



WHITE PAPER

Special Projects

The ever-changing world of event broadcasting is both exciting and complex. It is rare for two events to have the same requirements. Therefore, technology needs to be forward thinking, adaptable and constantly evolving whilst costs have to be kept low in a world of diminishing revenue sources. There are many challenges to consider: viewers expect a more immersive experience; available bandwidth is increasingly difficult to source and is expensive; legacy and new technologies need to be compatible and the end product quality needs to be high. The list can feel endless.



A dedicated team of industry-experienced engineers

Most often, the solution required is unique for each broadcaster to help them gain a competitive edge, improve efficiencies or reduce resource use — sometimes, they are trying to achieve all three at once. For this reason, Domo Broadcast Systems has brought together a dedicated team of mechanical, software, FPGA and hardware engineers who have the skills and knowledge needed to create custom-designed solutions. They have direct broadcast industry experience, so they know it must work as it is rare for there to be a second chance and that deadlines are absolute and usually tight. Whether it's designing an all-electric KA band satellite vehicle or building bespoke vehicle systems for use in Formula E, World Rally, Le Mans etc. they get the job done.

They are also the same people building Domo's own line of the most innovative equipment in the industry. They have a strong desire to push the boundaries of what can be achieved. Tell them something can't be done and that's motivation enough for them to prove otherwise. It's the same dedication they bring to their bespoke work on your special projects.

Skills available for your special project

Our engineers have all the skills necessary to undertake complete custom designs, including:

- . System integration
- . Mechanical design including in-house 3D printing capability.
- . Hardware design including PCB layout tools.
- . Software and GUI development,
- . FPGA, VHDL and DSP skills.

Domo specialises in ...

- . Low-latency video encoding and decoding, including HEVC and H.264
- . Audio and data encoding
- . IP interfacing and streaming
- . Data interfaces, such as transport stream and CAN
- . RF waveforms, and modulation and demodulation.
- . Encryption and de-encryption
- . Frequencies, from UHF to 8GHz
- . RF power amplifiers
- . Mechanical design particularly small packages and rugged vehicle packages.

Case study: World Rally vehicle system

The broadcaster needed a bespoke transmitter capable of withstanding the stresses of being mounted in a vehicle competing in the most extreme of terrains. Our team met with the customer to jointly develop the project specifications and undertake some mechanical modelling.

Domo developed a transmitter with four camera inputs providing seamless switching between them. Transmission is via COFDM modulation at 2W power. An integrated return-data channel controls the cameras and changes settings. All video is recorded on-board the vehicles, including meta data such as stage times. Recordings can be replayed over air. GPS data and CAN engine data are received from third-party systems and encapsulated for onward transmission. The system includes a built-in battery and charger, with circuit breakers for safety.



The whole system was successfully deployed and continues to provide the coverage the customer was seeking.

Case study: America's Cup mast system

The ability to broadcast from the top of the mast of an America's Cup sailing boat, was no small ask. The mechanical design was crucial, needing to work directly with mast fixings as well as being aerodynamic and easy to fit and replace during mast changes. It also had to be completely watertight! In addition, collaboration was needed with TV production companies and boat-building companies across the world to ensure the bespoke solution developed worked within the boats' design parameters and met the needs of broadcasters.



The resulting system developed by Domo Broadcast included transmission and power amplification equipment and antennas, as well as mesh radio receive equipment for telemetry, team audio and control.

Case study: Formula E

The team at Formula E were looking for a never-before-seen solution that would allow for 220 on-board cameras to be distributed across 22 cars in a single race. They needed to be able to transmit multiple camera angles simultaneously or individually, with seamless built-in switching, real-time over-air playback and remote operator control of multiple cameras — and of course video quality had to remain pristine, despite the vehicles' high speeds.

The solution developed by Domo Broadcast included several new elements:

- . A bespoke radio housing bringing in the nine cameras on car, genlocking all the cameras and providing seamless switching.
- . Recording of all the cameras with sophisticated meta data.
- . Encoding and transmission in ISDBT.
- . Housing all this in a small, rugged, lightweight package suitable for race car integration.
- . A carbon fibre camera and antenna housing to sit on the top of the car, hosting front and rear facing cameras. The front camera has a clear film roller mechanism designed bespoke to clear dirt from the lens.

In addition, Domo Broadcast developed a complete software suite of tools for transmission control, camera settings control, and video management of the race. These custom software packages were developed directly to the user's requirements.

The result was a revolutionary and award-winning bespoke system that has not only greatly enhanced viewer experience, but also opened up new data sharing opportunities that will improve production and potentially enhance driver safety. The remote production capability from so many cameras is economically and environmentally significant. Not only is it providing extremely high-quality content, but it is also reducing the number of resources needed on site, including people, and the associated financial and environmental costs that go hand in hand with having people on site for a world series.

Although the case studies contained in this paper focus on fast-moving sports, the Domo Broadcast team relishes a challenge and can turn their hand to just about anything that broadcasters seek to achieve.

The more complex, the better!

