Case Study 012 – Broadcast Service Routing and Distribution over Single Mode Optical Fibre

This case study describes the application of RF over fibre technology to transmit broadcast services over long distances

Introduction

Broadcasters and program producers continue to push the content delivery envelope when covering or recording live events. High profile events require a large range of equipment designed to capture all aspects of the event, relaying images, audio and data from an array of cameras and microphones back to the production suite in the Outside Broadcast (OB) truck.

Typically, content is relayed back to the broadcast control hub from remote equipment deployed in a 'star-type' network configuration. However, in many situations conventional triax transmission is no longer suitable because of its bandwidth limitations and subsequent signal attenuation and degradation. These problems often necessitate using costly line-amplifiers. Therefore, to handle greater bandwidth requirements fuelled by the growth of High Definition (HD) services, the industry is now exploiting the immense bandwidth offered by fibre optic technology. Furthermore, the use of fiber optic equipment offers the broadcast industry reduced size, footprint and weight.

This case study will describe how fibre optic based technology is used in the broadcast industry.

Applications

The trend in OB locations is for wider coverage areas and an increasing number of coverage points to be linked. The industry has standardised on the use of radio cameras and radio microphones for such operations, which allow more extensive coverage. The wireless camera and microphones are typically set up in dual or quad diversity arrangements to ensure continuous coverage. The cameras and microphones transmit signals to receive points or nodes. These combined signals are then transmitted from the nodes to the control van via a hardwired connection. Although wireless cameras enable a more flexible OB topology, wireless technology alone does not solve problems associated with the physical link between the OB control van and the remote receive points or nodes. These connections are often to multiple locations and need to handle multiple HD feeds from the cameras. These situations are beyond the limit of triaxial cable, which traditionally has been used in OB. Fibre based connections offer higher performance signal transmission over many tens of kilometres and are lighter and faster to deploy in temporary OB installations.

How Fibre Optic Technology Works

The key that allows the benefit of fibre optics to be exploited in broadcast applications is the ability to take RF signals and convert them into the optical domain without loss of signal integrity. A further enhancement has been made possible by miniaturising the electrical to optical (E/O) transmitters and receivers. These small form factor modules (shown in figure 1 below) can be built into wireless camera / microphone receivers to convert raw or down-converted broadcast signals onto optical fibres for relay back to the OB control van. Such camera receiver units are available from several manufacturers and have been deployed in sports stadiums, race tracks and even golf courses as they steadily replace the conventional triax solution.

Figure 1

PPM RF to Fiber Optic Converter Module (E/O)

The major benefit is that fibre optic transmission enables remote location of wireless reception nodes, which are connected to back to the OB van using fibre optic cables. These cables are light and easy to deploy and allow the receiver units (such as shown in figure 2) to be located in the main OB control van for ease of monitoring and operational flexibility. These innovative OB set-ups can be configured with variable channel input systems and SMPTE HDTV hybrid fibre cables can be employed to deliver power to the remote E/O transmitters.

Figure 2

Image of Typical Wireless Camera Receiver

Case Example 1 - A day at the races

Video & Audio Broadcast

To cover a live event like the Grand National, broadcasters deploy an OB set-up with at least quad diversity, comprising eight or more receiver sites that comprise antennas and down-converters and receive transmission from the wireless cameras. These remote sites form a mesh network of coverage, relaying live content back to the OB hub over optical fibre. Back in the OB truck, the optical receivers convert the media back to RF which is then fed into the editing suite.

Figure 3

Horse Racing Coverage Using Wireless Camera and Fibre Optic Technology

Field deployed equipment such as this enables images to be broadcast from a number of roaming cameras in the paddock, the stands and the jockey's enclosure. Mobile cameras beam back images alongside the actual race track, while live pictures from Jockey-Cams fitted to their helmets relay a jockey's view of the race (figure 4). Signals from all these deployed wireless cameras and microphones are picked up at the receive sites, where E/O modules convert the incoming electrical signal into optical signals that are transmitted on single-mode optical fibre to the OB truck. Inside the OB control suite, receiver equipment converts the optical signal back into electrical signals, enabling live coverage of these events with the minimum of set up time and maximum flexibility.

Case Example 2 – A Night at the Opera

Audio Broadcast

Audio broadcasters have enhanced the quality of live productions such as Proms-in-the-Park, Out-door Opera and Red-Carpet Theatrical Event through an OB set-up comprising wireless microphones that transmit to antenna receive points which have amplifiers and E/O transmit modules. A fibre optic cable links this remote point to E/O receiver stations within production control suite inside the OB truck figure 4.

Figure 4

Production Control Suite Inside OB Truck

Broadcasters increasingly prefer to deploy temporary OB systems that incorporate a live fibre feed between remote receivers and the production suite. Wireless microphones are distributed throughout the auditorium or venue to capture live sound. At the remote receiver nodes, audio signals are converted into optical signals prior to transmission over single mode RF down-links to the production suite housed in the OB van.

In order to capture the unique atmosphere of an outdoor performance, Broadcasters invariably deploy either dual or quad diversity and high gain antenna to assure continued coverage where ever the sound source maybe on the stage.

Using optical fibre to link remote receiver sites, broadcasters have developed an extremely flexible OB arrangement that requires very little set-up time. The ability to distribute wireless microphones creates a new dimension in audio broadcasting that delivers un-surpassed coverage of live events.

Broadcasters are realising the flexibility afforded by the inclusion of fibre optic technology within the OB set-up. The industry has found a solution to its bandwidth problem and optical fibre is fast becoming the transport platform used throughout the world by broadcasters gathering breaking-news and sporting events.