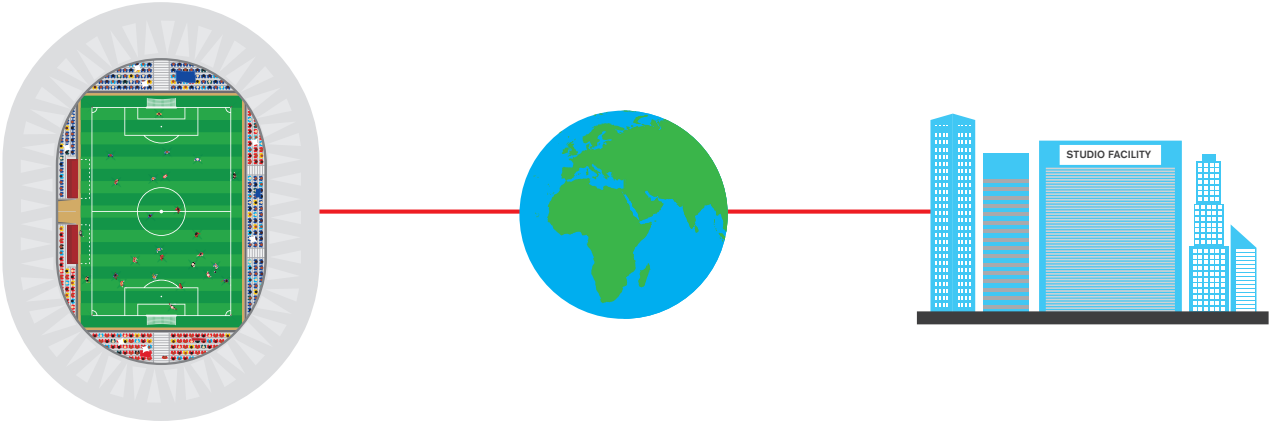
REMOTE PRODUCTION – GOING THE DISTANCE

WHITE PAPER 2017 – ABSTRACT

Remote Production is fast becoming more prevalent as many broadcasters look to it as a means of generating a wider range of high-quality content.

However, this method of live broadcasting has its own very specific issues. This white paper identifies those issues with regard to audio production and offers a practical and cost effective solution.

An illustrative case study is included to give context to the discussion points and demonstrates the application of the solution.



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REMOTE PRODUCTION – CONTROL OVER DISTANCE

Remote production gives broadcasters the ability to capture a wider range of live events, such as regional sports, news or music festivals, and mix them in a remote facility hundreds or thousands of miles away.

Many of these events might be of restricted interest, and may be broadcast to a narrow audience demographic. They may be regional news events which require a lot of content generation in a short space of time. They may require temporary infrastructures which need to be highly portable.

Remote production technology provides a realistic alternative for these events – the production of high quality content with fewer resources.

The barriers to effective remote broadcasting are speed (or latency), control and infrastructure.

1. Speed; the single biggest issue. Broadcast audio workflows rely on effective monitor mixes with no latency. This can be difficult to achieve when your studio is hundreds or even thousands of miles away.

To avoid the audio making a long distance round-trip, on-site remote production equipment should have local DSP to generate monitor mixes and IFBs with no latency. An operator in a remote studio needs direct control over channel functions such as mic gains, aux send/monitor mix levels and fader levels from the remote console control surface.

There also needs to be a convenient method for managing the DSP and bus configuration on-site. It must be simple for on-site engineers to set-up IFB routing and remote monitor mix levels at the venue, especially considering that many remote production broadcasts will not utilise as many staff. These considerations guarantee that venue infrastructure, routing and monitor feeds are functional prior to transmission. Local DSP also means there is no latency for commentary or talent monitoring.

With all DSP for monitor mixes taken care of on-site, the studio transmission console can concentrate purely on the main programme mix.

2. Control; operators need real-time control over mic gains, fader levels and monitor mix levels.

Effective remote production requires a simple method to control the parameters of the remote production unit from a control room located many miles away, giving the operator control over channels, busses and other parameters from the studio control surface.

In other words, the operator sits behind a console that he is already familiar with and assigns remote channel paths to local faders, just like any other channel.

This functionality should include channel path fader levels and cuts, aux send levels and ons, aux master levels and cuts, VCA linking via the studio console, as well as control over EQ, dynamics and direct outputs.

The operator needs to independently mix all the remote site IFBs and aux buses in addition to the local transmission mix on the studio console.

For full scalability, there should be the ability to link multiple remote production units to the same studio-based console. This is useful for shows with multiple events happening simultaneously.

"Remote, or at home production, will no doubt increase over the next five years as technology evolves to allow production teams to work from the same facility week in week out, especially on longer form multi day events."

Gordon Roxburgh, Technical Manager, Sky Sports

3. Infrastructure; or, which transport to use to move signals around. Multiple synced signals need to be moved in real time, and often down the same physical infrastructure. Audio, data and video all need to be considered, as well as multiple control protocols.

Infrastructures need to be versatile to connect via a range of transports, allowing the broadcaster to use a preferred transport method. This minimises initial expenditure and gives confidence in using an established transport mechanism. The studio console mixing the transmission can in turn assign these signals where required on the desk, so workflows are the same as any other broadcast. Working in this way means the learning curve is shallow and transitioning to a remote production workflow causes minimal disruption.

As our industry develops, these transports need to develop too. The flexibility to incorporate changing AoIP and IP protocols like Dante, AES67 and even SMPTE 2022, is essential. A remote production unit should be flexible enough to deal with any transport.

RP1

To address these issues Calrec has created the RP1. A 2U single box solution, RP1 provides local DSP to enable the generation of monitor mixes and IFBs with no latency. It gives an operator in a remote studio direct control over channel functions such as mic gains, aux send/monitor mix levels and fader levels. It also provides a mechanism to embed audio into existing backhaul technologies, such as SDI or SMPTE 2022.

In addition, RP1 allows broadcasters to create low-cost on-site Hydra2 networks for all audio routing requirements. It provides connectivity to any Calrec Hydra2 I/O box providing ways to adapt to the requirements of any situation. Such connectivity also gives broadcasters access to Hydra2's inherent management features, such as port protection, alias files, and access rights.

Fundamentally, it enables broadcasters to cover a greater number of specialised events, such as regional or college sports and smaller entertainment events, at significantly reduced costs, making it possible to develop an increasingly wide range of content.

Calrec's RP1 Remote Production Solution.

CASE STUDY: ATP TENNIS

RP1 trial testing was carried out during the ATP tennis finals. Connectivity was between the O2 Arena in North Greenwich, London, and Sky Studios at Osterley, London in November 2016. The trial was set up in parallel to the ATP Tennis live broadcast.

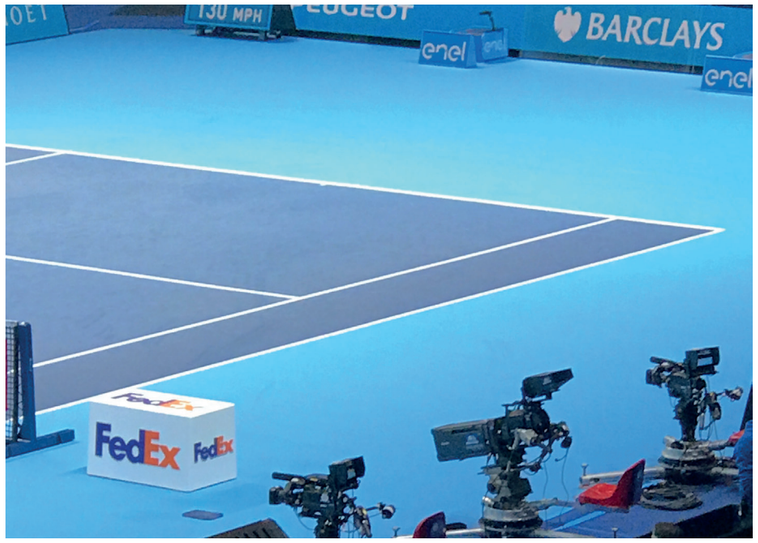
The RP1 unit was located in a technical bay at the O2. 16 microphones from around the court, umpire chair and commentator positions were connected to the RP1 via MADI.

The RP1 took in the MADI data from a DirectOut M.1k2 MADI router, which was sent to one of four aux IFB outputs and then sent back out of the RP1 unit via MADI.

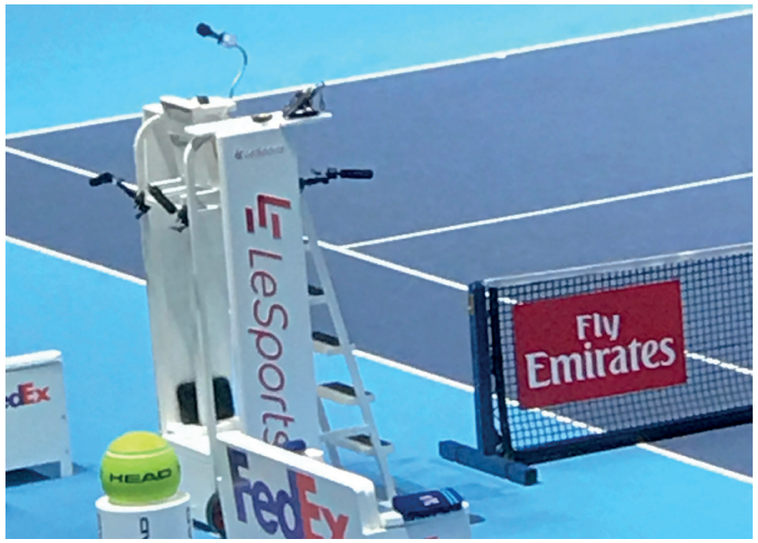
The MADI inputs were embedded into SDI streams before being passed through an SDI-Codec unit and fed into a Cisco switch and sent via IP over 20 miles of fibre on a managed network with a latency of no more than 40ms.

The signals were received at Sky Studios where the audio was de-embedded and remotely mixed on a Calrec Artemis console in Sky Studio 8.

The main purpose of this trial was not to show that audio could be passed over IP to another site, but to prove that the microphone channel inputs to the RP1, and the IFB Auxiliary outputs from the RP1 at the O2, could be controlled over long distances in real time over the same IP connection via the Cisco Catalyst 2960 switch. Control was tested both directly from the Host console surface and from a GUI running on a browser in a variety of locations to the LAN1 port on the rear of the RP1.



Camera Mics for either side of the net and Mics at ends of the court.



Umpire Chair Mics:- 2 rear Mics, 2 courtside Mics and the umpire Mic.

The first connectivity test was the control of the RP1 via a web browser. Once RP1 is up and running it allows several web clients to connect into it using a Calrec application called 'Calrec Assist.'

Two instances of Calrec Assist were setup; one at the O2 and the other next to the console in Osterley. The functions of the RP1 were setup and controlled from both positions to prove that parallel control could be achieved.

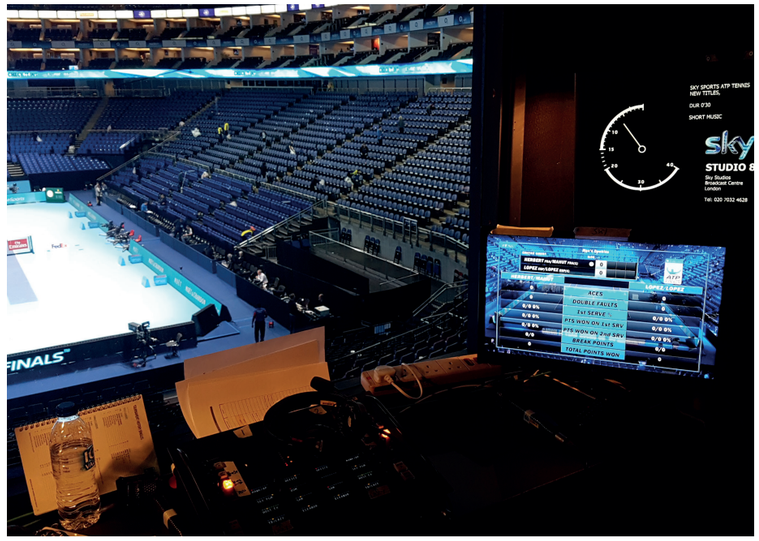
Each instance of Calrec Assist can fully control any of the channels and auxiliaries whilst other instances of Calrec Assist were simultaneously controlling other path parameters.

The second method of controlling the RP1 unit was achieved by mapping the RP1 channels and auxiliaries on to the Artemis Light control surface of the Host console back at Sky Studio 8, next door to the transmission console.

In a live scenario the remote channels and transmission channels would be mixed on the Artemis, thus allowing the operator to control both the transmission mix and the remote production mix from the same surface.

Apart from clearly identifying which channels and auxiliaries were coming from the remote site, the operator could control these 'remote' paths in the same way as its 'local' paths.

The test showed that control was achieved from both the host surface and various instances of Calrec Assist. While lag was recorded, this was insignificant and had no effect on production.



Commentator Position Mic & Headphones.

Calrec Assist allows the user to access and control all the functions of the RP1 unit including:

- Show creation.
- Loading and saving Shows.
- Saving and loading memories within Shows.
- Configuring the virtual fader bed for mono, stereo and surround input sources.
- Configuring the IFBs for commentator output feeds.
- Patching various I/O units to channels and buses.
- Applying mic gain, phantom power, trim, balance etc. to channel inputs.
- Controlling fader levels and Cut Aux Sends and Direct Outputs.
- Having the ability to monitor and meter the inputs and outputs of the unit.
- Routing channels to various buses as required.

"The RP1 allows us to re-invent the audio workflows for remote working, allowing critical functionality to be remotely controlled from the main studio complex. With its Hydra2 network built in, it allows the RP1 to be the core of the OB audio facility, and not just an add on 'blackbox'."

Gordon Roxburgh, Technical Manager, Sky Sports

METHOD AND FINDINGS

1. The RP1 Remote Production Unit receives the mic inputs from various locations around the venue and commentary positions. It outputs to stereo IFB monitor headphones via Hydra2 I/O boxes at the remote site.

RP1 is a 32-channel mixer with channels that can be configured as mono, stereo or 5.1. Any channel can route to any of 12 aux buses, which can be used to create local monitor mixes.

Routing capabilities are very flexible thanks to a built-in 768 x 768 matrix router. This router means that RP1 has maximum physical output capacity of 704 signals using modular slots and Hydra2 port on the rear of the unit.

Depending on the transport infrastructure it is possible to have all 704 signals transported from the venue (say, on multiple MADI streams), and patch additional mics from the venue without touching the channels (i.e. a direct input to output patch). One need only add sources to channels for IFB controls, which can be set up through Calrec Assist.

This router provides a flexible way to manage signals. Let's say you need three separate outputs for monitoring, two separate mono sources locally (e.g. channel and aux) and the ability to send one monitor out on an embedded path.

You can send the RP1 monitor output (and PFL) back to the studio console and configure an external input to listen to the monitor output (or the PFL) of the RP1. You could also bring some inputs and buses back to the studio console using any transportation method. You can patch as many of the buses or inputs sources as you want.

There are no limitations on the type of I/O box connected to a H2Hub network – I/O boxes can be any of Calrec's range of fixed format, modular or Fieldbox I/O – but the H2Hub has an upstream connection limitation to a Calrec Router of 512 bi-directional channels, so the total I/O connected must not exceed 512 signals.

2. RP1 can contain SDI Embedder & De-embedder modules.

With no built-in audio codec, customers can use any existing backhaul technology, which saves time and money, and provides the confidence of using familiar transports. Calrec's modular card slots allow the user to send audio over long distances.

RP1 can connect via analogue, AES, MADI, SDI, as well as emerging IP solutions such as AES67 and Dante. The card slots in the rear of the RP1 enable even more efficient connectivity; embedder cards can be directly plugged in the back of the RP1, and a de-embedder card can be plugged directly in the modular I/O at the studio console.

3. Remote audio was sent to Host console using SDI over video codecs, J2K+AoIP.

RP1 can embed audio into existing video transport mechanisms, and using an established video transport to embed the audio ensures that there are no synchronisation issues. This integrates seamlessly into established workflows that the broadcaster is already using, such as J2K for an SDI source. RP1 works within the parameters of existing broadcast infrastructures.

4. Studio programme audio feeds can be returned to the remote site using SDI over video codecs, J2K+AoIP.

At the studio console, all the remote I/O resources appear like any other local I/O box, so workflows are the same as any other broadcast. For confidence and cues, video signals can be sent from the studio to the venue on the same transport. This would normally be a feed of the programme output to give a visual reference for onsite talent.

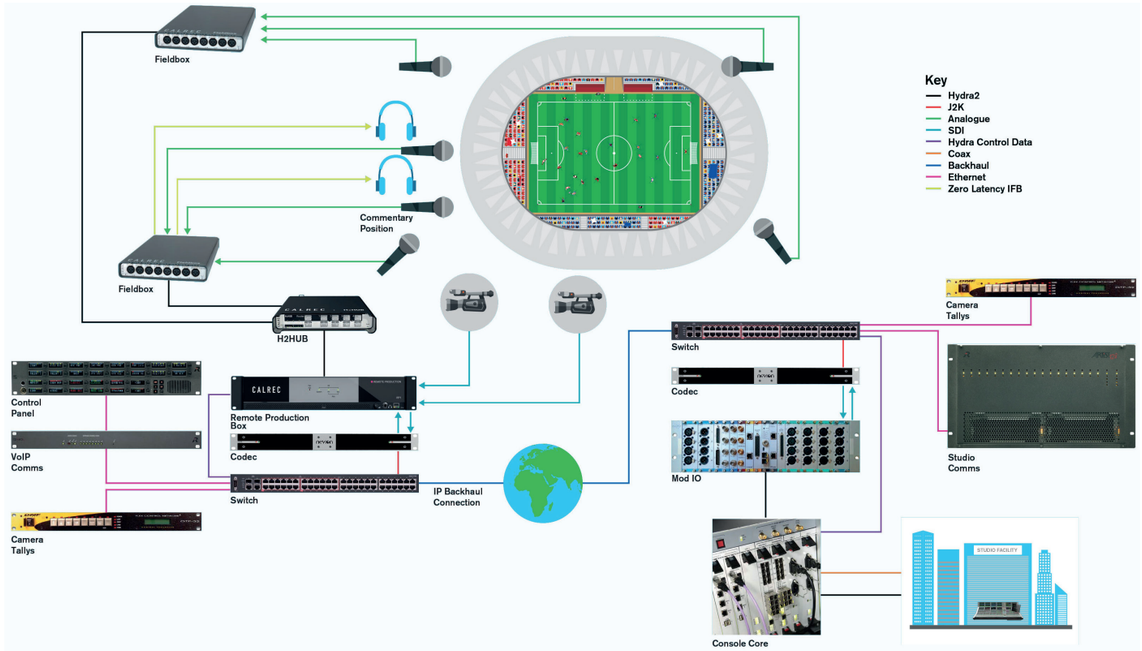
5. Hydra 2 True Control data is passed between the RP1 and the Host console, or Calrec Assist via IP ports.

The transport layer is UDP and TCP with a network layer of IPv4. Although latency depends on how far the data must travel, Calrec control data needs nothing more than a standard QoS setting. Including network switch delays, RP1 aims to achieve a maximum round trip message time of no more than 400-500ms.

RP1 uses UDP ports at both the remote site and the venue, and additional TCP connections at the venue.

UDP ports are used for monitoring device connectivity and status; TCP connection is used for the control protocol once connected, and for Calrec Assist.

TYPICAL SPORTS VENUE SHOWING SETUP WITH RP1 TO IP SERVICE



6. Control of remote faders, including mic Inputs, is managed from the Host console by use of control faders acting on remote production channels.

Calrec's RP1 uses a system called True Control, which includes channel path fader levels and cuts, as well as aux send levels and ons, and aux master levels and cuts. Future development will include VCA linking via the studio console, and control over EQ, dynamics and direct outputs via Calrec Assist.

True Control allows an operator to independently mix all the remote site IFBs and aux buses in addition to the local transmission mix on the studio console. In fact, Calrec's True Control provides the ability to link five independent RP1 units to the same studio-based console.

7. Control of remote auxiliaries allow creation and adjustment of IFB monitor feeds on the remote site (with no round-trip IP delay). These are managed from the Host console by use of control auxes acting on remote production buses.

There are 12 x aux buses on the RP1 for creating local monitor mixes and IFBs for latency free mixing at the venue.

Channel and input controls such as mic gains and 48V phantom power can be set from the Host console or via Calrec Assist if console connection is offline.

IFB/Aux outputs to the talent can be mixed and monitored locally at the venue, but there may be times when the audio operator at the studio console needs access to these mixes.

RP1 aux signals can be sent back to the studio and routed into the studio console as external inputs. This way an audio operator can make a clear distinction between monitoring an RP1 external aux output and an aux output local to the studio.

8. Remote processing and routing can be controlled from multiple Host console surfaces or Calrec Assist.

Calrec's True Control system makes it simple to manage the transmission mix as well as sending control signals. RP1 channels and buses can be assigned to the fader strip with IFB routing, inputs and fader controls, so there is no need to switch between the desk and a PC screen for the remote sources and the local mixing console source.

There may be several consoles at the Host studio which all need control of the RP1 sources at different times. It is possible to do this on an ownership basis.

Network protection is a broadcast pre-requisite, and should be a central consideration for key broadcast design principals. While several consoles can connect to any one RP1, only one console can be connected at any one time, and once set up all the operator needs to do is hit the Connect button on the console. Control must be released before someone else can take it. Should the connection be lost, a different console can quickly establish a new connection.

Calrec provides the ability to link five RP1 cores to the same studio console, all with independent True Control and transmission mixes. There is also a control room monitor output and AFL/PFL functionality on channel paths and auxiliary outputs.

For example, if the monitor and PFL output are brought back from the venue, these can be routed into the Host console as external inputs; Calrec Assist can be used to trigger a PFL on the RP1 unit and listen to it via the external input. The PFL activation of the remote channels is achieved through the fader-surface screen in the Calrec Assist application – this is accessible to the RP1 at the venue, and also at the Host console.

9. Calrec Assist can be used at the Host console to modify infrequently changed remote production settings.

DSP and bus configuration can be managed with Calrec Assist. This enables all venue infrastructure, routing and monitor feeds to be checked prior to establishing the link with the studio console.

Calrec Assist can adjust RP1 input settings, such as gain, phantom power and input, plus fader levels on studio console meters.

Changes made through Assist, such as changes to mic inputs feeding the studio console, will be seen on the studio console. It allows the user to access and control other functions too, such as show creation, I/O unit patching to channels and buses, routing, and saving and loading memories. Calrec Assist has access to the RP1 from the venue and the studio console.

This means if you are at the venue, you can use the RP1 to set up and test mics, for example, and you can use Assist at the studio to do the same. There is no hierarchy of influence with Assist control messages – changes can be made to the RP1 from any Assist client, and the last message received will affect the RP1 settings.

There may be instances where this open control may not be desirable, such as during a live broadcast. In this case the console software has a "Block" switch, which prevents Assist from making any fader and cut data changes at the venue on channels under True Control from the studio.

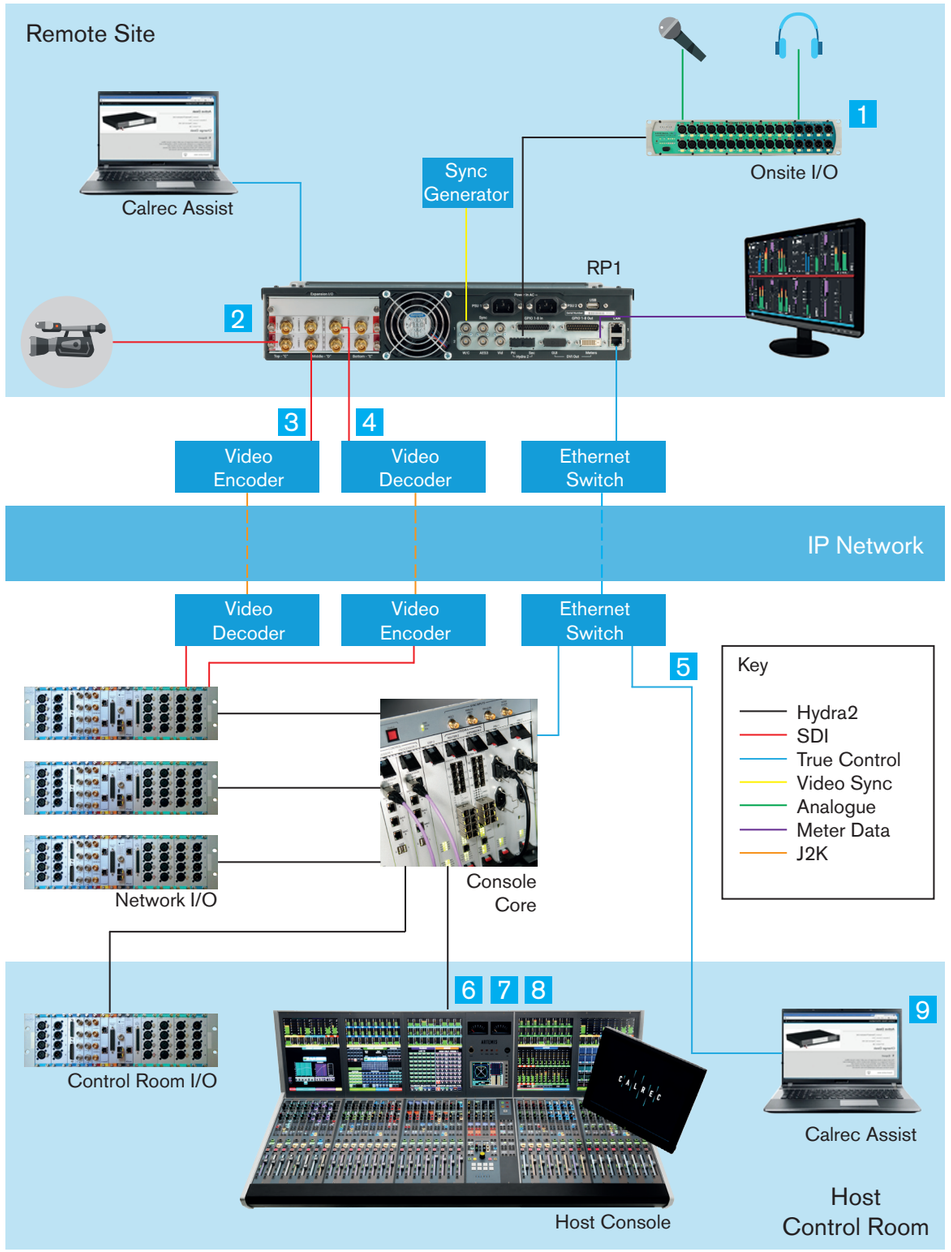
In contrast, RP1 also has an "Independent" switch which ignores any True Control data from the studio console and allows operators at the venue to set their own levels without interference.

Network requirements to make Calrec Assist at the studio work with a remote RP1 are minimal. The RP1 at the remote venue needs a data connection back to the studio console, as well as a VPN or direct link for other IP devices. Calrec Assist only needs 200kbps with a max latency of around one second to be manageable.

Once the RP1 is on the Host studio network it can be accessed by typing the IP address of the RP1 unit into a Chrome web browser. That means it can be accessed via a corporate network on an iPad or a PC/Mac, or even on the studio console PC.

The trial use of RP1 in this environment shows that it can solve the problems identified in this paper, and provides an efficient and cost effective remote production solution.

DETAIL OF CONNECTING RP1 TO THE OUTSIDE WORLD



* The numbers on the diagram refer to the points made in this section.

SUMMARY

"Remote, or at-home production, will no doubt increase over the next five years as technology evolves to allow production teams to work from the same facility week in, week out, especially on longer-form multi-day events. We are not going to see every major soccer or cricket match being remotely produced in the short term, but key areas such as the remote production of the presentation of events will increase.

"The RP1 allows us to re-invent the audio workflows for remote working, allowing critical functionality to be remotely controlled from the main studio complex. With its built-in Hydra2 network, it allows the RP1 to be the core of the OB audio facility, and not just an add-on 'blackbox'.

"The key hurdles are no longer technical, we can tick all of those boxes now; the critical steps to a remote production being a success is to work with the production teams and all the key stakeholders at the planning stage to ensure we are all going in the same direction.

"'Flight Rules' have to be defined to ensure that everyone understands how the programme being made differs to a traditional Outside Broadcast. As the event evolves these flight rules evolve too and the programme gets better and better.

"On events that are a longer distance away, where latency becomes an issue for simple conversations, its also critical to work with the on-screen talent to give them appreciation of the challenges.

"Ultimately by being efficient and working differently we can create a better product. Allowing presentations to break out from a studio environment to the actual event will always be far more engaging for our viewers.

"The production crew working back at base likely have access to far more resources than in an OB truck; for example a producer before a show can be working in a high end edit before arriving in the gallery to make the live programme."

Gordon Roxburgh, Technical Manager, Sky Sports

RP1 Benefits

- Studio Operator has full control of remote resources.
- Redundancy of power, audio and control as standard.
- Specialised OB equipment and full audio team not needed for smaller events.
- Small 2U Footprint with a wide variety of I/O options.
- Cost effective and easy to set up/configure.
- Multiple RP1 units can be connected to Host Console.
- Real time control of latency-free commentary mixes.
- Can be controlled standalone using a web browser from any IP connected location.

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