

A photograph of a woman with long brown hair, seen from behind, sitting at a desk and working on a silver laptop. She is wearing a grey blazer. On the desk, there is a grey shoulder bag and an orange power bank. The background is a bright, slightly blurred indoor setting.

WORK FROM HOME
by Ross Video

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Introduction

At the beginning of the COVID-19 pandemic nobody knew what effect this virus would have on our working lives. The impact of COVID-19 has been more profound than we could have imagined, and the majority of us have had to change our working practices and workflows in response.

Our industry has experienced great upheaval, with productions either being cancelled without replacement or completely restructured to ensure social distancing both in front of and behind the camera.

One way to comply with distancing requirements and minimize the potential risk of infection among colleagues is through the adoption of a "Work from Home" strategy, which sees broadcast equipment being moved to the home office. However, there is the question of how this strategy can be made to work effectively in a live production environment or scenario.

Many productions had to respond to the pandemic at very short notice and, in the absence of precedent, simply let staff work from home. This change in approach certainly helped contain the virus, but also made us consider how to produce content more efficiently and in a decentralized way in the future. In addition, every trip to and from a production site has a corresponding carbon footprint that should be considered and minimized. All in all, there are plenty of good reasons why we should take a closer look at the possibilities and solutions around Work from Home (WFH) and Remote Production.

Factors and Considerations

A key consideration for any Work from Home plan should be bandwidth, from the perspective of the relevant monitoring and program feeds. Realistically, not every person in a remote location will have a dedicated high-performance and managed Internet connection like the type available at their regular main facility. The monitoring of uncompressed signals (SMPTE ST 2110) will probably not be possible in any private household. Likewise, not every private household offers public IPv4, which allows NAT rules and port forwarding to be used.

Another important decision that needs to be made relates to equipment. Does it make more sense to move equipment to remote sites or leave the equipment in the managed main facility while the feeds from different locations are transferred to the production location(s) but the staff still carry out the production from home? Shipping large racks of equipment to unknown (probably private) production locations can be a logistical and operational challenge, and remote control can be troublesome. This is especially true when you are not on-site and want to rewire something, or if you want ship equipment back and reconfigure it after the production has finished. The amount of equipment that is on-site should therefore be as low as possible to keep the monitoring and control as simple as possible.

Keeping the production equipment in your main facility may be preferable insofar as the (limited) technical staff at the facility can support you with equipment preparation if needed. You can also rely on the facility's managed services, such as VPN, predictable upload and download bitrates, redundant networks, and access to servers, all of which may help give you more confidence.

Several new solutions and services have recently been launched to compress a signal and make it available worldwide via low-latency streaming. This is possible both from and to dedicated hardware or software decoders, as well as completely browser-based or app-based applications via services such as Zoom, Microsoft Teams, or Skype. Over the following pages, this paper will outline some common and rising open-source streaming formats that can help you with this task. Free and paid for services are both briefly outlined, any of which can help support a Work from Home production.

Services and Solutions

WebRTC

- Based on HTML5 and JavaScript – uses (S)RTP for the transmission
- Can mainly be used to send data (voice/video/other data) in peer-to-peer fashion across browsers in real-time
- Web socket available
- It will need an upload/download bandwidth of at least 200-250kbit/s to enable a connection (with very poor picture quality)
- Error Correction: Very limited recovery of dropped frames / focus on "fire and forget". Public internet could somehow lead to bad picture and connection quality and lags in the stream
- Depending on the location, operators must deal with possible bandwidth limitations (find alternative distribution ways over 4G/5G/satellite link/etc.)
- CPU for encoding and decoding video – the better the quality, the higher the CPU load (but it's normally fine)

SRT

- “Secure Reliable Transport” – Invented by Haivision in 2012, open source since 2017
- Very fast if HW encoder/decoder are used (100msec-150msec end to end latency)
- Format-agnostic streaming container – can be encrypted with AES-128/AES-256
- UDP based / no TCP allocation needed
- With a public IPv4, NAT rules/port forwarding for one port needed only
- Browsers do not allow UDP socket natively at this stage – no web socket (for now)
- Error Correction: Intelligent packet retransmit mechanism implemented on top of UDP data flow
- Analyses bandwidth and roundtrip times steadily to adjust its error correction and increase stream stability
- Encoder/Decoder combination could be used for getting feeds from the remote location with a good and reliable error correction method instead of using WebRTC and tools like Microsoft Teams, Skype, Zoom, etc.

RIST

- “Reliable Internet Stream Transport” is also an open-source, high-performance media transport by using RTP / UDP at the transport layer to avoid the limitations of TCP (ideals somehow comparable to SRT)
- Load sharing via bonding – several paths from encoder to decoder can be taken (mobile, wifi, etc.) and can be reconstructed at the receiver side
- No web socket (for now)
- RIST developers describe RIST as more suitable for broadcast than SRT as they support additional broadcast features to transport valuable content over public internet

Conference Tools (Zoom, Microsoft Teams, Skype)

- Managed tools or services to provide low latency video and audio transmission – especially for video conferences
- In our example, customers can use these tools to stream Multiviewers or feeds to the production staff to enable remote monitoring of audio and video signals
- The video signals from the production can be taken as an input to these tools with the help of small video-to-webcam converters like AJA U-TAP, Blackmagic Design WebPresenter, or Magewell USB Capture
- Most of the time 1x Multiview is fine for this kind of application
- It will combine many signals in just one stream
- It will not slow down the available upload/download bandwidth like compared to transferring multiple feeds

VPN

- “Virtual Private Network” – This can be used to access to your production network to enable secured TeamViewer access and a Ross DashBoard connection for controlling the production equipment remotely
- In segregated networks, many VPN connections often do not provide an IP address in the same subnet as your production equipment, so the IT group should be asked to help with this

TeamViewer

- For accessing the devices that are in the main facilities, the software application TeamViewer is a good choice

- TeamViewer is recommended for XPression/Tria/Mira instead of Microsoft Remote Desktop as it won't affect the graphics card performance (GPU)
- It is also capable of playing back the remote audio on your remote production kit (e.g. Graphite's RAVE Audio Mixer)
- If your IT group is pointing at security issues, TeamViewer can be set to “local mode”
- It will accept connections that are in your LAN only
- It will not communicate to the TeamViewer server on the Internet
- If you access the facility with the help of a secured VPN, you can control it easily with a local connection and use all the functionalities the remote tool can offer

Ross DashBoard

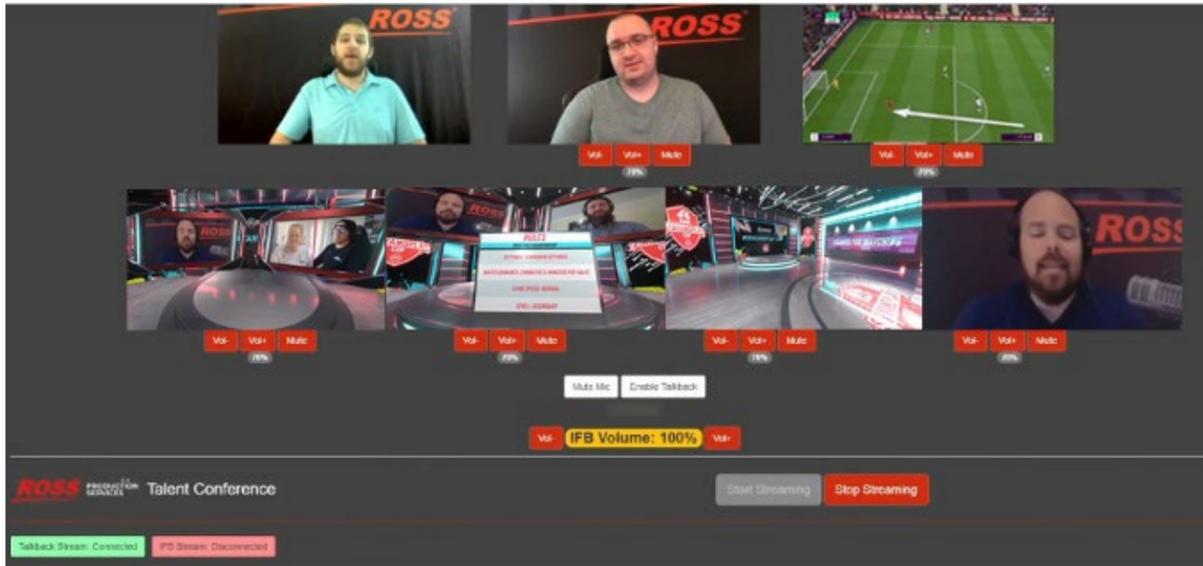
- DashBoard is Ross Video's free control and monitoring software for (nearly) all Ross products as well as third-party products that are compatible with openGear and DashBoard
- DashBoard is a powerful tool that is used to create custom control panels that can interface with the products, simplify workflows, and potentially communicate with third-party products (via TCP commands for example)
- In case of upload/download issues and long loading times, DashBoard can create a DashBoard Proxy Server
- It will transform the openGear protocol (OGP) binary to a lightweight JSON-type OGP, which uses JSON's bulk messaging functionality to send fewer messages
- The proxy server can cache information and send them as a compressed message
- This can be much more robust over a limited bandwidth VPN
- OGP binary 26MB file converted to OGP JSON 800kB file
- Our DashBoard user guide provides more information on configuring and accessing a DashBoard proxy server

Intercom

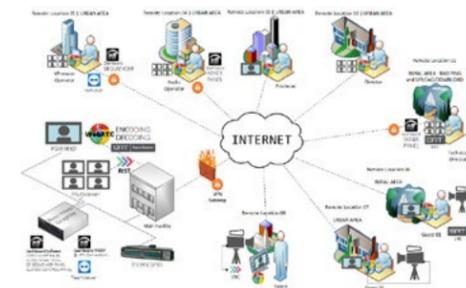
- Communication is the key – so this tool needs to be selected wisely
- Conference tools like those described above are not the ideal solution for this, as they allow everyone to talk
- In advanced Intercom systems, multiple line feeds (program, PFL, aux) can be fed into the intercom for monitoring purposes
- Remote and cloud systems are available for many intercom systems out there in the market, with options that are hardware or software panel based (some of them can be installed on your mobile device)
- Consult your intercom partner for a tailored solution

Ross Production Cloud

Ross Production Services (RPS) recently announced an innovative integration of all these services and technologies into one platform – the Ross Production Cloud. PRS developed this platform as a direct response to the challenges posed by the pandemic, and it has already been used by a number of international customers to support their live productions. In each case, guests and staff were all in different locations, and RPS used the Voyager graphics rendering solution from Ross to create a hyper-realistic studio environment that contained virtual displays and enabled the participants to be integrated directly into the set.



The monitoring backbone of these productions was a cloud solution that streamlined the video monitoring and Talkback functionalities for both their clients and production staff. This monitoring was built on WebRTC to integrate it more easily into a website and offer the participants and staff control buttons for Talkback. The input feeds from the guests can be ingested with a software decoder that supports multiple standards and is capable of handling SRT, HLS, RTP and WebRTC. These streams can then be output as SDI video to a production core which consists of a central SDI routing platform with integrated MultiViewers (Ross Ultrix) and SDI video switcher (Ross Carbonite Ultra or Ross Acuity).



Example Use Case: Ross Graphite

In the use case example shown in the diagram above, we used a Graphite all-in-one 4RU production solution that combines a video switcher (on dedicated hardware), a RAVE audio mixer engine, and a clip player and CG for on-air graphics. The entire production can be prepared before the show and controlled during the event with the help of Ross DashBoard and TeamViewer via VPN, as they are in the main facility within a managed network controlled by the IT group.

This workflow will also enable the technical staff members to rely on a managed network infrastructure instead of outsourcing the production and locating it at the talent or guest location where you might not know how stable and well-maintained the connections are. The login to VPN allows every production staff member (XPression, Audio, Producer, Director and Technical Director) to access the production equipment in the network via VPN. On top of this, every production staff member can get the MultiViewer feeds from the Graphite system displayed within a normal browser at their location via a WebRTC service. Depending on the implementation of this streaming service and the infrastructure, this path can also be realized in many ways: it should mainly be built upon on a low-latency encoding and decoding solution. If the preferred method is SRT or RIST, a normal VLC Player or specific hardware decoders can decode these streams. Below the line, the most important factor for a successful production is latency. The lower the latency, the more the production staff can react with speed and confidence.

Audio Operator

The Audio Operator can access the Graphite's built-in RAVE software audio mixer remotely. RAVE allows for mixing and processing of up to 48 stereo mixer channels including EQ, limiter, and compressing. If the signals are routed correctly, the operator can also listen to the feeds and correct the levels remotely by using TeamViewer, as it will tunnel and playback the audio of the remote unit. It is also possible to connect a physical audio surface with faders via USB to the audio operator's PC, which some operators may prefer.

Technical Director

The Technical Director can mix the show with the help of Graphite's built-in software panel within Ross DashBoard. Again, the interoperability of DashBoard is quite powerful here and if the Technical Director wants to use some hardware buttons, they can take a Carbonite panel and control the Graphite system via VPN. A very minimalistic control panel option could be an Elgato Stream Deck, which is a consumer panel known for esports and streaming applications. The Stream Deck can be connected via USB to the Technical Director's PC which can communicate with the Graphite system via VPN with the help of RossTalk commands and control it remotely.

XPression Operator

The XPression operator can use TeamViewer to control and manage the graphics. This makes sense for more flexible access to the CG, but there are also other ways to access the sequencer. Using the XPression DashBoard API, the engine can provide a sequencer control panel with preview where the operator can also quickly update the template content within DashBoard. This option can be a very handy tool, especially for scripted and regularly repeated show formats.

Talent and Guests

Turning our attention to the other side of the lens, the feeds from the talent and the guests can be transmitted to the main facility in many ways, and each signal path has its own set of advantages and disadvantages. In our example, we used WebRTC which is appropriate for a predictable and stable upload and download bandwidth and lower ping. Due to its simplicity, it helps get guests into a show quickly, but it's not particularly creative and viewers may get the feeling that they are watching a conference call that is being broadcast live.

Alternatively, the guest's contribution could be managed with dedicated hardware encoders (SRT and/or RIST). This would enhance the quality of your show significantly but could also require additional equipment and cameras at the remote location. This may make more sense for longer production series with a limited amount of technical hands, as it allows staff to set things up remotely and then leave the production location and socially distance. This streaming also uses the internet for sending signals back to the main facility. In comparison to a satellite link, the delay is very low and could certainly enable people to interact with each other during a conversation. In our example, these encoding and decoding solutions are located at the remote locations in rural areas. These can be used for both encoding and decoding at the remote locations, which means getting camera feeds into the main facility and pushing feeds out of the main facility to the production staff or guests at the remote locations.

Conclusion

To sum up, work from home productions are absolutely possible – it's just a matter of how we implement and use the tools that we already have. There are many ways to separate the production staff, guests, and talent from each other safely. Even the production staff can work from home depending on the show, and the ability to stream over the internet makes this possible. However, a successful work from home production requires good preparation and planning with a sharp focus on what you need to see, hear, and especially control. Control is the most important factor, and the powerful DashBoard control system from Ross can help you radically simplify workflows and manage your production much more effectively.