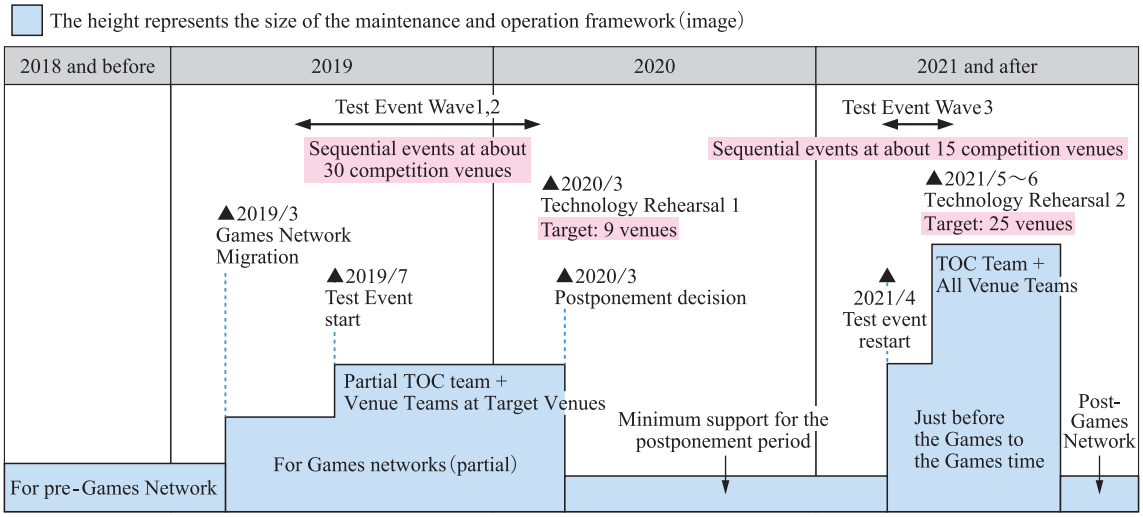

Figure 1 Transition of Maintenance and Operation Framework (conceptual diagram) The size of the maintenance and operations framework changed accordingly for the test events and the technology rehearsals.

2. Maintenance and Operation Framework of the Data Network for the Games

2.1 Establishment of the Framework and its Transition

In October 2018, while carrying on the maintenance and operation services of the existing office network for staff work, we began to consider specific operations about the data network for the Games toward the actual Games time. Then, in March 2019, as starting to use the data network for the Games, we launched a full-fledged maintenance and operation framework to aim to improve proficiency and accumulate experience.

However, especially in terms of cost, it must not be practical to allocate and continue the resources needed for the actual Games time more than one year in advance. So we expanded or downscaled the framework as per the test events and the technology rehearsals held. As there was a new factor that was the postponement for one year, we promoted the preparation of the Games time operation by keeping changing the size of the framework as shown in Figure 1.

There are two teams for the Games operation, one is the TOC Telecom Team, which is in the Technology Operations Centre (TOC), and the other is the Venue Telecom Team, which is in each venue.

2.2 TOC Telecom Team

The TOC is responsible for all the operation of technologies provided by the Organising Committee for the Games by monitoring its normality, providing on-site (venue) support, and coordinating with other operation centres. The TOC consists of several team staff, who are in charge of each technology service area and work closely with technology partners such as Atos for IT integration and OMEGA for the clock, timing, and scoring systems.

The TOC structure was organized following the start of the test event, i.e., through the increase in the number of venues to be maintained and operated, and eventually, the TOC Telecom Team had 35 positions and 49 seats at the Games time. A total of more than 200 members worked 24-hour shifts during the Games, supporting the overall technical operations related to the event by collaborating with other teams within the TOC and the venue telecom team (Figure 2).

The shift formation requires numerous operation members, and the challenge is to equalize and enhance the operational skills among those members. For this reason, we made 83 PnPs (Policies and Procedures) in total, including design information, business rules, manuals, and operation flow documents regarding the data network for the Games. The knowledge required for the operation of the data network for the Games was extensive, and members in major positions at the TOC and competition venues needed to be familiar with about 20 to 30 of these documents. We reviewed and updated these PnPs based on the experience from test events and technology rehearsals and periodically deployed those to each member at study sessions and other events to efficiently share appropriate knowledge.

In the TOC room, a dashboard was projected on the

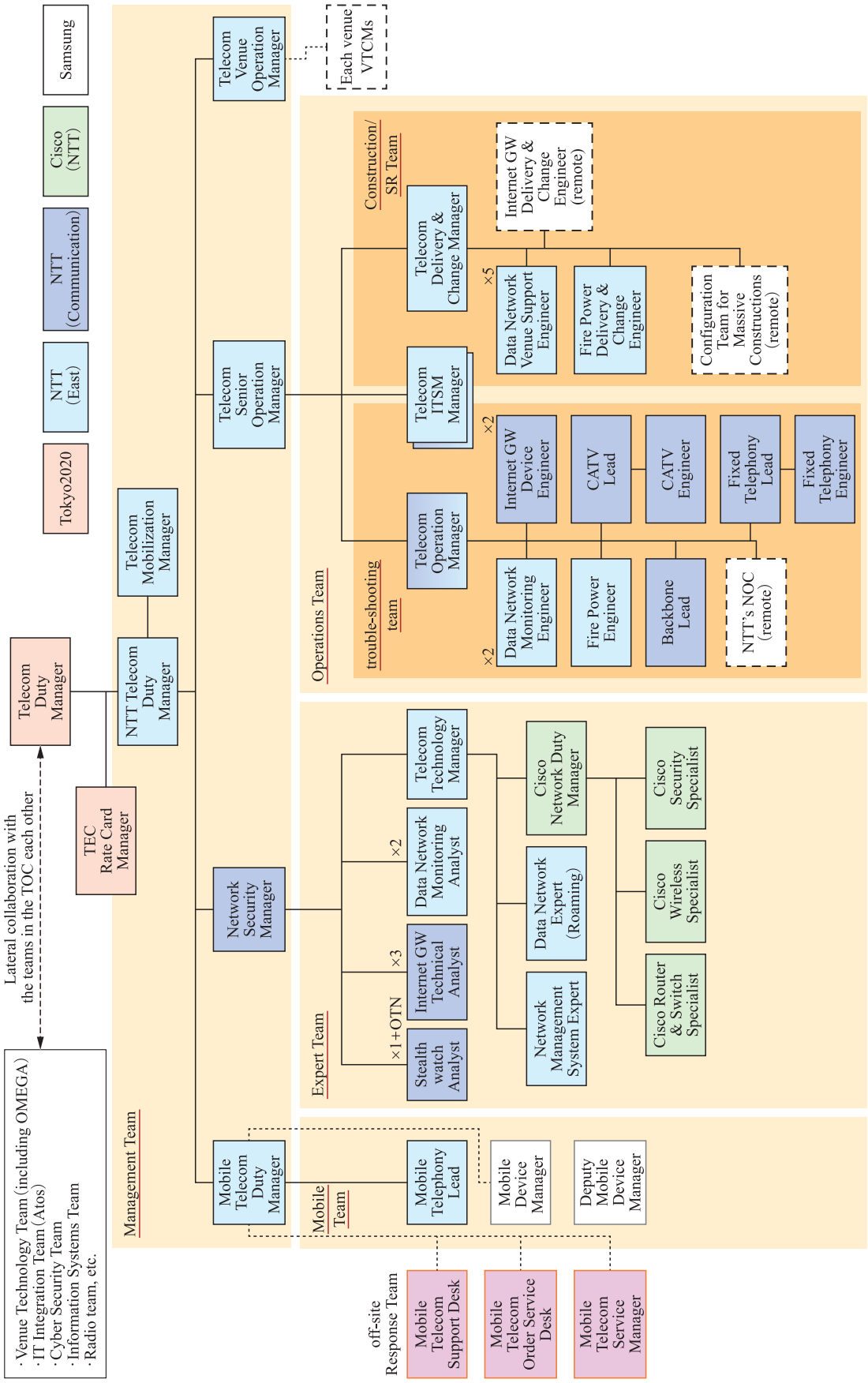

Figure 2 TOC Telecom Team Structure Assigned thirty-five positions and worked closely with the venue telecom team and other teams within TOC.

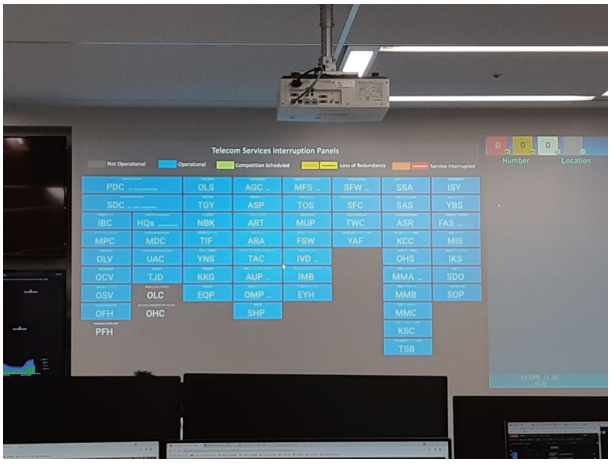

Figure 3　Dashboard (panel) in Front of the TOC　The panel indicating each venue changes to green during competition, yellow for incidents that do not affect services, and red for incidents that do affect services. (©2021-International Olympic Committee-All Rights Reserved)

front wall of the room so that all members who started their shifts could overview the operation status of each venue (Figure 3), macro traffic trends (Figure 4), and the number of client connections by network or by venue (Figure 5).

In addition, NTT supported the TOC by preparing a particular formation from their office for emergency response in case of a large-scale circuit failure caused by natural disasters.

2.3　Venue Telecom Teams

At each venue, the Venue TeleCom Manager (VTCM) headed the Venue Telecom Team and conducted on-site operations with technical support from the TOC as needed. The Venue Telecom Teams were responsible for communicating with users on-site

Figure 4　Dashboard (traffic) on the Front of TOC　Visualize macro traffic trends and understand daily changes.

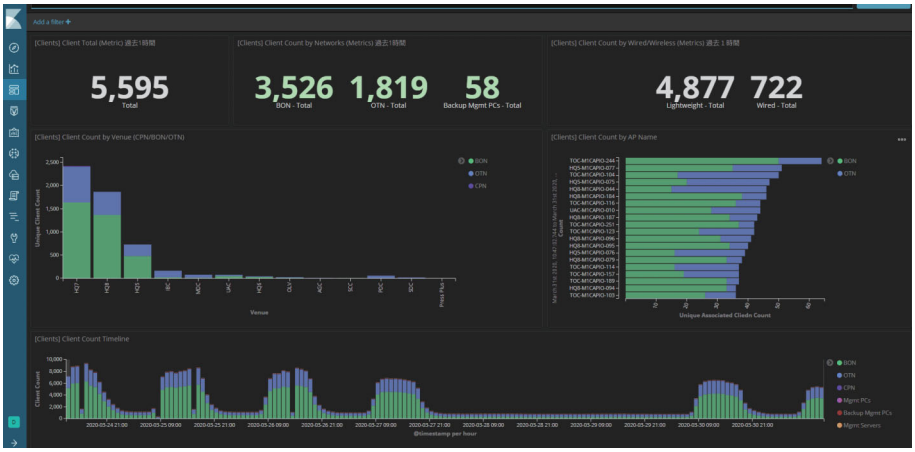

Figure 5　Dashboard in Front of TOC (Number of Connected Devices)　Intuitively grasp the number of client connections by network/venue.

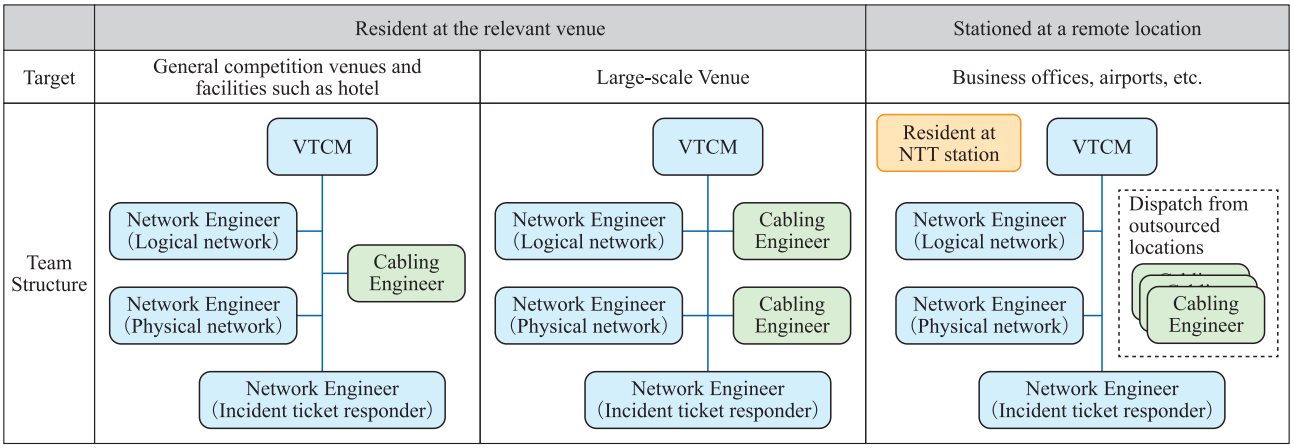

Figure 6 Venue Telecom Team Structure The venue telecom team, headed by the VTCM, was flexibly organized depending on the feature of the venue.

and quickly responded to inquiries such as Wi-Fi device properties and requests for cabling changes.

In a typical competition venue, we defined the number of positions and seats for a venue telecom team would be five, and about 20 headcounts were assigned to the team to respond during the competition by working shifts according to the competition hours. As shown in Figure 6, the number of seats and shift members were increased depending on the size of the venue to strengthen the operation performance. On the other hand, the same member was assigned to multiple sites to reduce the total number of permanent staff for improving the efficiency of operations. In the end, a total of approximately 900 members covered all venues.

Although we organized the venue telecom team of each venue only for test events, technology rehearsals, and the actual Games time, we assigned the members who installed the data network for the Games at the venue to the operation and maintenance team of the same venue in principle. It should enable an efficient and flexible operation and maintenance service to be provided by members who had an accurate grasp of the installation status and who had fostered a trusting relationship with the other people engaged in the construction at that venue.

The venue telecom team organized a comprehensive venue installation document, and it enabled the TOC team members to understand the venue installation status and physical constraints without having to visit the venue, and enabled the TOC to provide prompt support when an incident or a new service request arose at the venue.

Table 1 Number of Telecom-related Incidents and Tickets

	Sev. 1	Sev. 2	Sev. 3	Sev. 4	SR	Total
June 2021	0	0	151	369	315	835
July 2021	0	3	219	1,201	762	2,185
August 2021	0	2	74	388	265	729
September 2021	0	0	14	57	60	131
June-September Total	0	5	458	2,015	1,402	3,880

Severity 1 : Critical services are disconnected.
Severity 2 : Redundancy is lost.
Severity 3 : Some services are unavailable.
Severity 4 : One user is affected
SR : Service request, configuration change, etc.

3. Network Operation Performance

3.1 Incidents and Service Requests Handled

We managed all information of all technology-related incidents centrally by issuing incident tickets on the IT Service Management Tool (ITSM), which conformed to the ITIL international operating standard. Table 1 shows the number of incident tickets handled by the telecom team at the TOC and each venue. Sev. and SR in the table indicates Severity and Service Request, respectively.

There were no Severity 1 incidents related to telecommunications that could have had a significant impact on the competitions. However, there were some Severity 2 incidents during the Games time, such as power failures of communication equipment due to power supply troubles. There also were incidents of insufficient performance and connection difficulties of Wi-Fi for press agencies, due to a greater than expected number of Wi-Fi terminals connected at the same time.

One lesson for the future Organising Committee will be, the high density Wi-Fi solutions for Venue Media Centres and Tribunes to meet the operational needs of media should be studied in advance. Please refer to 2-4 of the special issue for more details.

SR cases include specification changes and the addition of Wi-Fi APs (access points), which occurred after the Games stakeholders arrived at the venue to check the operation of their devices. These SRs accounted for more than one-third of the total number of tickets, indicating that new requests and changes occurred routinely during our operations.

According to the record of the Rio de Janeiro 2016 Games, approximately 7,000 telecom-related tickets had been issued the sum of between June and September of that year. It would be one of the indications that we provided a stable data network for the Tokyo 2020 Games with few troubles, and also provided appropriate telecom services to meet stakeholders' requirements before they started to use.

3.2 Usage of the Data Network for the Games

Figure 7 plots the number of clients connected to each network from one week before the Olympic Games to the end of the Paralympic Games. July 28 was the heaviest day, with a total of approximately 114,000 connections to the Back Office Network (BON) for the business use of the Organising Committee staff, the Competition Network (CPN) for the competition system, and the Olympic Technology Network (OTN)

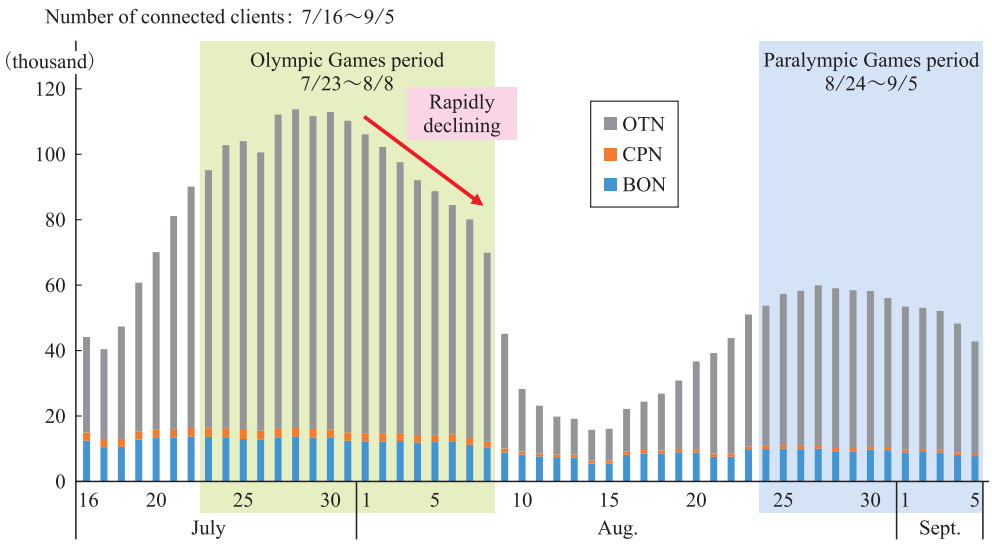

Figure 7 Number of Devices Connected to the Data Network for the Games On July 28, 97,384 devices connected to the OTN, 2,672 to the CPN, and 13,661 to the BON, reaching the maximum number of connections throughout the Games, followed by a rapid decline toward the closing ceremony.

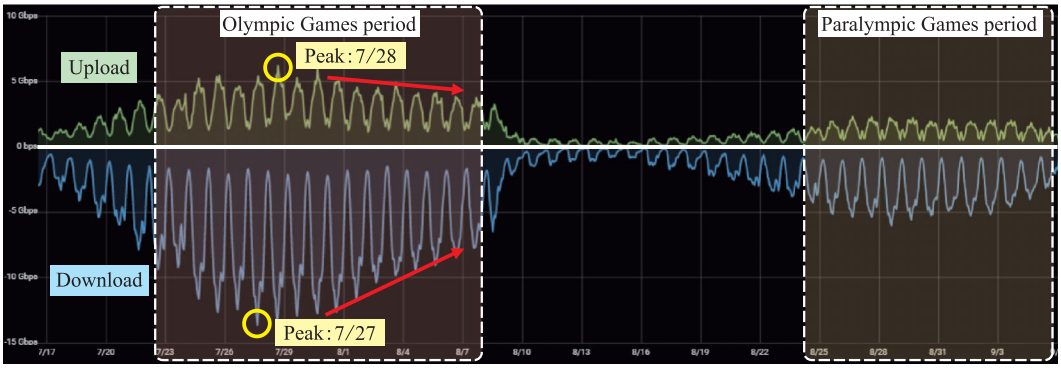

Figure 8 Internet Traffic during the Conference The upper panel shows the uplink traffic and the lower panel shows the downlink traffic. In the latter half of the Olympic period, the decrease in uplink traffic was smaller than that in downlink traffic.

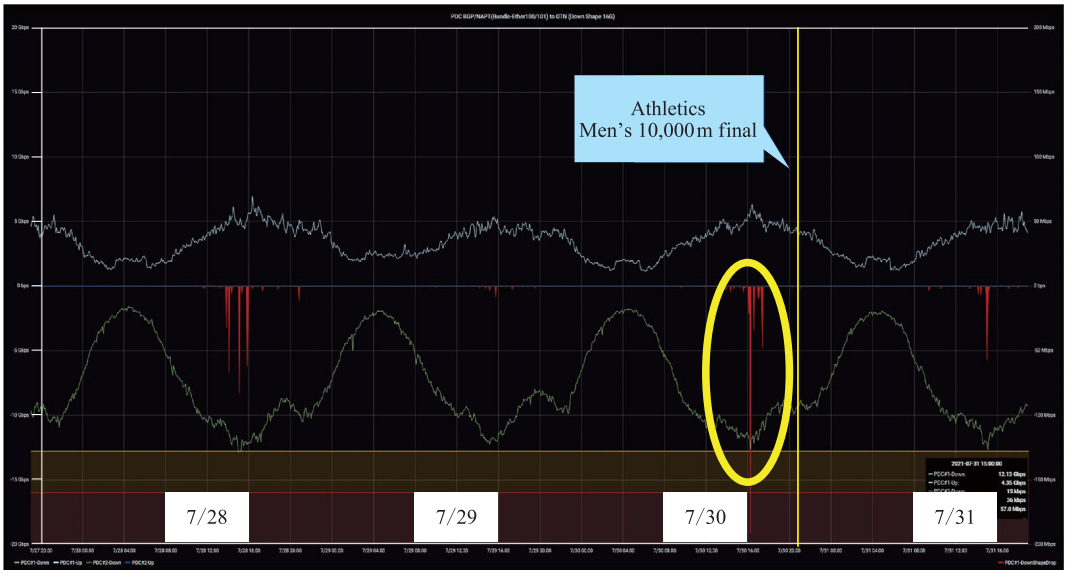

Figure 9 Internet Access Congestion from July 28 to 31 The red area indicates the occurrence of packet drop, especially just before the men's 10,000 m final on July 30, though it did not affect the operation of the competitions.

to provide the various services to the stakeholders.

In the figure, we can also see a rapid decline in the number of users from the peak compared to past Games because many foreign athletes and stakeholders who used the data network returned home immediately after their competitions due to the coronavirus disease 2019 (the COVID-19) countermeasures. It is precisely a characteristic of the Tokyo 2020 Games.

As shown in the graph in Figure 8, peak Internet access traffic was 13.66 Gbit/s for downlink on July 27 and 6.19 Gbit/s for uplink on July 28. After this peak, the pitch of decrease in uplink was smaller than that in downlink toward the closing ceremony, probably because the remaining users were continuously uploading data using something like SNS applications. There were two peaks in a day, one during the daytime and the other at night. And even during the late-night period, there constantly generated 3 to 4 Gbit/s of a sum of upstream and downstream traffic.

During the Olympic period, We took a 20 Gbit/s access line for the Internet access, and we saw heavy traffic and downlink congested in a short time on July 30, as shown in Figure 9. We were ready to expand the bandwidth promptly, but since there observed no user impacts on the operation of the Games, we judged it was no need for the expansion. Consequently, the Internet access had the proper bandwidth estimated from the design phase.

The Internet traffic on the entire data network for the Games has signature traffic characteristics because of the wide variety of backgrounds of the users involved in the Tokyo 2020 Games, and because the purpose, time, and way of use will vary significantly from user to user. In 2-7 of this special issue, we analyze the trends of communication ports and destinations based on the traffic logs observed during the Games.

3.3 Operational Results from a Security Perspective

The stakeholders usually arrive at the venue just before the Games and begin using the data network, but for the Tokyo 2020 Games, their arrival in Japan has commonly been delayed until the very last minute due to the COVID-19 countermeasures. Therefore, the security sensors could not have enough time to learn network usage trends and adjust their detection specifications before the Games. As a result, we often observed some false positives, but proactively used flow information and visualization tools to complement those, and handled the status by the configuration of blocking or disconnecting as appropriate.

Table 2 lists the major security events detected and handled during the Games with their detail and the number of each.

As for vulnerabilities, in response to starting to use the data network for the Games, we established a scheme under which the unified expert team managed the exploratory collection of vulnerability information, risk assessment, and formulation of countermeasures and actions to deal with them. By continuing this scheme, including the one-year postponement period,

Table 2 Security-related Operation Performance (7/21/2021-9/5/2021)

Security-related operations on the data network for the Games			Number of cases
Detection	Security-related events (including false positives)		1,848
	Detection of large number of connections to the web authentication page		69
	Rogue Wi-Fi access points detected		11
	Vulnerabilities found, risk assessed, and worked around		7
Actions Taken	Deployment of blocking	Internet backbone	38
		PDC Router	8
		Firewall/UTM	7
	External IP addresses blocked		2,603
	Isolated unauthorized devices		5

this team was able to respond to vulnerability threats on time. Seven cases of vulnerability information were received and responded to during the Games.

The following are actual examples of events that we have blocked. It had been occurring several cases that could result in security threats in the OTN in which users brought in a variety of devices.

(1) Attack from External to Internal

We found an illegal file (Trojan horse) injected into an IP address assigned to a specific user in the OTN via FTP transmission. We identified the source IP address and blocked that with a firewall.

(2) External→Internal→External attack

An IP address assigned to a specific user in the OTN was relaying suspicious communications by opening a TCP port of an open proxy for the Internet. We asked the user to stop the service on the device while we blocked the session by applying an anti-virus/anti-bot policy to that IP address in a firewall.

(3) Attack from Internal to External

An external organization pointed out that they observed our global IP address, which is the source of connection from OTN to the Internet, scanning for vulnerabilities in SMB communications toward the Internet. We identified the device, blocked the connection port, and asked to clean up that.

3.4 Analysis of Network Operations

As described in 2.2, the data network for the Games combined various technologies and solutions. Therefore, it was principal not only to operate each segmented telecom service but also to catch and analyze the overall trend of the network.

So we supposed that we could detect problems across systems and teams at an early stage by grasping the status of the overall picture both in a steady-state and in an emergency state. However, it has great difficulty in defining "an emergency" on a particular network that is as large as the Olympic or Paralympic Games, installed in such a short period, and the usage conditions change drastically every day. Hence, neither manually setting thresholds in advance nor tuning by machine learning would be an effective way of detecting problems.

In the Tokyo 2020 Games, we captured the changes in network usage by monitoring the total amount of logs from each communication device. Please refer to 2-8 of this special issue for details.

3.5 Dealing with the Postponement of the Games

In March 2019, that was when we implemented the data network for the Games and started to use and operate it, we were planning to keep the operation by absorbing various possible service requests, reflecting the experience of the test event, and considering that the number of users (staff and contractors) would gradually increase toward the Games.

However, the plan was disrupted by the unforeseen postponement of the Games by one year due to the COVID-19. Firstly, since the staff in the Organising Committee would have to keep working even during the postponed one year, it was necessary to secure additional resources (personnel and costs) to maintain the data network for the Games. Secondly, the possibility of discovering bugs and vulnerabilities in implemented products and solutions would increase, and those could reach the end of the product lifecycle (EOL) as well, we had to take some measures for those cases.

There had already been procured an enormous number of L2/L3 switches (7,500 units) and Wi-Fi APs

(11,000 units), and it would have a significant impact on us if those needed firmware changes. So we carefully conducted technical verification, version and security patch control, and continued to take appropriate measures. Eventually, we had no fatal impacts on the EOL issue, and we were able to keep the operating level as initially planned until the Games, with some products receiving special extended maintenance services from partner companies.

Another massive impact of the postponement was the sudden increase in the number of remote access VPN users due to the encouragement of telework at home. Since we had already implemented the remote access system at the time, we were able to keep up with the sudden change in needs by adding licenses and redesigning the system to improve performance. The usage trends of this remote access VPN are described in detail in 2-9 of this special issue.

However, "the management network" was a completely closed network that could only be connected on-site, and we could not perform the maintenance and operation work remotely. The lack of consideration of secure alternatives for operations during a pandemic would be one of the points to be regretted.

4. Conclusion

The data network for the Tokyo 2020 Games had been supported by the dedication of many members of the maintenance and operation team.

As well as considering operability at the Games time in designing the network, we implemented the data network more than one year before the Games so that the telecom team started their maintenance and operation activities from then, assuming their respective positions in TOC and Venues in the future. It enabled the teams to gain operational proficiency and improve their skills through long-term preparation. As a result, the postponement of the Games gave us more than two years to make it mature, and we could refine the operation document and improve the operation level based on various experiences.

On the other hand, the capacity design and deployment plan of the data network for the Games had been based on information from previous Games, and it should not be clear whether it would be optimal until users entered the venue and started using it. We had to be prepared for more changes than anticipated because the IOC had advised us that "Too many changes, but change with a smile" from the beginning, and we know there should be high expectations for the IT environment in Japan/Tokyo from the stakeholders.

It was very effective to make the telecom team members aware of this situation and building up their tolerance for sudden changes in requirements and additional requests. The postponement of the Games by one year should also be one of the "changes". They could handle various SRs that occurred even at the last minute as quickly and flexibly as possible in response to each user requirement without critical disruption.

The stable operation of the data network for the Games was made possible by diligent preparation and high awareness of all members of the telecom team. I would like to express my sincere applause to all of the team for their efforts.

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