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ICT

PRO-FLOW

Enabling Internet video streaming & collaboration with sub-second latency

Online – fixed and mobile – video consumption is soaring. Due to the increasing usage of mobile devices such as smartphones and tablets, for instance, current global mobile video traffic is estimated to amount to a staggering 4.4 million terabyte (or 4,400,000,000 gigabyte) per month.

While the industry has already realized major advances in domains such as video encoding, expanding networks' broadband capacity and optimizing the underlying (video) content delivery network architectures, the massive amounts of video that are transported and consumed today inevitably lead to latency (i.e. signal delay) issues.

"With the PRO-FLOW project, we had two major objectives in mind. On the one hand, we wanted to come up with intelligent approaches – both at the client and the server side of the network – to significantly reduce latency when it comes to accessing video-rich web portals (think of frequently-visited, video-rich news sites such as Belgian vrtnws.be), while still managing the trade-off between performance and security properties. We wanted to investigate, for instance, whether we can use people's viewing profiles to predict their viewing behavior and use that knowledge to reduce their favorite video streams' signal delay," explains Tim Wauters, PRO-FLOW's research lead – and member of IDLab, an imec research group at Ghent University.

"The second part of the PRO-FLOW research project focused on doing the same for Internet-based video collaboration platforms. In educational use-cases, for instance, we want up to a hundred students to be able to easily and remotely connect to their tutor's ex cathedra lecture using their own devices – while still allowing a high degree of interactivity, which necessitates the avoidance of disturbing delays and hiccups," adds project lead Stijn Rammeloo (Barco).

THE OUTCOMES

1. **A personalized delivery network (PDN) architecture to store users' favorite video content from video-rich web portals as closely as possible to their physical location, and accelerate browser processing, to reduce signal delay**

Today, content delivery networks (CDNs) are used to store generally popular (video) content relatively close to end-users – to provide higher availability and higher performance. With PRO-FLOW's PDN approach, however, users' preferred content can be stored even closer to their physical location (in their home gateways or their web browsers, for instance).

The resulting PRO-FLOW demonstrator leverages a number of novel approaches to do so. A first one includes profiling users by checking which videos they are watching, and using that info to already store related content on that user's gateway or browser. The demonstrator also uses novel video transfer protocols (such as HTTP/2) to speed up the transmission of video fragments, resulting in the reduction of signal delays with a factor four. Finally, client-side (browser) optimizations reduce latency even further by efficiently taking into account web application design patterns based on HTML5.

2. **A low-latency virtual classroom experience – with Internet video streams that automatically adapt to users' individual network and device characteristics, leading to 20% bandwidth gains**

Today – best-case scenario – when joining a video collaboration session, users have the option to statically select a video stream with a quality level that more or less matches the capabilities of their Internet connection and the device they are using.

As part of PRO-FLOW's low-latency virtual classroom experience approach, WebRTC – an inherently point-to-point (p2p) technology that is well suited for applications such as video collaboration (and that has already been integrated in most of today's web browsers) – was extended to support multi-point video collaborations while still maintaining the individual network adaptive characteristics of p2p WebRTC (i.e. automatically adapting video quality to optimally exploit specific network connection and device characteristics) with minimal additional overhead, bandwidth and computing power. This approach allows bandwidth gains of as much as 20% compared to today's static approaches.

3. Low-latency, bandwidth-efficient 360° video transformation

Finally, two 'low-latency, bandwidth-efficient 360° video transformation' demonstrators were developed. The first one, showcased by Nokia at Mobile World Congress'17, shows an end-to-end system for delivering ultra-high-quality 360-content (16K resolution), with novel video processing functions at the edge of the network. It allows content to be adapted and transcoded on-the-fly to respond to head-rotation and zooming commands, without any user-perceived latency. A second demonstrator shows how the bandwidth per user can be minimized with the use of high-efficiency video coding (H.265), while preserving low-latency and computational cost as low as H.264.

NEXT STEPS

More research on this topic is either planned or ongoing. For instance, part of the PRO-FLOW learnings and technological developments are already being leveraged in the ongoing imec.icon LECTURE+ project – which aims to accommodate effective learning in remote classrooms through technology-enhanced user engagement.

Also, firm plans exist to continue to pursue the 360° video research track – and to expand this research to immersive, virtual reality video streaming.

FACTS

NAME	PRO-FLOW
OBJECTIVE	Enabling Internet video streaming & collaboration with sub-second latency
TECHNOLOGIES USED	HTTP/2, WebRTC, HTML5 HEVC(H.265), H.264
TYPE	imec.icon project
DURATION	01/01/2016 – 31/12/2017
PROJECT LEAD	Stijn Rammeloo, Barco
RESEARCH LEAD	Tim Wauters, IDLab – an imec research group at Ghent University
BUDGET	3,650,015 euro
PROJECT PARTNERS	Androme, Barco, Nokia Bell Labs, VRT
IMEC RESEARCH GROUPS	DistriNet, an imec research group at KU Leuven, IDLab, an imec research group at Ghent University, EDM-IT (UHasselt)

PRO-FLOW project partners:

ANDROME · BARCO Visibly yours · NOKIA Bell Labs · vrt

AGENTSCHAP INNOVEREN & ONDERNEMEN · Vlaanderen is ondernemen

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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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