

Design and Evaluation of a Second Screen Interactive Digital Media Solution using MPEG-DASH

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About the presenter

- Jomar Brudeli
- M.Sc. in Electronics Systems Design and Innovation from NTNU, 2019.
- Specialisation in Multimedia Signal Processing.
- Wrote a Master's Thesis in 2019 based on this project.
- Currently working as an R&D Engineer for a company producing high-end equipment for professional video delivery.

Research Interests?

The research is part of the activities of the Sense-It group at NTNU

<http://www.iet-multimedialabs.org/>

It belongs to the Digital Storytelling strand where:

Our focus within Digital Storytelling is in defining, designing, demonstrating and assessing Immersive Media Experiences (IMEx). Our work is applied in many different domains and often used for involvement and engagement in complex issues. Our methodology is through design and implementation of Interactive Digital Narratives (IDN) and modelled and assessed through User Experience and Quality of Experience (QoE).

About the Project

- Collaboration with Mixed-Media production company KapOow and NTNU.
- Received funds from the The Research Council of Norway.
- Research technology to be used in the Mixed-Media Sci-Fi Horror Comedy, THEY CAME.
- KapOow provided all multimedia content used in the project.

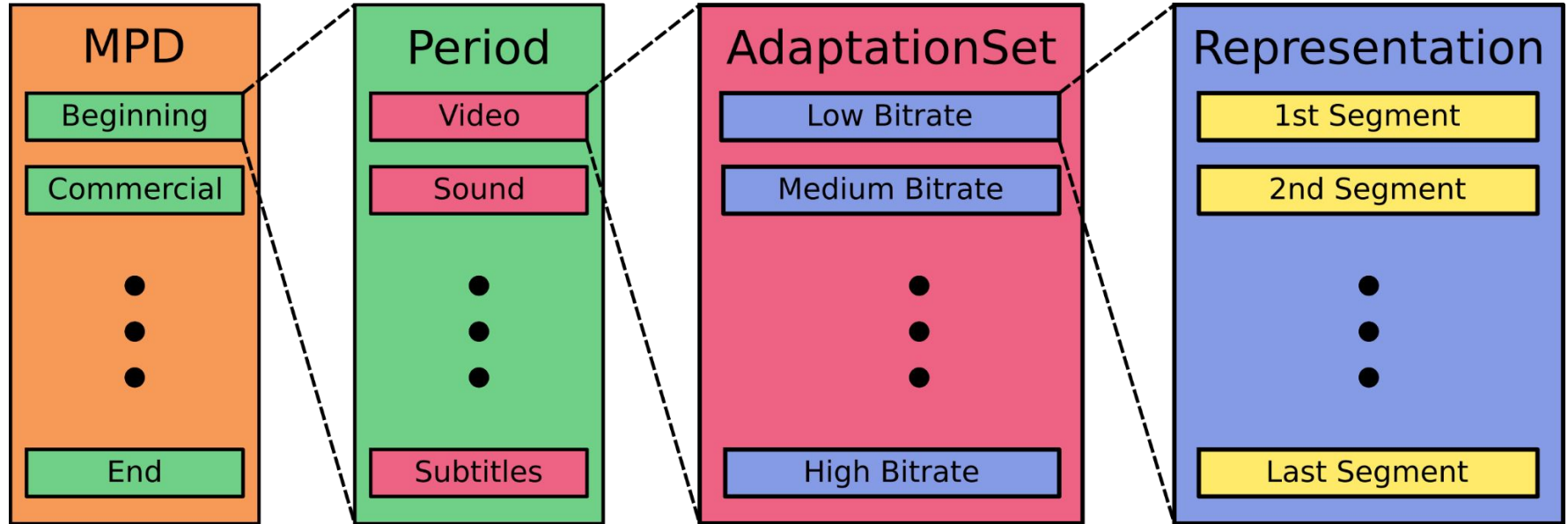


MPEG-DASH

Moving Picture Experts Group - Dynamic Adaptive Streaming over HTTP

- Standard for video streaming over HTTP.
- Uses a Media Presentation Description(MPD), also known as the manifest
- The manifest is a XML-document used to structure all the parts of a media stream (e.g., Video segments in different bitrates, audio, subtitles, metadata).
- Events may be signaled in the Manifest, using the EventStream element.

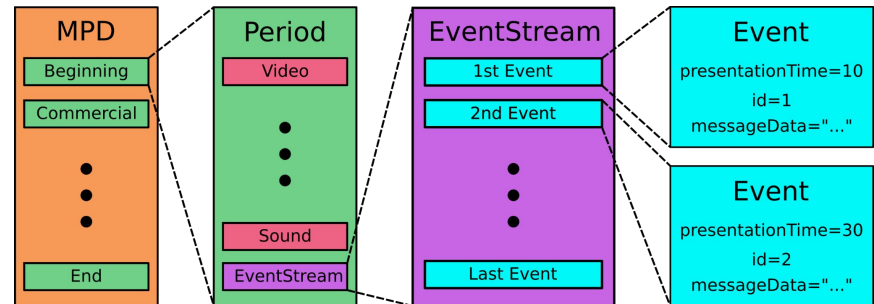
MPEG-DASH MPD Structure



EventStream and Event elements

- EventStream
 - @schemeUri - provides a Uniform Resource Identifier (URI) to determine which scheme the event follows.
 - @value - optional, and used to distinguish between different types of events in a scheme.
- Event
 - @presentationTime - defines when event should occur.
 - @duration
 - @id
 - @messageData

urn:mpeg:dash:event:2012



Second Screen Technology

- The user watched content on a master screen (e.g., Television, Computer, Cinema.)
- Holds another second screen in their hands (e.g., mobile phone, tablet) than is used to enhance the experience in some way.
- The second screen can be a tool for storytelling, interactivity, and increased immersion.
- In a modern world where television and other sources of media competes with mobiles for the users attention. This technology is trying to utilize that second screen instead of competing against it.



Design Method

- User-Centered Design
- Develop prototypes and evolve based on feedback from users.
- Final prototype evaluated by a group of target audience.

Trigger Synchronized Events on Second Screen

- Use MDP Events to trigger a response on the users second screen.
- In collaboration with KapOow's creative team, five different events where implemented for this project.
 - Video
 - Audio
 - Vibration
 - Web
 - Path-choice

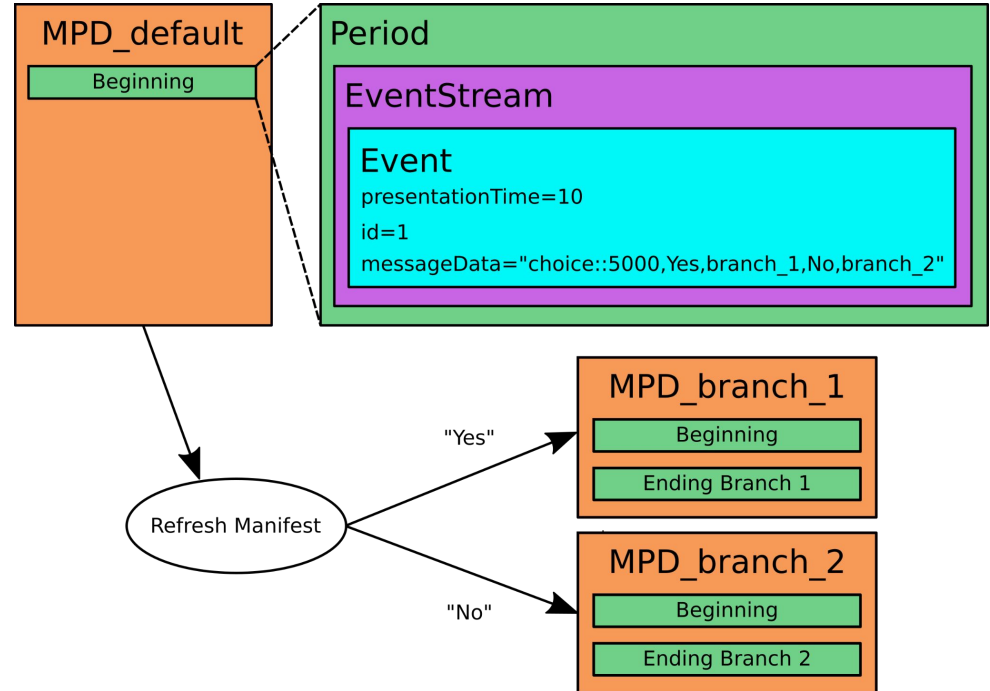
Define a new URI for trigger events

- We suggest a new URI for second screen trigger events.
 - `urn:mpeg:dash:event:trigger:2019`
- Example of EventStream element from our implementation.

```
<EventStream schemeIdUri="urn:mpeg:dash:event:trigger:2019 value="1">  
  <Event presentationTime="10" id="1" messageData="video::test_video.mp4" />  
  <Event presentationTime="30" id="2" messageData="sound::test_sound.wav" />  
  <Event presentationTime="60" id="3" messageData="vibration::1000,255" />  
  <Event presentationTime="90" id="4" messageData="web::https://www.ntnu.no" />  
</EventStream>
```

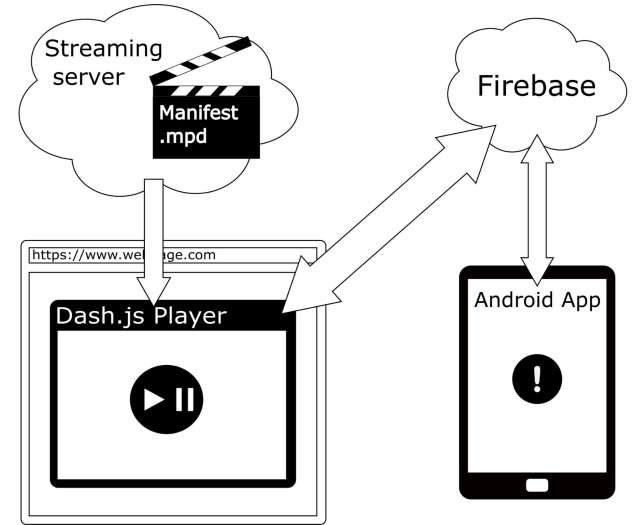
Path Choice - Branching Storylines

- Use an Event to query the user for feedback.
- Update the manifest based on the users response.
- Could be used to implement branching storylines.



Final Prototype used for QoE evaluation

- MPEG-DASH Manifest fetched from a server.
- Google Firebase used as backend.
- Custom Dash.js player that handles the events.
- KapOow provided content.
- 4 different types of events implemented.
 - Audio
 - Video
 - Vibration
 - Web Content



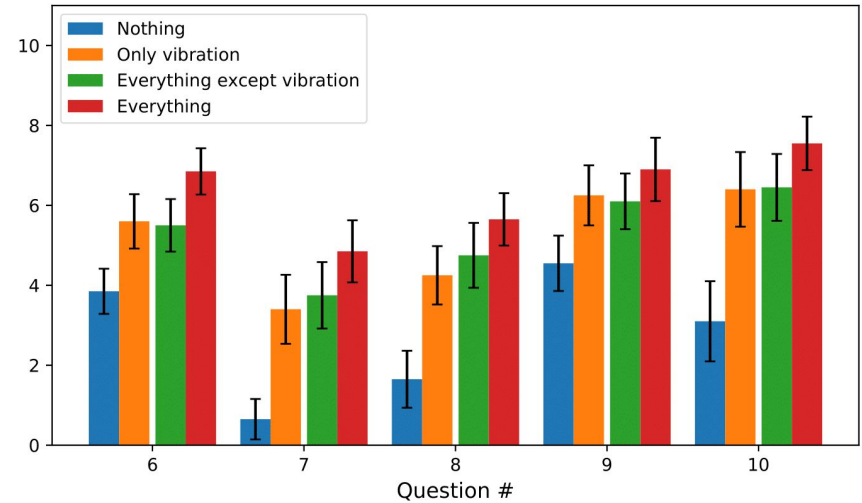
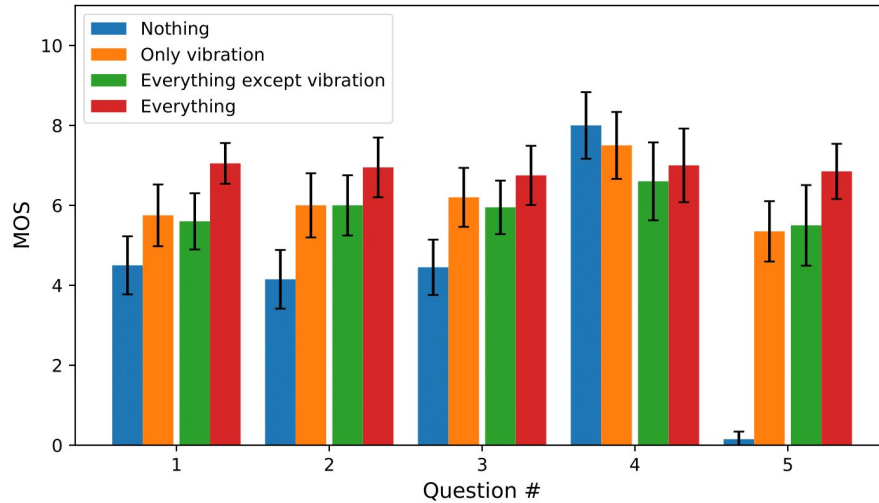
1. User logs in on a webpage and on a mobile application.
2. Starts streaming the video while holding the phone in their hands.
3. Synchronized events gets triggered on the mobile at certain times (as defined in the Manifest.)

Evaluation - Quality of Experience (QoE)

- How to assess QoE for end-users of second screen applications?
- Subjective evaluation experiment
- Evaluated by a target group, chosen from interested candidates.
- Focused on the effect of triggering synchronized vibrations on the second screen.
- The users tested the prototype four times with different triggers implemented.
 - None
 - Vibration
 - Vibration, Sound, Video and Web
 - Sound, Video and Web.
- After each view, 10 questions were answered with a score from 0 to 10.

Results from QoE evaluation

- Indicates increased QoE with vibration triggers, compared to without.



Conclusion

- Use MPEG-DASH EventStream to trigger events on second screens
- Define a new URI for Second Screen Events.
- Use EventStream and MPEG-DASH to implement Path Choice - Branching Storylines.
- Implemented prototypes used for subjective evaluation experiment to try and measure QoE.
- Results from subjective evaluation experiment indicates the synchronized vibration on the Second Screen has a positive effect on QoE.

Thank you!