WHITEPAPER

THE FUTURE OF LIVE PRODUCTION

Remote and distributed production

SONY

nevion

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1. INTRODUCTION

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1.1 Doing more with less

When it comes to broadcasting, without doubt, content is king. Content is what draws in viewers, and generates revenue, with live programming offering amongst the most compelling viewing.

However, viewers have a huge choice of nowadays, from user generated content (e.g. social media) on their phones to movies in cinemas.

To compete, broadcasters need to secure and produce more content, in a timely manner (e.g. first to cover breaking news). They also need to leverage one of their USPs: high production values.

All this is expensive though and, in a highly competitive environment, broadcasters are under enormous pressure to reduce costs.

In short, broadcasters need to find ways of doing more, with less.

One way they can do that is by transforming their workflows with the help of technology.

1.2 Sharing production resources

IP technology has transformed the logistics and economics of production workflows in recent years, and will continue to do so. It has done so by enabling the sharing across geographical locations of:

- Real-estate, e.g. studios, control rooms, datacenters
- Equipment, e.g. processing
- Most importantly, people, i.e. the talent, but also the production specialists

1.3 Better production

This sharing means productions can be nimbler and more cost effective (as equipment and people don't have to be moved and can achieve a higher degree of productivity). Productions can also involve the very best resources, to guarantee the high-production values that are key differentiators in the market.

1.4 IP the enabler

This sharing of resources is achieved because IP's ubiquity in LAN, WAN, 4G/5G and the Internet, enables the geographical separation of 3 major aspects of production:

THE ACQUISITION, I.E. THE TALENT OR ACTION, AND THE EQUIPMENT SUCH AS CAMERAS, MICROPHONES, ETC

THE CONTROL, I.E. THE PRODUCTION STAFF AND THE CONTROL SURFACES THEY USE

THE MEDIA STORAGE AND PROCESSING, I.E. SWITCHING, GRAPHICS, LOGO INSERTION, RECORD/PLAYBACK, ETC.

This separation is of course very familiar in file-based productions. For example, a documentary might be shot in Kenya, the video files uploaded to some digital storage, to be edited and produced by specialists in the US and the UK.

What's new is that this separation is now possible in live production also, where the need for very low latency has always presented a considerable challenge. This is now transforming not only the way broadcasters produce live events, but also influencing the decisions they need to make about their business in the future.

2. PRODUCTION LOCATIONS

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The 3 major aspects of production (acquisition, storage and processing, and control) can now be separated geographically, to meet business, production, and technical needs.

2.1 Acquisition locations

The acquisition obviously needs to take place where the content (e.g. action, talent) is located. This can be:

- In a studio in the main facilities
- In a studio in the other facilities, e.g. in the regions
- In a pop-up studio at a separate location, e.g. for a vox-pop around a major event
- At an event location, e.g. a stadium, a concert venue
- Along a course, e.g. for skiing, running, or cycling
- At an ad-hoc location, e.g. as part of news gathering
- At someone's home, e.g. for expert interviews

2.2 Production control locations

Historically, the (production) control has been close to the acquisition – after all the word "gallery" refers to the fact that there was a line of sight between the control room and the studio.

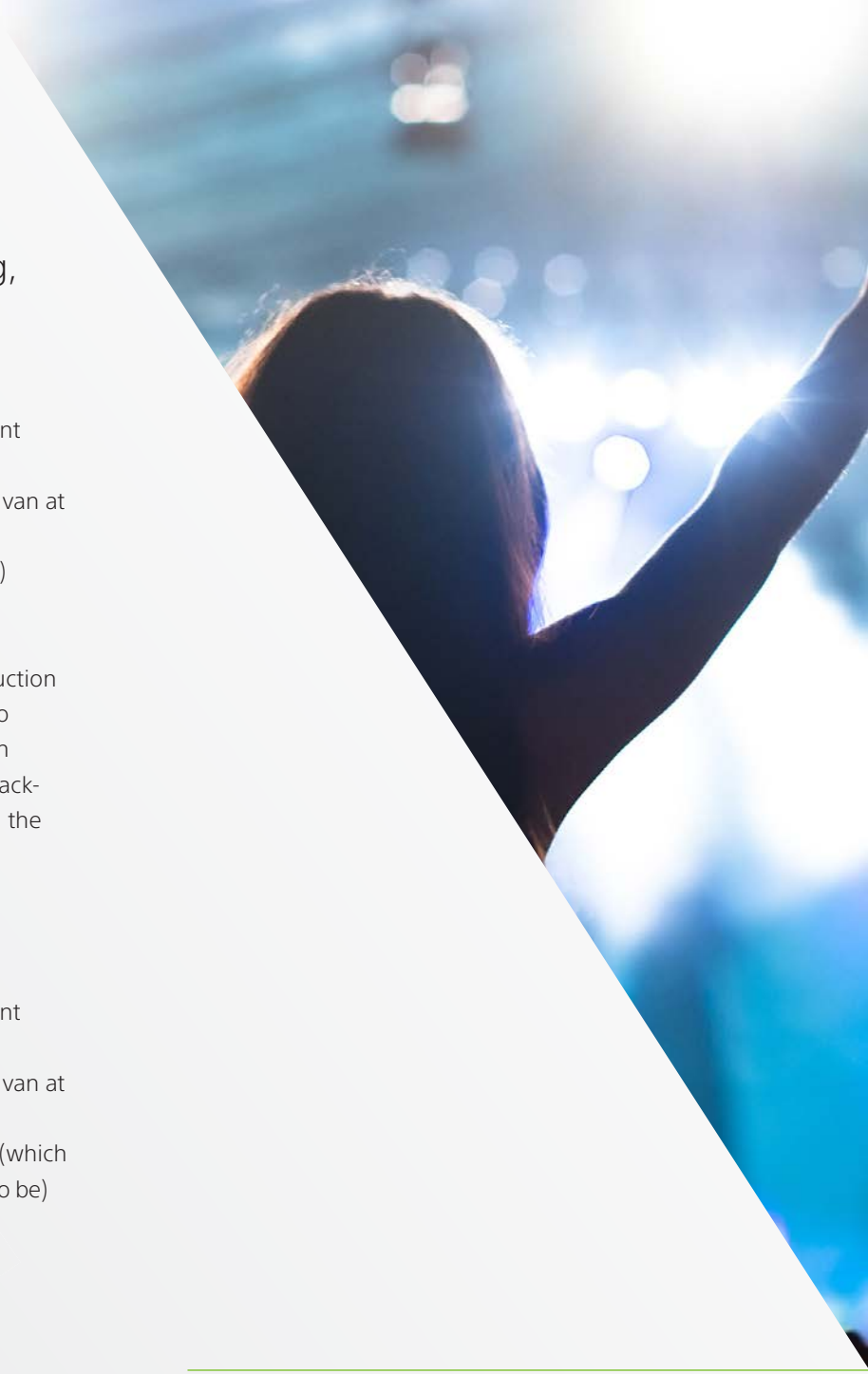
However, that restriction is no longer necessary. The production staff can now be controlling a production from locations as diverse as:

- A control room in the main facilities
- In a control room in other facilities, e.g. in the regions, possibly but not necessarily where the acquisition is taking place
- In a dedicated or temporary room at an event location
- In an outside broadcast production truck or van at or near an event
- At home (new since the Covid-19 pandemic)

2.3 Media processing locations

Media processing has been close to the production control until relatively recently, due primarily to technical limitations (especially the connection requirements between control surfaces and back-end processing). But IP has changed that, and the processing can now take place:

- In a datacenter in the main facilities
- In a datacenter in other facilities, e.g. in the regions
- In a dedicated or temporary room at an event location, near the production control
- In an outside broadcast production truck or van at or near an event
- In a centralized datacenter or private Cloud (which could be in main facilities, but does not have to be)
- In a public Cloud



3. PRODUCTION MODELS

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3.1 The DPP models

The ability to separate acquisition, media processing and control geographically, and the variety of options for locating each of those 3 aspects of production create many possible scenarios for live production.

Conveniently, in its "Live Remote Production" report (first published in April 2021), the DPP suggested 5 models that provide a useful way to map all the various scenarios[1].

"ON LOCATION" MODEL

"REMOTE CONTROLLED" MODEL

"CENTRALIZED" MODEL

"DISTRIBUTED" MODEL

"CLOUD" MODEL

Table 1: 5 Models of live production (DPP, 2021)

3.2 Additional models

There are other models of course. For example, Nevion a Sony Group Company has delivered projects based on the following models:

"REMOTE PROCESSING"

e.g. PLAZAMEDIA "Doppelpass" project, 2016

"PRIVATE CLOUD"

e.g. Discovery project, 2020

Table 2: Additional models (from Nevion projects)

While the DPP models were conceived for live remote production, they can be extended to any type of production. For example, the "on-location" model is relevant both for productions using an outside broadcast truck, and also to productions in the facilities (with the studio, control room and the datacenter all located in the same location). The same model can also be used for not only live, but also near live or file-based productions. This makes the model extremely versatile in examining options.

[1] thedpp.com/glr

3. PRODUCTION MODELS

3.3 Example: dynamic affinity using private clouds

Nevion delivered an IP media network solution for production to Discovery (Europe) which radically transformed workflows for the broadcaster. This production infrastructure involves two private Clouds (in the UK and the Netherlands) that provide the storage and processing capabilities for their regional facilities across Europe. The highly scalable system enables any control room in the regions to use any of the resources in either of the Clouds, with usage and capacity being managed automatically. This concept is known as “direct affinity”.

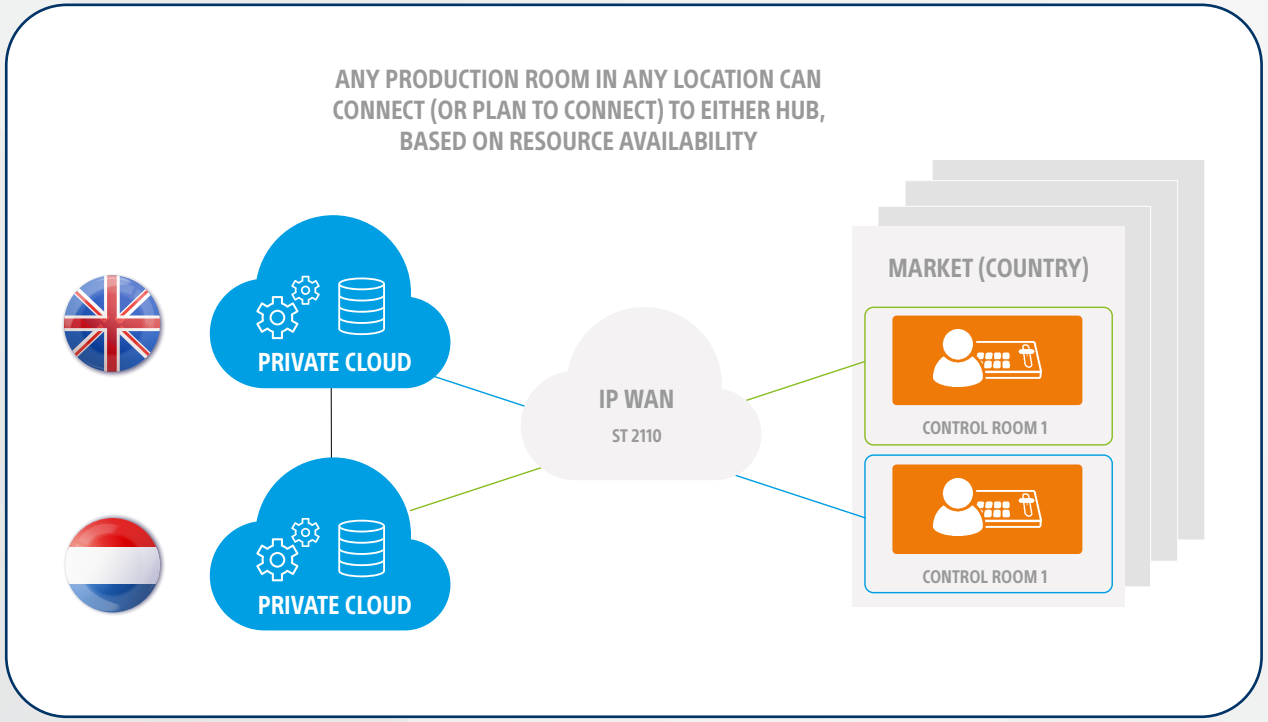

Figure 1: Example production with private clouds

4. DISTRIBUTED PRODUCTION

4. DISTRIBUTED PRODUCTION

In practice, broadcasters will not use one particular model exclusively for all their live productions: they will pick the most appropriate model for the circumstances.

In fact, they may well pick multiple models for a single production. For example, the coverage of sports event in a stadium could involve a centralized remote production, with live signals transported to the central facilities over a WAN, combined with Cloud production for the record/playback feeds.

In short, broadcasters will potentially have a whole array of production capabilities spread across multiple locations, some fixed and others being mobile (such an outside broadcast production truck or flight cases) that can be tapped into when needed. This is a truly distributed production.

NB: This definition of "distributed production" here is much broader than that of the DPP model shown previously.

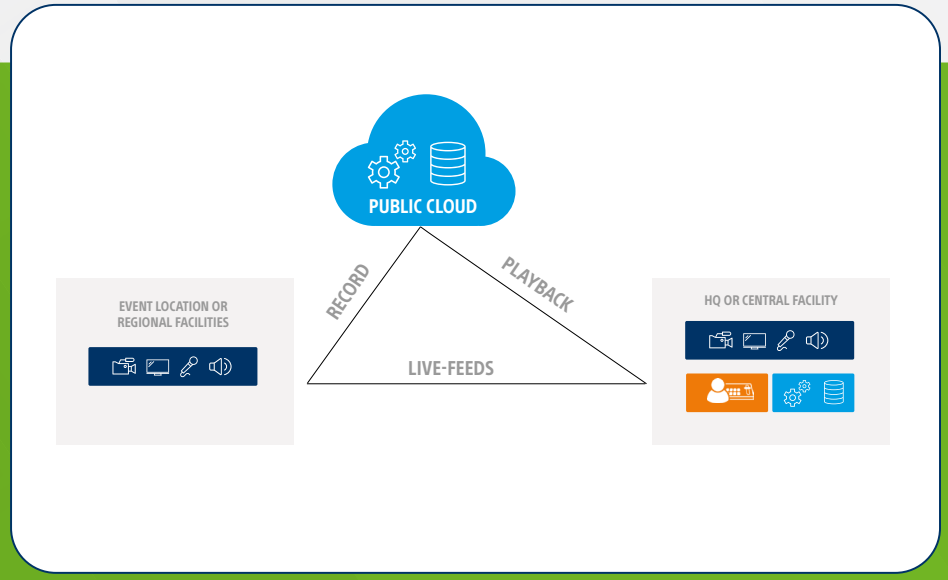

Figure 2: Example remote production

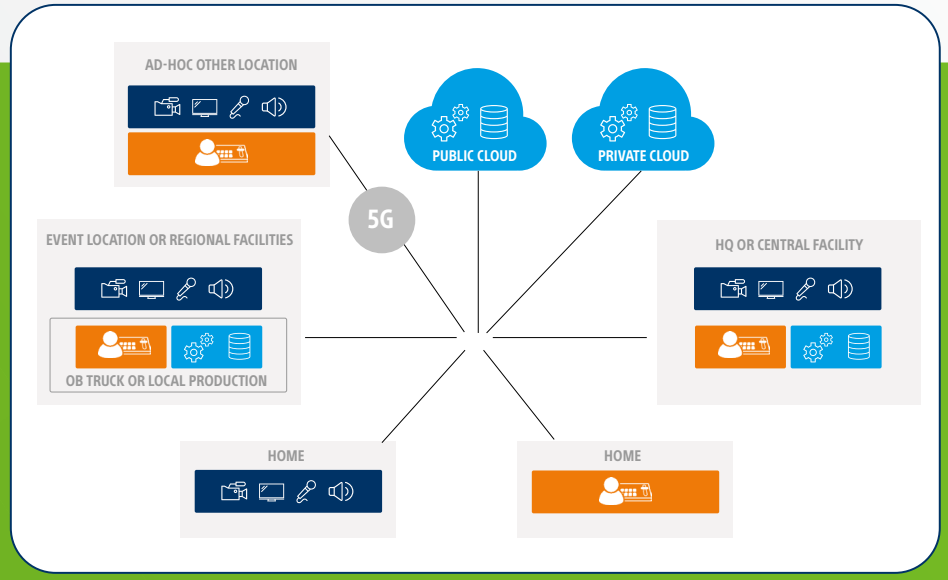

Figure 3: Distributed production

5. FACTORS FOR PRODUCTION MODEL SELECTION

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With IP, IT and Cloud technology, there is now an abundance of options for live, near live and file-based production. Decisions need to be made by broadcasters both at the strategic level (i.e. where should they invest in the medium- and long-term), as well as the operational level (i.e. which model should be used for a particular production).

The factors influencing these decisions are numerous, but fall roughly into 3 categories:

- Business imperatives
- Production needs
- Technical considerations

5.1 Business imperatives – strategic

The business imperatives are particularly important in shaping the strategic direction of investments (medium- and long-term).

5.1.1 Business strategy

The strategy of the business will have an important influence on the type of production models that will be generally favored. For example, some organizations will want to focus on core competencies, i.e. creating content, and favor outsourcing the production infrastructure. Others may see the ownership and control of the infrastructure as a potential competitive advantage.

5.1.2 Cost model

There are broadly two main cost models for production:

- Largely CAPEX-based, in which broadcasters invest in the infrastructure and equipment needed for their all their productions
- Largely OPEX-based, in which broadcasters pay for the use of the production capabilities on a need basis

The CAPEX model has been the traditional model for many broadcasters, whereas the OPEX model is often associated with the emerging public Cloud production – though is also applies to any type of production that can be bought as a service (e.g. outside broadcast production).

Both models have benefits, including those summarized below.

OPEX model benefits	CAPEX model benefits
• Aligning production costs with needs • Not having to make big (CAPEX) investments up-front • Not having to invest in excess capacity (that will only be used occasionally for the most demanding situations) • Not having to worry about depreciation • Being able to scale to any production environment • Potentially having access to the very latest equipment and functionality	• May be cheaper than OPEX models for everyday needs, especially if equipment usage levels are raised through better sharing (using IP) • Investments can be postponed or even cancelled if need be, without substantially impacting production (reducing OPEX spending will affect production) • May match more closely the accounting needs of an organization, for example in terms of having assets on the books and keeping operating costs low

Table 3: Benefits Opex and Capex based production models

Some broadcasters will make a strategic decision to go primarily towards an OPEX model (for example smaller organizations with limited funds) and others will choose a CAPEX model.

A more likely model though will be a hybrid of CAPEX+OPEX (for example CAPEX for everyday use, and OPEX for exceptional needs like major events).

5. FACTORS FOR PRODUCTION MODEL SELECTION

5.1.3 Business continuity

A business imperative for broadcasters is to be able to broadcast live without any interruptions. This need is obviously driven by commercial interests, e.g. the impact of interruptions on advertising revenue. However, for many broadcasters, there are also legal obligations to be able to broadcast under any condition, including emergency situations.

Business continuity obviously must be an important consideration when choosing a strategy for live production. In particular, the hosting location of the processing, and the connectivity to that location could be critical. Could live production still take place if connection to the processing site is lost? This is an important question for the distributed (as defined by DPP) and Cloud production models in particular, which rely on offsite processing.

5.1.4 Choice

It's in the broadcasters' interest to have the choice of suppliers – to avoid being locked-in and to allow for the best option to be picked every time.

With the adoption of industry standards by vendors, that choice is generally assured when broadcasters opt to own the production equipment (CAPEX model). In fact, multivendor environments are usually the norm these days.

Where broadcasters decide to go for a service approach (OPEX), the choice of service providers may be much more limited.

5.2 Production needs – operational

5.2.1 Location of production staff

In some cases, the production staff need to be on-site, for example to be able to communicate face-to-face with other people involved in the event. This could be particularly important when it's difficult or impossible to be fully control the environment, e.g. a sporting event that might be affected by the elements or not have a predetermined end time. This type of situations will obviously favor an "on-location" or "remote processing" production model.

In other cases, it would be better for the production staff to stay in a central location, so that they can work on other productions also for example.

Looking more into the future, there may come a time when live productions will use "distributed" models (including "from home" production) to tap into the very best people – in the same way file-based production already does.

5.2.2 Costs

Costs are important in any production, and without doubt shipping less equipment on site and avoiding unnecessary travel will always favor "centralized", "distributed", "(public) Cloud" or "private Cloud" production models.

Similarly, OPEX models may be advantageous, especially where extra processing capacity is required.

5.2.3 Practical constraints

For some situations, for example news, time is of the essence, and being able to set-up a full production rapidly is key. In other situations, the location may be awkward or have limited space.

Such cases can may make on-site processing and control impractical, and therefore favor centralized, distributed or Cloud models.

5.2.4 Production values

The number of cameras and microphones involved in the production, and the picture quality (e.g. 4K or 8K) will have a great bearing on the production model, primarily because of technical issues.

5. FACTORS FOR PRODUCTION MODEL SELECTION

5.3 Technical considerations – operational

5.3.1 Latency

While latency is not much of an issue in file-based or even near-live production, it is the enemy of live production.

Transporting and processing signals create delays between the acquisition and control, potentially causing real problems in live production (as people involved in the production need to interact in real-time with each other, and decisions need to be implemented immediately).

The production set-up (e.g. the distance between the event location and the central facilities), the connectivity in place, and the tolerance for latency in production will dictate the model used.

For example, if the event is taking place many thousands of miles away, the transport latency over such a distance will favor an "on-location" model rather than "centralized model" (to use the DPP terminology).

5.3.2 Bandwidth

The bandwidth available will dictate how many signals (especially video) can be transported between locations, and therefore whether the processing can take place away from the acquisition.

Compression can increase the number of signals that can be carried on the available bandwidth, but it also introduces latency so a balance will need to be struck (for example by using an ultra-low latency compression like JPEG XS).

The bandwidth is less of a factor in determining the location of the control, as production staff will typically work on a proxy video feed (e.g. a multiviewer image provided as a single feed), and the control traffic requires little bandwidth.

5.3.3 Processing capacity

The processing capacity available will influence where the bulk of the processing will take place. For high-end productions with many signals for example, a centralized model may provide the best option as the equipment in the facility may offer the greatest processing power.

5.3.4 Reliability and security

Reliability and security will always be a concern in live production, as they can affect business continuity (see above).

Ideally, both should be guaranteed 100%, but in practice the value of the content (e.g. breaking news) or the cost-effectiveness (e.g. for low end-productions) may justify the use of less reliable and less secure transport and processing, e.g. using Internet connectivity. For other productions, reliability and security cannot be compromised on.

5.4 Summary

In selecting the right production model(s) for them, broadcasters will have a variety of business, production, and technical considerations.

It is very unlikely that a single model will be the solution to all the broadcaster's production needs though, and therefore the objective should be to build an infrastructure that is resilient and versatile, supporting multiple models easily.

6. BUILDING DISTRIBUTED PRODUCTION

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6.1 Rethinking IP projects

Building a fully distributed production, in which all (or at least many of) the production options are available, is done incrementally, over time. Each move to IP in a facility (main or regional), each new IP-based outside broadcast set-up, each expansion into the Cloud, goes towards the end goal of a fully distributed production.

For that reason, every individual IP project needs to be considered in the context of the wider aim of an eventual distributed environment, to avoid taking decisions that will make extremely difficult and costly the task of "federating" all the production capabilities when the time comes.

6.2 Bridging distance

Distributed production fundamentally involves geographic diversity, with both on premise and off-promise elements. The key to success is making this transparent from a production point of view: to the production team, it should feel like they are on site, with all the processing equipment near-by.

This requires certain elements to be in place.

6.2.1 Remote control

Every aspect of the production acquisition and processing must be "remote-controllable".
For example, cameras and switchers should be controllable across IP networks, potentially over considerable distances.

6.2.2 Multi-network connectivity

Distributed production involves a combination of IP LAN (in the facilities or on location), IP WAN (connecting locations together, as well as Ground-to-Cloud-to-Cloud-to-Ground – GCCG), 4G/5G mobile connectivity and even the Internet.

While all types of network share the same intrinsic core technology (IP), they are fundamentally different in several ways, for example in terms of their reliability.

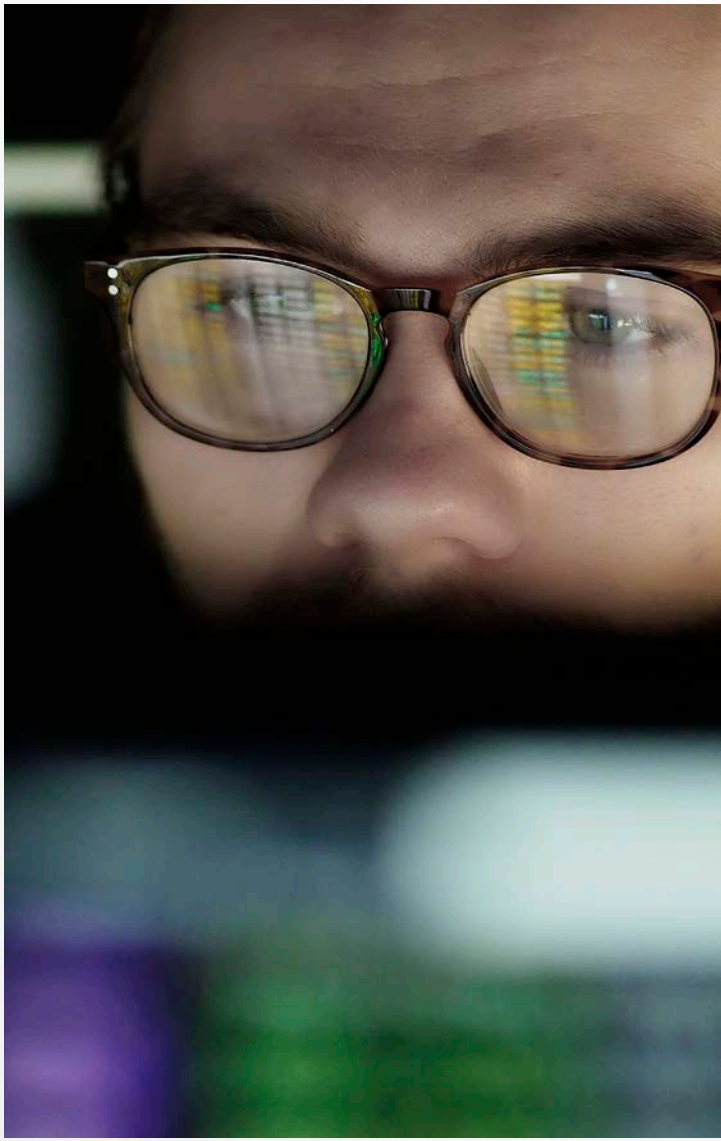
They will also typically involve equipment from different vendors, e.g. Arista, Cisco, Juniper, Huawei, etc.

For distributed production to work, the connectivity across all these networks needs to be smooth and seamless.

6.2.3 Media transport

In order to leverage IP networks for broadcast production, a media transport layer must be added.

This transport layer needs to handle the adaption between traditional broadcast technologies and IP. It also needs provide all the transport protection necessary to ensure full reliability, with a minimum latency. It may also provide functionality such as compression (e.g. video encoding).



6. BUILDING DISTRIBUTED PRODUCTION

6.2.4 Management

Probably the most important piece of all is the management layer.

Management is different from Control (as used until now in this paper) in that the former refers to the software and systems that manage all aspects of the production (including the network itself), while the latter is the human interface, e.g. the control surfaces. Obviously, both work very closely together.

To achieve a fully distributed production, the management needs to be fully convergent, i.e. work across any network. So, for example, it must be possible to establish a connection between a camera and a switcher (processing side) wherever these might be located.

6.2.5 Multitude of technologies

Modern broadcast production involves a multitude of technologies, including

- SDI, SMPTE ST-2110, NDI
- Transport protection, e.g. SMPTE 2022-6, FEC, RIST, SRT
- Video compression, e.g. JPEG XS, JPEG 2000, H.264, H.265, etc
- Synchronization, e.g. black burst, PTP (IP), etc.
- And more

The technologies required will need to be accommodated in a distributed production.

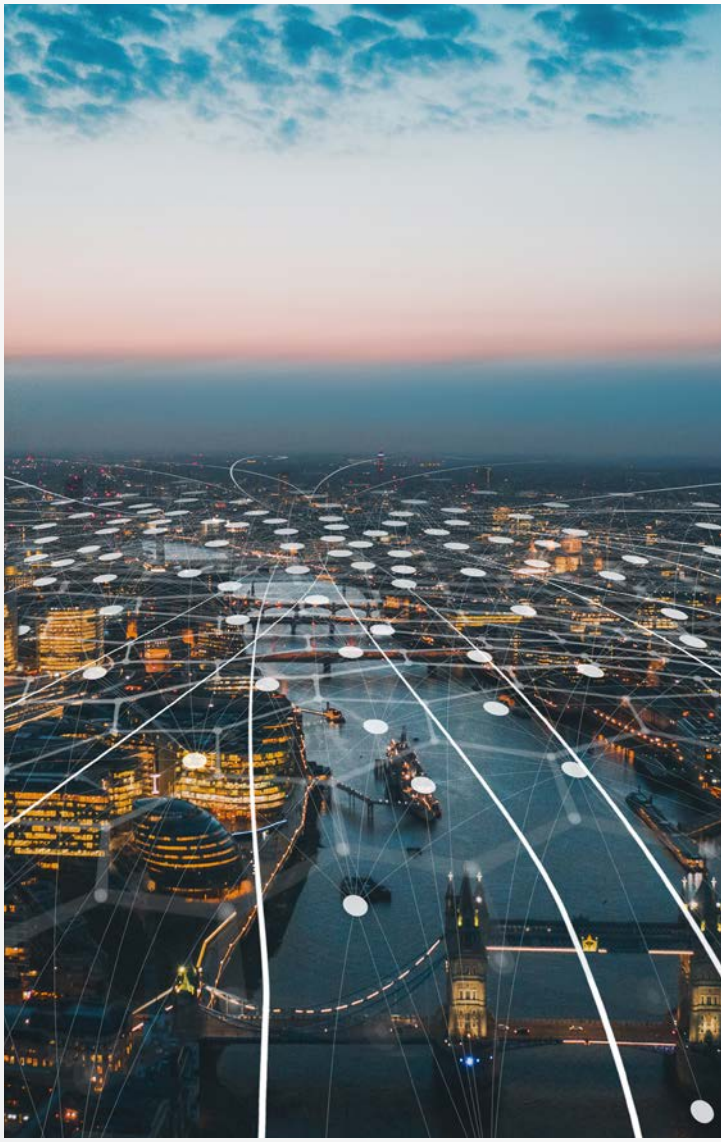
6.2.6 Scalability

Scalability is arguably one of the most complex issues to deal with in distributed production.

Live production often involves many signals, with video signals requiring a huge volume of data to be transported in real-time. When the number of potential end points (signal source and destinations) in a distributed production is added to this, it is clear that the media network needs to be very scalable to handle the challenge.

6.3 Expertise and experience

While the focus is often on products and functionality, the key to success in the creation of a fully distributed production (indeed in the deployment of any IP project) is the expertise and experience of those involved in designing and delivering the solution.



7. CONCLUSION

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7.1 Technology is revolutionizing production workflows

IP, IT and Cloud technology are in the process of revolutionizing live production, in a way that it has already with file and near-live production.

Fundamentally, the technology transforms the logistics and economics of production, by allowing production control, storage and processing to be separated geographically from each other. This creates multiple models for production, which can be chosen to best suit medium/long term business needs and short-term production requirements, while adapting to the technical constraints.

In practice there will not be a universal production model. Instead, broadcasters will develop a distributed production infrastructure overtime, which will enable any combination of models to be used on a need basis.

7.2 Sony and Nevion – experts you can trust to transform your production

This incremental evolution underlines the importance of making the right decisions every step of the way to avoid problems developing later. Choosing the right partner for each project is therefore of fundamental importance.

As well as offering best-in-class products, Sony and Nevion have unique expertise and experience, built on the delivery of hundreds of IP projects across the world.

For more details about how Sony's and Nevion's can help, please refer to the "Sony & Nevion's Distributed Production Offering" whitepaper.

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