Player cameras for esports broadcasts

QRUXEL PRODUCTIONS


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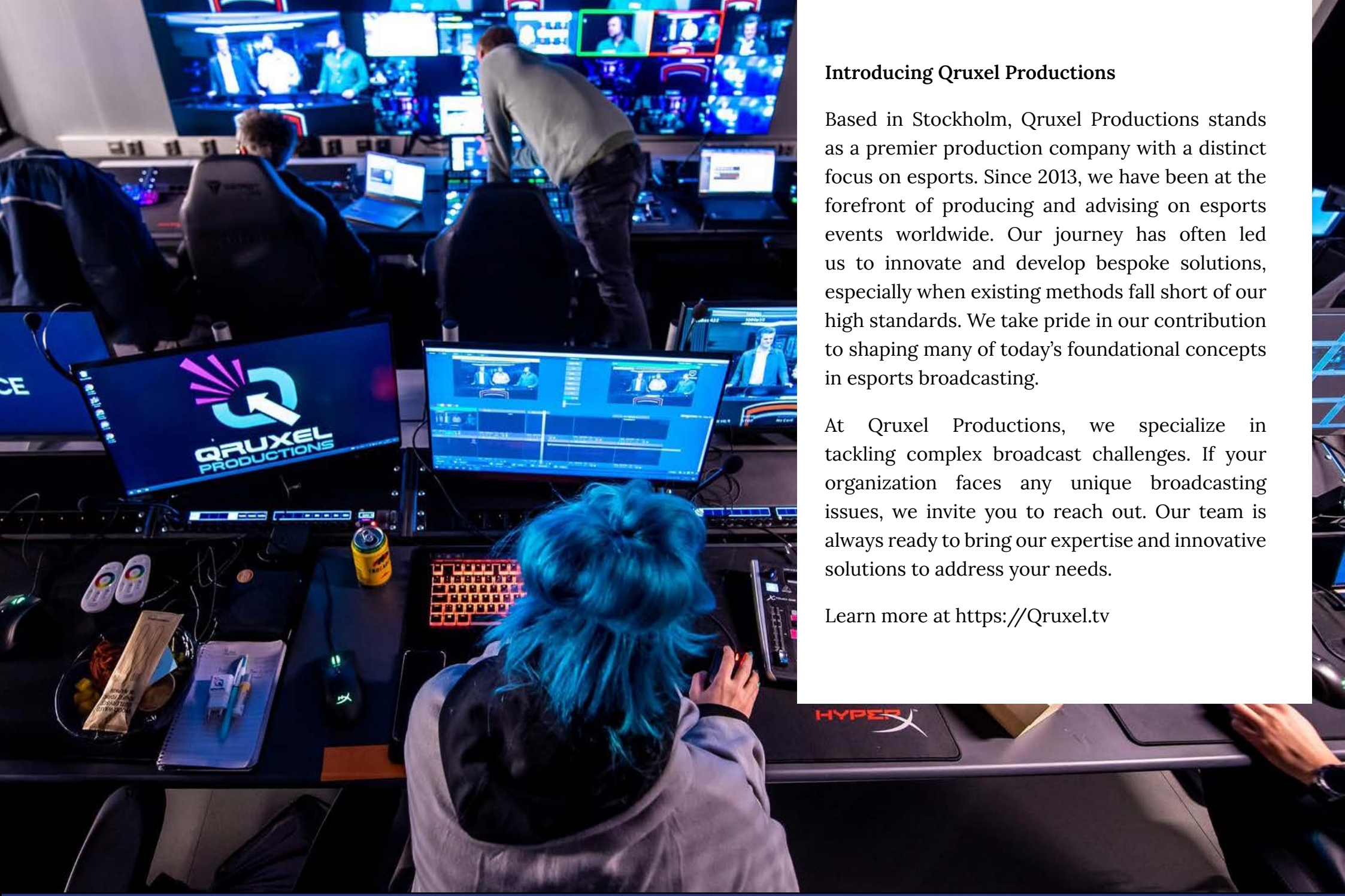
For the past fifteen years, esports has been a pioneer in advancing broadcast technology. Esports audiences expect a viewing experience that closely resembles their personal gaming sessions, necessitating broadcasts with superior clarity and fluidity, often surpassing traditional TV standards.

One of the main challenges in esports broadcasting is the prevalent use of the first-person perspective, which requires advanced technological solutions to circomvent the limitations of the h264 codec.

This paper addresses a key challenge in live esports broadcasting: how to effectively convey the emotions and reactions of players who are seated just inches from their monitors?

Player cameras, focusing specifically on the players, have been a standard feature for quite some time - but finding the best way to implement these cameras has remained elusive until now.



Introducing Qruxel Productions

Based in Stockholm, Qruxel Productions stands as a premier production company with a distinct focus on esports. Since 2013, we have been at the forefront of producing and advising on esports events worldwide. Our journey has often led us to innovate and develop bespoke solutions, especially when existing methods fall short of our high standards. We take pride in our contribution to shaping many of today's foundational concepts in esports broadcasting.

At Qruxel Productions, we specialize in tackling complex broadcast challenges. If your organization faces any unique broadcasting issues, we invite you to reach out. Our team is always ready to bring our expertise and innovative solutions to address your needs.

Learn more at https://Qruxel.tv

CONTENTS:

THE CHALLENGE:
CRAFTING THE OPTIMAL PLAYERCAM SOLUTION

COST PER CAMERA

Years ago, esports typically featured 1-vs-1 formats and it was feasible to use high-end studio camera for each player.

Today most events feature 10 players, but in some cases as many as 64 players can play on stage simultaneously, which significantly increases costs.

LIMITATIONS OF USB WEBCAMS

Using standard webcams seems like an easy fix, but it's not viable. Player PCs are tightly controlled to prevent cheating. Any additional software, including webcam software, could be blamed for affecting gameplay. Additionally, players' PCs are frequently moved between warm-up areas and the stage, complicating webcam use.

ADVANTAGES OF PTZ CAMERAS

Players' proximity to their monitors and their varying postures require frequent camera adjustments. Previously, this meant manual, on-stage camera realignment, which was disruptive and inconsistent. PTZ cameras allow for remote, precise adjustments, ensuring players are always correctly framed without disturbing them.

SDI or NDI?

Traditionally, we've preferred SDI for its reliability, despite its need for extensive cabling and limited input availability on video mixers. Previously, we managed this with a sub-mixer setup near the stage when playercams were needed.

This time we wanted a NDI-based system for its simplicity, PoE capability, and ability to feed multiple systems like instant replay and LED walls simultaneously. NDI's single-cable solution also eliminated the need for multiple connections required by SDI.

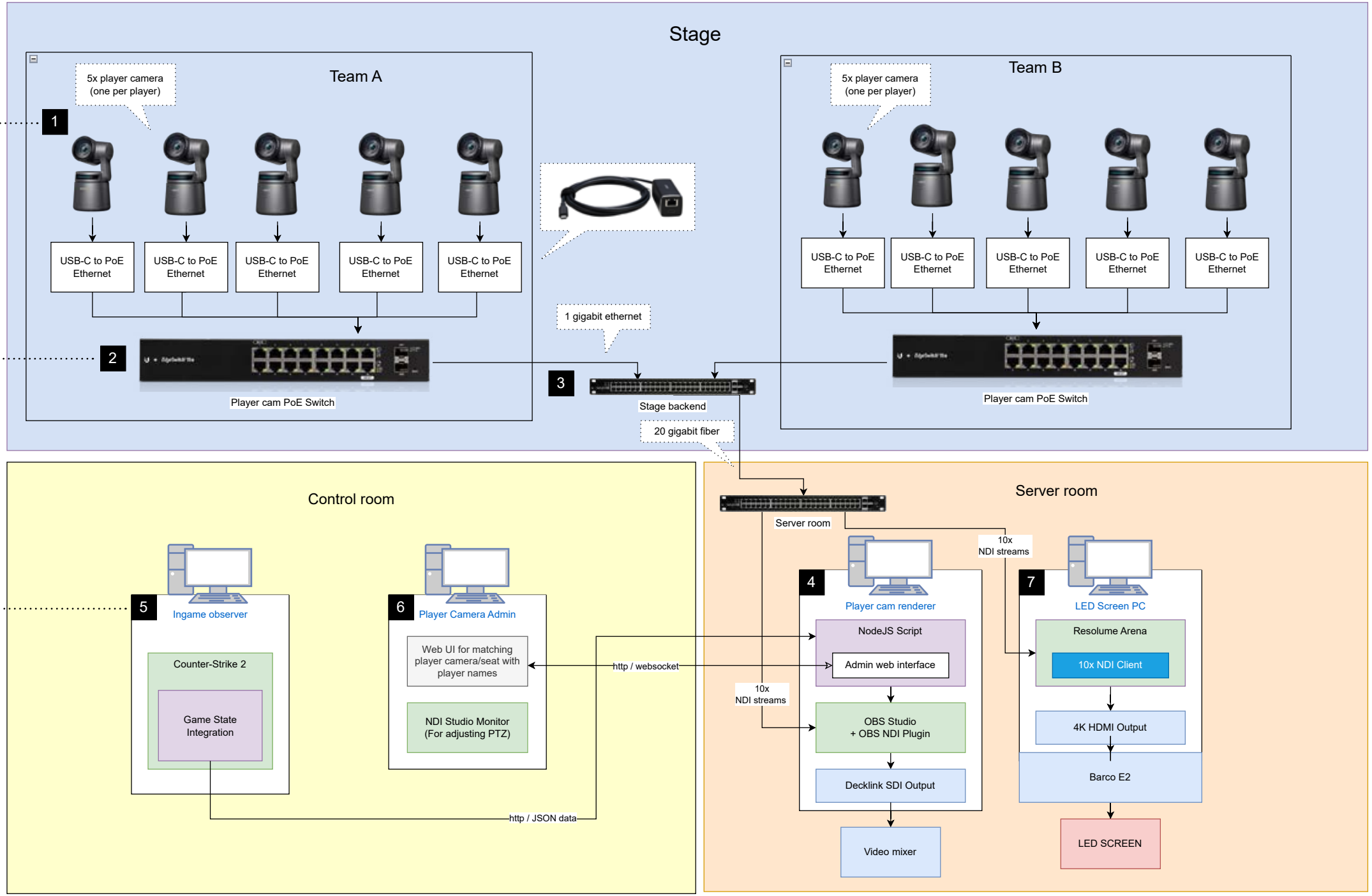
LOW-LIGHT CHALLENGES

Esports stages often have dim lighting to keep players focused, contrasting with the bright lights used for team victories or match ends. Cameras must excel in low-light conditions and have effective auto-exposure to handle these varied lighting scenarios.

These numbers correspond to the headers in the following chapters

THE SOLUTION

Technical drawing: Player-cam setup in a professional esports Broadcast



1 CAMERA SELECTION

Tail Air cameras from OBSBOT was straightforward choice for several reasons:

- **High-Quality Imaging:** These cameras perform well, even in low-light conditions.
- **Unobtrusive Design:** Their compact and non-invasive design is ideal for player comfort.
- **Efficient Setup:** Each camera requires just one cable, combining power (PoE) and network (NDI).
- **Full PTZ Capabilities:** They offer complete pan, tilt, and zoom functions.
- **Short Focus Distance:** This feature is essential for capturing clear images in the confined space of esports arenas.
- **4K Resolution:** The cameras can zoom up to 2x without any loss in quality, thanks to their 4K capability.

We mounted the 10 cameras on table tripods with flat bases to avoid interference with players' equipment like monitors and mousepads.

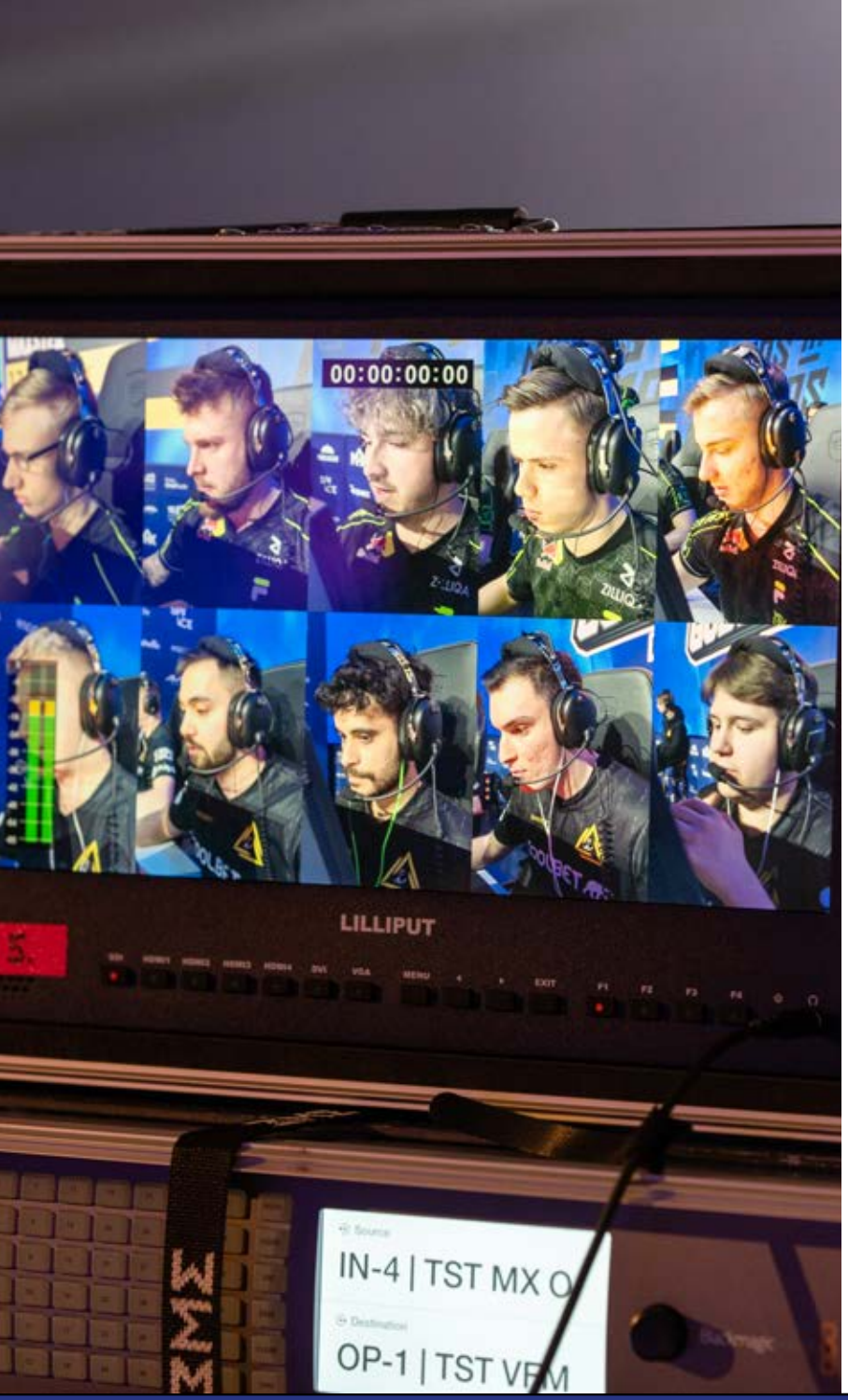
2 POE SWITCH AND SETUP

For our setup, we utilized two Ubiquiti EdgeSwitch 150w units, each featuring 8 ports. These switches were selected for their ample PoE wattage, capable of powering 5 cameras per team effectively. Additionally, they include two SFP slots, offering the flexibility of fiber connections if needed.

3 NETWORK BACKEND

The network backend for our project was managed by an external provider, who allocated a separate VLAN for us. This is a standard practice for handling a large volume of NDI signals. They ensured a robust 20Gbit uplink between the stage backend and our production equipment, which effectively addressed potential bandwidth concerns from our numerous NDI feeds.

In the absence of such infrastructure, our alternative would have been to use dedicated network (or fiber) cables to the production backend. This is crucial to avoid any interference with the players' network connections, which could lead to serious issues.



4 RENDERING BACKEND

Transitioning from NDI signals to SDI for our predominantly SDI-based production posed a unique challenge. We needed a reliable system that could switch between the OBSBOT camera feeds with minimal latency.

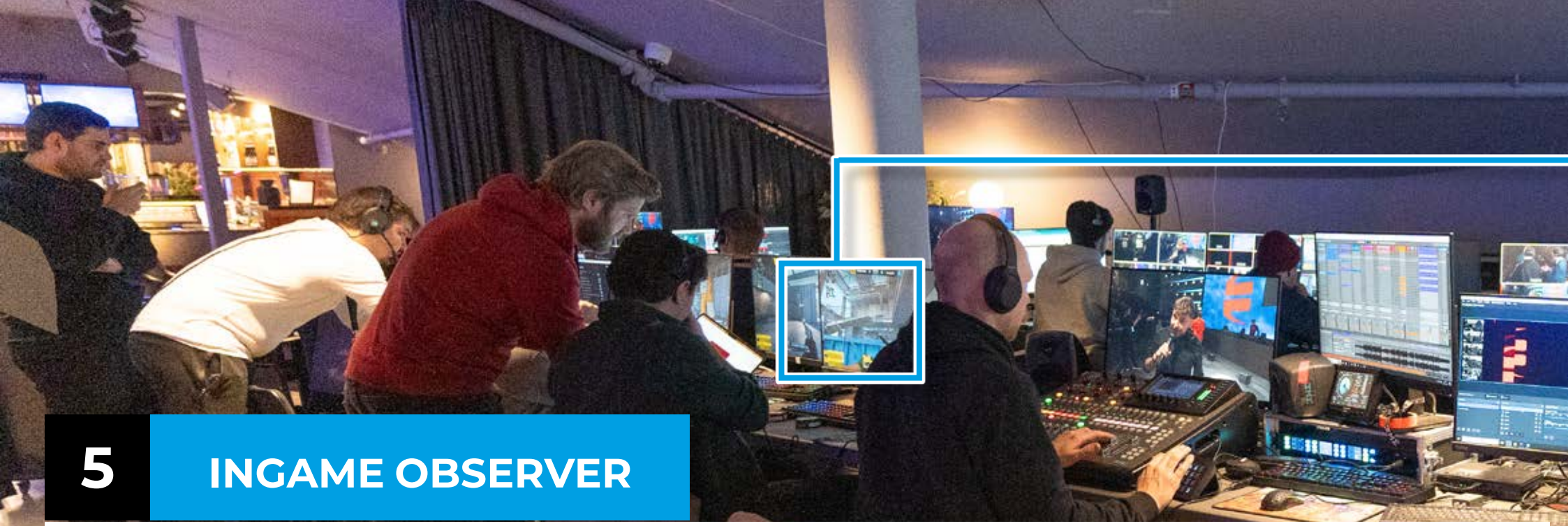
Our solution was an OBS Studio setup, leveraging its Decklink Output plugin. This plugin facilitated the conversion of the NDI signals to SDI through a Decklink Duo 2 card's output.

To overcome the inherent delay in the initial connection to new NDI signals, we kept all 10 feeds active simultaneously.

Since NDI HX is a h264-based codec and demanding for decoding many streams, it required a robust setup .

We used a desktop PC equipped with an Nvidia 3080 Graphics card, balancing the decoding workload between the GPU (for some feeds) and the CPU (for others).

After encountering initial stuttering, we managed to achieve smooth operation by reducing the bandwidth of each camera feed and setting the framerate to 25fps instead of 50 which is our standard. Additionally, our backend server ran a NodeJS script to process in-game data from the Observer. For streamlined management, this script interfaced with a local Bitfocus Companion installation, which, in turn, controlled scene switching in OBS. While direct control of OBS via our NodeJS script might have reduced the delay slightly, we prioritized manageability in our setup.



5 INGAME OBSERVER

In esports, the Observer, or Spectator, can be likened to a virtual camera operator within the game. Much like a technical director operates a video mixer, the Observer dynamically selects the most engaging player point-of-view (PoV) to display during a live stream.

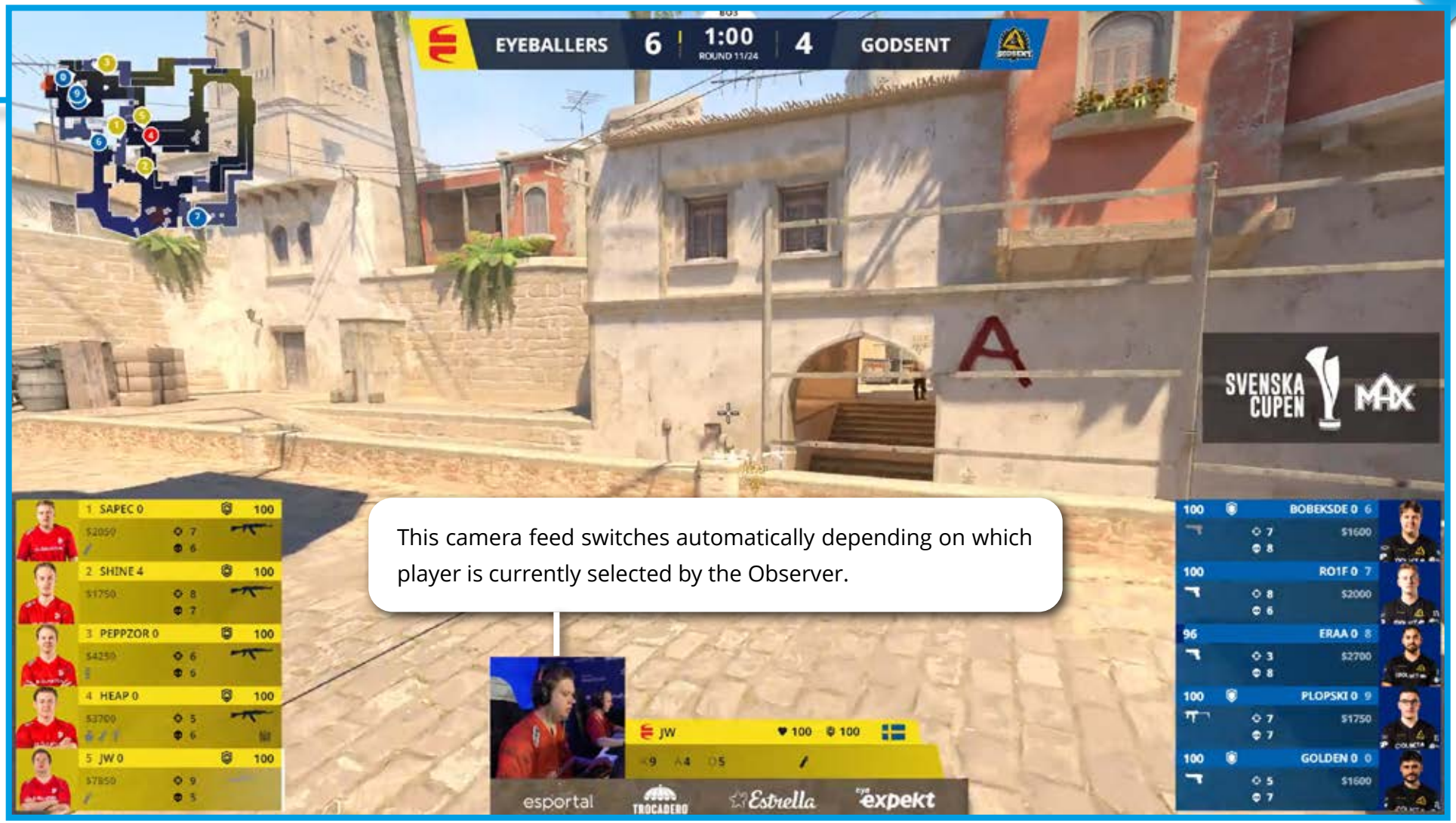
While the primary focus is often on first-person views, professional Observers also use virtual dolly-camera paths to enhance the broadcast with wider establishing shots. Over a typical 30-50 minute match, an Observer might switch between players around 500-1000 times.

Manually syncing the player camera with the current on-screen player would be an immense challenge. This is where “Game State Integration” (GSI) in games like Counter Strike 2 becomes invaluable.

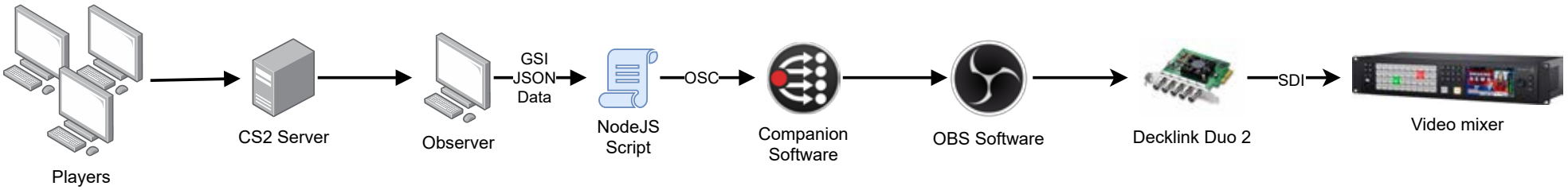
GSI sends continuous game updates as JSON packages, providing vital information such as player status, weapons, scores, and crucially, the currently selected player.

This is also applicable during virtual dolly moves when no specific player is selected.

By enabling GSI on the Observer’s computer and configuring it to transmit data to our NodeJS script, we can automatically switch player cameras based on the game’s real-time data. This integration significantly streamlines the broadcasting process and ensures viewers don’t miss any critical moments.



This camera feed switches automatically depending on which player is currently selected by the Observer.

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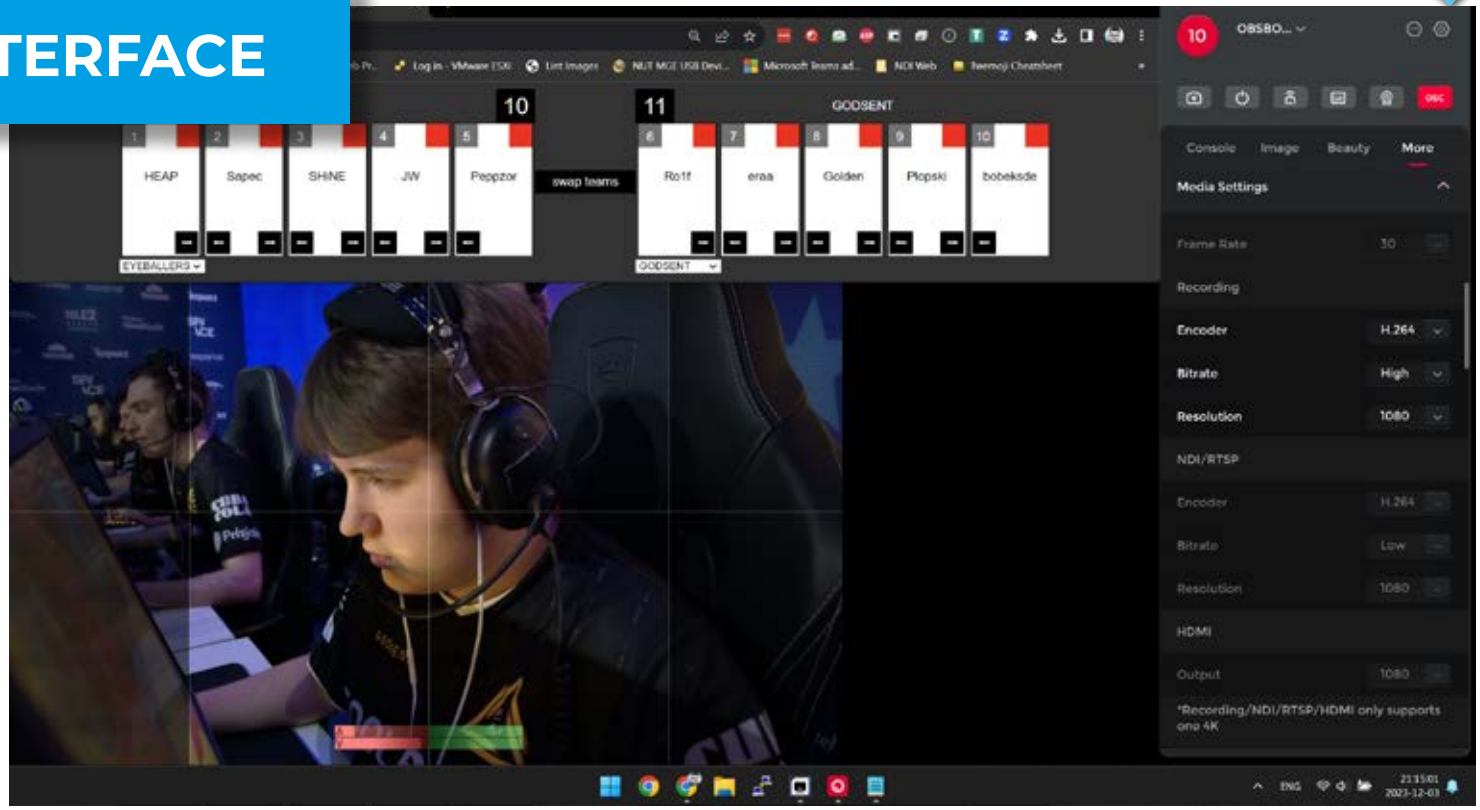
6 ADMIN INTERFACE



To bridge the gap between in-game player selection and physical player camera location, we developed a simple yet effective solution.

Since the game's Game State Integration (GSI) doesn't track players' physical seating arrangements, we created a web-based UI within our NodeJS script.

This interface displays the teams and the players connected to the game. Prior to each match, we arranged the player names in the UI to correspond with their seating positions on stage. The system also saved these arrangements, reducing setup time for teams with consistent seating orders.

For those in need of a similar NodeJS script solution, Qruxel Productions is available for consultation and support.

Additionally, the Player Camera Operator was responsible for managing the PTZ cameras' positioning and Camera Control Units (CCU). By running a local instance of the Companion software, we configured a system where the admin could easily switch between cameras.

Each camera button in the Companion interface not only switched the NDI stream in the NewTek Studio Monitor but also sent an OSC command to the OBSBOT Webcam software, allowing seamless transitions and adjustments of the cameras in the preview monitor.

7 LED SCREEN

The management of the LED screen was handled by an external team. They employed a dual-computer setup, each running OBS to generate NDI signals for each half of the expansive 40:9 screen. Each feed incorporated five cameras, along with player names and additional data.

These NDI feeds were then processed through a computer running Resolume Arena, which was responsible for outputting the final composite image onto the LED screens.

An alternative approach could have involved directly playing the NDI feeds from the cameras on the Resolume computer. However, by using two auxiliary computers, the intensive task of decoding all ten camera streams was efficiently distributed, ensuring smoother operation.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FINAL THOUGHTS

The event was a resounding success, and the camera setup performed as expected. However, as with any pioneering technology, there are areas we anticipate improving in future events.

FIRMWARE UPDATES

The firmware used during the event was in its early stages. Since then, there have been several updates, potentially resolving some of the minor issues we encountered.

PERFORMANCE AND CONNECTIVITY

We faced initial performance challenges, partly due to the 100mbit limitation of the PoE Ethernet adapter. There are rumors of OBSBOT releasing a gigabit version, which should enhance performance. Additionally, managing simultaneous high and low-resolution NDI streams from the same camera seemed to strain the system. We're hopeful that future firmware updates will address this.

AI AUTO TRACKING LIMITATIONS

The AI auto-tracking feature was unreliable for our needs, often losing track of the subject. Future enhancements, like area limitation for tracking and a default position reset, could make this feature more viable.

BANDING ARTIFACTS

We observed banding artifacts, particularly when players' faces were illuminated by their monitors. This is a common issue arising from the mismatch betweenmonitor refresh rates and camera shutter speeds. The severity of these artifacts was notable, and we believe that more nuanced shutter speed controls, along with potential firmware updates, could mitigate this issue.

Overall, we are highly satisfied with the camera setup and its performance. We eagerly anticipate the opportunity to utilize these cameras again, bolstered by the prospect of continuous improvements and updates.

USEFUL LINKS

QRUXEL PRODUCTIONS
https://Qruxel.tv

OBSBOT TAIL AIR PRODUCT PAGE:
https://www.obsbot.com/obsbot-tail-air-streaming-camera

OBS STUDIO
https://obsproject.com/

NDI TOOLS
https://ndi.video/tools/

OBS-NDI PLUGIN
https://github.com/obs-ndi/obs-ndi/

BITFOCUS COMPANION
https://bitfocus.io/companion

INFORMATION ON GAME STATE INTEGRATION
https://developer.valvesoftware.com/wiki/Counter-Strike:_Global_Offensive_Game_State_Integration

About the author

Ludvig Fjell is the founder and CEO of Qruxel Productions. With his roots in software development, Ludvig transitioned into the realm of esports broadcasting, identifying and addressing the need for innovative solutions and fresh perspectives within the industry.

While leading Qruxel Productions, he passionately engages in roles that resonate more with an inventor and broadcast engineer, actively contributing to the technical and creative aspects of production. His expertise and influence extend across major esports broadcasts in Europe, Asia, and the United States, showcasing a blend of leadership and technical proficiency.