Online Media Innovations in the Service of Transport and Logistics 4.0: a 5G Paradigm

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***Abstract* – With the rise in online media consumption, a cloud-based infrastructure for harvesting, accommodating, transmitting, and distributing sports and esports content, including infrastructure to allow content creators and producers of live coverage to react to live outcomes via innovative workflows is required. The paper describes how the COPA EUROPE project, through its three target use cases, can lead to innovation in the online media sector and directly influence the transition to Transport and Logistics 4.0 by providing seamless media transmission (e.g., the live feed of containers) accelerating the adoption of such technologies by the industry.**

Keywords—Over-the-Top media services; 5G; Glass-to-Glass; Innovation; Quality of Experience

I. INTRODUCTION

Assessing the perceived quality of images and video sequences is a complicated task because there are numerous and diverse factors involved in human perception subjectivity [1]. Nonetheless, accurate quality assessment is vital in managing resources such as memory and bandwidth requirements. Currently, the user's Quality of Experience (QoE) is used as a measure to encode this information and capture the evolving scenario of video streaming. Ideally, human viewers should perform quality assessment, but manual annotation of images and videos is a time-consuming and labor-intensive process. Therefore, there is a growing interest in automated QoE estimation, which has practical implications. State-of-the-art approaches use machine learning (ML) algorithms to automatically assess user experience by generating a model during a training phase using human-annotated examples, enabling them to estimate annotations of unseen examples during inference [2].

For this reason, the COPA EUROPE project plans to deploy a Cloud-based infrastructure for gathering, storing, converting, and distributing digital media relating to European sporting events. The platform aims to provide end-to-end streamlined workflows that enable engaging storytelling of live esports and sports viewing over-the-top (OTT). The system will include all necessary core services and components for collecting, creating, and distributing high-quality interactive digital content across multiple channels worldwide. To demonstrate the project's objectives, COPA EUROPE conducts pilot activities in nearby market environments to exhibit how its core technologies align with 5G wireless communication technologies. One of the three use cases (UCs) that will be executed throughout the project runtime is UC3, known as "Glass-to-Glass" live coverage streaming over 5G networks. This use case leverages the new 5G technology and benefits from the 5G BERLIN testbed located in downtown Berlin Charlottenburg, in the vicinity of the Technical University of Berlin (TUB). The testbed includes the latest commercial 5G standalone hardware, as well as experimental components. The "glass-to-glass" application allows esports media streamers and viewers to connect over 5G in new ways, making it easier for professional or amateur broadcasting operations of any size, from a one-person show to a full-scale production, to deliver non-stop live sports coverage through reliable, high-quality streams from remote locations and/or congested network environments. The application tests "glass-to-glass" use cases that require extremely low latency and extremely high bandwidth, which are the key features of the 5G standalone (SA) technology.

Development of such technologies can prove to be vital in the transition to Transport and Logistics 4.0 and the wider adoption of 5G technologies in the sector by industry stakeholders as there is a need for seamless data transmission of video, audio and sensor feedback especially in the case of freight transport and can be vital in the case of sensitive or dangerous cargo.

The platform developed by COPA EUROPE can serve as a paradigm of the capabilities of such technologies can bring and the innovation that can be fostered by focusing on solutions to the T&L sector. Our platform is designed to be versatile and can be used not only to send and receive data but for active monitoring with the use of drones and other surveillance technology. In the next sections we will describe our testbed and give a more high-level description of the project which can serve as a reference for future applications.

II. THE COPA EUROPE 5G TESTBED

The 5G Berlin testbed utilizes a 5G core network, with the network type being 5G New Radio (NR) SA. The network

architecture consists of two base stations controlled by the 5G core, based on the ETSI-TS138.104 standard, version 15 [3]. The control units of the two base stations are linked to the 5G core through a backhaul switch, and the transmission mode employed is Time Division Duplex Access (TDDA), with a maximum bandwidth of 100 MHz. On the other side of the 5G core, a Next Generation Firewall (NGFW) router is connected to enable two applications: connection to the Internet and integrating a local edge computer via the switch. External access to the system components is possible via a Virtual Private Network (VPN) connection. The switch ports of the system support a minimum of 10 Gbps. The 5G testbed consists of one Radio Access Network (RAN) system and one Open RAN (O-RAN) system. The RAN system's antenna is located on the roof of the FHHI building and is already operational, while the O-RAN system controls Small Cells.

The functionalities of the 5G testbed in our project include OTT content delivery where applications from partners of the project are supported through the VPN access to the 5G testbed (including a User-Generated Content (UGC) application, professional multi-cam contribution, streaming engine and video gateway and others), ultra-dense network deployment (UDN), beamforming, Network Slicing (tested for 2 slices) and end-to-end low latency.

To validate the 5G testbed we employ the following techniques:

- To determine the Hypertext Transfer Protocol (HTTP) DL rate, an HTTP server is installed on a VM in the 5G network. For the validation, the ROMES4 software from Rohde und Schwarz is used together with a Quectel RM500Q modem. With this measurement equipment, the HTTP DL rate, the RTT between VM and modem as well as the received power (Reference Signal Received Power [RSRP]) at the modem can be determined. By measuring the RSRP at the modem, the network coverage of the macrocell on the TU campus in Berlin is determined and a map is created from this.
- To determine the UL an DL rate to a smartphone, iPerf3 is installed on a VM in the 5G network. Magic iPerf and a ping meter are installed on the Huawei P40 Pro smartphone. With these measuring tools, the UL and DL rate as well as the RTT between VM and smartphone, can be determined.
- Validation of the internet speed via the 5G network to the smartphone, for example with https://www.speedtest.net

III. THE COPA EUROPE PROJECT

COPA EUROPE is a project that aims to meet the ever-increasing demand for non-linear sports consumption, both for live sports and eSports, by leveraging Over-the-Top (OTT) sports media services [4]. The project seeks to combine these services with new and innovative media technologies to democratize the consumer experience, enable cost-sensitive live video from anywhere, and personalize the distribution of content to change the experience of each viewer individually. To achieve this, COPA EUROPE will deliver a cloud-based infrastructure that can efficiently harvest, accommodate, transmit and distribute digital media with regard to sports and competitive events. The infrastructure will allow content creators and producers of live coverage to react to live outcomes through innovative workflows, resulting in a more engaging and personalized experience for the viewers.

By providing an advanced and innovative media infrastructure, COPA EUROPE will enable content creators to react to live outcomes and adjust their coverage accordingly, making the viewing experience more personalized and engaging. Additionally, the infrastructure will democratize the consumer experience by enabling cost-sensitive live video from anywhere, making it more accessible to a wider audience. Using cloud-based technologies and innovative workflows, COPA EUROPE will revolutionize the consumption of sports and competitive events, bringing fans closer to the action than ever before.

The project through its three use cases (UCs) will utilize technologies like 5G to address indicative business cases, targeting close-to-market prototypes. These use cases aim to disrupt the sports media distribution ecosystem by transforming the existing centralized architectures (UC1), cultivate European eSports as a broadcasting property (UC2) and “Glass-to-Glass” live coverage streaming over 5G networks (UC3). The overall concept of the project is presented in Figure 1.

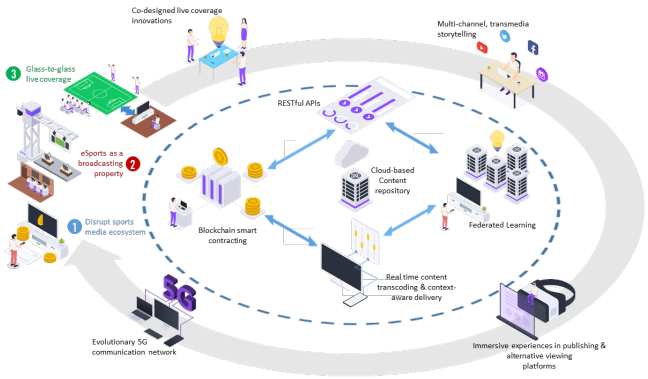

Figure 1: COPA EUROPE’s overall concept.

IV. CONCLUSIONS & NEXT STEPS

This paper provided the COPA EUROPE project’s contribution to the impact of 5G for non-linear sports consumption especially with the growth of live sports and eSports. Particularly, the paper presented the 5G testbed that will be used to achieve the project’s objectives with focus to UC3 that will enable live coverage streaming over 5G networks.

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