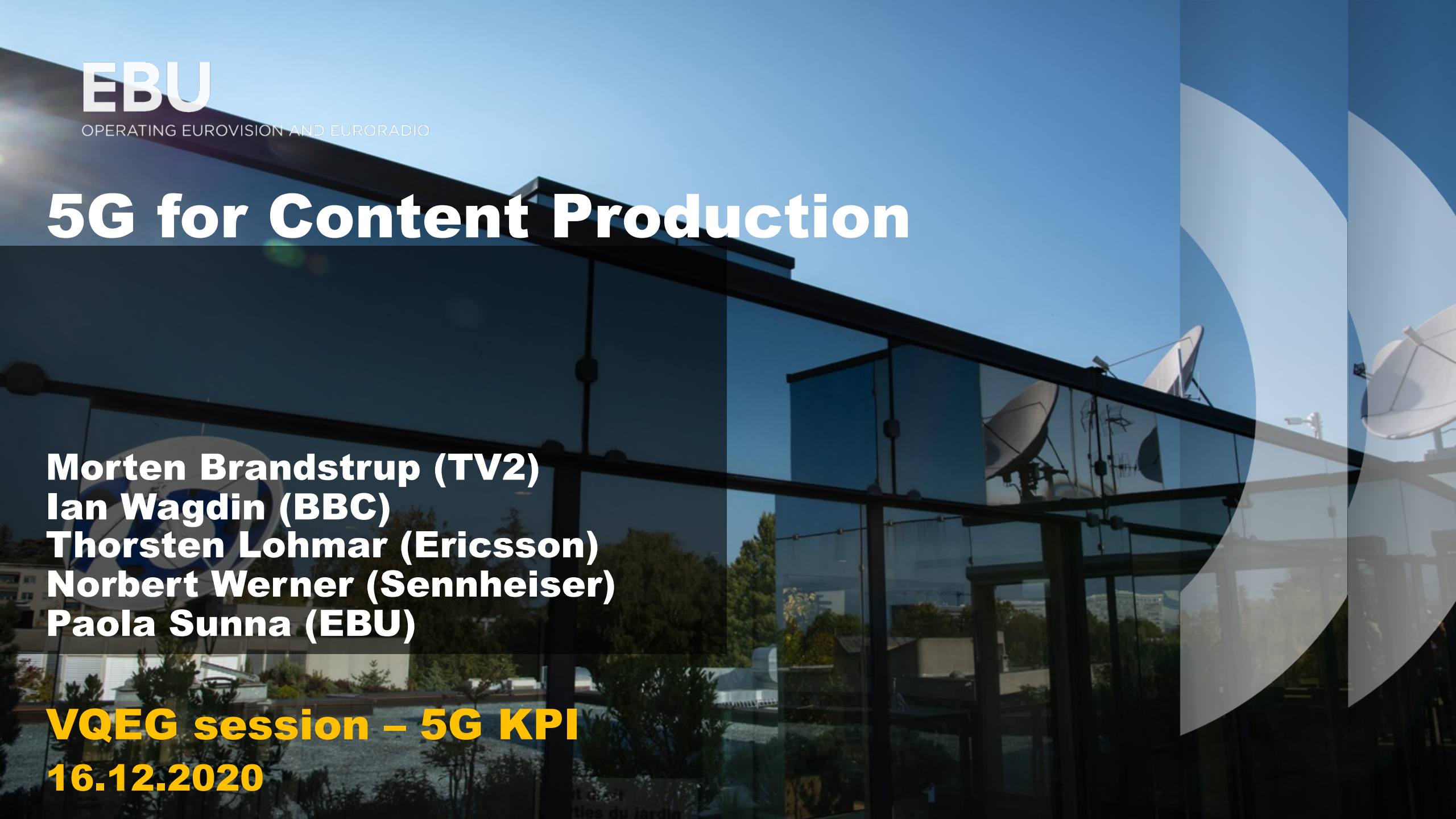


EBU
OPERATING EUROVISION AND EURORADIO

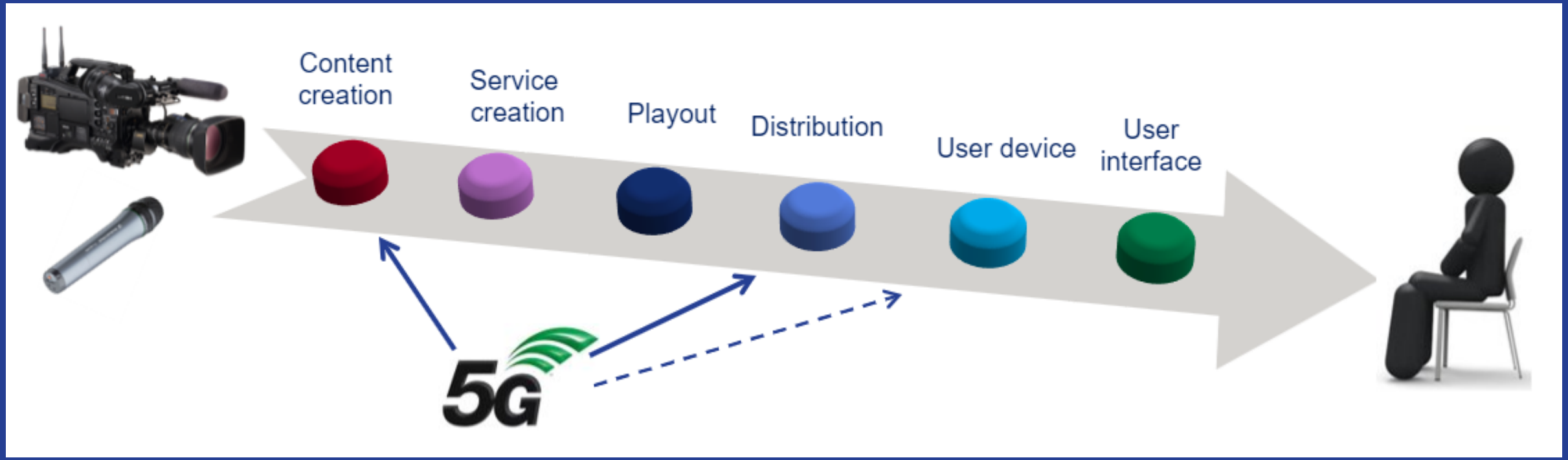
5G for Content Production

Morten Brandstrup (TV2)
Ian Wagdin (BBC)
Thorsten Lohmar (Ericsson)
Norbert Werner (Sennheiser)
Paola Sunna (EBU)

VQEG session – 5G KPI

16.12.2020

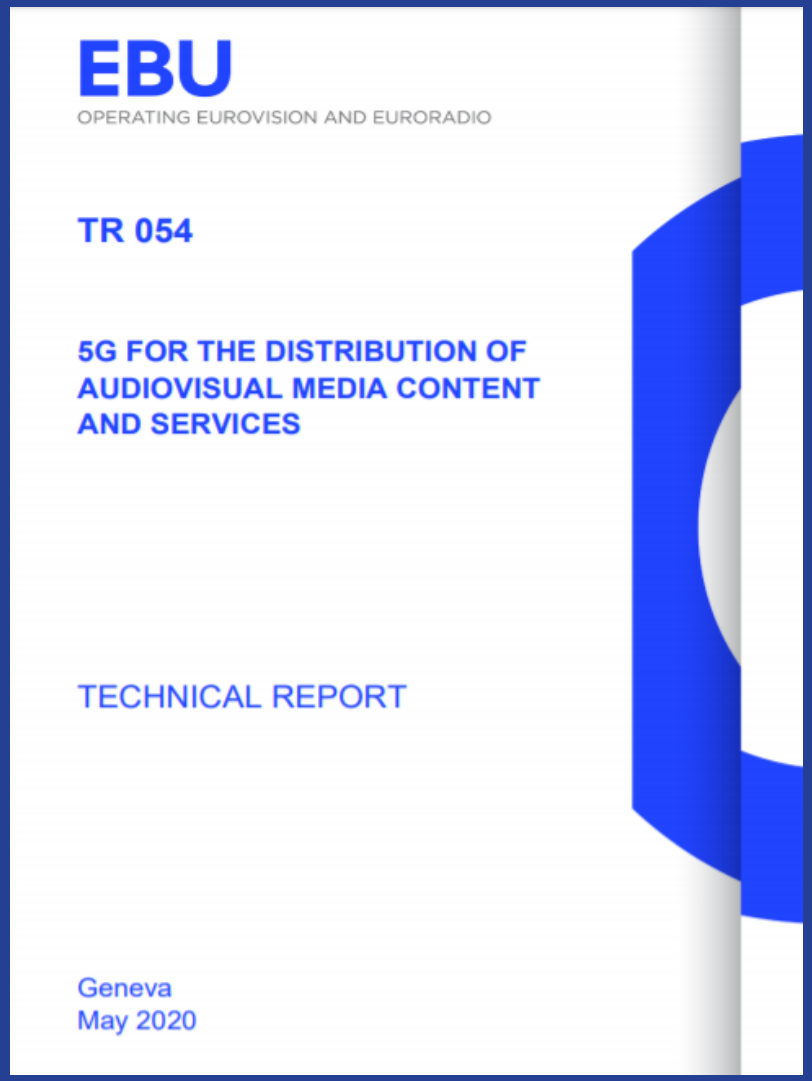
5G ROLE IN THE MEDIA SECTOR



PRODUCTION USE-CASES

- **Newsgathering**
  connectivity over quality, often single camera
- **Broadcast of a live event**
  remote live TV production, live commentary. Multicamera (3-5)
- **Large Sports Event**
  Olympics etc, many cameras (100's cameras but not all wireless)
- **On-site live events**
  wireless microphone, in-ear monitors,
  telemetry and remote control
- **Wireless studio**
- **Non live production**
- **Media file transfer**

EBU TECHNICAL REPORTS



5G-RECORDS
HORIZON 2020 PROJECT

HORIZON 2020

5G PPP

5G RECORDS

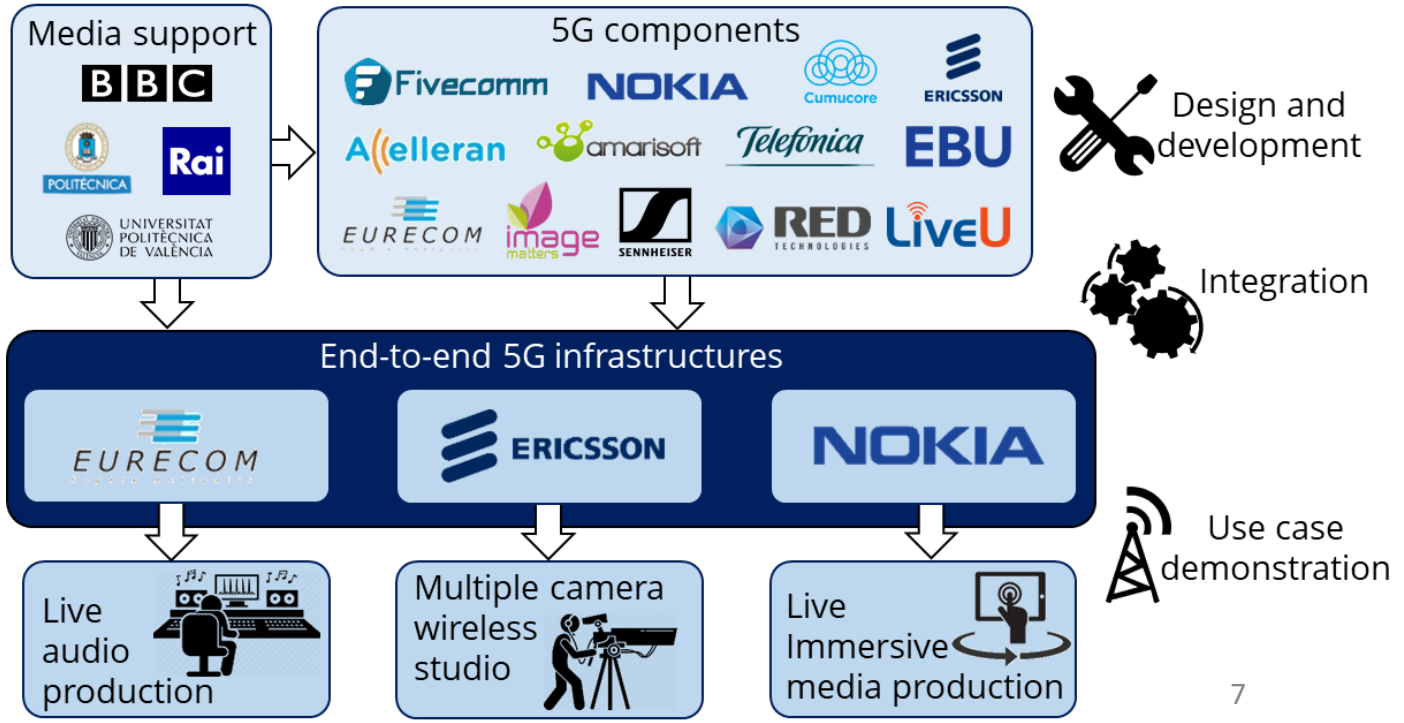
5G key technology enablers for emerging media content production services

ICT-42-2020

5G core technologies innovation

1. Project Overview

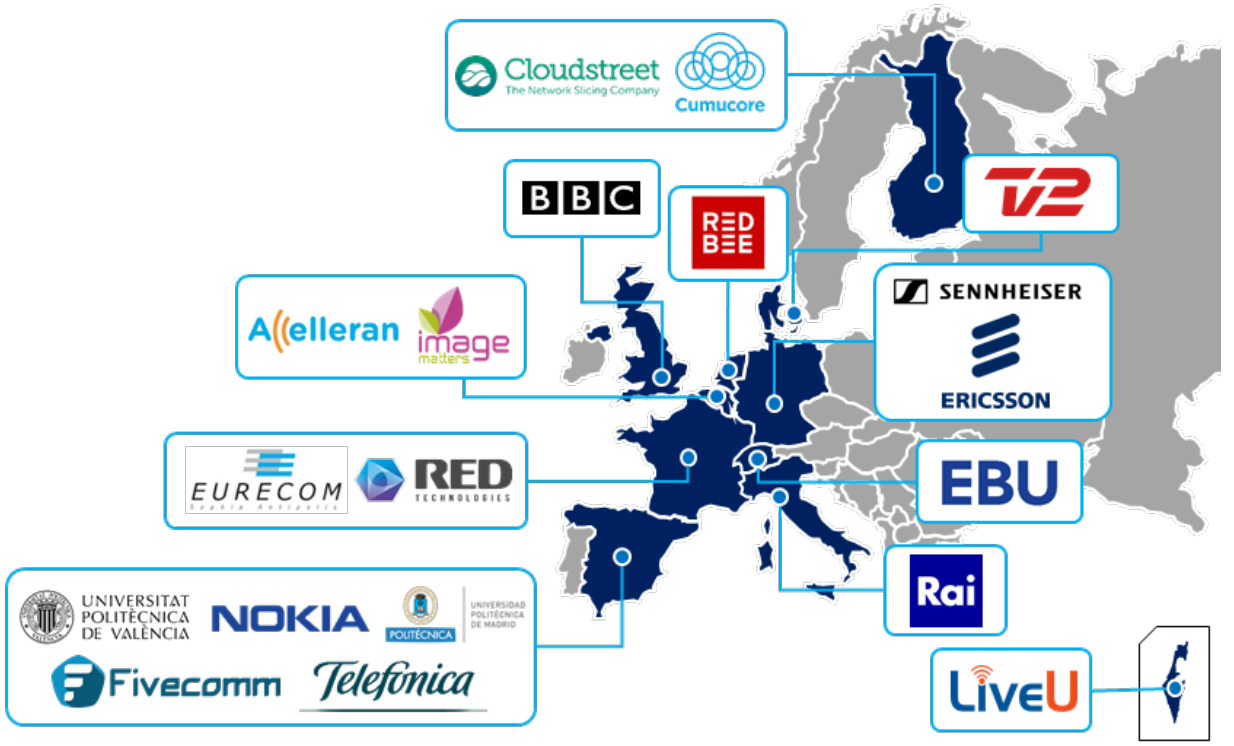
- 5G-RECORDS is about the development, integration, validation and demonstration of **5G components** for **professional media content production**.
  - Developed within previous 5G-PPP projects and earlier R&D investments
  - To be deployed specifically for content production
  - Business-to-business (B2B) perspective
- **3 end-to-end 5G infrastructures**:
  - 5G Core (5GC)
  - Radio Access Network (RAN)
  - End devices
- **3 use cases**:
  - Live audio production
  - Multiple camera wireless studio
  - Live immersive media production
- **Duration**: *24 months*
  - Sept. 2020 – Aug. 2022
- **Budget**: ~7.4 M€



2. Consortium

11 countries 18 partners

- Accelleran, Image Matters
- TV2
- Cumucore
- Eurecom, RED Technologies
- Ericsson, Sennheiser
- LiveU
- RAI
- Red Bee
- Fivecomm, Nokia, Telefonica, UPM, UPV
- EBU
- BBC



- x7 high-tech SMEs, x2 5G infrastructure providers, x1 MNO, x2 media vendors, x4 broadcasters, x3 research centres and universities.

5. Use case Live audio production

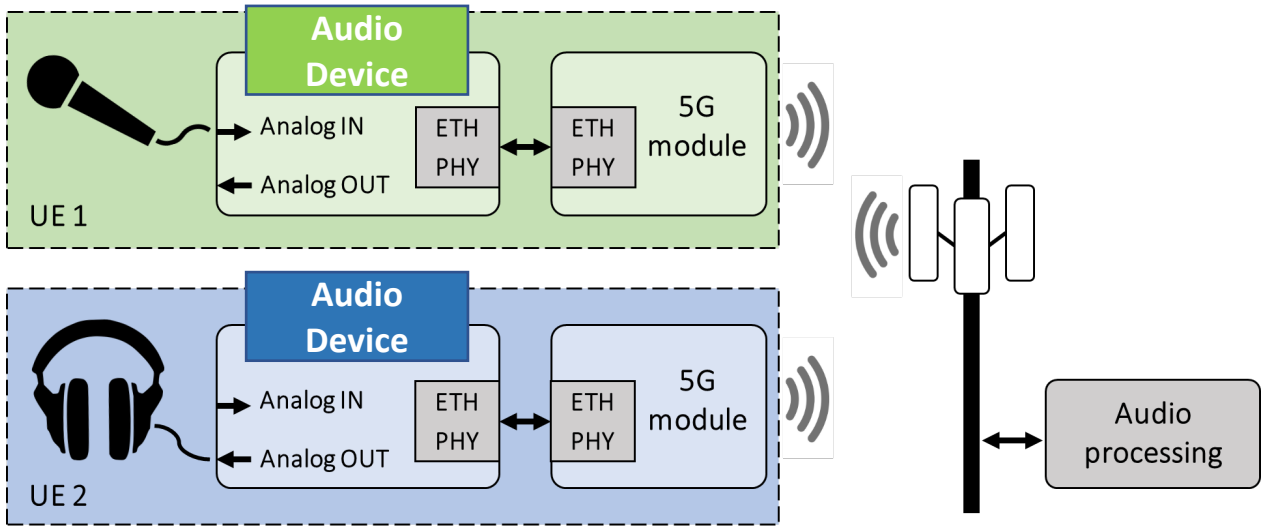
- **Main partners**:

leader

- In a live audio production setup (e.g. music concerts, music festivals, TV shows), the artists are equipped with professional Programme Making and Special Events (**PMSE**) equipment
  - 5G wireless **microphones**
  - In-Ear Monitor (**IEM**) systems
  - **Control tools** and gateways between 5G and traditional audio infrastructure domains.

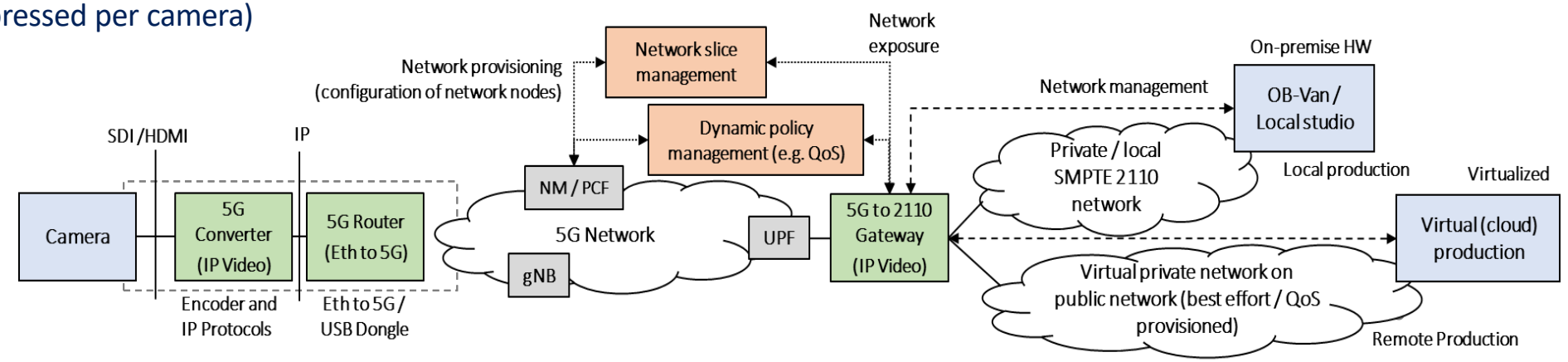
- **4 main areas of work**:
  - Capturing of live audio data
  - Temporary spectrum access
  - Automatic setup of wireless equipment
  - Use of a local NPN

- **Requirements**:
  - End-to-end delay < 4 ms
  - User data rate ~500 kbps
  - Synchronization of all audio sources ± 500 ns



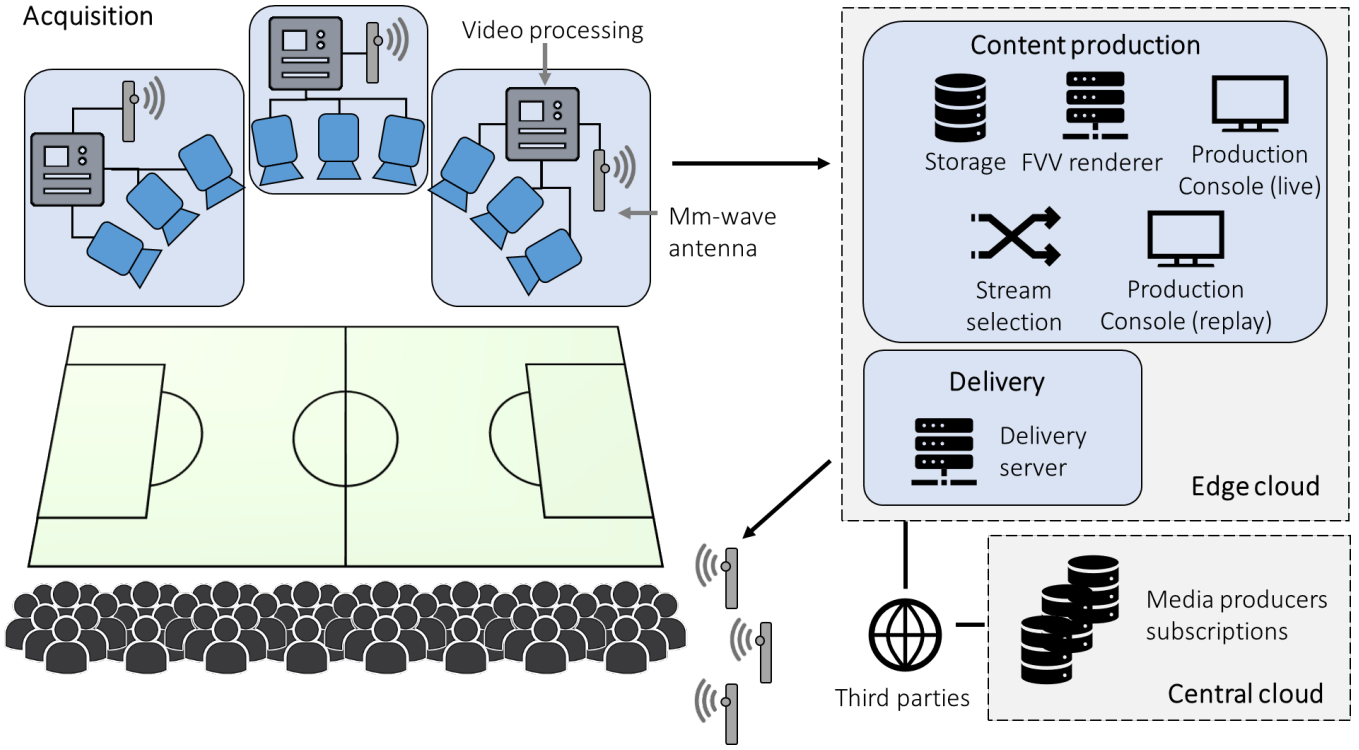
5. Use case Multiple camera wireless studio

- **Main partners:** ERICSSON *leader*, LiveU, EBU, BBC, image matters, Rai, Cumucore, Fivecomm, Universitat Politècnica de València
- The best of an **IP studio** combined with the super-fast and highly reliable wireless 5G connections
- 5G will facilitate new types of workflows addressing 3 core requirements:
  - Flexibility and reduction cost in setting up productions
  - Scalability from small to large events
  - Shareability of content along the production chain and between creative stages
- **2 sub use-cases:**
  1. Multiple cameras (~5) in a wireless studio. Wired/wireless functionalities will be combined using a fully IP system
  2. Outdoor production scenario with 2 or more 5G-enabled cameras and sound capture devices connected to NPN
- **Requirements:**
  - Bandwidth: 40/50 Mbps (compressed per camera)
  - Latency: ideally less than 40ms
  - High reliability is expected



5. Use case live immersive media

- **Main partners:** NOKIA leader, Telefónica, Universidad Politécnica de Madrid, Universitat Politècnica de València
- Real-time end-to-end free-viewpoint video (**FVV**) system that includes capturing, 5G contribution, virtual view synthesis on an edge server, 5G delivery and visualization on user terminals.
- The 5G connectivity allows a portable FVV system to operate in real time with reduced deployment cost and high flexibility.
- **Video workflow in 3 stages**:
  - Capturing.
  - Encoding and transmission.
  - Synthesis and visualization.
- **Requirements**:
  - Media acquisition: up to 1.5 Gbps per camera.
  - Radio uplink speeds of 20-200 Mbps.
  - Downlink speeds of 2-20 Mbps per user.
  - Connected end-users: 10-100 per 1000 m^2.
  - Reliability: 1 error every 10 min.



5G-RECORDS
LIVE AUDIO & WIRELESS CAMERAS
ZOOM-IN

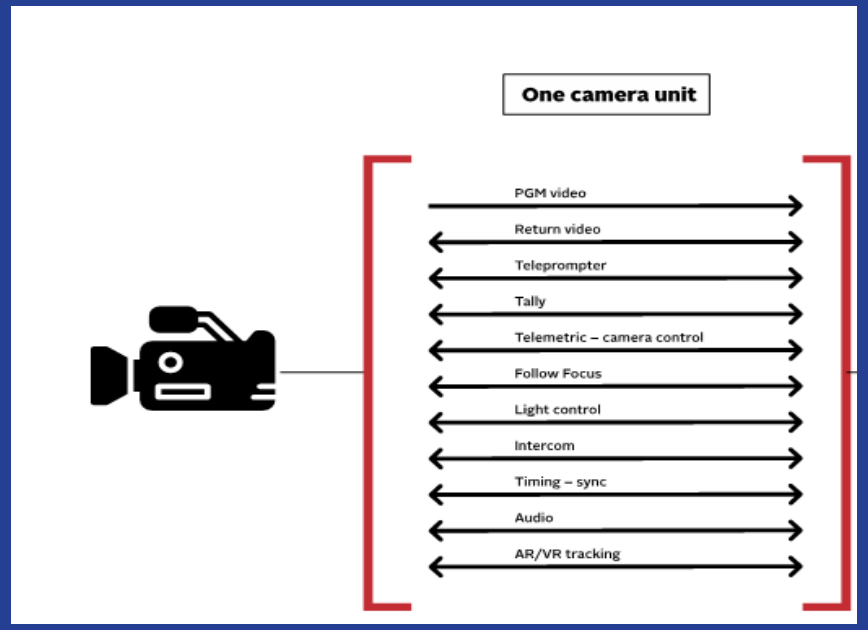
PROFESSIONAL CONTENT PRODUCTION

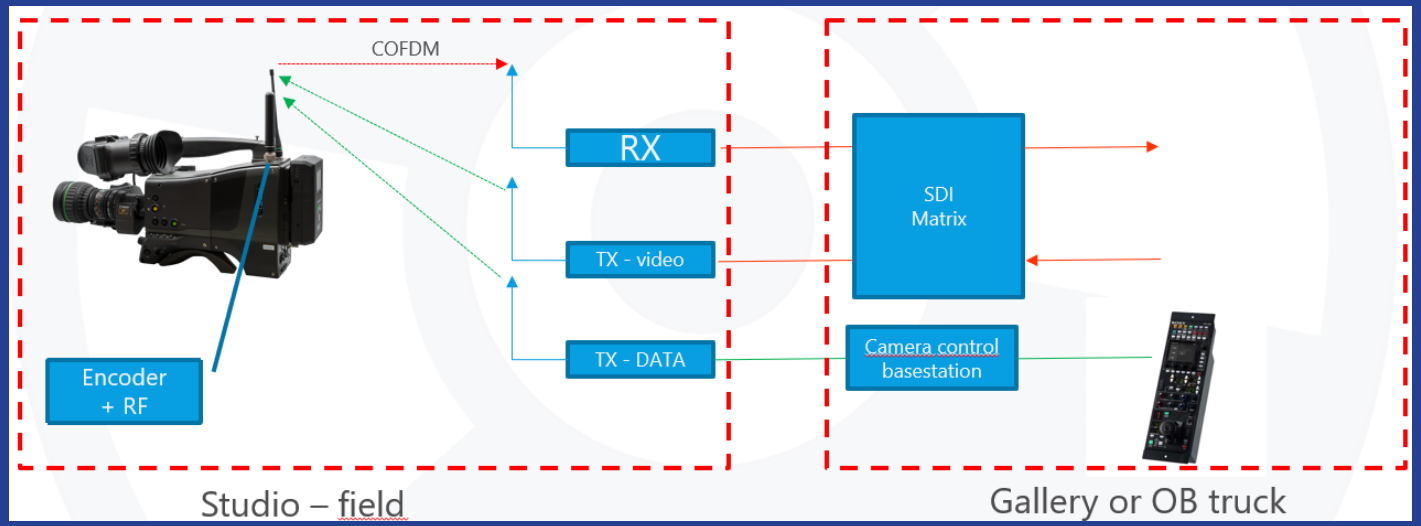
SPORT EVENTS, NEWSGATHERING,ETC

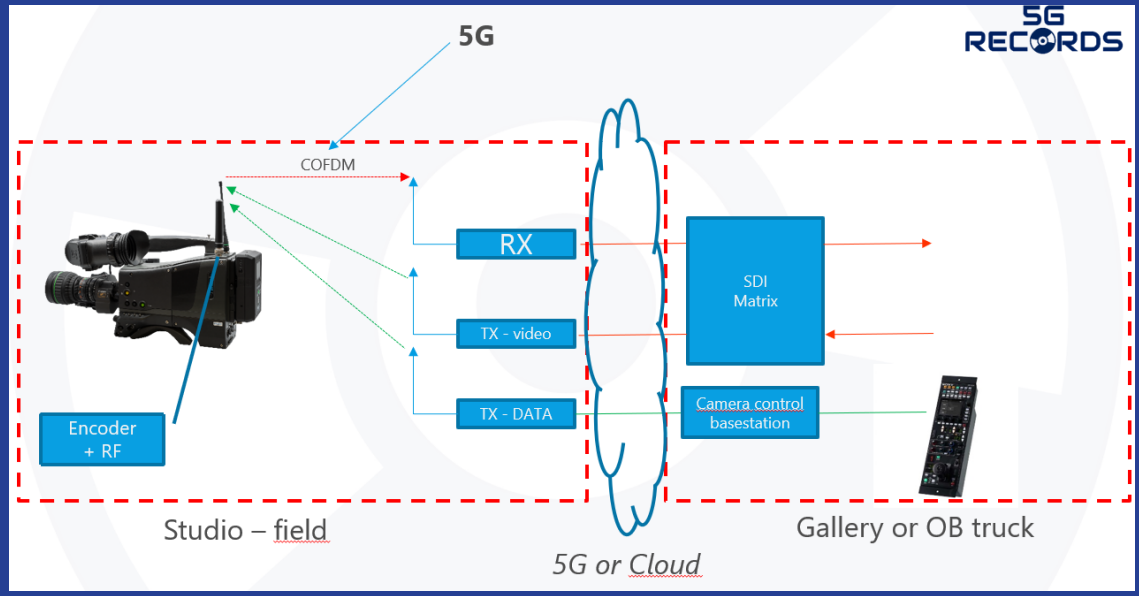
How it happens currently ….

- DVB-T based transmitter:
  - Bandwidth: 30/40Mbps
  - Latency: >= 20ms
  - UHF link for the «camera» controls
- Bonded cellular systems:
  - Bandwidth: depends from the number of aggregated modems; 30-70 Mbps
  - Latency: >=700ms- 1s
  - Some of them capable to deal with return video, tally and intercom (separate solutions)
  - Plug & Play/vendor lock-in

TRADITIONAL SET-UP TO 5G ENABLED SET-UP







USE-CASE (WIRELESS CAMERAS)

- NR Midband (3.8GHz) – 100MHz: around 120Mbps – 200Mbps (uplink)
- 4-5 «wireless» cameras 5G enabled: around 30/40 Mbps each
  - Codecs (standardized): H.264/**HEVC**
    - **JPEG-XS, VC2: at least 100Mbps**
  - Latency (enc +dec): from 30ms to 100ms depending from the configurations
    - normal latency: no restrictions on the GoP structure (I, P, B frames) →reorder on the decoder side
    - Intra ONLY: given the available bit-rate, we expect poor quality
    - IPPP…IPPP : latency and quality to be checked
    - Frame divided in multiple slices: latency should improve, quality to be checked

Codecs assessment, including multiple generations to simulate also the «emission» path

REQUIREMENTS – VIDEO (WORK IN PROGRESS)

- **Scenario: wireless camera**
- **Constant frame-rate (professional broadcast production), consistent latency and jitter model, maximum acceptable latency <** 250ms
  - higher latency could be tricky to manage some sport events; shading is not the most critical part, the hard part is for the director, he needs to get the images of the action as close as possible to “live” to communicate properly to different camera operators.
- **The system shall support a packet error rate of 10-8 (Packets that do not conform with the end-to-end latency are also accounted as error. The packet error rate requirement is calculated considering 1500 B packets, and 1 packet error per hour is 10-5/(3*x) , where x is the data rate in Mbps and then rounded)**
- **A/V sync**

REQUIREMENTS – AUDIO (WORK IN PROGRESS)

Scenario: wireless audio production containing microphones and in-ear monitoring systems.

- **Constant bit-rate (professional audio production)**
  - About 2.4 Mbit/s per stream
  - Roundtrip latency mouth to ear <4ms; higher latency packets are handled as lost packets; this latency budget already includes 2 milliseconds of audio processing.
- **Packet error rate $<10^{-6}$ for a packet size corresponding to 1 ms audio data.**
  - Further, a consecutive minimum continuous error-free duration ≥ 100 ms must be ensured to allow inaudible packet loss concealment on application layer.
- **Synchronicity between all audio devices <500ns**

IMPAIRMENTS INTRODUCED BY THE NETWORK

- Key focus: Constant framerate, consistent low latency, sustainable high quality, precise device time synchronization

- Issues
  - Residual packet losses lead to visual and audio degradations
  - Packet loss recovery typically introduces additional network jitter (jitter spikes). Network jitter impacts the frame rate (allowing late frames) or leads to visual degradations (discarding late frames)

QOE MEASUREMENTS – MANY FACTORS INFLUENCE THE QOE

- **Video: "automated/objective" measurements to avoid subjective evaluation assessments/expert-viewing**

- **Audio: PLC (packet-loss concealment) algorithm, compression algorithm, audio content, packet-loss duration, error-free duration**
  - PER is no sufficient indicator for QoE
  - No objective measurements available
    - Not necessarily comparing input/output


Thank you!