Beyond 2020 —Olympics, Broadcast Production, Internet—

3.1 Introduction

How will people remember 2020? Life is different for everyone, but no doubt many will share the memory of 2020 being the year the COVID-19 pandemic began. COVID-19 had a major, widespread impact on our lives as it raged around the world. One effect was the postponement of the Tokyo Olympic and Paralympic Games. People may have a range of views on what its significance really is, but 2020 was supposed to be remembered as the year the Olympics and Paralympics came to Tokyo.

3.2 The Olympics, Paralympics, and Broadcast Productions

Broadcasting, particularly television broadcasting, has become inseparably linked with big events in recent years, especially major sporting events such as the Olympics and the World Cup. The media wants large-scale events to attract an audience, and event organizers rely on the mass media to more effectively use their influence. Wide-bandwidth broadcasting can provide a rich media experience (visual, auditory) and thus occupies a dominant position when it comes to covering big events that attract the interest of people all over the world. Broadcasting is the only mechanism that allows people in every country around the world to receive rich media virtually simultaneously. The Internet is still outmatched when it comes to this sort of content distribution on a massive scale.

Even in this context, the Olympics and Paralympics broadcasts are quite special. A huge number of events take place in a short period of time, with programs produced and broadcast around the world. Since 2008, Olympic Broadcasting Services (OBS), established by the IOC, produces international coverage on all Olympic and Paralympic events, and this coverage is supplied under contract to broadcasters around the world. In Japan's case, a consortium of broadcasters called the Japan Consortium has a contract with the IOC. The coverage supplied does not contain announcer/analyst commentary in every language, nor any individualized coverage, so the broadcasters have to do the work of adding these elements into the production. Sudden demands often arise with these sorts of large events. An athlete may win an event unexpectedly (surprise contender), sparking a sudden need for live coverage, or two high-profile events may end up being held at overlapping times. Such uncertainties inevitably lead to a shortage of production resources.

Production of this sort of event coverage is generally handled on-site. This can mean, for example, sending a large truck converted into a broadcast vehicle (called an outside broadcasting van or OB van) to set up in a stadium parking lot, tasked with collecting feeds from cameras and microphones deployed inside the stadium, and with staff stationed in the vehicle to edit the audiovisual content. A prime example of this editing work would be video switching, but there is a whole lot of production work involved besides, including video camera aperture control and microphone audio mixing & adjusting. So a lot of broadcast engineers are needed on deck.

OB vans are fully equipped with all the production equipment they need so they can function independently. The onboard equipment has equivalent functionality to that back at the station but with slightly fewer inputs and outputs. But when the vehicles are not in use, that onboard equipment remains completely idle. This is because it is not realistic to install and remove the equipment every time the vehicles are put into use given the onboard space limitations. But in some cases, such as when the equipment is quite expensive, broadcasters need to make as much use of it as they can, so it is transported into the field on occasion. In any case, this is not an efficient way of doing things.

Ensuring enough broadcast engineers are on deck can also be difficult when covering separate events taking place at the same time. Broadcast engineers have to travel to the location to operate the equipment, which creates a travel time overhead. This makes it impossible for them to cover multiple events at the same time, so multiple broadcast engineers must be assigned separately to each location. And when covering events too far away for a day trip, the broadcast engineers often have to stay in faraway hotels.

3.3 Path and Barriers to Remote Production

I began to wonder if we might use IP to address the situation by using it to facilitate the remote production of broadcast programs (Figure 1). In simple terms, this means equipping cameras and microphones with an IP gateway so that video and audio recorded on location can be ferried over long distances in high quality via IP, allowing the production work to be performed at the station. This opens the door to the idea of gathering the necessary resources for producing programs in a single place. Only a bare minimum of equipment need be taken out on location, and engineers need not travel to perform their jobs. No doubt this would not only reduce overheads but also increase efficiency and quality of work (although it may be sad news for engineers fond of going on the road).

The desire to improve efficiency by consolidating equipment as well as the engineers/operators who use it is a common one for the ICT industry. Amid the ongoing trend of shifting from on-premise systems to the cloud, from solutions to services in the past dozen or more years, companies have constantly sought to save on labor and streamline investment outlays by adopting ICT. All sorts of media has come to be distributed via IP over the last 20 or 30 years, with the last remaining area of any considerable size being that of broadcast production technology.

More and more broadcast equipment is supporting IP, partly urged on by the roll out of 10GbE and 100GbE high-speed Internet. Support for IP has ramped up rapidly in the last five or six years, and it is now commonplace for broadcast equipment to feature an Internet interface (mainly SFP+, SFP28 or QSFP). In response to this technological innovation, IP technology is increasingly being implemented in large-scale broadcast station equipment, particularly in the US and Europe. Within the broadcast equipment space, IP technology has now spread to the point that it can no longer be left out of the conversation on future prospects.

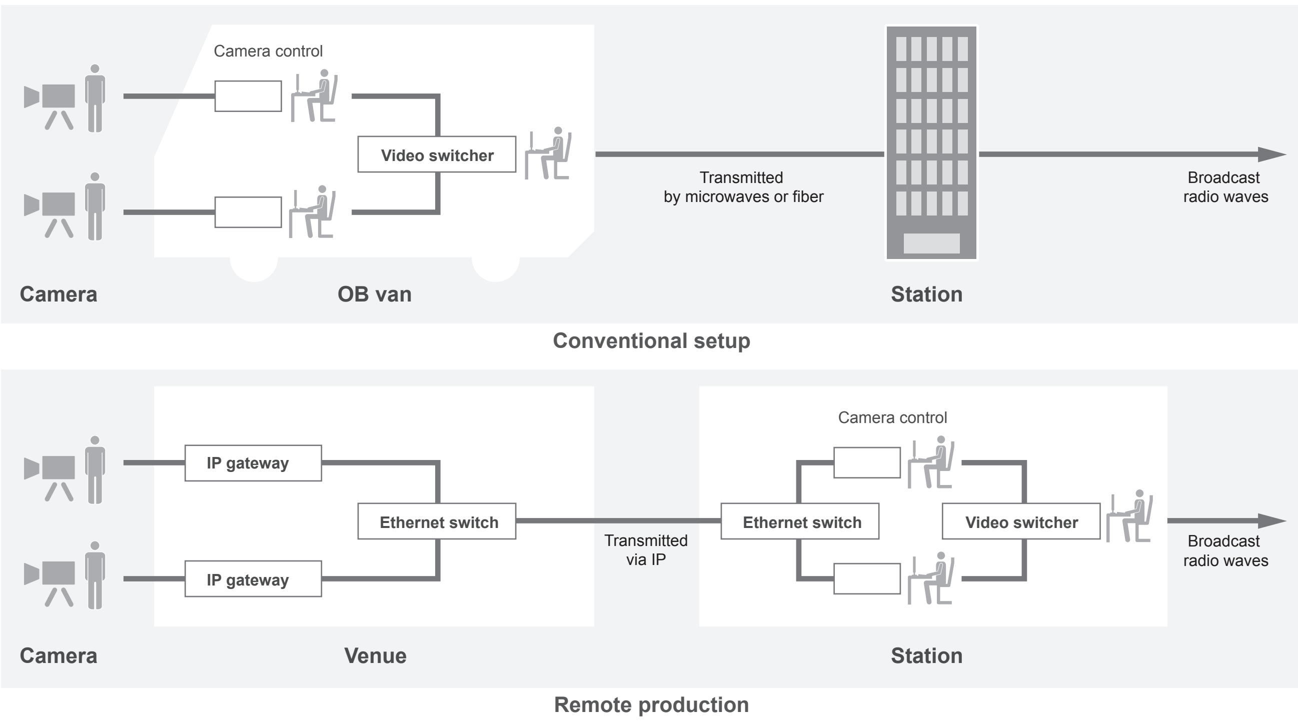

Figure 1: Conceptual Diagram of Remote Production

As with IP support at the station building, high-capacity data lines are also essential to making remote production work. Covering large sporting events typically involves setting up over 10 cameras and dozens of microphones to record events. If these sources are to be transmitted without compromising current production quality levels, then several data lines in the 10GbE or 100GbE class are needed (transmitting full high-definition video without compression requires around 1.5Gbps, and 4K requires around 13Gbps). These are far greater quality requirements than those for online broadcasts created for OTT (over-the-top) services. Telecommunications carriers do provide these sorts of high-capacity data line services, but in almost all cases they involve annual contracts with high monthly charges. This is above and beyond what broadcasters need given that they budget outlays on a program-by-program basis. It also takes considerable time to sort out the necessary arrangements for setting up these data lines, so the reality is that these services are not amenable to "casual" use cases such as setting a line up for three days only to cover a weekend event.

Remote production can be seen as one type of work-style reform, and from a big-picture perspective, it can be viewed in terms of the digitalization trend. Digitalization can not only facilitate workflows, it can also alter them from the ground up. Put differently, unless you ultimately seek to overhaul the workflow itself, you cannot maximize the effect of your efforts with digitalization. However, one opinion voiced by some involved in production following a remote production proof of concept we conducted can be summed up as follows: "This sinks a scalpel into our practice of centralizing production on-site by gathering people together." The problem, it seems, is that IP divides the flow of communication that close proximity had made possible. This is no longer a technical issue; it falls into the realm of organizational theory for digitalization. It is also in some sense a test case for how the industrial and business world should prepare in the face of a declining birthrate.

Evidently, issues remain to be addressed if we are to implement remote production on a daily basis. To liken it to climbing a mountain, we have climbed 50%, or perhaps 80%, of the way up the summit trail, so the truly hard yards still lie ahead of us. While we are gradually acquiring the skills, gear, budget, and timing we need to make the summit, there is a sense among those involved in the process that bringing these together all at once will be difficult. Some, perhaps, may even give up and turn back from the summit.

However, IP networks surely have other contributions to make. Instead of aiming for the world's highest peaks right out of the gate, another approach is to start by tackling the mountains that are currently more within your capacity to summit. Just as I was thinking this, the COVID-19 pandemic threw the world into disarray. And an issue of concern to everyone and of much greater urgency than the implementation of remote production came to the fore. Namely, measures to prevent the spread of COVID-19 in the workplace. In Japan, for example, we urged people to avoid the 3 Cs (closed spaces, crowded places, and close-contact settings).

3.4 The Important Relationship Between Remote Work and Networking—A Test Using VidMeet Online

Remote work is these days seen as a key part of companies' response to the COVID-19 situation. Until the present moment, remote work usually came up in the context of work-style reforms, but it is now held up as an effective strategy for combating viral infections. Broadcasters are no exception here, and workshops on remote work were even being held at European broadcasters as of March 2020. Limits placed on the number of people allowed in workplaces made it impossible to assemble the teams needed to produce programs in the usual way. To get around this, employees log into their workplace via a VPN to control resources at the station remotely. Among the announcements and discussion in this area was a story about one stout-hearted individual who controlled the switcher that is essential to live broadcasts from a remote location, which really seems like quite an astonishing feat.

So, what form should networking that facilitates remote work take? To me, this seemed like an issue worth pursuing in 2020, and I sought an answer from the real world in the form of a demonstration. That demonstration was VidMeet Online, which was run online by a number of interested individuals from October to December 2020.

VidMeet is an event that began in 2017 as a Video over IP study group. I have organized nine such meetings at IIJ so far, but COVID-19 forced us to suspend these activities. So in the early summer of 2020, an online meeting for interested individuals from manufacturers and providers of broadcast and IP equipment took place. With all sorts of events shifting online or being cancelled, the attendees discussed the prospects of themselves organizing online events. As we settled on a direction, a decision was made to use the VidMeet name in the event title. VidMeet provides an opportunity to contribute to the community, and I think it was well received as an appropriate name for the event.

The theme of VidMeet Online is "New operational styles created by broadcast equipment combined with the Internet, datacenters, and the cloud". We were interested in what would happen if broadcast equipment were centralized in datacenters and the cloud and linked via the Internet. The appeal of this event is in figuring out how remote networking, which is a readily available resource, can contribute in a broadcast production setting. We looked at what we can do right now with even less footwork than is required with remote production (Figure 2).

The concept for the event was to use the datacenter as the broadcast station and participating companies' offices as the broadcast locations. The Flet's Hikari service was

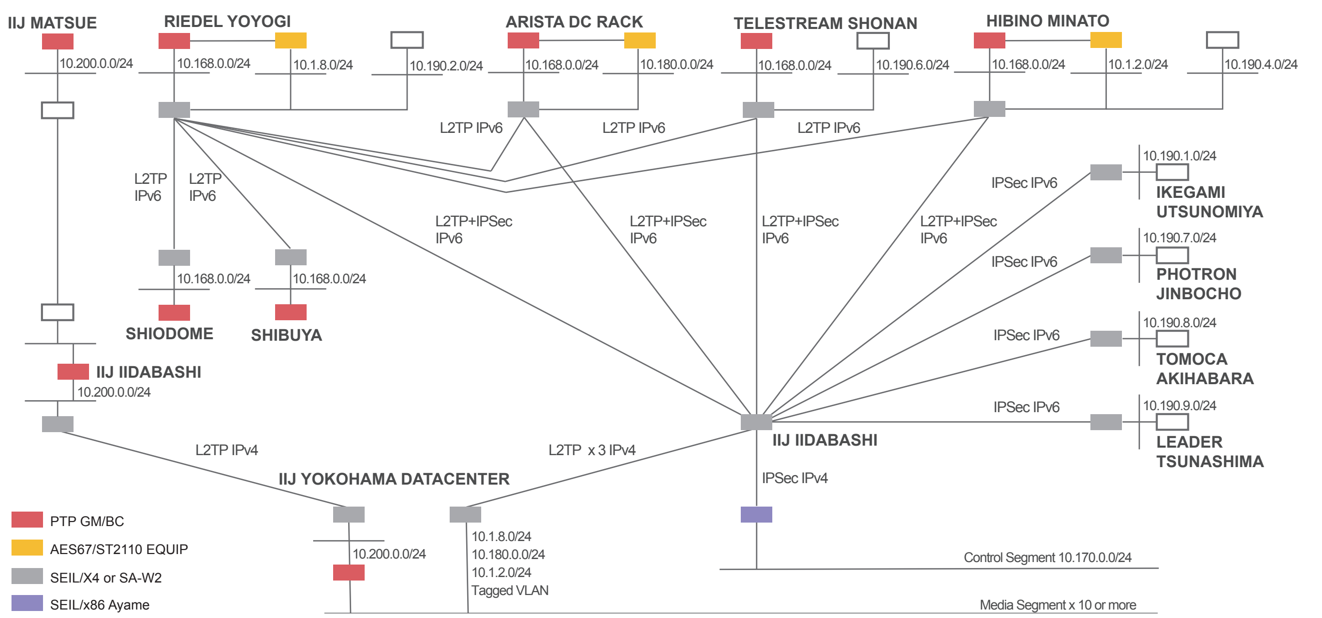

Figure 2: VidMeet Online Network Structure

used to connect the companies and the datacenter, with the connections made via an Internet VPN (Figure 3).

We had two reasons for locating the broadcast equipment in a datacenter. One is that datacenters would have to be a candidate destination when looking to outsource and relocate station systems. While it's probably not possible to relocate all broadcast equipment, we wanted to explore the possibilities. For resources that can be moved to a datacenter, the option of ultimately moving into the cloud also comes into view. The other reason is that we wanted to connect the broadcast equipment to a high-capacity Internet line and control it remotely. If we could successfully perform a demonstration of broadcast equipment located in a datacenter over the Internet, this would mean that the technology could also be used for remote networking. The users taking part in the demo would be unexpectedly verifying the practicality of this technology.

The following tests were run during the VidMeet Online demonstration.

- Place the hardware control panel in the office and control the video processor installed in the datacenter via VPN.
- Feed voice packets generated in the office via a VPN to the voice processor at the datacenter for mixing.
- Operate the video packet analyzer installed in the datacenter from the office via a Web browser.
- Control the broadcast camera robot arms installed in the office via an Internet VPN.
- Configure and operate the network switch via a VPN.
- Remotely control the video server set up in the datacenter.
- Send PTP packets over VPN to synchronously drive broadcasting equipment at multiple remote points.

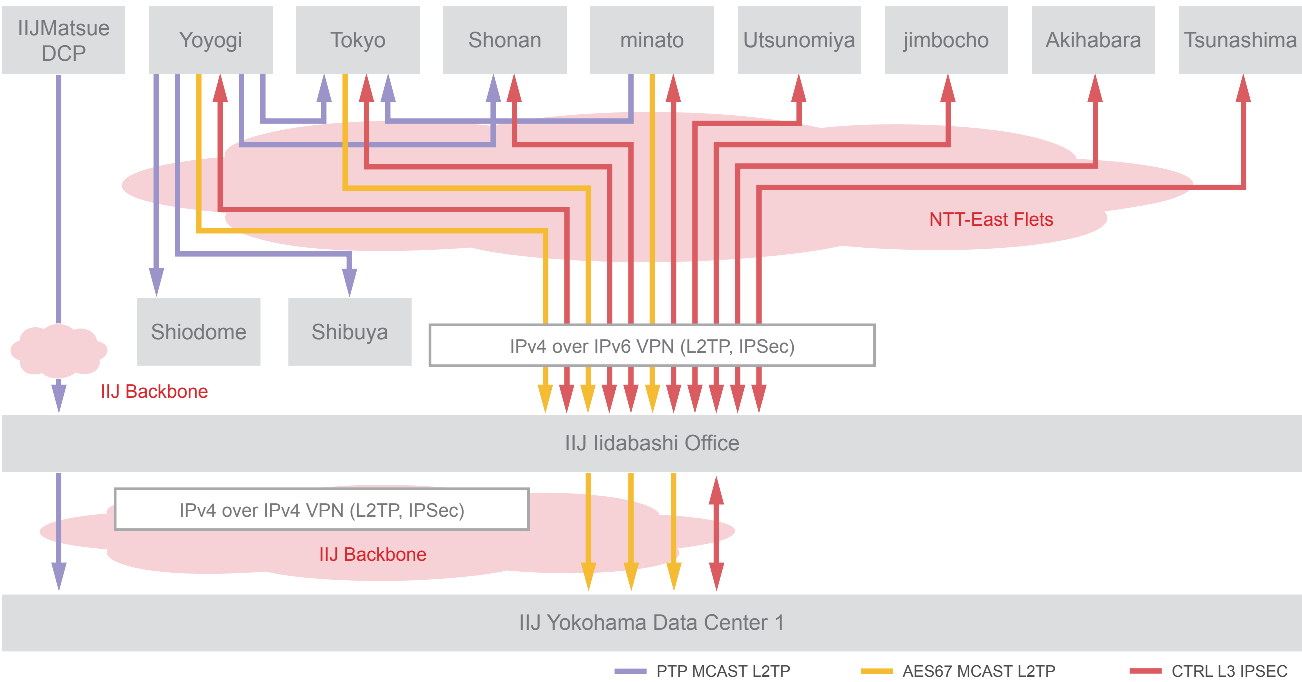

Figure 3: VidMeet Online Flow of Traffic over VPN

We also set up VMware ESXi servers in the datacenter on virtual infrastructure, installed applications on the virtual servers, and mainly operated control servers.

- The control servers installed on the virtual servers control the video server equipment set up in the datacenter and at the remote locations.
- We installed a monitoring application on the virtual servers to monitor the various devices.
- Interoperability between devices is checked on a metadata control server on the virtual servers.

Figure 4: Rack-mounted Broadcast Equipment

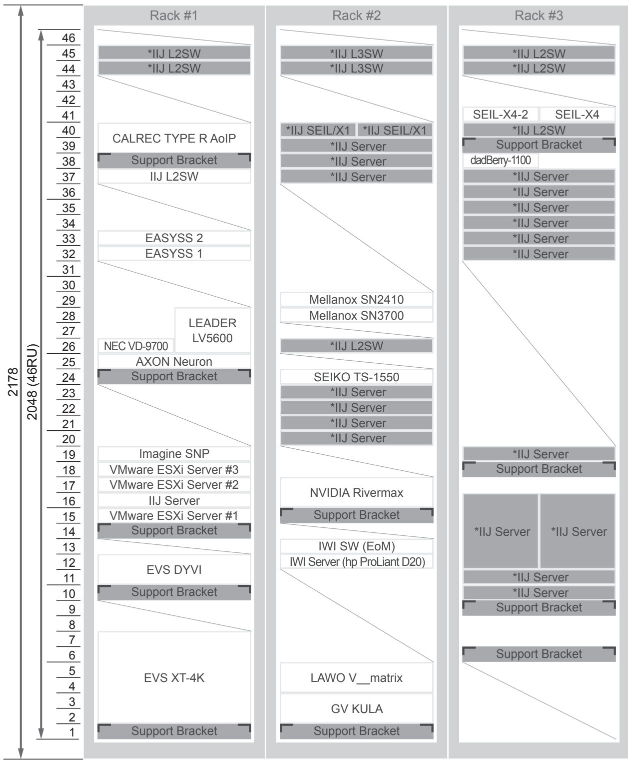

Figure 5: Rack Mounting Schematic

Datacenter racks usually have routers, switches, and servers installed in them, but for VidMeet Online the racks contained the sort of equipment seen in broadcast stations and vehicles. Since this is a rare sight for a telecommunications carrier's rack, I obtained permission to show you some details (Figures 4 and 5, Table 1).

When we actually built the VidMeet Online network, my thought was, "This could, surprisingly, be quite sufficient for practical purposes." We only used general-purpose protocols—L2TP, IPsec, and OSPF—to build the VPN, so it was

Table 1: VidMeet Online Participants

Arista Networks, Inc.
IKEGAMI TSUSHINKI CO.,LTD.
ITOCHU Cable Systems Corp.
Internet Initiative Japan Inc.
Intelligent Wave Inc.
NVIDIA Corporation
OTARITEC Corp.
Servants International Corporation
Seiko Solutions Inc.
Telestream Japan GK
NEC Corporation
TECHNO HOUSE INC.
TOMOCA Electronics Co., Ltd.
Network Additions Co., Ltd.
Hibino Corporation
PHOTRON LIMITED
Macnica, Inc.
Media Links Co., Ltd.
Leader Electronics Corporation
Riedel Communications Japan KK
One Diversified Japan GK

a fairly basic setup. Yet the tests we ran using the network were extremely wide-ranging, as listed above, and I think in terms of testing aspects of remote control and remote work, there have not been many examples of events like this around the world.

We ran these tests continually in the form of demonstrations from October 6 to December 11, 2020, announcing the results through webinars as well as seminars run by participating companies. We held a total of 16 webinars with over 300 cumulative attendees. The webinar presentations and announcements from each company have been archived, so I encourage you to visit the website at https://vidmeet.tv/.

It's worth noting that we even ran the project itself via remote networking. Although we did bring the equipment into and later remove it from the datacenter, and although physical work was performed by the participating companies, we controlled all the installed equipment via the network. Meetings and webinars took place via Zoom, with no physical gatherings held among project members. Networks can be highly useful from the perspective of project management too. Looking forward, I think this will prompt us to take a fresh look at how to best divide up things in terms of the importance of being on-site and what tasks can be done online.

3.5 Network Headed for the Cloud

VidMeet Online demonstrated the technical feasibility of remotely controlling broadcast equipment. The key going forward will be how we are to apply this knowledge to production environments and actual project proposals. We have opened the door to the possibility of connecting systems in broadcast vehicles and so forth via mobile VPNs for centralized monitoring in the cloud. Naturally, we cannot say that using mobile connections in the field is 100% safe and stable. Congestion can occur at crowded event venues, for instance. Data line selection becomes all the more important if the idea is to use cloud technology. A range of scenarios remains to be considered, such as the use of Flet's services in addition to mobile and the use of network services directly connected to the cloud.

Use cases for cloud technology in broadcast production and broadcast station systems are unquestionably on the rise. This has been happening in other industries for several years now, and broadcast stations have already started working on Web servers and video streaming. Cloud technology is one of the most impressive fruits of the Internet and the ICT domain in general, and there is very little choice but to use it at this point. One example is the centralized control and monitoring of cloud-based network devices.

The combination of devices used in broadcast production systems differs depending on program content, specifically program scale and direction. Until now, the equipment was simply set up on location, but things are not so simple when using IP. IP addresses must be assigned first of all, and we also need to configure network switches, implement PTP, and check and configure monitoring of connections between devices. Setting up complex systems like this without IP engineers would be quite problematic. The training and development of IP engineers at broadcast stations is still in its infancy, and the reality at present is that broadcast engineers are simply doing what they can to pick up IP technology in between performing their main work duties.

Adopting tools used in the ICT field is likely to be effective in this environment. Typical examples are applications for the centralized management of network switches and tools for monitoring broadcast equipment. For example, installing, operating, and managing network switches manually is not scalable for large-scale systems; tool-based centralized management is efficient in such cases. And these sorts of tools are adaptable to dynamically changing situations. The existence of tools that can set up and run equipment without being physically present on site is also a huge help in terms of reducing engineer workloads. Indeed, not having to travel to the location and the ability to set things up in advance is synonymous with avoiding the 3 Cs.

Perhaps the real benefits of networking are something best experienced through not-so-glamorous aspects such as remote monitoring and the operation of equipment. Networking technology allows you to perform work right at your fingertips or anywhere around the world with essentially no distinction between the two, and connecting devices together may serve to reduce some of the effort that was until now unavoidable. Looking at it from another angle, we could say that networking is an indispensable technology for enhancing the quality of work performed. So it offers exactly the same potential benefits as remote production.

So evidently considerable scope remains for services and solutions that employ networking to contribute to better broadcast production environments. There remain many pockets still to be tapped.

One point that bears mentioning here is that these sorts of networking applications were certainly not born out of the COVID-19 situation. What has happened is that COVID-19 has brought methods that were already around into focus for pretty much everyone. Indeed, many engineers in ICT have been working this way for some time. Working remotely from home is naturally an application of networking technology, and so too is the operation of servers located in datacenters and the cloud from an office. In short, these technologies gained renewed attention in 2020 as their effectiveness in helping us respond to COVID-19 became recognized.

3.6 The Great Potential of Cloud Technology and Software

One other key trend is unfolding: the move toward software implementations. Broadcast equipment has a very narrow focus and is only really marketable to broadcast stations. The number of broadcast stations is limited, and it is not an easy market to break into, and this inevitably means higher equipment costs. As such, there is now a trend toward implementing equipment in software using commodity IA servers. Of course, LSI and FPGA are often selected for the processors used in devices that process video and audio in real time, and these sorts of products will no doubt continue to come in the form of specialized hardware ahead. Control servers, on the other hand, do not require as much processing power, so a CPU is often sufficient. This means the products can be implemented solely in software, obviating the need for in-house development and maintenance of specialized hardware, so there are advantages in terms of maintainability and expandability.

The trend toward software implementations has accelerated over the last decade. Appliances based on IA servers were quite common in the past, but sales of software by itself have ramped up more recently. Support for virtualization technology has increased, and taking a further step forward, cases of manufacturers starting to provide their own SaaS are also on the rise. And, needless to say, the underlying foundation of SaaS is cloud technology.

In the future, it will become commonplace for software-based control servers to be run in the cloud, controlling broadcast equipment located in station buildings and broadcast vehicles over the network. An advantage of running control servers in the cloud is that it allows centralized control of many systems at once. And when combined with existing networks and VPNs, this setup allows for control server access from any location. So someone could monitor and control broadcast equipment from their PC. No doubt this form of operational support will be needed in the remote-work paradigm.

Of course, control servers do not necessarily have to be located in the cloud. If there are severe communication latency requirements for the controlled devices, a network topology that meets those requirements will be needed. The pros and cons of running control servers in the cloud should be evaluated in view of the specific characteristics of the application. Perhaps, instead of taking the cloud route, it will become common to have a server cluster within the station building. What's important here is that control servers are set up on virtual infrastructure. This makes migration between devices easy, and looking ahead, it will help lower the barrier to going back and forth between the cloud. In other words, we should be putting preparations in place to maximize the benefits of software implementations.

3.7 Possibility of Providing Clocks via the Network

Now, let's look at a technology by which networking could make substantial contributions in a broadcast production setting. That technology is PTP over WAN.

Across broadcast systems in general, video and audio are sampled, quantized, encoded, and treated as time-separated digital data. A measure of time, or a clock in other words, is essential if the original video and audio are to be recreated from this data. This is not an absolute time clock—one that reads 9:00am on January 1, 1970, for instance—but a relative time clock that is used to synchronize timing. Digital devices are always equipped with a clock. In the case of broadcast equipment, separate equipment is set up to generate the synchronization signal that coordinates the entire system, and this signal is provided to the individual devices. Audio and video can get out of sync during recording and playback unless all devices handle the data at the same time. The clock signal for video equipment, referred to as the black burst signal, has traditionally been supplied via coaxial cable. This method has long been in widespread use. But with the shift toward using IP in broadcast equipment, IP is also now used to transmit this clock signal. PTP (Precision Time Protocol) was developed to synchronize clocks via a network. PTP uses Ethernet or IP to transmit information and provides a high level of time accuracy on the order of nanoseconds. It uses GNSS as the source and generates more accurate time information than signals provided by satellites. Because this information is extremely accurate, it is usable as a synchronization clock signal (it also includes absolute time information). The device that sends this high-precision time information out over the network is called the PTP grandmaster (or the GM for short). The protocol has been standardized by the IEEE, but it has such a wide range of applications that several standards organizations have published profiles tailored to the usage patterns of each industry.

Some barriers to the implementation of this technology do exist, however. All network devices on the routes through which PTP packets pass must support PTP. This is the case not only for the PTP GM and the broadcast equipment that receives the signal but also for the network switches that connect them. PTP-enabled devices perform special processing on just the PTP packets. To maintain accuracy, PTP-compatible devices continuously receive and correct time information from upstream, with the GM being the highest level source. When sending a PTP packet further downstream, this corrected time information is stamped on the packet. PTP-enabled devices must process packets in this manner for each separate Ethernet port. An awareness of this flow of PTP information is crucial when designing the network.

The network switches that currently support PTP are generally middle-class models or higher (probably with price tags of a million yen or more). Not all models from all manufacturers support it, so devices must be chosen carefully when installing a system. Plus, incorporating PTP technology into existing LANs and WANs is likely to be quite difficult. This is because it can lead to equipment being replaced and the question of whether certain services support PTP (there are probably not any WAN services that support PTP). If devices without PTP support exist on a route, the PTP packets will be forwarded with the original timestamp information preserved. The protocol cannot guarantee accuracy in this case, and fluctuations in packet arrival times will occur beyond the range for which it is possible to correct.

When broadcasting on location, there is also the problem of not being able to tell if a signal from a GNSS satellite will be available without testing for reception. Broadcast vehicles cannot always be set up under open skies. In generally good locations, signals may be available from 10 or so GNSS satellites, but clock accuracy is affected as the number of available satellites decreases. When a broadcast vehicle is set up between buildings, for example, sky visibility will be limited, so it may not be possible to obtain a sufficient signal from GNSS satellites. So it is argued that providing PTP over a network would be better in such cases, since a network will definitely be available if the system is being set up in the first place to enable remote production and remote control.

PTP over WAN is a technology to solve these problems. Its purpose is to supply PTP signals to remote locations even over networks without PTP support.

Several manufacturers are trying out approaches to PTP over WAN. IIJ is a member of the RPTP Alliance, through which it is promoting the development of this technology.

The RPTP Alliance is a project launched in 2019 with the aim of forming a proposal for the next generation of PTP. Its objective is to verify and popularize a technology called RPTP (Resilient PTP). Transmitting PTP signals over wide areas has until now required an expensive, dedicated network. In response, RPTP will enable high-accuracy synchronization over long distances, be compatible with PTP, and enable synchronization even on networks that cannot handle PTP signals. The companies currently driving in the RPTP Alliance's activities are Media Links Japan, Network Additions, Seiko Solutions, and IIJ.

RPTP does not modify PTP in any way. So existing PTP GMs do not need to support it. What RPTP does is add modifications to the synchronization algorithm on the signal receiving side so that the protocol can handle the time fluctuations on non-supporting networks. This provides a mechanism for resending rectified PTP packets. The conventional PTP synchronization algorithm assumes a clean LAN environment, and thus the development of RPTP is challenging from a technical perspective. But it is hoped that, because there will no longer be a need for all devices to support PTP, RPTP will ease the strict network design requirements and be easier to use.

The RPTP Alliance also participated in VidMeet Online to test PTP over WAN on the IIJ backbone. An L2 network was constructed between IIJ Matsue Data Center Park (DCP) and IIJ Yokohama Data Center 1 to facilitate PTP traffic. A GM was set up at IIJ Matsue DCP to transmit PTP packets to IIJ Yokohama Data Center 1. And the synchronization signal was converted from PTP to Black Burst (BB) so as to provide PTP and BB synchronization signal sources at the same time to the broadcast equipment. This was the RPTP Alliance's first experience distributing PTP and BB to broadcast equipment from multiple manufacturers. In each case, we were able to establish synchronization without any problems and confirm the broadcast equipment was operating normally (Figure 6).

We have also succeeded in supplying PTP signals to remote locations in tests using wide area Ethernet services outside of the IIJ backbone. Further, we have confirmed that when we generate a BB synchronization signal from PTP and supply it to a broadcast production camera via a coaxial cable, the camera operates normally and the video captured can be transmitted without any problems (Figure 7).

We believe these results prove that RPTP can be effective. The RPTP Alliance plans to continue its efforts toward establishing RPTP as a real-world-ready technology and seeing it deployed in business.

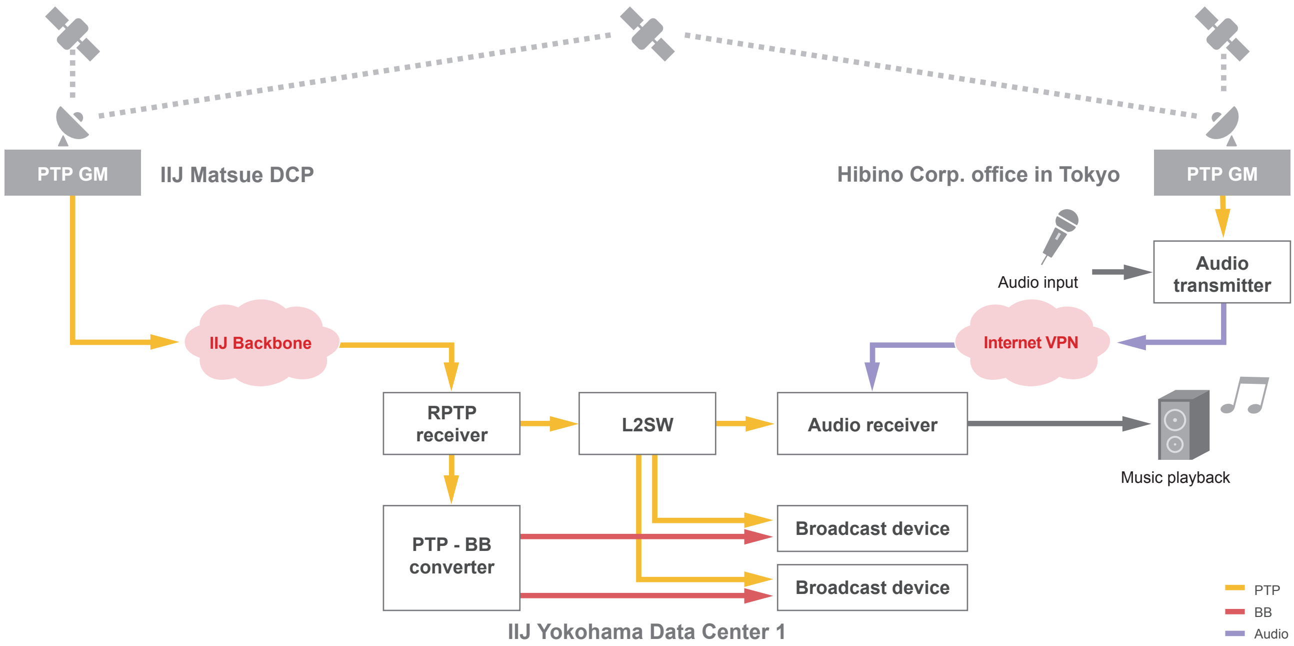

Figure 6: VidMeet Online Tests

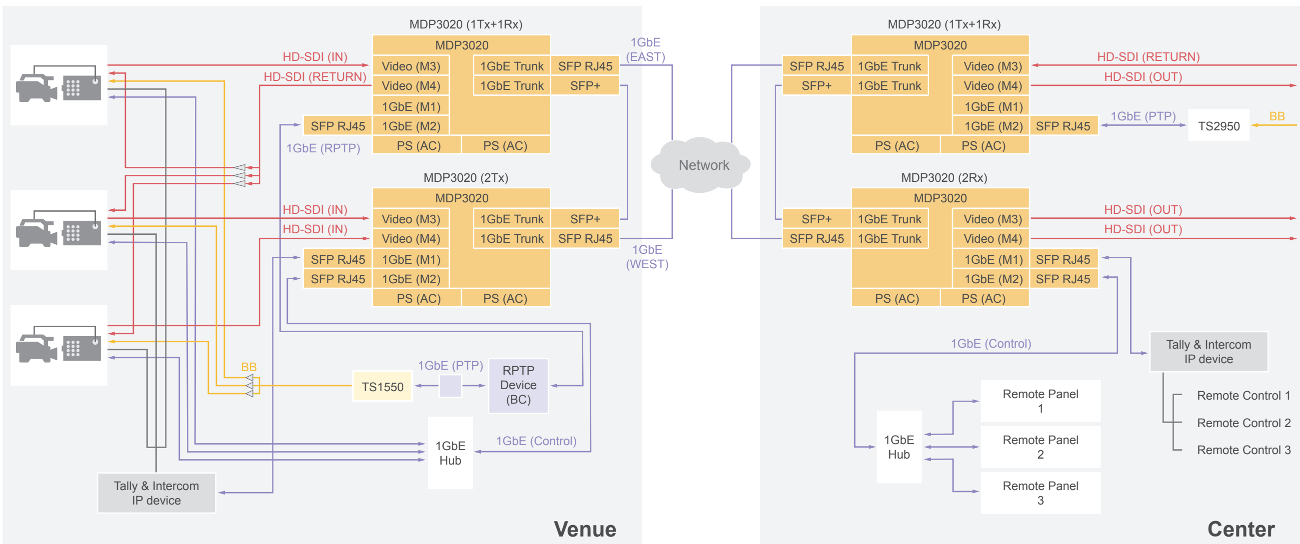

Figure 7: Successful PTP-BB Conversion

3.8 What VidMeet Online Revealed…2021 and Beyond

Eventually, high-capacity data lines will be set up at live broadcast locations. For the 2019 Rugby World Cup, an IP line was laid at International Stadium Yokohama, where the final was held, and coverage of the final was edited and produced in Australia. So while a backup crew and equipment were stationed in Shin-Yokohama, the basic operations were handled in Australia. And thus remote production is actually already a real option in a global context. Remote production achieves efficiency in response to increasing demands, and it will no doubt become commonplace and continue to increase in importance.

Yet the Olympics and Paralympics are held every two years, in the summer and in the winter, so there is a wait between games, and the host country is of course different each time. This is not an easy field to tackle. As discussed, IP has contributions to make to broadcast production in more everyday scenarios. The first step is to connect, at least in part, systems that are not yet IP-networked. We should determine the scope of application for technologies that are already widespread, inexpensive, and easy to deploy. Incorporating these sorts of endeavors into everyday operations and systems will allow us to build up technologies and experience.

I have also been searching for potential business deployments of IP-capable broadcast equipment. In fact, I have a real sense that our customers recognize connection services, which occupy the most basic position among IIJ's services, as a key technology and select them on that basis. Among IIJ's many services, connection services have the deepest history, with a wealth of both technical and sales experience, and with a wide variety of services on offer, making them one of the best services our customers can rely on. And cloud services are essentially rendered meaningless unless the connections are stable. The availability of a range of coverage including Flet's and mobile services in addition to dedicated lines is also a point of appeal. I believe that renewed recognition of the importance of connection services represents the fruits of mutual understanding.

Broadcast equipment and IP networks are set to become more deeply entwined ahead. Networking has an integral part to play in unleashing the true value of the cloud as well as in remote production and remote work. I hope to continue helping drive the evolution of networking as we seek to make it as easy as possible to use in a way that satisfies the many requirements in settings where mobility and responsiveness are crucial, such as broadcast production.

Bunjji Yamamoto

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Mr. Yamamoto joined IIJ Media Communications in 1995 and has worked at IIJ since 2005. He is mainly involved with the development of streaming technology and efforts to popularize Video over IP. He has presided over VidMeet since 2017.