CREATIVE INDUSTRIES:
AN INTRODUCTORY GUIDE TO ‘UPLINK & DOWNLINK’

UK 5G Innovation Network

INTRODUCTION

Delays are unacceptable when live broadcasting and against a backdrop of reduced budgets and shorter timescales, viewers expect richer, higher-quality content. Yet the creative sector has long struggled with limited upload capability. The ability to configure 5G to meet specific upload requirements, allows 5G networks to comfortably rise to the challenge, facilitating richer and more reliable coverage and greater flexibility.

This guide has been designed to explain the concept of uplink and downlink and the role of private networks in a broadcast setting, while considering some of the practical ways to configure satellite telecommunication to ensure it can meet the specific demands of the creative industries.

We don't claim to have all the answers here, indeed this forms only one part of a wider body of content produced by UK5G to help guide the creative sector through how to deploy 5G—and, of course, each case is unique. It is also important to note that, though this paper focuses on creative industries, this information should be applicable to a range of sectors.

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WHAT ARE UPLINK & DOWNLINK?

In satellite telecommunication, a downlink is a link from a satellite down to one or more ground stations or receivers whereas an uplink is a link from a ground station up to a satellite. Put simply, a downlink determines the speed and capacity at which you can download content to a local device i.e. a film to a tablet or smartphone.

Uplink determines the speed and capacity at which you can upload content from a local device for instance from a camera back to a studio. Some companies sell uplink and downlink services to television stations, corporations, and to other telecommunication carriers.

Every network - cellular or Wi-Fi, transports data up into the network before shifting it down to your device - but the networks operated by mobile operators have traditionally been configured to focus on their ability to deliver data down, more than they are to take data up. The same is true for your home broadband, for instance, where you have the ability to download 80% more data than you can upload, which is why streaming is improving but sharing a large PowerPoint often requires the use of a file sharing service.

Typically, entertainment-type applications focus on the downlink because a lot of data is needed to deliver to an edge device. But when it comes to industry, creatives want to be able to extract lots of data from the edge (whether that's a control room or an outdoor event with multiple cameras linked together using 5G) into a place where it can be processed and forwarded: Glastonbury, for example, needs both a massive uplink at the site and a massive downlink for the person watching at home.

Why is this important for broadcast?

For broadcasting outdoors, you need to be able to live-stream, which relies on a strong signal. And when it comes to things like live sports, music festivals or the news, delays are simply not an option. A large, secure and reliable uplink mechanism is key.

With 4G, the analogue signal is very variable. The beauty of 5G is its ultra-reliable signal, far greater capacity and security because of end-to-end encryption. Public 5G networks today are still only available in relatively limited locations and as with previous generations, will favour downlink over the uplink. Although this may change in the future, it's likely to be the case in the short to mid-term. As a result, they likely will not fully meet the requirements of live broadcasting. Private 5G networks, however, may present a solution.

How are private networks different?

A private 5G network is any network to which access is restricted. It offers you guaranteed capacity - critical for live broadcasting - but most importantly, it is fully controllable and customisable to your specific needs. Put simply then, private networks can provide more uplink by configuration, enabling you to tune the network to meet your requirements, including adjusting the uplink and downlink to either be more balanced or favour uplink.

Richard Barrington, Executive Consultant and Business Development Director for Perform Green, and currently working on a number of public sector 5G feasibility studies and the 5G Connected Logistics Project (5G CAL), said: “5G is without a doubt the best option for when you need large uplink capabilities. In real-time, you can deliver massive amounts of information, data, games, whatever you desire. Without having cables everywhere!”

TIPS & ADVICE

- Start by clearly defining your specification; taking the time to precisely define exactly what you need a network to deliver is key to ensuring you end up with something configured to your needs
- Make sure to accurately identify a provider that is capable of delivering your requirements and be clear that you will be managing your supplier against your specification. The UK5G Supplier Directory is a good place to start
- Consider having someone in your project team that can perform a 5G assurance role - they don't need to necessary "do the doing" but they can play an important role working with suppliers to ensure uplink requirements are being met
- Consider your spectrum carefully. Upper band n77 (3.8-4.1GHz) is available as a shared access spectrum through an application to Ofcom and is successfully supporting use cases that require high uplink from live sports broadcast to XR applications
- The uplink and downlink can be tuned but you need to ensure that each use case has a static requirement (for example, an equal split of uplink and downlink)
- Be prepared to tinker! At this early stage in 5G's lifecycle it is likely that you may need an element of trial and error to secure the uplink you require; be prepared to build in time for this. If you don't have the skills internally, one option can be to purchase a full solution from a vendor; they will then be responsible for ensuring the network performs as per your needs
- Consider the cost of resources (such as any cloud storage required)
- Smaller organisations need to be careful when selecting their team, ensuring they choose those best placed to consider the data volumes involved
- Pay attention to "minor details" so they do not become bigger challenges (the phishing of team inputs, for example)

WHERE HAS THIS BEEN DONE?

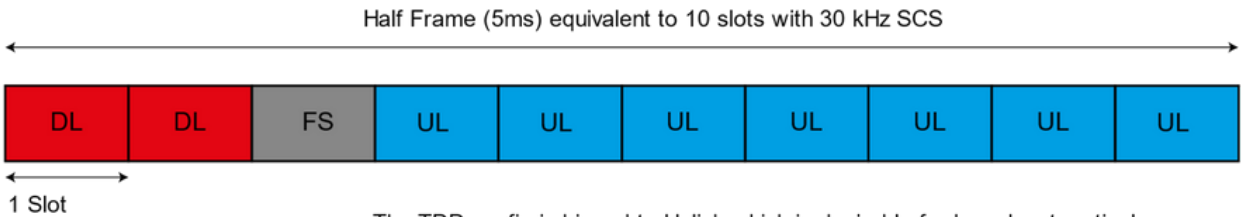
Recent successful trials as part of 5G Edge-XR, used a 5G Network in a Box (NIB) solution from Neutral Wireless to provide wireless connectivity for sports broadcasting and virtual/mixed and augmented reality (XR) applications. The same solution was also used in the world's first demonstration of 5G for sports broadcasting at the Silverstone MotoGP in August 2021, and by BT to broadcast a Saracens Rugby game using 5G and cloud-based technologies.

This is a lab-grade portable 5G standalone network that was operated in the upper n77 shared spectrum band (for those who like the technical details, it comprises a 3GPP Release 16 compliant 5G Packet Core (5GPC) and gNodeB (gNB) base station implemented entirely in software, running on a Commercial Off the Shelf (COTS) server unit).

Offering advice, Malcolm Brew, a Senior Research Fellow at the University of Strathclyde who worked on the project, said: "Due to its software-defined nature, the NIB solution is highly configurable and customisable, allowing it to support a diverse range of use cases and verticals".

In the n77 band, both downlink and uplink use the same channel at different times, with a technique known as Time Division Duplexing (TDD).

For broadcast requirements, BT needed a TDD configuration that was far more biased towards uplink and so during the 5G Edge XR trials, the NIB was configured with a 7UL: 2DL slot configuration, which is illustrated below.



With the majority of slots assigned to the uplink, capacity and throughput were increased; with this, a maximum throughput of ~700Mbps can be achieved.

The end result? The trials comfortably delivered multiple HD video streams from 5G enabled cameras, providing live coverage of the events at Saracens and MotoGP and supported 5G Edge-XR's high bandwidth XR applications.

BT also worked alongside the BBC at this year's Commonwealth Games to trial a standalone 5G private network for the broadcast coverage of the event. They achieved an uplink of 150 megabytes per second, with the portable private network providing coverage in a challenging environment and allowing for live cameras to connect directly and securely to the private network.

Looking beyond the creative industries, 5G CAL's specification was sub ten milliseconds latency, with at least 100 megabytes uplink, in order to remotely operate an autonomous 40-tonne truck. The downlink speed was minimal because they were only controlling the vehicle to turn left or right and go faster or slower: as a result, they ended up with 80% uplink and 20% down.

Produced by UK5G as part of a series of guides providing insights into 5G Rollout and Deployment. Check the UK5G Website for more guides and reports.