

# 2017-H1 Project Progress Report

## MOS2S

Media Orchestration from Screen to Screen

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## Project key data

### ACRONYM and full-length title

15022	MOS2S
Program Call	ITEA 3 Call 2
Full-length Title	Media Orchestration - Sensor to Screen
Roadmap Challenge	Smart cities

### Project duration and size

Size	Effort: 101.99 PY	Costs: 10.9 M€
Time frame	Start: 01-10-2016	End: 30-09-2019 (36 months)

### Coordinator

Netherlands	TNO
Type	Research Institute
Contact person	Gjalt Loots
Email Address	gjalt.loots@tno.nl

### Project Status

Latest FPP	Change Request (19-01-2017)
Latest PPR	
Latest Review	MOS2S #1 (p.m.) (01-06-2017)
Upcoming Review	MOS2S #2 (a.m.) (27-06-2018)
PCA status	Signed: 29-07-2017

### Consortium

Country	National Coordinator (Company)	Total Effort (PY)	List of Partners
Belgium	Luk Overmeire (VRT)	19 PY	IMEC, KISWE, Nokia, VRT
Korea, Republic of	SooHyun Bang (Mooovr)	9 PY	ETRI, Mooovr
Netherlands	Reinout Huisman (Amsterdam ArenA)	51 PY	Amsterdam ArenA, Bosch Security Systems B.V., Game On, Inmotio Object Tracking BV, Koninklijke KPN NV, TNO
Turkey	Özer Aydemir (Bor Software inc.)	20 PY	Bor Software inc., DİA Yazılım San. ve Tic. A.Ş., KoçSistem

### Project Acronyms

KPI	Key Performance Indicator
MOS2S	Media Orchestration from Sensor to Screen
PPR	Project progress report
PCA	Project Cooperation Agreement

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## 1. Project one page description

The proliferation of novel consumer-priced audiovisual and environmental sensors, producing huge amount of data and video, represents an important aspect of the Smart City environment. Harvesting this data in an orchestrated fashion enables a variety of attractive applications for citizen information, participation, entertainment, experience, safety and security. However, the successful development, testing and deployment of Smart City solutions with and towards its end-users is highly complex. Most cities are not equipped to deal with the required process of infrastructure development, technology deployment and end-user trialing, or do not provide the advanced underlying infrastructure to test and deploy these innovative ICT solutions.

With the MOS2S project (Media Orchestration from Sensor to Screen), an international consortium of partners will develop and test audiovisual Smart City technologies addressing the needs of its inhabitants, and embed these solutions in a dedicated Smart City Playground. This playground provides for a venue platform as stepping stone towards a full Smart City Operating System, and for the support of proof-of-concepts and trials. As such, the playground has the unique potential to accelerate the creation and market introduction of new unique Smart City applications, based on a range of sensors and datasets, to improve profitability, sustainability, safety and customer experience.

The project partners focus on media orchestration platforms and technologies, that allow for orchestrating devices, data and media streams, and resources into a rich and coherent media experience on various end-user devices, including virtual environments. Applications include crowd journalism (citizen information and participation), smart habitats / venues, live events (citizen experience and entertainment) and event security (citizen safety and security). These cases build upon advanced sensor, networking and cloud infrastructures, and leverage emerging media and data analysis, analysis, processing and streaming technologies. The international MOS2S consortium comprises large-scale industry partners, small-to-medium enterprise partners and research and technology organizations. Together they provide all necessary technological components: networking and cloud technology, data brokerage, orchestration between video sources and sensor data, video analysis and stitching, broadcast (sports in particular) production and distribution, and a smart venue as a proxy for a smart city.

The combined technologies and experience of these partners enables unique world class innovation, that will allow them to introduce captivating new products and services. The applications that MOS2S provides will impact the global markets of wireless data communications (3G/4G/5G), the market of broadcast production (news and sports production in particular) and audiovisual terminal equipment, including signage. Given the size of each of these markets, the global impact of MOS2S can be very significant.

## 2. Project overall status

### 2.1. Top 4 overall targeted innovations

#### 1. Data & video acquisition: multi-stream capture

**Main contributors:** VRT, Kiswe, Nokia (B), ETRI / MOOOVR (KR), InMotio, GameOn, Bosch (NL).

**Description for innovation and state-of-the-Art:**

MOS2S will provide tools to perform stitching and encoding of new professional camera setups in real-time as well as tools for adding good metadata to captured content. These tools will have interfaces towards the production tools, to allow production to steer the acquisition. For adding good metadata, we will determine the metadata first. This means extending upon existing mechanisms to determine timing (e.g. extend NTP), location (e.g. combine GPS and Wi-Fi location mechanisms) and orientation (e.g. using built-in sensors or compare the captured pictures to Google Street View), to achieve the MOS2S requirements. This metadata will then be added to the captured stream, which will be partly session information and partly metadata directly matched to the streaming output. Adjustable camera settings will be made available to the production tools by creating new interfaces. Advanced onboard camera analytics provide object classification and crowd density analysis. 4D stitching will be explored for projecting the stitched video on 3D models, making operation even further intuitive. In addition, advanced bandwidth management will be developed to transmit only the required data, saving network and computational power.

#### 2. Data & video analysis

**Main contributors:** Amsterdam Arena, TNO, GameOn, InMotio (NL), Nokia, VRT (B).

**Description for innovation and state-of-the-Art:**

The challenge is a data fusion finely and accurately managed to benefit from all sources based on the video ingest time and location (i.e. geo-location of the four corners of the different camera scenes). The idea is to implement technology, eventually supporting its evolutions as requested, for dynamically combining video streams, dynamic metadata in general and results of video analytics in particular. Advances requested are in an accurate geo-location and time stamp of each produced video frame and a seamless infrastructure managing consistently all information as streams, each fitted with the necessary synchronization data. The other challenge is proper insertion of alternative videos in the regular displays with a smooth rendering. Furthermore, proper storing of the combined content to the cloud respecting to the 3D scene reconstruction requirements, and video histogram equalization for heterogeneous sources in online debate application are the other subjects which we can mention as innovations.

#### 3. Brokering & orchestration of video and data

**Main contributors:** Kiswe, Nokia, VRT (B), TNO (NL)

**Description for innovation and state-of-the-Art:**

MOS2S will actively contribute to the media orchestration standard (MPEG-MORE) and be the first to implement it. MOS2S will help refine the media orchestration standard architecture and its

elements, lead the writing of the specification and help with validation by implementation. Considerations respecting to the cloud issues in media orchestration will also be studied.

#### 4. Video streaming & delivery: Multi-stream consumption

**Main contributors:** VRT, Kiswe (B), KPN, TNO (NL), ETRI (K)

**Description for innovation and state-of-the-Art:**

The targeted solution will provide tools – integrated within state-of-the-art OTT solutions based on the MPEG-DASH standard – enabling the orchestrated delivery and consumption of new immersive and interactive content formats to a set of heterogeneous and interconnected devices. MOS2S will enable the orchestrated delivery of new immersive and interactive content formats over the top of the existing infrastructure by enhancing the existing MPEG-DASH standard with tools enabling the description in both temporal and spatial domain as well as its synchronization of the play-out on a heterogeneous set of devices. These extensions will enable the orchestrated delivery of various timed media assets coming from various sources to a plethora of end user devices. Additionally, MOS2S will further enable the delivery of new immersive and interactive content formats by optimizing the delivery function with respect to network, device, and user capabilities. This requires a tighter integration of delivery and rendering functions with enhanced interactivity features based on the user's context.

## 2.2. Top 4 overall targeted business impacts

### 1. Creating tools for audience engagement and media production optimization

**Description:** Change redaction process for interactive radio production and creating (new) formats. Potentially license to other broadcasting companies through a spin-off.

**Main contributors:** VRT, Kiswe (B)

**Market/competitors:** The market features a number of tools that address a part of the desired solution. Many tools for communication with users (Phonebox, Tweetdeck, Arctic Palm) exist but are not merged into the radio production processes. Some radio redaction systems (e.g. Pluxbox RadioManager) already offer some integration for social media channels, without good support for deploying and adding new and/or custom services. The application we develop is merged into the radio making workflow and covers the entire chain from information acquisition to broadcasting.

### 2. Creating compelling TV and companion screen application for live event experience

**Description:** Consortium partners have developed first versions of a coach-on-the-couch application, where viewers at home can now share the joy and feel the frustrations of being the coach using augmented reality layers in an in-stadium smartphone app. They can determine their team's game tactics, follow a specific player, and get more information about the players and the game in real time. All this is made possible by a data-integrated interactive video system and mobile application combining tracking data and ultrahigh definition video images. At home, too, tracking and UHD video data streams shown via an app on an IPTV set-top box allow the couch potato to become the coach supremo and enjoy an innovative TV experience of a live sports or music event. These applications allow an (IP)TV and/or online video service provider to reduce churn and attract new customers.

**Main contributors:** Bosch, GameOn, ArenA, TNO, InMotio, KPN (NL)

**Market/competitors:**

Entertainment market, sport broadcasting market. Ericsson Piero

(<http://www.ericsson.com/broadbandmedia/what-we-do/piero/>) / Deltatre DIVA

(<http://www.deltatre.com/online-solutions/diva/>) / EVS C-CAST (<https://evs.com/en/product/c-cast>). Our main differentiator is access to professional EPTS and we have an efficient streaming technology (tiled streaming).

### 3. Developing an efficient video delivery system for UHD and 360/VR content

**Description:** Consortium partners have improved upon video delivery systems, that employ tiled streaming. Tiled streaming enables distribution of UHD and 360/VR video at extremely high quality, using standard encoding / decoding systems, for both on-demand and live content and in a way that is massively scalable to millions of users simultaneously over any CDN, using standard http streaming technology at bitrates comparable to normal video. Tiled streaming works by dividing the video into tiles, and only sending the tiles that are in view. Compared to alternative, server-based approaches, tiled streaming is much more scalable and requires much less encoding and server resources. In particular, a bandwidth reduction of a factor 5 can be realized. The tiled streaming technology has been patented and standardized via MPEG.

**Main contributors:** ETRI (K), TNO, ArenA, KPN (NL)

**Market/competitors:** Fraunhofer HHI

(<https://www.hhi.fraunhofer.de/en/departments/vca/research-groups/multimedia-communications/research-topics/tile-based-hevc-video-for-virtual-reality.html>) / GPAC (<https://github.com/gpac/gpac/wiki/Tiled-Streaming>)

Our main differentiator is an strong IP position (TNO/KPN) and MPEG SRD standard-compliant implementation.

### 4. Capture monitoring of UHD and 360/VR content

**Description:** *Provide an 360VR broadcasting solution using high quality and wide field of view videos to deliver an immersive experience to the home environment.*

**Main contributors:** ETRI (K)

**Market/competitors:**

Sport broadcasting market. The potential competitors are the Intel TRUE VR, NOKIA OZO and Voysys.

## 2.3. Top 4 overall project result KPIs

	Current value	Targeted value
<b>1. 8K-grade 360VR broadcasting system</b>	3840x2160	8Kx2K

<metric description>



<b>2. Bandwidth reduction for streaming UHD content to screens with lower resolution</b>	20 Mbits for 4K video	10 Mbits for 4K video to HD screen
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<b>3. Realtime video stitching resolution on end-user application</b>	HD	4K+
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<b>4. Number of new broadcasting formats based on UGC</b>	1	3
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Integrated in existing work flow and extend existing content experience or create new content formats.

## 2.4. Top 4 overall risks

	Severity	Probability
<b>1. Partner problems (e.g. underperforming partner; a key partner leaves the project; disagreement between partners)</b>	High	Rare

### **Avoidance action:**

WP leaders monitor progress (including potential partner conflicts) at WP level and communicate difficulties to the Project Coordinator. The consortium agreement will ultimately provide a framework for underperforming partners and conflict resolution procedures. Reassignment of responsibilities and resources to other partners will be considered as a final option.

### **Back-up / mitigation plan:**

Fill gaps with existing partners, or try to partner with new parties to be able to complete MOS2S successfully.

<b>2. Expertise risks (e.g. a key person with a specific expertise leaves the project)</b>	Medium	Possible
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### **Avoidance action:**

Proper documentation through project reporting and deliverables can mitigate this risk, although depending on the profile and the moment of the project, work may need to be rescheduled in order to bring a new person up to speed.

### **Back-up / mitigation plan:**

Clear communication channels in the project will allow partners inform the coordinator promptly of this risk. Perform critical tasks with more than one person.

3. Project execution risks (e.g. critical milestones or large-scale are delayed)	Medium	Possible
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**Avoidance action:**

The expertise of partners (coordinators and management) will allow rapid identification of drifts that could affect the large-scale.

**Back-up / mitigation plan:**

A hands-on day-to-day coordination are a key management element to mitigate this risk.

4. The smart venue infrastructure (networks, cloud storage and processing, sensor and data capture) components do not integrate.	High	Rare
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**Avoidance action:**

Proper documentation through project reporting and deliverables can mitigate this risk, although depending on the profile and the moment of the project, work may need to be rescheduled in order to bring a new person up to speed.

**Back-up / mitigation plan:**

Clear communication channels in the project will allow partners inform the coordinator promptly of this risk. If problem persists, either reach out to other venues or suppliers of vendors to increase chances of successful integration.

## 2.5. Changes in the technological and business during the reporting period

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### 3. Exploitation

#### 3.1. Partners' market access

Koninklijke KPN NV	ind	NLD	13 PY
<p>KPN is the Dutch incumbent with its own fiber and copper networks in the fixed domain and 2G/3G/4G networks in the mobile domain. KPN is also a dominant TV and online video service provider in The Netherlands. Currently, KPN is rolling out the first LoRa network that will have total national coverage. LoRa will act individually and alongside the other mobile networks and is especially suited for IoT solutions. KPN is the Dutch market leader on both mobile and fixed connections within the business market and consumer market. KPN provides millions of clients with different products and services. KPN has (by December 2015) 1.864 million TV subscribers, almost 3 million broadband access clients (68% over 100Mbps), a bit over 3.5 million mobile subscribers (99% over 50Mbps). KPN takes in an enabling position in the Internet of Things marketplace. With its focus on collaborating with eco-system parties (from start-ups to corporates) and matching demand and offer in the market, from</p>			
KoçSistem	ifc	TUR	11 PY
<p>KoçSistem has an Itea project named Baas about smart buildings and has another Itea project named SITAC about smart homes. KoçSistem is planning to add a dynamic and smart camera security module to its existing smart things system. In this way a completed smart system will be developed.</p>			
Amsterdam ArenA	sme	NLD	9 PY
<p>Set up new services for ArenA, the city of Amsterdam, and exploit created technology directly in two ways: either launch services ourselves or export the project outputs to other national and international applications. Several presentation about MOS2S where given to visitors of the Amsterdam Innovation ArenA, amongst others FC Barcelona, Chelsea, European Central Bank, the World Bank, the Norwegian and Danish FA and the Supreme Committee Qatar. An MOS2S article was included in the magazine of the ArenA which was sent out to more than 5000 subscribers: business partners and share and stakeholders of the ArenA and Ajax. A vlog was developed as part of the Test Capture Event during the friendly match NED – ITA. Organization and hosting of the Next Level Stadium Technology and DIF Event where MOS2S technology was demonstrated. Leads amongst others are: KNVB (Dutch FA), Several Football Clubs in Europe and Several (Inter)National Broadcasters.</p>			
TNO	res	NLD	9 PY
<p>TNO has indirect market access. We typically do not directly exploit technology and services ourselves, but make our knowledge and technology available to business and government who may use this to their needs. However, in the reporting period, TNO has put effort in establishing a spin-off, with the focus on bringing tiled streaming to market. Furthermore, TNO has put effort in integrating its tiled streaming software libraries in the mobile application of NL partner GameOn, thereby working towards a commercial exploitation opportunity.</p>			
Bor Software inc.	sme	TUR	7 PY
TBD, depending on use case.			
Bosch Security Systems B.V.	ifc	NLD	7 PY

New product development on the video security camera's portfolio. Focus on user experience and other benefits for our global customers is essential. With the new remote commissioning functionalities Bosch will achieve the installation benefits with the PTRZ solution. The PTRZ solution is also essential for the MOS2S partners for easier stitching solutions. Main end-users that are interested in the new development are stadium solutions, high-end industry solutions and traffic solutions. Bosch Security Systems is researching the opportunity to generate gen-locking in basic CCTV camera solutions so that the CCTV camera can provide a better footage for broadcasting. This is discussed together with Inmotio and Game-On.

VRT	ind	BEL	8 PY
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As a public broadcaster, VRT's mission is to provide high quality programmes and services to a wide audience on all platforms. Among its leading principles are useful and justified news and information, increased user participation and stimulation of social responsibility ("sense of community") and being an innovator and reference in a fast moving media landscape. The MOS2S results will enable VRT to integrate the concept of citizen journalist in the core of its news production workflow, increasing the audience involvement in each step of the news creation process from ideation to consumption. VRT will further exploit the gained insights in MOS2S to deliver high-quality and novel digital storytelling formats to its viewers, both for news and live event experiences, and via the VRT Sandbox approach stimulate the creation of spin-offs and strengthen the Flemish media ecosystem by further cooperating with and transferring knowledge to Flemish (innovative) market players based on the dev

DİA Yazılım San. ve Tic. A.Ş.	sme	TUR	6 PY
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DIA is able to reach about 1000 business partners to exploit products of MOS2S over small enterprises and enclosed industrial zones.

Game On	sme	NLD	7 PY
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Consumer app for viewing and sharing video content, with the possibility for in-app purchases, in combination with a (web-based) video platform for sports venues that handles storage, metadata management and further remarketing. Commercialisation possible within one to two years.

Inmotio Object Tracking BV	sme	NLD	6 PY
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Live data feeds to media companies, such as broadcasters and sports rights owners etc. The timing of this development is well chosen given the fact that the FIFA is planning to allow and standardize the use of EPTS in football games. RFID tracking systems are still getting more and more popular in sports. They have an added value for coaches and for fan experience. Inmotio develops RFID-enabled next gen statistics that combine real time figures with mixed-reality overlays. These features are used to attract the traditionally conservative broadcasting companies. A set of attractive next gen stats should seduce the broadcasters to apply for RFID technology in all stadiums. In addition Inmotio has developed samples for a new generation league statistics portal to be used by coaches and media.

Nokia Bell N.V.	ifc	BEL	7 PY
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we confirm the exploitation tracks layed out in the initial proposal: - realtime analytics for Nokia customer care solution based on MOS2S social media / text analysis pipelines - CDN capabilities for user generated multimedia - MOS2S can play a role in the indexing and discovery functionality (text+video analysis pipelines) and in the fusion between multimedia and sensor streams (core WWS platform)

ETRI	res	KOR	4 PY
ETRI has no direct marketing capability but ETRI has usually transferred novel technologies to our partners. In Korea, content providers and entertainment companies are requesting those multiple camera systems for the live event broadcasting use case. Furthermore, ETRI is looking for marketing opportunities on 8K 360VR service area.			
Mooovr	sme	KOR	4 PY
Provide solution for better VR video quality with easy manipulation of rig with good performance cameras. Find ways to handle tremor from shooting stage.			
KISWE	sme	BEL	3 PY
Kiswe Mobile makes an interactive and mobile experience for watching sports and entertainment events. Its applications feature multiple-camera streaming of live events as they happen to mobile devices, where the user then has interactive control over what they choose to see. We would like to contribute in the area of user generated video contributions in live sports & entertainment events, and aid in researching the ability to validate and influence ingest quality, and orchestrate a unique user experience over a large, unpredictable ingest pool of streams. Our intend is to inegrate the positive results of the project into the Kiswe technology stack, as part of its B2B business. The results considered will be both at the intelligence level (How UGC can contribute to professional productions) and feature level (How can we identify and coach for better UGC contributions). Recent conversations with broadcasters confirm the interest & activation of UGC contributions in sport and news.			
IMEC	res	BEL	1 PY
IMEC aims to add economic and social value through excellent research and the creation of human capital in the domain of ICT. IMEC carries out this multi-disciplinary research for the Flemish business community and the Flemish government. This includes all technological, legal and social dimensions of the development and exploitation of broadband services. This project will enable IMEC - IDLab to further extend its expertise in Semantic Web technologies and Big Data Analytics. In particular, IDLab's research strategy is in line with the vision of the Semantic Web stack where the ultimate goal is to create an environment of trusted sources and services (either on the Web or within the enterprise). The real-time, efficient, and scalable use of aggregated resources within the Big Linked Data cloud in real-life applications steered by the industry will be a large step in climbing this Semantic Web stack within the Data on the Web community.			
Samsung Electronics	ind	KOR	0 PY
Globally through established online and offline market channels.			

### 3.2. Top 8 overall partners' Exploitation Related Achievements

1	Exploitation	New system	8K-grade 360VR video solution	Planned
Summary		The solution consists of multiple camera systems, real-time monitoring and stitching systems and adaptive encoding and streaming systems.		
Impact		More immersive experience can be provided to home environments (quantification: 2)		
Partners		ETRI		

2	Exploitation	Collaboration	Provide data and video for fans	Planned
Summary		Game On is working closely together with the partners to develop automated near live system where we can collect data and video inside the stadium. This data will have to be processed in real-time and combined with all sorts of visualisations and sent to different screens. The applications to view and use the data will have to be compliant with all devices. This system can then be sold or licensed to broadcasters which they can then provide to their users and viewers.		
Impact		Providing different types of data in a video feed to consumers will definitely be the norm in the near future. With the partners that are creating this system we are in the front seat. (quantification: 15)		
Partners		TNO, Amsterdam ArenA, Game On, Bosch Security Systems B.V., Koninklijke KPN NV, Inmotio Object Tracking BV		

### 3.3. Realised Exploitation Related Achievements

Dissemination	Exploitation	Standardisation	New company	Patent	Human capital
Total: 1	Total: 1	Total: 0	Total: 0	Total: 0	Total: 0

## 4. Project progress during the reporting period

### 4.1. Overarching work progress during the reporting period and issues

#### 4.1.1. Top 4 Technical Achievements

##### 1. Test capture in NL use case

During friendly soccer match, played in March 2017, between the national teams of the Netherlands and Italy at the Amsterdam ArenA, MOS2S recorded the match with multiple 4K camera's and obtained an large amount of sensor data in real time. We used this video/audio/sensor capture in development of three demonstrators, in which spectators can experience the match in a highly interactive way in the best quality possible. The demonstrators were an interactive TV application running on a Set Top Box, a tablet application on an iPad, and an immersive VR experience on a head mounted display (Samsung Gear VR).

##### 2. Tour of Flanders capture

In partnership with the VRT sports department (Sporza), we created the app "Rondereporter", to allow people sending their moments of the Tour of Flanders cycling race whether they were at home, or at some interesting location along the race parcours. We used this app to test a new way of publishing user generated content by using a long form article. The editorial team was able to curate the best content, to accommodate it with a title and description and to publish it live in the article. The captured content formed the basis to develop the IBC 2017 demonstrator, in which the tight integration of the redaction process on the one hand and an interactive multi-layer cycling experiences on the other hand was shown as a concept. One of the main developed features allows the sports journalist to create on-the-fly key "moments" of interesting race events while the race is ongoing, which can be added as an additional layer on top of the broadcast stream.

##### 3. Development of Music for Live application

Music for Life, a yearly end user action-based event for charity purposes of the VRT radio channel Studio Brussel (December 2016), was the first real-life test case with a refactored version of the crowd contribution apps developed in the FP7 Icosole project, including new features such as:

- enabling co-creation and interaction between production team and event organizers: user generated content was shared on third party platforms for the first time (UGC photos and videos on Facebook and on television as an overlay)
- Preliminary version of a chat interface as main interaction between end user and editors
- Personalized after movie for contributing end users, consisting of their sent-in photos.

The Music for Life 2017 test case will further elaborate based on the concept demonstrated at IBC (see above "Tour of Flanders" capture), and the findings from the Music for Life 2016 test case, featuring live hangout with ongoing action representatives, content clipping for redaction staff and beacon-based large screen experiences at the event location. This will generate a lot of added value in the content creation process and user experience during the Music for Life event.

##### 4. Development and application of UWV camera rig

As an initial development for the supposed multiple camera solution, 4K-grade core technologies are achieved. The real-time multiple camera monitoring and stitching system receives multiple HD



camera feeds from a 360VR rig and results in a stitched 4K stream on the 2D equirectangular domain. Also, a tile-based decoder and player show the adaptive rendering functionality for efficient usage of network bandwidth and computing power.

#### 4.1.2. Top 4 next technical targets

##### 1. Develop online debate application for crowd journalism

Online debate will allow people to talk publicly about arguable events such as a live sports game, a political issue, economy etc. The debate format includes one anchor, four debaters and interactive viewers who can participate via surveys, emotions buttons and text comments.

The Backend of the platform will be developed with Sails.js (is a very well known MVC framework for Node.js, includes socket.io in default setting). Some other reasons to think about Sails.js for backend development are its low resource requirement and suitability to test driven development methodology. Furthermore, the Frontend of the platform is planned to be developed with angular.js. For the Server Side development, we are planning to use Nginx, Apache and node server for hosting. In the design, Nginx handles all the 443 and 80 requests and proxy passes those requests to the Node.js server. However, Apache will handle the static content of the website behind the Nginx Cache mechanism.

We are planning to use Wowza Streaming Engine for webRTC streaming, RDBMS or MongoDB for database requirements and Redis server for caching.

Considering the challenges, we might underline three major issues; choosing right frameworks for project development, handling high load conditions are expected to happen when the system gets popular, and issues inherited because of using the Wowza webRTC server (Wowza has some minor performance problems similar to Kurento, but it is much better in the sense of development, and transcoding between VP9 and H264, etc).

##### 2. Live hangout feature for crowd journalism

A novel live hangout feature that is tightly integrated with the editorial redaction tools and end user app will be developed and a first version is planned to be tested during this year's Music for Life (December 2017). This new feature will allow people to call in live via the app to report on ongoing actions at any action location across the country. Before possibly going live on antenna, the radio journalist can communicate with incoming callers, prepare them for the live broadcast and put them in a waiting queue. Radio journalists will get a clear overview of all incoming callers to manage their live contributions. The resulting experience can be published on social media or on television. Live hangout will generate additional content from a motivated crowd, that could not be acquired with the traditional professional capturing processes.

##### 3. Integration EPTS data with STB app for live TV

In an industry-first proof-of-concept application, the KPN IPTV service and associated set-top box can now be enriched with a coach-on-the-couch application; this application, running on the KPN STB, includes a newly developed interface between the data server hosting data from the Inmotio Electronic Player Tracking System and a visualisation overlay. The overlay can show real-time player positions, and real-time individual player features, such as current speed, distance travelled and even heart rate.



#### 4. VR application for fan experience experience

The real-time stitching performance is supposed to be 8K-grade with more than six HD cameras. Also, the 360VR solution will be applied to the 2nd use case event to show the matureness and feasibility of the 8K-grade 360VR broadcasting service.

##### 4.1.3. Top 4 issues

#### 1. Media access rights (NL)

The Champions League can be seen live at Veronica and Ziggo Sport Totaal. The Dutch premier league can be seen live on the FOX Sports channels and in summary at NOS Studio Sport. The qualification matches of the Dutch team can be seen at NOS Studio Sport. Most of the friendly games of the Dutch squad are broadcast live by SBS6. Inside the Stadium: Ajax owns the match content, together with the opponent team.

**Impact:**

Media Rights Inside Stadium: Medium

Media Rights Outside Stadium: High

**Mitigation action:**

The Dutch Consortium has frequent meetings with the Eredivisie CV, KNVB, FOX and Ajax about the project in relation to media access rights.

#### 2. 3D modelling of complex environments (T)

**Details:** MOS2S project focuses on large scale 3D reconstruction, especially 3D reconstruction of the urban environments. Urban environments contain a large number of different types of objects and moving objects as well. In such environments, detecting, matching, and tracking distinguishable visual features in a set of video frames is one of the the biggest challenges in the reconstruction domain.

**Impact:**

Poor robustness of model and low accuracy.

**Mitigation action:**

There is a wide variety of techniques for 3D reconstructing of the environments and creating 3D models. The final technique should be selected by considering the geometry and material characteristics of the objects in the environment. Various techniques will be implemented and the results will be compared in order to reconstruct the environment with high accuracy.

#### 3. Privacy and legislation for crowd contributors

**Details:**

The ArenA has a privacy policy: <http://www.amsterdamarena.nl/privacy-policy.htm> and as part of our Amsterdam Innovation ArenA we have developed a Data Governance Model together with KPMG:

1. <https://home.kpmg.com/nl/nl/home/insights/2017/04/data-analytics-voor-amsterdam-innovation-arena.html>

2. [https://www.compact.nl/articles/governing-the-amsterdam-innovation-arena-data-lake/?zoom\\_highlight=amsterdam+arena](https://www.compact.nl/articles/governing-the-amsterdam-innovation-arena-data-lake/?zoom_highlight=amsterdam+arena)

Impact:

Low (as all risks are mitigated).

Mitigation action:

We have developed ad Privacy Policy and Data Governance Model based on all applicable privacy laws and regulations.

#### 4. Seamless streaming on heterogeneous networks

##### **Details:**

The streaming of video over heterogeneous networks remains an important aspect of large-scale video services. For venue-scale applications, where thousands of visitors need to have access to downstream video from the event, sufficient networking infrastructure is required. For upstream video, e.g. for massive crowdsourced live mobile streaming, access to network-based ingest and processing is required.

##### **Impact:**

The success of large-scale mobile video services can be significantly hindered by network bottlenecks, which reduce performance and scalability.

**Mitigation action:** The MOS2S consortium partners provide solutions at different levels; the venue partner invests in networking infrastructure to guarantee bandwidth and low-latency. Intelligent streaming technology for large-scale interactive downstream video streaming are a crucial part of the MOS2S technology development. For upstream user-generated video streaming, we employ proven techniques to cope with NAT traversal and firewalls, such as STUN/TURN functionality.

## 4.2. Details of technical progress per work package

### **WP 1: Use cases and requirements**

The objective of WP1 (Use cases and requirements) is to lay the foundations for the project activities, to ensure the smooth interworking of the individual parts and to align the project with the needs of the market. In WP1, partners explore relevant use cases and usage scenarios for MOS2S from the point of platform functionality and valorisation potential, so that from these use cases the design requirements can be distilled for the design tasks listed under WP2. Initially the envisaged use cases are Crowd Journalism and Live Events (e.g. sports, music).

As part of the change management activity under WP5, T5.2, the WP1 structure has been modified in order to better reflect the needs of each use case and demonstrator per year. That is, y2 and y3 iterations of deliverables D1.2/3/4 have been created, with yearly task / deliverable leaders. In order to accommodate these increases in responsibilities and workload, Tasks 1.2 and 1.3 are combined into T1.2, and associated deliverables D1.2 and D1.3 are combined into a joint deliverable D1.2.x. T1.4 is renumbered to T1.3, and D1.4.x is renumbered to D1.3.x. In y1, TNO (Omar Niamut) was responsible for deliverables D1.1.1/D1.2.1/D1.3.1. In order to accommodate these increases in responsibilities and workload, the delivery date of D1.1.1 was set at M05, and the delivery date of D1.2.1 and D1.3.1 was set at M09.

In the reporting period, deliverable D1.1.1 (Use cases and demonstrator definitions) has been

submitted to reflect the work performed as part of T1.1. This deliverable provides use case descriptions and demonstrator definitions to showcase the R&D efforts from the MOS2S consortium partners in the 1st project year. In the reporting period, deliverable D1.2.1 (Platform, component and external interface requirements) has been submitted to reflect the work performed as part of T1.2. This deliverable provides requirements for the added functionality required for MOS2S that needs to go in the platforms and into the external interfaces to these platforms. Finally, in the reporting period, deliverable D1.3.1 (Application requirements) has been submitted to reflect the work performed as part of T1.3. This deliverable

In summary, all y1 deliverables for WP1 have been submitted. For the next reporting period, WP1 will focus on the y2 deliverables, describing the 2nd use case and associated demonstration, and the related updates to the platform and interfaces, as well as the definition of new applications.

## **WP 2: Reference architecture and component development**

Based on the requirements from WP1, the respective legacy platforms will be augmented to support MOS2S specific features. Additionally, component code running on top of the platforms will need to be designed, tested and subsequently integrated into a research prototype that can be used for the MOS2S demonstrators.

A unified reference architecture will be designed based on the available legacy platform architectures and the requirements produced in WP1. It will at the same time allow interoperability with the legacy platforms and form a solid basis to define, implement and test the applications and new platform components required in WP3.

In WP2, the following updates to the workplan have been made:

- To reduce the involvement and responsibilities of Turkish partners, the WP2 leadership has been transferred to Nokia (Philippe Dobbelaere).
- Task 2.3 (component development and test) is removed and the corresponding effort is transferred to T2.2 for the generic components and to T3.1 for the application specific components.

WP2 starts in month 7/semester 2 of the MOS2S project, with deliverables coming up at the end of semester 2.

## **WP 3: Applications and demonstrations**

The objective of WP3 (Applications and demonstrations) is to design, develop and integrate use case specific applications and functionality on top of the platform functionality and generic components researched and prototyped in WP2. In WP3, partners design crowd contribution, professional capturing and editorial dashboard, and enhanced (mobile) end user applications to realize the envisaged Crowd Journalism and Live events use cases. These applications will be integrated with the researched and developed platforms and back-end components in WP2, and will drive the different yearly MOS2S demonstrators.

In WP3, the following updates to the workplan have been made:

- as a result of a Belgian funding decision, the role of IMEC has been reduced and WP3 leadership has been transferred to VRT (Luk Overmeire).
- T3.1 (Application design) task leadership has been transferred to KISWE (Jorre Belpaire) and delivery date of D3.1.1 has been set at M10.
- T3.3 (Demonstrator design and evaluation) task leadership is rotated on a yearly basis. In y1, T3.1 is led by Amsterdam ArenA (Reinout Huisman). In y2, T3.1 will be led by ETRI (Seong Yong

Lim) and in y3, T3.1 will be led by VRT (Luk Overmeire). Deliverable responsibilities are changed accordingly.

WP3 has started in M7. In the reporting period, deliverable D3.1 (Application Design) has been prepared for submission (delivery date M10) to reflect the work performed as part of T3.1. This deliverable provides the detailed design information on the features and functionalities of applications developed in WP3 to realize the Year 1 demonstrator.

The Dutch live sports event Year 1 demonstrator in Amsterdam Arena will show how integrating data and video will impact the end user experience when participating in or watching live events, including in-venue and in-home examples. This demonstrator encompasses a companion screen and set-top-box application and will be further complemented with a corresponding crowd-based live cycling event (test capture for Tour of Flanders on April 2nd 2017), and high-quality 8K 360VR immersive experiences for live events in Korea.

First versions of the crowd redactor dashboard, have already been developed and tested in different real-life use cases such as a music event (Music for Life), a public News event, Tour of Flanders, and a planned News event (Trump's visit to Brussels on 24th of May).

#### **WP 4: Dissemination and exploitation**

In the first year for the WP Exploitation and dissemination the following activities took place:

##### **CONFERENCES & EVENTS**

Participated

1. Media Fast Forward – December 2016, Brussels, BE
2. Next Level Stadium Technology Event – 8 Feb 2017, Amsterdam Arena
3. South By Southwest - March 10–19, 2017 Austin, TX
4. Digital Innovation Forum – May 10 & 11 2017, Amsterdam
5. World Stadium Congress – May 21 – 24 2017, Doha
6. Dutch Sport Infrastructure Trading Mission to USA June 18-22, 2017
7. Mediajaarcongres Expertsessie Sport en Media-innovaties, June 29, Studio 21 Hilversum

##### **(SOCIAL)MEDIA**

1. MOS2S launched a web site under the URL <http://mos2s.eu>, for which a logo, style guide and bumper were developed.
2. Social media channels were secured, such as Twitter and Facebook
3. A vlog was developed as part of the Test Capture Event during the friendly match NED – ITA.
4. An MOS2S article was included in the magazine of the Arena which was sent out to more than 5000 subscribers: business partners and share and stakeholders of the Arena and Ajax.

##### **PRESENTATIONS**

Several presentation about MOS2S where given to visitors of the Amsterdam Innovation Arena, amongst others FC Barcelona, Chelsea, European Central Bank, the World Bank, the Norwegian and Danish FA and the Supreme Committee Qatar.

##### **EXPLOITATION AND DISSEMINATION STRATEGY**

A strategy document for exploitation and dissemination is currently under development taking into account the valuable feedback received during our year 1 review with ITEA was held on June 1st

in the Amsterdam and Demonstrator Experiences during the IBC.

Leads amongst other are: KNVB (Dutch FA), Several Football Clubs in Europe and Several (Inter)National Broadcaster.

#### **WP 5: Project management and sustainability**

In the first half year of Project Management and Sustainability, the following activities took place.

We established a formal admission with Samsung Electronics (Korea) as a new full team member of MOS2S. An NDA was agreed on with their legal department, which was uploaded and approved by the ITEA organisation.

With all partners, including our new partner Samsung Electronics, we have negotiated, agreed and signed a Project Cooperation Agreement. The ITEA organisation was notified this, and our PCA sign date is listed on the ITEA project portal.

MOS2S launched a web site, inspired by a few other ITEA3 projects, under the URL <http://mos2s.eu>. This web site will be updated regularly with news items, and was filled with information that represents the background, consortium and goals in its current state.

MOS2S has been present at the Digital Innovation Forum in Amsterdam, where we had a booth with some of our demo's. We received a high number of visitors, such as Public Authorities, other ITEA project teams with possibilities for synergies, as well as universities and industry partners exploring collaboration.

Last but not least, our year 1 review with ITEA was held on June 1st in the Amsterdam ArenA. All WP leaders were present, as well as key project members from the Netherlands, Belgium as well as Korea. We received positive feedback overall (rating '+') , being a "high potential project with the great advantage to be already inside the Amsterdam ArenA to refocus on the business orientation". The review was held 7 months after the MOS2S kick-off meeting.

### **4.3. Per partner progress during the reporting period**

#### **4.3.1. Partner's main contribution and effort**

Partner	Planned effort	Actual effort	Contact
TNO	2.31	1.33	Gjalt Loots
Main contributions during the reporting period: - Project coordination: regular calls and meetings with the country coordinators, preparing and finalizing the Project Cooperation Agreement, updated the project planning and WP structure (reported in D5.2). - WP1: y1 WP lead, responsible for deliverables D1.1.1, D1.2.1 and D1.3.1 - WP3: developing and testing technology for test capture and 1st year demonstration - WP4: dissemination at DIF2017			
Discrepancy explanation: Planned effort includes 2016 activities; moreover, a significant effort peak is expected and			

Partner	Planned effort	Actual effort	Contact
	planned in August and September, to prepare and execute the 1st year demonstration at IBC2017.		
VRT	2.35	2.25	Luk Overmeire
	Main contributions during the reporting period: We have refactored and enhanced a toolset for crowd contribution and interaction, consisting of an end user app and an editorial toolset, resulting from the FP7 project Icosole, in particular extending the editorial app. We iteratively developed software updates during the following test cases: Music for Life (december 2016), a public VRT News event (January 2017), Tour of Flanders cycling event (April 2017), Trump's visit (May 2017) adding and evaluating new features in co-creation scenarios.		
Nokia Bell N.V.	0.97	0.65	Philippe Dobbelaere
	Main contributions during the reporting period: contribution to use case definition and initial requirements analysis design and implementation of text and video analysis pipelines based on our WWS platform showcase of the results in the demo created for the IBC Future Zone exhibition		
	Discrepancy explanation: MOS2S actual start for Nokia Bell Labs was around 15/11, initial ramp up was a bit slower than planned but we are catching up since 2017Q2. Anyway, most of Nokia Bell Labs effort was planned in year 2 and year 3 due to resource balancing with earlier started funded projects. Also WP2, that we lead, only starts after semester 1. (PM=20days, PY=230days) period planned actual 2016Q4 2.27PM 1PM 2017Q1 4.27PM 3PM 2017Q2 2.6PM 3.5PM		
KISWE	0.745	0.667	Jorre Belpaire
	Main contributions during the reporting period: 1. We ran an experiment during the Tour of Flanders 2017, together with VRT. We ran initial UGC production experiments by mixing the UGC contributions into UGC only content streams, synchronized with the main event. We validated its OTT production value and identified challenges with UGC in uncontrolled environments. 2. We extended the Kiswe KPS to accept live UGC streams, and specified/prepared the API updates required for VRT to integrate into their production toolkit.		
	Discrepancy explanation: We have included the effort since start of the project to compare with the Planned Effort presented. We were 1 manmonth behind schedule by end of June 2017 due to a late kickstart of the project and some		

Partner	Planned effort	Actual effort	Contact
	internal priorities. In the meanwhile we are on schedule (Sept 18) thanks to a catch up and the IBC efforts.		
ETRI	0.76	0.76	Seong Yong Lim
	Main contributions during the reporting period: Using the stitching module which ETRI is developing, a 360VR content was shared and demonstrated at IBC 2017		
Game On	0.97	0.97	Cyril Rutten
	Main contributions during the reporting period: Development of tablet application, which demonstrates orchestration of live video and sensor information in realtime.		
	Discrepancy explanation: None		
Mooovr	0.805	0.81	Yoon Joung Kim
	Main contributions during the reporting period: Mooovr is developing a 360VR rig system which includes six DSLR cameras to cover 360 degree. Also Mooovr built a testing system for decoding and rendering performance for 8K 360VR video.		
	Discrepancy explanation: not applicable		
Samsung Electronics	0	0	Kyungmo Park
	Main contributions during the reporting period: Samsung Electronics is a brand new partner in MOS2S. We agreed on the ITEA NDA, and PCA just before the reporting period end.		
	Discrepancy explanation: To be detailed together with project coordinator.		
IMEC	0.26	0.11	Stefan Van Baelen
	Main contributions during the reporting period: Improving the RMLProcessor: The RMLProcessor is used for generating Linked Data from heterogeneous data sources. We extended the RMLProcessor for the MOS2S needs. In more detail, we took the following two actions: 1. we extended its data retrieval module to also support stream data. In the past the RMLProcessor used to rely only on static data and 2. we investigated alternatives architectures to support streams of big data in more efficient time.		
	Discrepancy explanation: In agreement with the Flemish country coordinator, IMEC has slightly shifted its MOS2S activities. However, IMEC will execute all its activities in MOS2S as planned.		
Bosch Security Systems B.V.	1	0.5	Maud Vonken
	Main contributions during the reporting period: Developing and investigating new technology for the PTRZ fixed dome camera		



Partner	Planned effort	Actual effort	Contact
	that is unfortunately delayed. Because of the delay Bosch is looking for better sensors to implement inside the camera for better light sensitivity and HDR. This will also contribute for a bigger usage of the camera inside the stadium during events. Investigating gen-locking opportunity to treach the same level as broadcasting camera's also looking at Sony (Bosch Security portfolio) This is necessary for broadcasting.		
	Discrepancy explanation: Bosch spend less time in the project because of the delay of the special PTRZ camera. Therefore Bosch Security Systems did not reach the amount of PY in semester one. Bosch is spending time on research to integrate new technology in the camera but is not yet finalized. Also delivering HW is delayed. Bosch Security Systems is looking for a new project within the MOS2S project where we can contribute more time and technology. focus on Security will also be one of the targets to achieve that.		
Inmotio Object Tracking BV	1.575	0.3	Edward De Boer
	Main contributions during the reporting period: Development of new live football stats: fatigue index, passing option probability. Development low end high resolution video system, design of new data lake portal for football statistics and video.		
	Discrepancy explanation: The Inmotio work regarding MOS2S is still in the design/investigation phase. More work is expected later. In addition our efforts of hiring an additional software developer have not been successful yet.		
Koninklijke KPN NV	2.905	115	Job Meines
	Main contributions during the reporting period: KPN has investigated the technical feasibility to integrate sensor data into the TV broadcast in the customers' living room. Based on these findings we have designed, implemented and tested an application on the settopbox. A future backend integration for the sensor information has been taken into account during the development of the application. Furthermore, we created a test broadcast channel to support the development and demonstration of the MOS2S application. Finally, discussions took plac		
	Discrepancy explanation: internal KPN work is less than expected and some work has been outsourced. question is if this could fit under ITEA or not. discussion will follow with lead partner.		
Amsterdam ArenA	2.69	2	Reinout Huisman
	Main contributions during the reporting period: (Co)Managing Dutch Consortium Deliverables Preparations and participating several Events to present project. Managed,		



Partner	Planned effort	Actual effort	Contact
	coordinated and facilitated the test capture event during the friendly Match Netherlands – Italy. Responsibility, coordination and preparations for the First Demonstrator Event Developing the exploitation and dissemination strategy. Hosting the first year ITEA Review Event Several Dutch Consortium and Consortium meetings. Weekly Internal Meetings.		
	Discrepancy explanation: Focus of the last semester was more on "non in-stadium" applications. Second semester 2017 and 2018 will have more focus on in-stadium related applications. Lot of time and effort took place in the months July, Augustus and September for the realization of the demonstrator event on the IBC. Based on IBC experiences exploitation and dissemination strategy can be further developed Safety and security component of the project will get more shape in the second semester of 2017 and 2018.		

#### 4.3.2. Actual vs. Planned effort overview

Report	Reported actual effort up to reporting period (PY)	Planned effort up to reporting period (PY) - total: 101.99 PY
Progress report in 2017 (semester 1)	127.057	21.2 (21% of total)

## 5. Feedback to previous STG remarks

We would like to comment on three aspects in this section.

1. Contrary to the comments we received on the first version of this PPR, all parties have agreed on and signed the PCA. This was also communicated to and confirmed by ITEA office end of July.
2. KPN has provided an explanation for the resources reported to the ITEA portal. The following was provided by them:

KPN has spent far less PY effort than anticipated because of internal priorities that were set differently after an software bug related incident in some tv firmware. Because of motivation and dedication of KPN towards the ITEA Mos2s project, KPN asked an external company to provide the necessary effort to meet the deliverables and to not bring the ITEA partners in some predicament. This had an extra positive effect of running a little bit ahead of schedule. This suits KPN fine because of the anticipations of the Mos2s innovations.

KPN is currently working on a budget neutral change request to shift some efforts from hours spent to cost of external parties. This will be done via the project coordinator.

3. We have submitted a draft value chain / business plan which will be completed before the end of 2017.