Free Viewpoint Television:
# új perspektíva a 3D videó továbbításban

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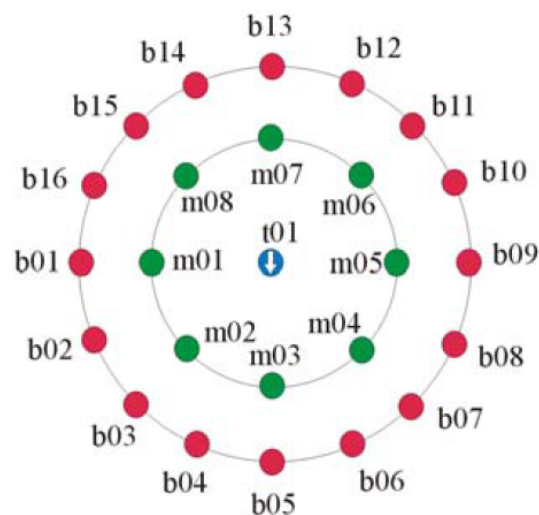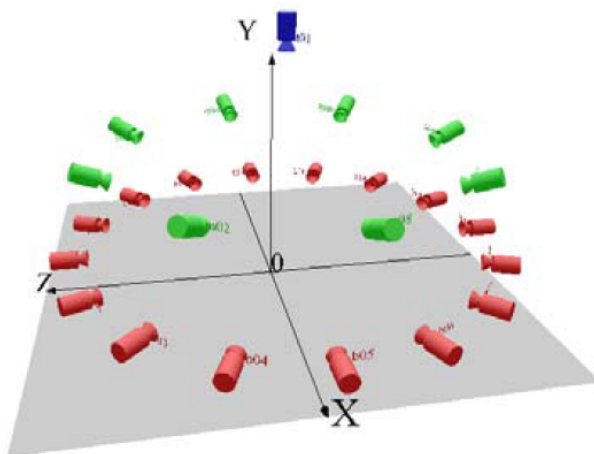
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Motivation

- FVV streaming is foreseen as the next big step in 3D video technology

- Free viewpoint video (FVV)
  - new approach of interactive streaming services
  - users are able to freely change their viewpoint

- Same functionality as CG objects
  - free navigation, can be viewed from any viewpoint/direction
  - integration into complete scenes

- But
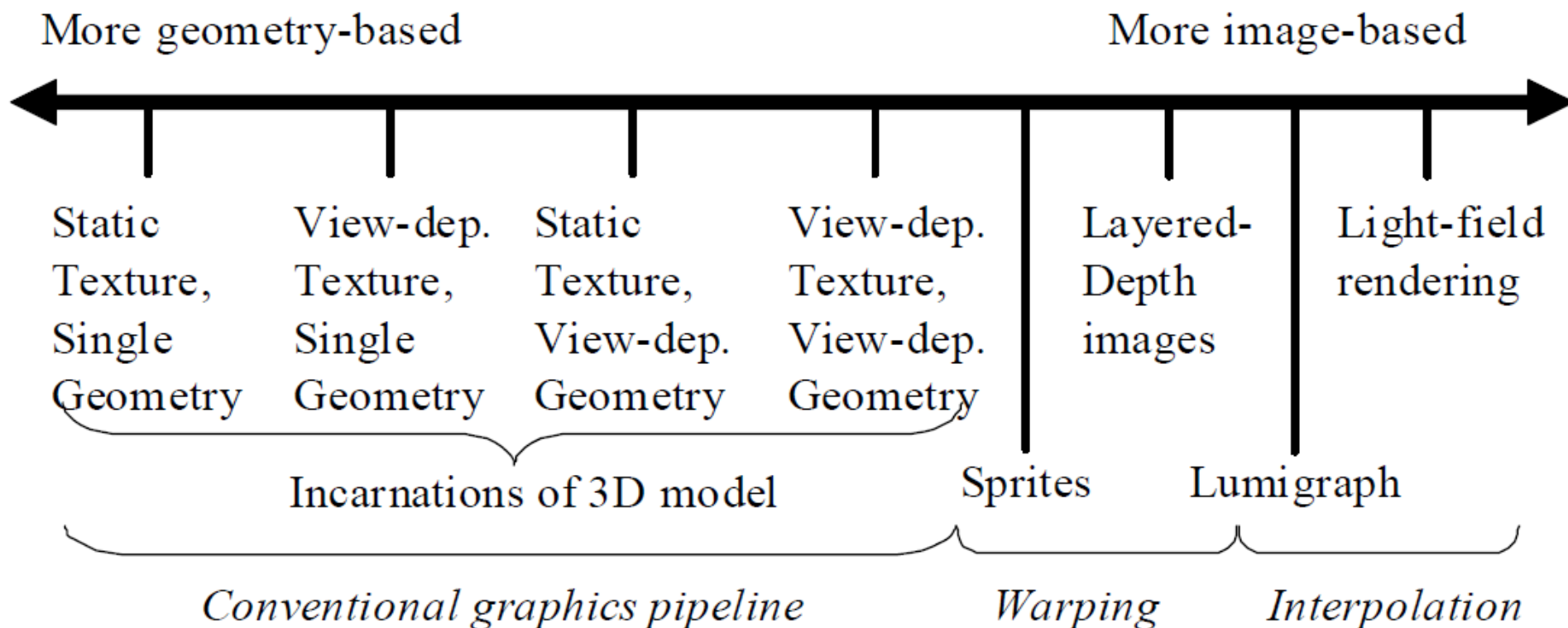 - depict appearance, motion, deformation of real world objects
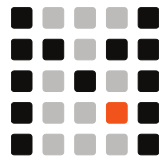
Motivation
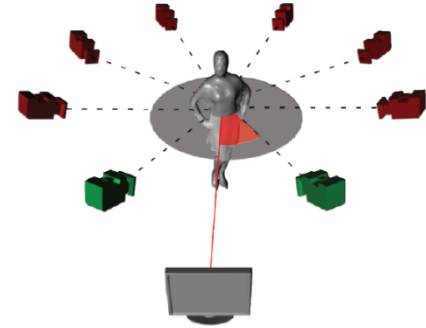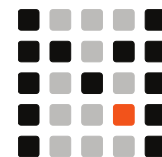
- **Synthetize desired viewpoint**
  - from two or more camera views
  - significant network and computational resources required
  - two or more camera views must be delivered to the users
    - depending on their continuously changing perspective

3D scene representations

More geometry-based

More image-based

Static Texture, Single Geometry

View-dep. Texture, Single Geometry

Static Texture, View-dep. Geometry

View-dep. Texture, View-dep. Geometry

Layered-Depth images

Light-field rendering

Sprites

Lumigraph

Incarnations of 3D model

Conventional graphics pipeline

Warping

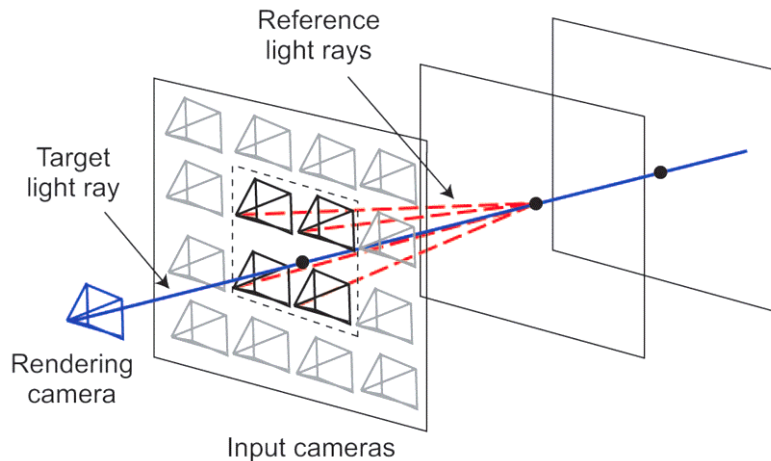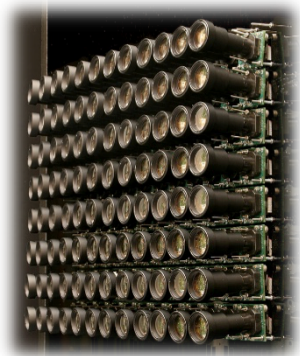*Interpolation*
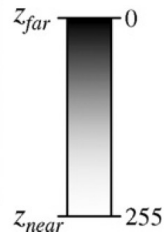
FVV synthesis

- The FVV experience becomes more realistic as the number of camera views used to sample the scene increases
    - causing network traffic load increase

- To generate an individual viewpoint from the camera sequences two methods can be used:
    - Light Field Rendering (LFR)
        - LFR interpolates a virtual view from multi-camera images
    - Depth Image Based Rendering (DIBR)
        - uses fewer images and a depth map to establish new views
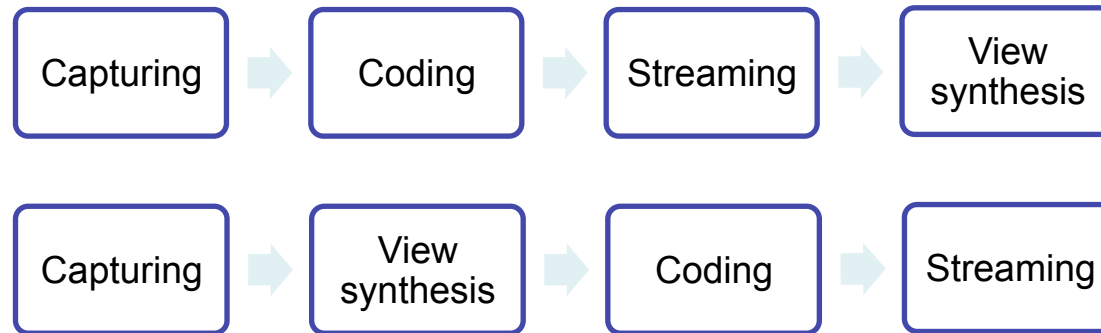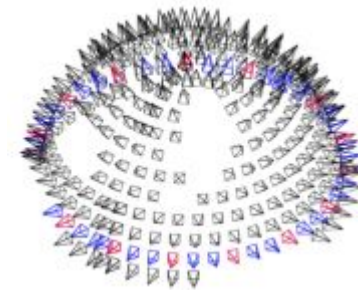
FVV service model

- A DIBR-based free viewpoint video service model main components:

Capturing → Coding → Streaming → View synthesis
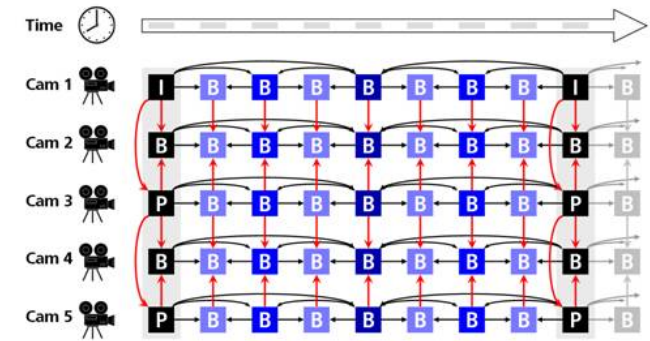
Capturing → View synthesis → Coding → Streaming

- Scene capturing
  - different camera array layouts can be used that impose practical limitations on navigation
    - e.g linear (1D), plane (2D) or dome type (3D)

FVV service model

- **Video coding**
  - Multiview Video Coding (MVC) exploits both inter-view and temporal redundancies
  - extension of H.264/AVC

  - Multi-view video plus depth (MVD) representation uses per-pixel depth map sequences associated with multi-view texture video
    - MPEG-C Part 3 standard supports video plus depth
    - requires an extra 10–20% of bitrates

- **Viewpoint synthesis**
  - any pixel of the image can be projected into the 3D space using the color images and associated depths and then projected back onto an arbitrary virtual camera plane, creating a virtual image

FVV service model

- **Streaming**
  - delivery of FVV is different from traditional video streaming
    - several video streams captured by different cameras
      - color + depth
    - camera streams required by customers may change frequently because of free navigation of viewpoint
    - FVV streaming requires significantly more bandwidth than single video stream delivery

  - three different FVV streaming models can be distinguished regarding to virtual viewpoint synthesis
    - Server-based
    - Client-based
    - Distributed

Media proxy

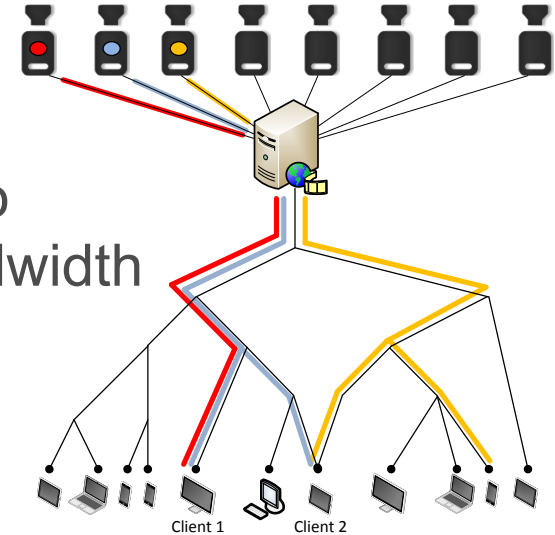Media server
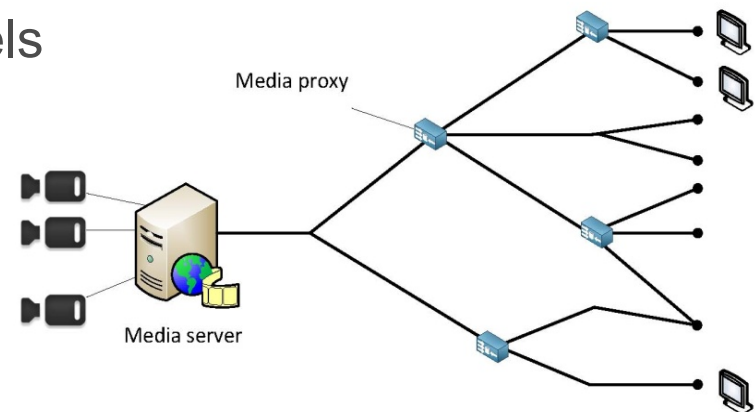
FVV streaming challanges

- Huge data
  - Multicast FVV streaming
    - Multicast delivery may be a solution to reduce the required FVV service bandwidth
   - each camera view is encoded and forwarded on a separate multicast group to the users

- Frequent viewpoint changes
  - leads to interrupted FVV service
  - due to network latency and frequent viewpoint changes, the required camera streams may arrive too late
  - viewpoint prediction

FVV streaming challanges

- Significant network and computational resources required
  - scalability problems
  - distributed viewpoint synthesis
    - where to locate the viewpoint synthesis functionality?

Media proxy

Media server
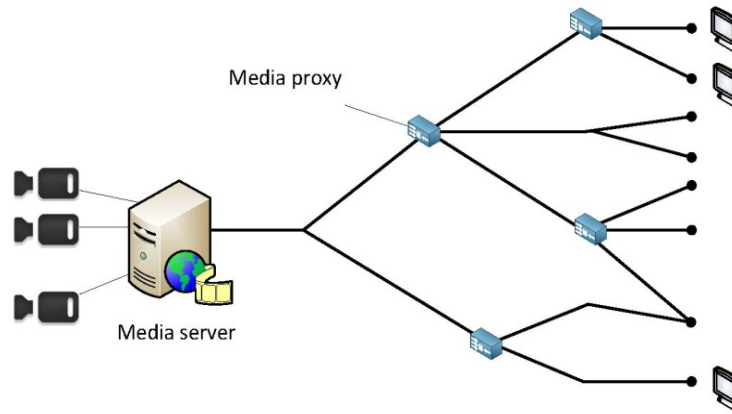
Glasses-free 3D displays

- **Next generation displays will be 3D**
  - 3D data is already there, but lost while displaying

- **Direction selective light emission**
  - common for all 3D systems having a screen
  - project light beams to the points of the screen from various angles

- **Holographic screen**
  - Direction selective property with angularly dependent diffusion characteristics
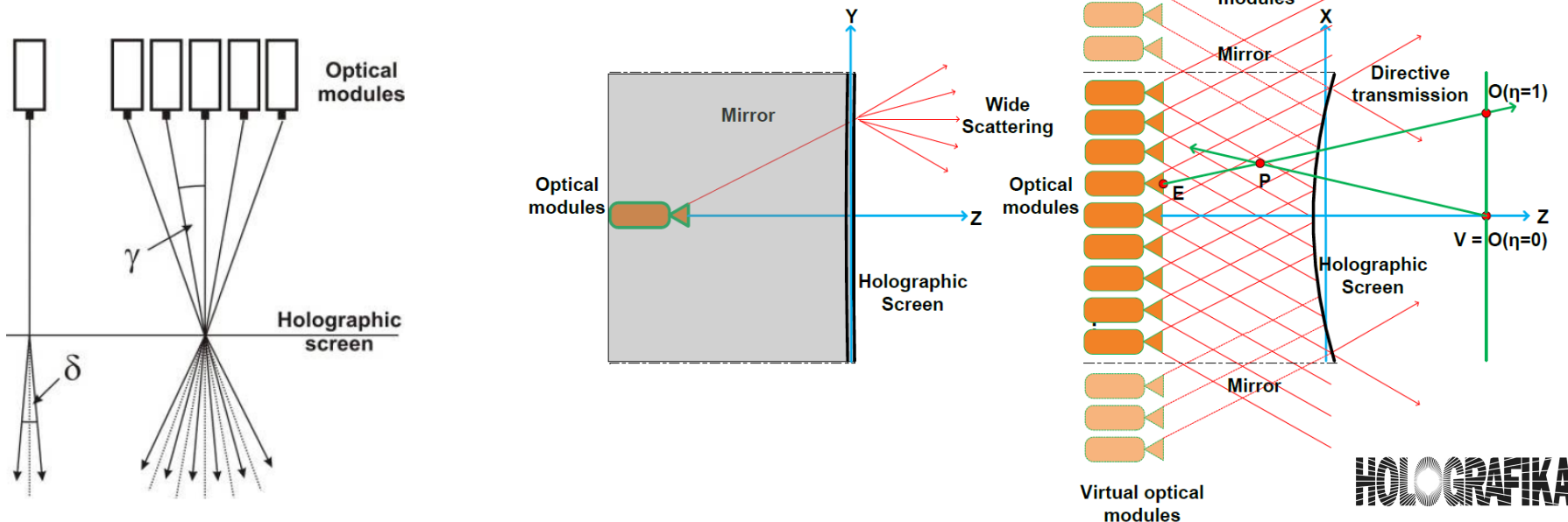
Questions?

THANK YOU FOR YOUR ATTENTION!