LIVE-G

This project aims to develop low-delay end-to-end video contribution and distribution techniques that leverage the latest developments in 5G cellular networks.

Low-delay streaming and swift channel-switching are crucial to get media consumers interested in watching video platforms. These consumers especially appreciate the seamless, low-delay streaming experience during live events, such as sports matches and concerts, and the convenience of effortlessly switching between channels at the click of a button.

However, broadcasters face technological challenges in meeting these demands, and the cost of acquiring and delivering live streams to broadcasters' control rooms is substantial. Consequently, delays of several seconds, and even tens of seconds, are commonplace.

In that respect, the emergence of 5G mobile connectivity technology marks a significant leap forward from 3G and 4G, offering enhanced reliability, data throughput, and lower latency. This positions 5G as a potent enabler for high data rate applications and mission-critical functions in IoT, AR, VR, and improved mobile broadband. Notably, 5G facilitates low-latency, end-to-end contribution and distribution for live event broadcasting, addressing the challenges faced by broadcasters and providing a more seamless and responsive experience for consumers.

FRAMING THE RESEARCH OBJECTIVE

The LIVE-G project set out to design and build an end-to-end technological pipeline, including video coding, transport and delivery techniques, that can be used for optimal video contribution and distribution over 5G networks.

To be able to create this end-to-end pipeline, the following five development objectives were put forward:

- Investigating 5G slices and protocols for low-latency.
- Developing high-quality video contribution over 5G.
- Multicasting over 5G for video distribution to large audiences.
- Advancing encoding and transport protocols for optimal multicast distribution.
- Developing techniques for fast switching between live camera feeds.

THREE MAIN OUTCOMES

These are the project's main outcomes:

1. The project partners created a fully functional and complete end-to-end proof-of-concept that was showcased during a hockey game at KHCL Hockey in Leuven on March 4, 2023. The setup included four fixed cameras linked to one encoder connected to a 5G modem, and one mobile camera with an onboard encoder and a 5G modem. After editing in the production truck, the video stream was encoded in HESP and sent to 5G end devices (i.e. mobile phones) capable of receiving FeMBMS. The video streams from all four fixed cameras were sent directly over fiber optics to measure the delay and to compare the encoded content over 5G. During the demonstrator day, several tests were run to measure the network quality. This setup and the performance that was measured made the LIVE-G project a one of kind technical achievement.

2. LIVE-G realized a first in kind native 5G multicasting/broadcasting implementation that outperforms 4G eMBMS with a throughput increase of 50%. Moreover, LIVE-G achieved synchronized multicast and unicast distribution with sub-second latencies, fast startup and channel change times (≤ 200ms), resilience to multicast packet loss through FEC and unicast fallback, and seamless transitions between unicast and multicast delivery.

3. Several aspects of the technology that was developed show a cutting-edge performance:
   - o The video contribution over 5G (camera to MCR/ production) has a packet loss under 0.001%, RTT below 24ms, and bandwidths of +240Mbps.
   - o The encoding and transport protocols for low-delay high-quality video contribution allow multiple feeds to be frame-synchronized, with contribution delays under 140ms and bit rates allowing for 1 UHD HDR or 4 Full HD streams.
   - o For encoding and transport protocols to achieve low-delay multicast video distribution over mobile 5G networks to end users, multiple adaptive bitrate multicast streaming scenarios were developed with startup delays and channel switching delays all below 200ms and total distribution delays below 700ms.

NEXT STEPS

Thanks to the LIVE-G project, companies in the broadcast solutions sector, such as EMG Belgium, now have the assurance that 5G can serve as a robust alternative to traditional contribution methods such as VSAT or fiber for camera contribution solutions. This confidence allows them to make further investments in 5G-enabled solutions, complemented by the developed codecs and transport protocols.

For network providers and telecom operators such as Citymesh or Telenet, the project results provide valuable insights that enable them to enhance and optimize their 5G service offerings. This improvement can extend to developing superior video delivery services or solutions for both business-to-business (B2B) and business-to-consumer (B2C) customers.

Similarly, streaming solution providers like Theo Technologies can leverage the multicast results from the project to fine-tune and optimize video streaming delivery. This optimization proves particularly beneficial for in-venue streaming, a market that is currently under exploration in follow-up projects.

LIVE-G project partners:

EMG · CITYMESH · THEO · UNIVERSITEIT GENT · imec · VLAIO

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FACTS

NAME	**LIVE-G**
OBJECTIVE	Enable low-delay live video contribution and distribution over 5G.
TECHNOLOGIES USED	5G, H.265, HEVC, H.264, AVC, multicast, slicing, video streaming, broadcasting, live streaming, HESP
TYPE	imec.icon project
DURATION	01/10/2020 - 31/03/2023
PROJECT LEAD	Pieter-Jan Speelmans, Theo Technologies
RESEARCH LEAD	Peter Lambert, imec – IDLab – UGent
BUDGET	2.517.300 euro
PROJECT PARTNERS	Theo Technologies, Citymesh, EMG Belgium, and Telenet
RESEARCH GROUPS	imec – IDLab – UGent

WHAT IS AN

IMEC.ICON PROJECT?

The imec.icon research program equals demand-driven, cooperative research. The driving force behind imec.icon projects are multidisciplinary teams of imec researchers, industry partners and/or social-profit organizations. Together, they lay the foundation of digital solutions which find their way into the product portfolios of the participating partners.

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