creating the
living network. *together*

Use cases & Challenges about Volumetric Video Immersive Experiences

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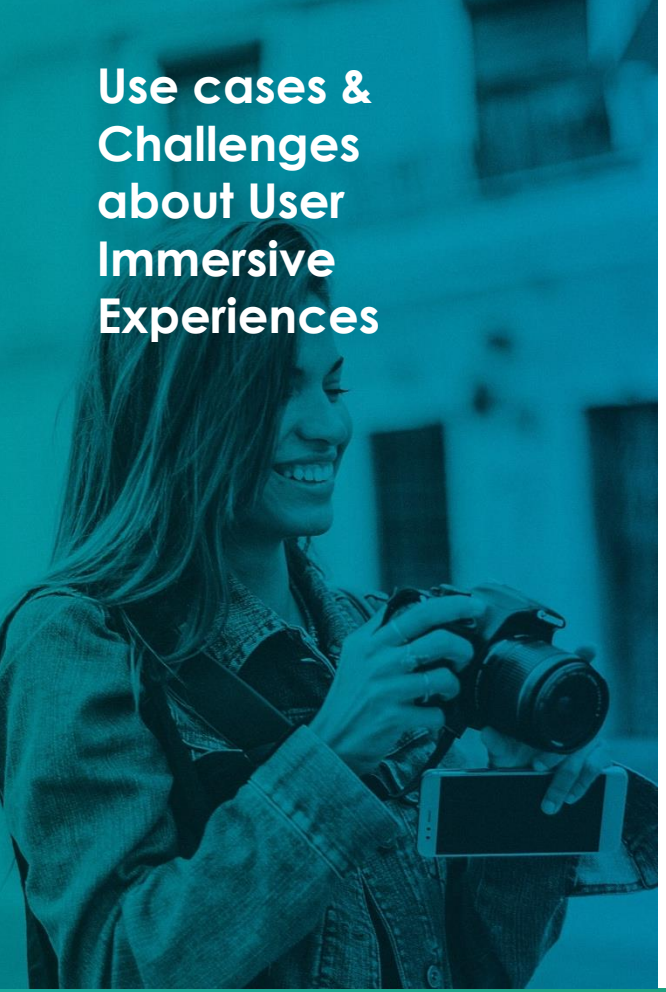


Outline

Volumetric video for new user experience

Content creation challenges

Challenges related to single user / multi-user experience

Future of Volumetric Displays and AR

Volumetric Video rendering

Perspectives

Experience of parallax

- **VR experiences**
  - Freedom of movement inside the content
    - Not only in front of the content anymore
  - Game engine content showing the direction to go, raising expectations
  - Still weird real
    - Flat content
    - Subject to sickness

➔ VR experience : where volumetric video is mandatory

Experience of parallax

- **On any viewing device**
  - Experience of parallax makes the user feeling more immersed in the content
  - Dynamic window concept on a 2D screen
    - Showcased at MWC 2019
  - Positive reactions in front of the screen

InterDigital dynamic window https://www.interdigital.com/videos/mwc19-volumetric-photobooth

➔ What type of content would make volumetric video mandatory ?

Virtual Camera motion

- **Volumetric Selfie**
  - Creative content from new capture setup
  - Volumetric selfie created from 1 single frame capture
  - Not a scan - you catch the instant emotion

InterDigital volumetric photobooth https://www.interdigital.com/videos/mwc19-volumetric-photobooth

➔ Creating attractiveness for such experiences

Freeze on Volumetric image

- Volumetric video to bring more on key moments
- More than just parallax

➔ Need for volumetric video for all content duration ?

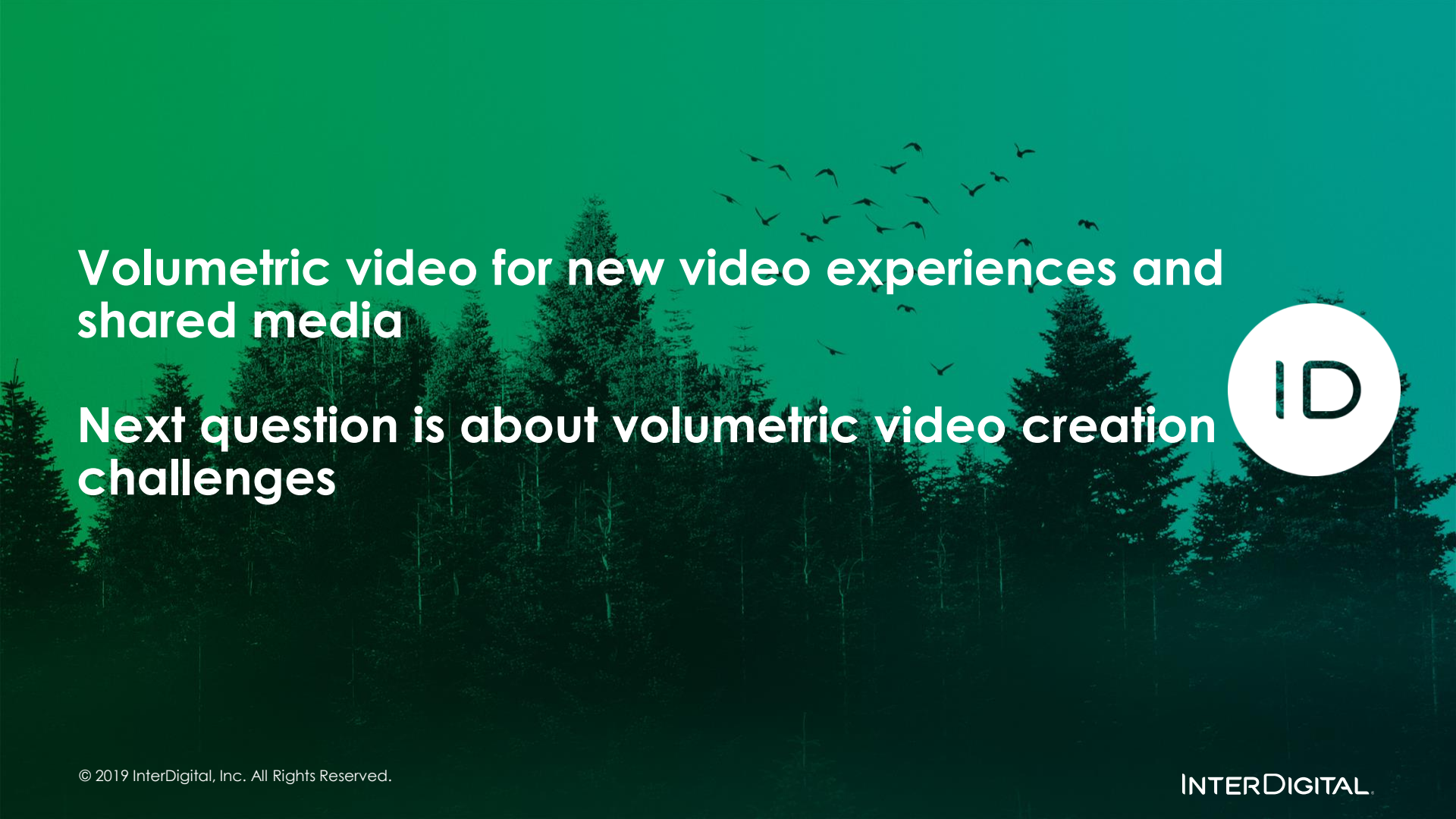
AR social experience

- **Volumetric video call**
  - From 3D video call to more immersive content
  - Up to Real Body Telepresence on AR devices
- **AR**
  - From Snapchat like filters to Avatars
  - 1st experiences with volumetric capture characters transported as 3D meshes

AR social experiences

- **Volumetric AR challenges**
  - Seamless blending
  - Real time streaming & interactions

➔ Volumetric video blending is mandatory for AR experiences



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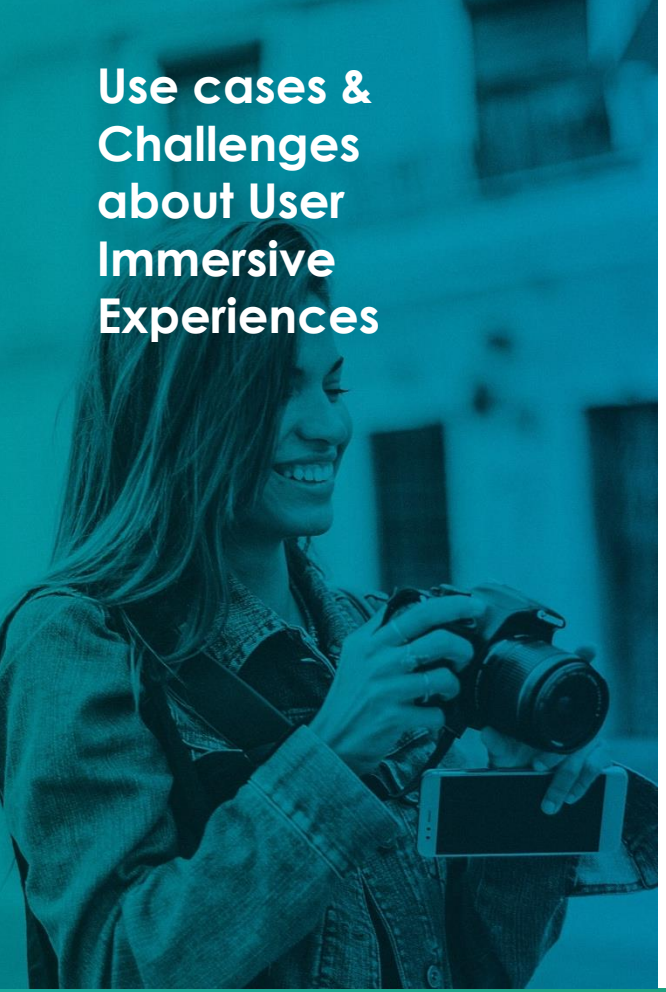

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Capture real video

- **Light Field camera arrays**
  - Trade-off between degree of freedom and rig design
  - Large environment capture challenge

Tools for creatives

- **Virtual camera motion**
  - From stop motion capture to virtual camera motion
  - New perspectives for creatives

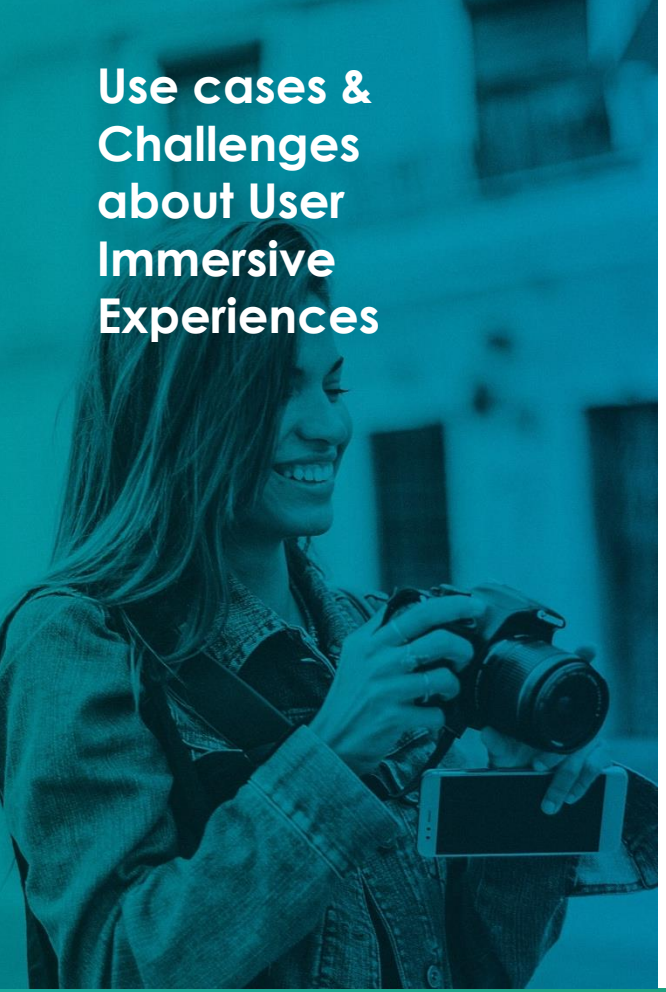
Compositing

- **Required tools**
  - For scene compositing to create video with parallax
    - From a non full light field capture setup
  - For large field of view content
  - For VFX compositing
  - 3D compositing tools today not adapted to multi-views content

➔ Required editing tools adaptation to ingest light field assets

Game engine plug-in

- **From game engine-based content**
  - Implementation of a virtual camera rig and a virtual path
  - Creation of multi-views + depth content to feed volumetric format pipeline
  - For lightweight volumetric content experience
  - To expend content repurposing paths
  - To enable fast deployment of volumetric experiences



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Single user experiences

- **Head mounted displays**
  - "Out of real world" experience
  - Real immersive experience with "no screen" feeling
  - Capture & real time rendering challenges

➔ Ultimate experience facing technical challenges

Single user experiences

- **Head mounted displays**
  - From limited toward extended DoF experiences
  - Enlarge displacement for the user
  - Some multi-spot experiences proposed
  - Trajectory based step could be an option

➔Required tradeoffs between experiences and tools

➔Adaptation of DoF to storytelling

Single user experiences

- **Smartphones**
  - Social content
  - AR primary device today
  - Volumetric effect limited by
    - “Screen border” effect
    - Screen size

➔ Design proper tools for simple but mass market experiences

Single user experiences

- **AR glasses**
  - Real world is volumetric
  - Mixed reality experience
  - Primary challenges today are on optics
    - (FoV, VAC, multi focal planes, brightness)
  - Next challenges to come
    - Real time content understanding
    - Volumetric content rendering

➔ Seamless blending of real world and volumetric content

Single user experiences

- **New 3D screens**
  - Directional 3D view
    - Eye tracking based
  - Good image quality since only stereo views generated out of 4K/8K display
  - Professional markets

➔ Volumetric video to bring differentiators to new 3D screens

Multi-user experiences

- **Multi-Views Screens**
  - Lenticular / Microlenses arrays on top of standard displays
  - Real time multi-views rendering
  - Today: resolution down sampling to cope with (4K) display
  - Solutions
    - New look and feel out of standard display experience to avoid « screen border effect »
    - Specific design to enlarge FoV

➔ Early stage prototypes

Future of Volumetric Displays and AR

- Volumetric video seen as ultimate user experience
- Light Field Display facing views/resolution trade-offs
- Holographic displays as the holly grail for seamless reality blending

- AR screen today first in industry without depth cues
- Holographic AR head up displays for automotive market

➔Today 2D screens able to render volumetric video

➔Early stage Light Field Displays and AR glasses

➔ long term vision is Immersive video for large scale video experiences

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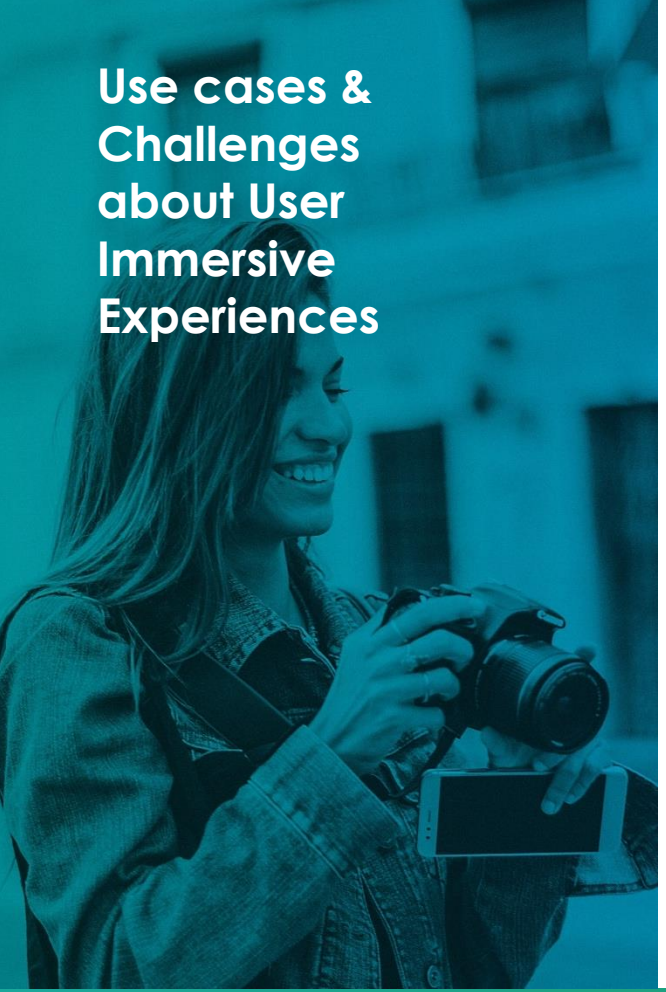

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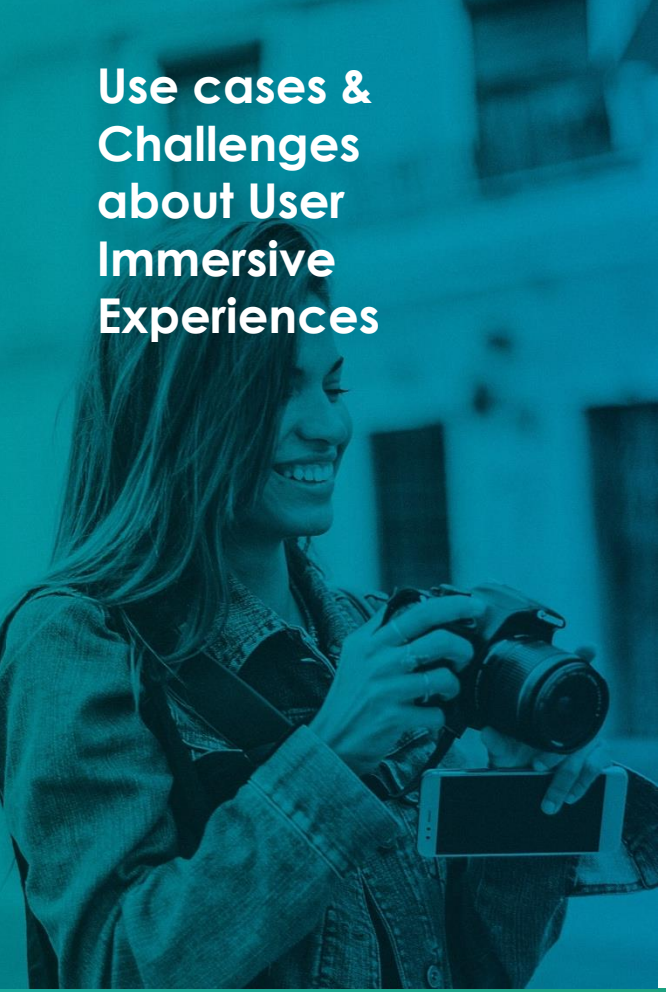
View Synthesis

- **Real video content**
  - Virtual View Synthesis = the core tool
  - Smooth rendering and Immersive User Experience

➔ End user quality assessment point



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Deep Learning

- Deep Learning for Volumetric content creation and rendering
  - Create or enhance depth information
  - Magnification or intermediate views creation
  - Unlocking some image-based rendering limitations
- State of the art mainly on still images and limited baselines
  - Showing promising opportunities

PERSPECTIVES: WE NEED

New content types where volumetric essence is core

Editing tools to ingest true volumetric content

Deep Learning solutions to scale content creation & unlock rendering technologies

Video formats & distribution solution

Adapted to diverse use cases

Adapted to market timeline

Showing a path to extended immersive experiences

Encoding and Rendering tools for next generation of capture and display devices

Thank you