REVIEW

Teradek Beam radio camera system

The Beam is the latest offering from Teradek, a Californian company now part of the Videocom division of Vitec Group plc. At the time of writing, all Teradek products are manufactured in the USA.
The Beam is an IP-based radio camera system but, in addition, it can also be used simultaineously as an operator intercom or IFB path. There is also a RS432 data path for camera control. The internal Mpeg 4 encoder can also be configured as a streaming server to connect to an offsite decoder directly via the Internet.

The steaming server function was tested, but managing the configuration at the roadside was not straightforward, neither could you change all of the required parameters that you might need when connecting to a teleport etc. so this was not pursued further. Perhaps the next firmware update will address this. The camera control data pathway functions have not been tested in this review.

REVIEW and PHOTOGRAPHS by ANDY SMITH

Comparing systems

Traditional SD and HD digital radio camera systems cost around £20K to £30K from the likes of Gigawave, Link or Cobham. The Teradek Beam comes in at under £4K so I was a little dubious about its comparable performance both in SD and HD at that price point.

Higher-end systems are based on a completely different method of transmission to the Beam. They use a transmission standard called COFDM (Coded Orthogonal Frequency Division Multiplex) - an RF modulation scheme that divides the single digital signal across 1,000 or more RF carriers simultaneously. The signals are sent out-of-phase, at right angles to one another (hence, orthogonal) so they do not interfere with themselves. The big advantage with COFDM modulation is that reflections and multipath signals you find in stadiums and buildings add to the robustness of the link rather than degrading it, as was always the problem in the analogue systems of the past.

A COFDM system will work extremely well around corners as the signal reflects off the buildings' surfaces to find its way out, even when no line-of-sight path exists between the transmitter and the receiver. In addition to the more advanced transmission scheme, these higher-end systems often support the ability to utilise multiple fibre linked diversity receivers to allow huge areas to be covered using one frequency.

The Teradek Beam differs to COFDM as it uses an IP transmission system, meaning that once it has encoded your video to an H264 IP stream, it is transmitted via a Wi-Fi path to the receiver. In this case, 5G Wi-Fi is being used; not 5G as in the next mobile phone system, but 5 GHz as a frequency while standard Wi-Fi is 2.4 GHz. Being Wi-Fi , it is likely you will be sharing the same channels with domestic users and, if the spectrum is busy, it's possible that your range will be restricted. However, there is far more space available at 5 GHz and not all domestic devices use 5G Wi-Fi at present.

The Beam has eleven selectable Wi-Fi channels so if you are experiencing interference you should be able to easily switch away to a clearer channel. With Wi-Fi, it is quite possible for several users to be on the same channel at the same time and not cause interference to one another. Wi-Fi uses spread spectrum technology where the actual link will regularly hop frequencies at differing times under its own control algorithms, so although you are on the same channel, you may not be on the same frequency at the same time. A major advantage to using Wi-Fi transmission is it is licence exempt which is not the case with COFDM systems.

First impressions

The Beam came packaged in a foamed-out Peli type case. The transmitter and receiver are both constructed in high grade metallic cases and feel very rugged.
On the transmitter, (on the camera operator side), there are two Ethernet sockets, one for WAN and one for RS432 serial data, together with the main OLED status display and some micro selection switches to navigate the menu. On the opposing side there is a Hirose power socket, a USB firmware upgrade socket, two 3.5mm stereo sockets for incoming and outgoing intercom and two BNCs for HDSDI in/out.

On the top there are three RF sockets where you can mount the antennas. Front and rear have V-lock plates enabling the entire unit to sit between your camera and your battery pack. For off-camera use, there is a ¼ whit tripod mount socket on the bottom. The receiver is very similar in style to the transmitter although a little slimmer as it does not have the V-lock

battery mounts. The same ¼ whit socket is on the bottom for mounting. Layout is also very similar to the TX. On one side are the two Ethernet sockets, the display and the menu navigation switches. On the far side are the power socket, USB, intercom and a single BNC for HDSDI out. Three antenna mounts are on the top. Neither unit is waterproof so would need some weather protection, especially if mounted up high to get best line-of-sight in foul weather. A simple dustbin liner or large food bag would suffice as long as it did not compromise the ventilation too much, but a custom cover might be more suitable.

Power

The transmitter was powered from the camera battery and didn't caused any excessive drain. The receiver is supplied with a mains power supply and short cable. There is a standard Power DC input connector on both units rated at 7 to 17 volts DC so auxiliary power input is possible.

Range

The manufacturers claim an 800m-range line-of-sight at 12Mbps. I was intrigued to find out if anything like that would be possible in the real world. To give it the best possible chance I took the system to my local lake. The receiver was attached to my car on one side of the water with the antenna at about 50cm above head height. I left an observer in the car with a monitor and walkie-talkie, and I set off roaming. I went a very long way, at least 250m, before I ran out of lake and the Beam was still working, but only direct line-of-sight. Once I was more than about 50m away, if I went behind an obstacle like a building or dense vegetation, it would fail immediately but it would recover very quickly once the link re-established. It usually took less than five seconds to provide good pictures again, and there was no need to reboot the receiver as has been reported with other systems of this type.

The other advantage is that it failed in a very elegant manner – slight pixilation, then a full frame freeze. No flashing, no banging, blocking or break-up. It was also very clean on the re-establish – freeze frame to sudden full motion again.
If I was closer to the vehicle (30 to 50m) then I could go behind obstacles like hedges and buildings and still maintain contact. Likewise, I could walk up a road for about 30m and then get about 20m around a corner before experiencing any trouble. In a fully populated street with lamp posts and other street furniture, parked cars and various trees and vegetation, I was able to get 70m away from the receiver before it would start to get marginal.

It also worked well from inside a domestic building, even from a room at the rear through windows and internal walls to the vehicle parked on the front driveway outside, all without direct line of sight. It was faultless at about 20m range.
For day-to-day News type operations, it's not usually about how far you can go, but more likely where you can park (to get sight of the satellite) and the advantages of not having to lay cables across footpaths etc. So if you can get 30m range reliably, maybe across a road without traffic in between affecting your output, then the Beam fulfils its task beautifully.

Latency

If you are going to use this system in a live broadcast environment, you will have to consider system latency and how anything in the signal chain may affect the delay in your presenter answering a question thrown from the studio. The beam is claimed to have a latency of two frames, about 80 milliseconds. With all the complex processing that is going on inside

Teradek Beam radio camera system

REVIEW

the system and to apply the compression required to get the picture across the link, two frames was quite an impressive claim so I had to measure it.

I used a 'Smart lips' lip-sync monitor and firstly checked the lipsync of the full signal chain, initially with the camera and monitor only, then the camera, monitor and the Beam. The Beam gave an identical result to just the camera and monitor so it was not introducing any new lip-sync errors. I used a similar method to check the Beam's latency, the delay between an input to the camera and the output appearing on the monitor. By taking the audio direct and the vision via the camera, the Beam and the monitor, you can calculate the delay. Again the delay in the camera and monitor was measured, and then the camera, Beam and monitor. Subtracting one from the other would give you the measurement for the Beam only. I got 100 milliseconds, so 2.5 frames - very close to the Teradek claims. I consider 2.5 frames delay to be very useable.

IFB / Clean feed circuit

The Beam also has a facility of a reverse audio bearer via its intercom circuit, so you can introduce the studio audio (IFB or clean feed) off the satellite path, an IP or GSM telephone into the receiver and this will appear on a socket on the transmitter. You can feed this into an earpiece on the presenter so they can hear the studio without cables. Very neat; (and it works, but we will also need to consider the latency of this part of the signal chain too. Any delay here will be as bad as the delay of the video going through the radio link. I measured this and found another five frames of delay. If you are using the IFB circuit, you must consider the system latency of 300 milliseconds or 7.5 frames.

Picture quality

The pictures were great. I am not able to say that they looked any different to pictures directly out of the camera under field viewing conditions. There is some compression on the link which will affect picture quality but this is selectable. You can go down as far as 5Mbps and up to 30Mbps via radio. However, if you go cabled between the TX and RX, you can select up to 50 Mbps. I don't see the point in this as you could just use an HDSDI coax for up to 30m, or fibre if you wanted to go any further. (For all my tests I used a 12Mbps HD link as I guessed there would be an impact on range and reliability if you went much higher, and satellite links are usually far less bandwidth than 12Mbps, especially for news.

Niggles

The only trouble I could find with the transmitter is that when mounted on the camera in front of the battery the HDSDI output BNC of my PMW500 was inaccessible with a full-sized cable as the

transmitter fouled the access. You couldn't use a right-angled adapter to help either as that fouled it too. I had to make up a smaller cable (RG213) and bend the BNC plug a little to make it clear.

The Beam's transmitter antennas are also very close to the radio mic receive antennas on a PMW500 and this did cause the radio mic receiver to break squelch if the radio mic TX was not powered. I was concerned that this would desensitise the radio mic receiver, so did some radio mic range tests with the Beam transmitter powered. The radio mic range was unaffected.

Boot up time for the TX and RX is 45 seconds. Fine when you first rig and establish, but 45 seconds is a long time if you suddenly need to change the camera


The Beam's transmitter antennas are also very close to the radio mic receive antennas on a PMW500

battery at two minutes to air. That's going to cause some panic at the broadcast centre, so you will have to adjust your working practices to ensure this does not cause a problem.

Operational testing

So much for trials without production pressure, now a real world test. Whilst I had the loan unit, I had a call from Links Broadcast to provide live camera into their Ku band uplink truck UKI 787. Links had hired in a Link XP COFDM SD radio system for the task but I offered to try the Beam to see if anyone would notice the difference. It was an SD job for Al Jazeera, uplinked to their Eutelsat 16 satellite capacity then direct to their MCR and studio complex in Doha, Qatar in the Middle East. We worked the link at 12Mbps, although we could have gone to a lower data rate for SD. The RF path was about 40m to the uplink across the road. The receiver was rigged above head height on the truck and SDSDI feed from the RX into the vehicle matrix. The transmitter was on the back of the camera between the camera body and the camera battery, making very little difference to the overall camera balance when handheld. Embedded SDSDI was connected from the camera to the TX. IFB was via GSM in the uplink and sent to the presenter via a radio earpiece.

We did the first three or four inserts into Doha. Mark, the SNG engineer, paid close attention to our output at all times and confirmed there wasn't any break-up caused by passing HGV's etc. By the end of the day, we had clean pictures throughout, and still nothing was said in Doha, so I concluded that we had provided normal service. That was a major success.

Later, I was invited to the NEC with Peter Rance to organise the links for a camera in amongst the exhibition on to some gigantic screens at the opposite end of the hall. I was unable to attend but Peter was able to get the Beam system running alone. The receiver was mounted as high as possible on a lighting stand. The transmitter was on the back of the camera, handheld in the crowd.


Setup for the Al Jezeera uplink

The Beam provided faultless pictures throughout the day, most of the time about 60m away from the RX, with heads and exhibition stands obstructing the signal pathway. Peter's production team were delighted with the results.

Conclusion

I've had the loan unit for a month and haven't found any major problems. It performs perfectly well as a short-range radio camera system. It's rugged and robust. The pictures are great with very little latency.
I don't think I would ever use the RS432 data, the streaming server, or the IFB/intercom in my application, but others may find it useful. I understand that the RRP is £3,999 and street price at the time of writing is around £3,500 – worth every penny in my view.

Profile

Andy Smith is a lighting cameraman who joined the BBC as a trainee in 1981. He worked in studios, location single camera and outside broadcast until 1997 when he decided to continue independently. Since then he has maintained his broadcast clients working across features, drama, newsgathering and current affairs as well as corporate and educational output. Andyalso works as a technical manager for content owners on live event broadcasts with a global reach.
www.andysmith.tv
www.ip-broadcast.tv
www.uk-transmission.co.uk