

5G-RECORDS

5G key technology enablers for emerging media content production services

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Abstract— 5G-RECORDS explores the possibilities that 5G technologies and innovations may bring to the content production industry. The project targets the integration and validation of 5G technologies as part of an overall infrastructure in order to meet the requirements of the emerging market players in Europe, especially in the context of professional content production. Three use cases will be deployed in professional environments, enabling performance measurements and evaluation, aiming to explore and demonstrate the feasibility of using 5G in the context of professional content production, opening new horizons for the industry and generating new business models that will help to deliver value.

Keywords— 5G, professional content production, technology enablers, end-to-end infrastructure, non-public networks.

I. 5G-RECORDS OVERVIEW

5G-RECORDS is a European H2020 project that aims to explore the opportunities that new 5G technology bring to the professional audio-visual (AV) content production sector. The main objectives of the project are as follows: (i) design and develop 5G components based on 3GPP Rel-15, 16 and beyond, (ii) integrate the developed 5G components into end-to-end 5G infrastructures, (iii) validate the 5G components in the context of the considered use cases, (iv) demonstrate the potential value that 5G brings to the content production sector, and (v) maximize the impact of project results and influence standardization and technical solutions. These objectives will be fulfilled via three use cases that represent different aspects of the media industry: live audio production, multiple camera wireless studio and live immersive media production.

II. CONSORTIUM

The project brings together a wide range of experienced partners whose expertise covers both 5G and content production value chains. In particular, the consortium consists of two 5G infrastructure manufacturers (Ericsson and Nokia), four partners that provide 5G core technologies (Cumucore, RED Technologies and Accelleran), 5G Modems (Fivecomm) and a major telecom operator (Telefonica). The content production sector is represented by four major European public broadcasters (EBU, RAI, BBC and TV2) and two leading media technology companies (Sennheiser, LiveU, Image Matters and Red Bee Media). The consortium also includes two universities (Universidad Politécnica de Valencia and Universidad Politécnica de Madrid) and one research center (Eurecom).

In addition, the project has a strong Advisory Board to monitor, evaluate and propose improvements to the work in

progress and respond to the results achieved. It is made up of seven companies belonging to both 5G mobile communications and content production sectors: Amarisoft, BT Sports, SWR, RTVE, NEP Group, Nevion and ZDF.

III. 5G TECHNOLOGY ENABLERS

5G-RECORDS relies on the following 5G key enablers to implement the three use cases infrastructures:

a) Non-public networks (NPN): technology that allows vertical users the deployment of 5G systems for private use. They offer the possibility of providing 5G network services to organizations without entirely relying on public mobile networks.

b) Network slicing: Virtual partition of the network that serves a specific purpose for an application or entity, usually with a set of guaranteed Key Performance Indicators (KPIs) and Quality of Service (QoS). Different network slices are tailored to specific use cases and will focus on assuring Quality of Experience (QoE).

c) Edge computing: Technology that allows the deployment of computing power closer to the network endpoints in order to improve real-time processing capabilities and guarantee specific KPIs such as response time and latency.

d) Open and virtualised RAN: Open and interoperable interfaces, complementary to 3GPP, supporting a multi-vendor ecosystem for future intelligent 5G vRAN platforms.

e) Ultra-Reliable Low-Latency Communication (URLLC): 3GPP Rel-16 usage scenario with stringent constraints in terms of latency and reliability especially suited to real-time processes.

f) New Radio Reduced Capability (NR-RedCap) UE: 3GPP Rel-17 device prototype with reduced capabilities, e.g. low-complexity and long-lasting battery life, to address industrial IoT applications with service demands similar to LTE Categories 1-4, i.e. higher than NarrowBand IoT (NB-IoT) and Cat-M, but lower than enhanced Mobile Broadband (eMBB).

g) Dynamic spectrum access: Process of increasing spectrum efficiency and network capacity via real-time adjustment of radio resources.

h) Mm-wave antennas/devices: New radio bands between 30-300 GHz, based on line-of-sight paths, with larger bandwidth availability aimed at providing extreme capacity for the busiest locations.

i) Orchestration: The flexibility of the 5G core service-based architecture provides network interfaces that are useful for the

orchestration process, that include interconnected equipment discovery, connection, authentication, authentication and resource discovery and provisioning.

j) *5G-TSN*: Time Synchronization is the process by which software or equipment has an accurate, common source of time information. 5G-TSN is a technology that, in conjunction with URLLC, aims to configure the 5G system as a time aware component that takes part on the synchronization process.

IV. USES CASES

Aiming to demonstrate the benefits brought by 5G to the content production industry, three different scenarios are being considered for its deployment, integration, and evaluation. They cover a wide range of media content production types and intend to contribute to the industry ecosystem.

a) *Live audio production (UC1)*: In a typical live audio production setup, performers are equipped with Programme Making and Special Events (PMSE) equipment such as wireless microphones and in-ear monitoring (IEM) systems. UC1 aims to deploy a local 5G wireless high-quality ultra-reliable and low-latency audio production network based on standalone NPN (SNPN) by designing a NR-Redcap audio device prototype. Latency is one of the main challenges for the professional audio use cases as well as reliability, synchronicity and spectral efficiency. In this regard, UC1 will focus on meeting a stringent round-trip latency requirement of 4 milliseconds (from microphone to IEM going through live audio processing tools and other network elements). Using 5G as a system-based approach will result in a reduction of today's efforts to handle remote production and spectrum access.

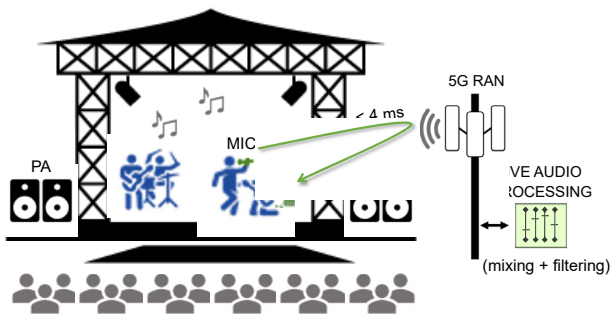


Fig. 1. Use case 1: Live audio production.

b) *Multiple camera wireless studio (UC2)*: This use case is based around multi-camera audio and video production in a professional environment. It will aim to replicate existing technologies such as COFDM radio cameras in terms of performance and capabilities using 5G technology. Furthermore, UC2 focuses on exploring multi-location scenarios with production facilities local to an event as well as remote and distributed production models. In some additional scenarios, it is expected to integrate 5G based contribution solutions using different types of network configuration to provide contribution links into production centers.

Current efforts are devoted to: (i) the development of the 5G-2110 Gateway, which will act as a media translator between different networks, (ii) the definition of the Operational Control Gateway architecture, including camera controls, timing & synchronization and device registration - these processes will be based on specialized technologies, such as NMOS, PTP, NTP, MQTT and so forth, (iii) the definition of a set of tests that will measure the network and media KPIs, and (iv) the definition of multiple scenarios in which the system will be tested.

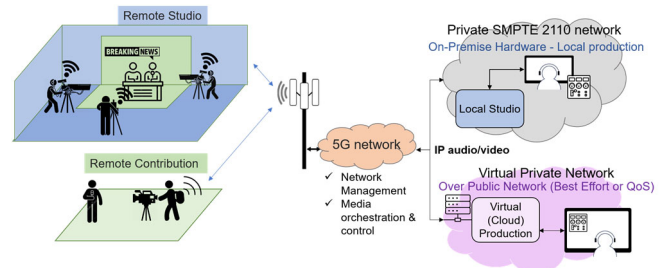


Fig. 2. Use case 2: Multiple camera wireless studio.

c) *Live immersive media production (UC3)*: This use case considers a real-time, end-to-end, Free ViewPoint View (FVV) system aiming to cover multitudinary events on theater or stadium-like venues, that includes: (i) video capture, (ii) 5G contribution using mmWave, (iii) virtual view synthesis on an edge server thanks to several Virtual Network Functions (VNFs), (iv) 5G delivery through VNFs and (v) visualization on users' terminals using the mmWave link on-premise or the core network for remote attendees. The system finally delivers a synthesized virtual video, offering customers a high level of immersivity and groundbreaking QoE. In addition, network slicing will also contribute to deliver assured QoS streams. A first trial setup has been deployed so far with the basic capture, cloud processing and 5G network infrastructures, enabling the first performance measurements.

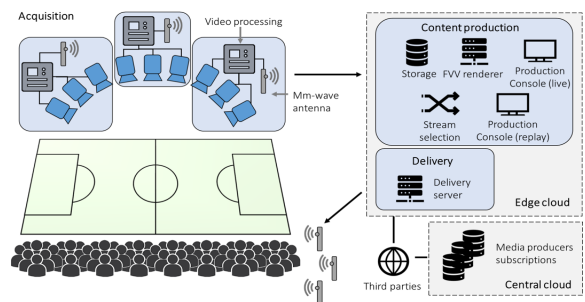


Fig. 3. Use case 3: Live immersive media production.

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