3D and Multi-View Video Streaming

Standards and Use cases

Thomas Schierl

Fraunhofer Heinrich Hertz Institute (HHI), Berlin, Germany

Fraunhofer
Heinrich Hertz Institute

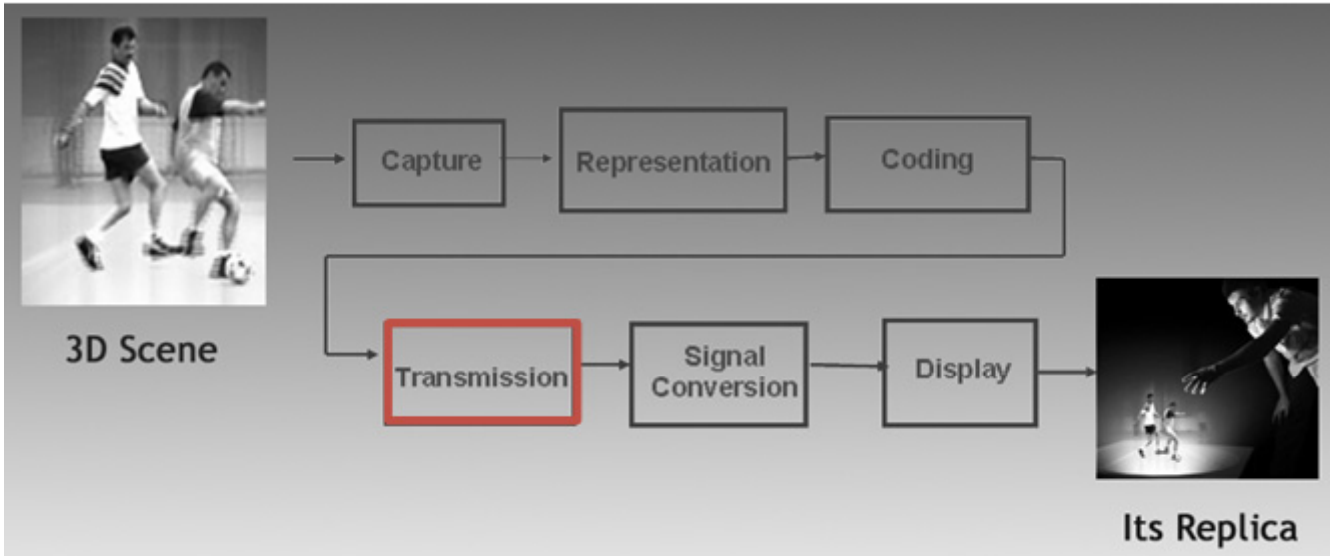
Outline

- **Adaptive 3D Multi-view Streaming**
  - Motivation: Varying Channel Conditions
  - Solution: Adaptive transport of 3D Video
  - Technology: 3D Transport (Example: H.264 MVC)
    - Broadcast transport
    - IP transport
  - Outlook: Fully scalable 3D

- **Use cases: 3D Multi-view over**
  - IPTV channels
  - Mobile Ad-hoc Networks
  - Mobile Broadcast Channels

Transmission in the context of 3D

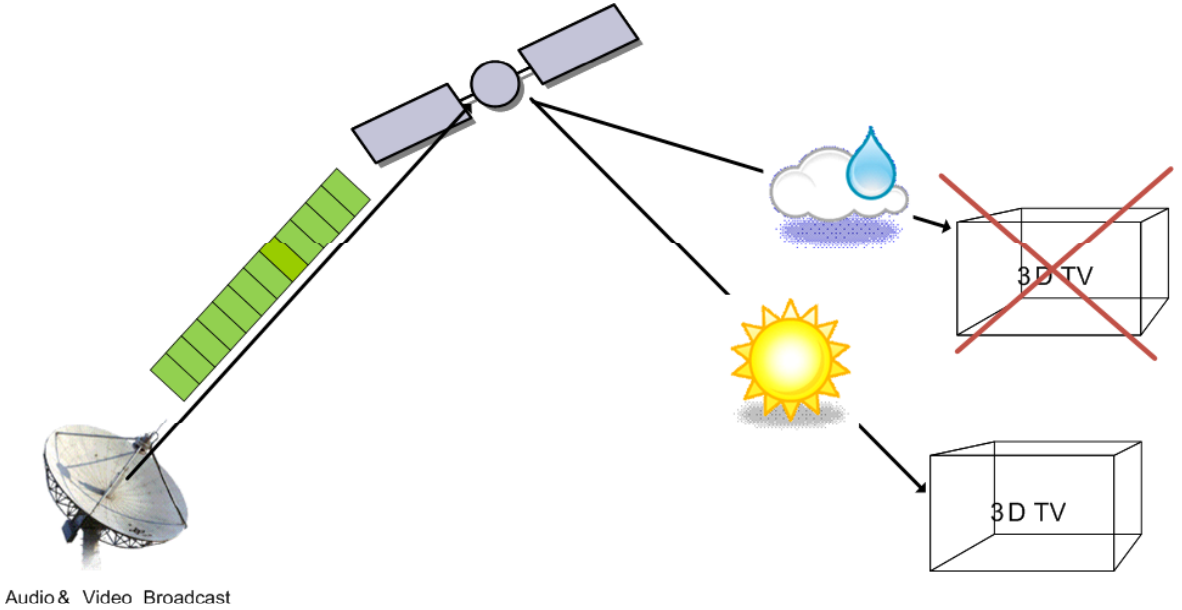
- **3D and Multi-view Video Transmission**
  - an *important* part of the chain as shown on next slides



Motivation: Varying channel conditions

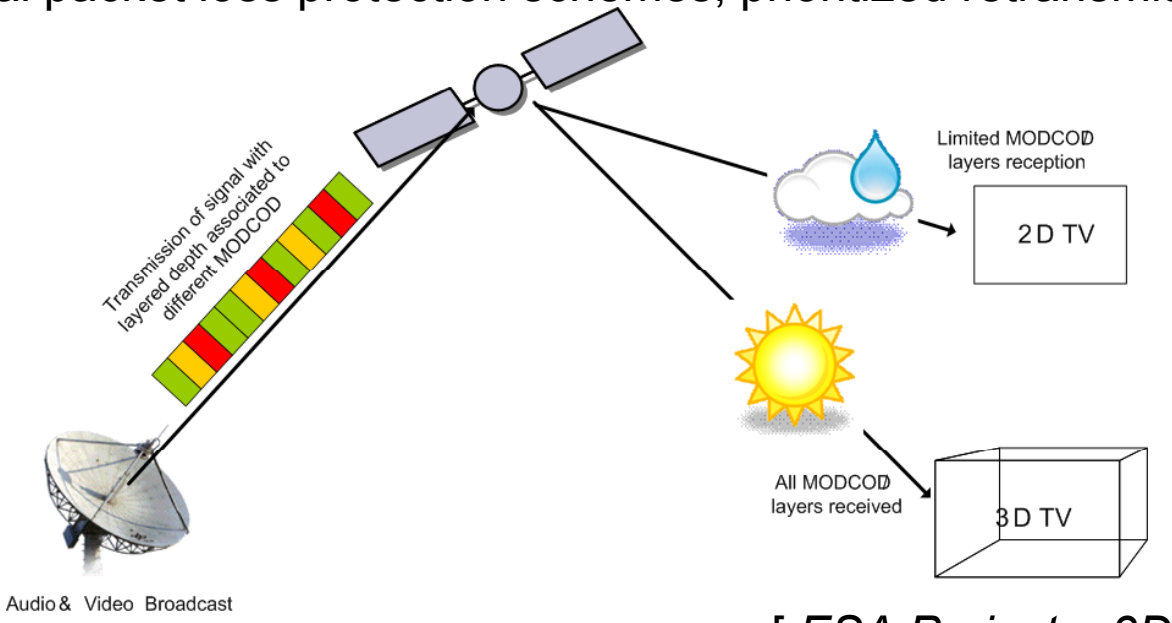
→ **Streaming requires Quality of Service**

- **Impossible to provide Quality of Service**
  - e.g. over the Internet
- **Or high cost to provide Quality of Service**
  - e.g. in satellite transmission, or mobile broadcast networks
  - service coverage needs to satisfy all (~99%) of the users



Solution: Adaptive 3D Streaming

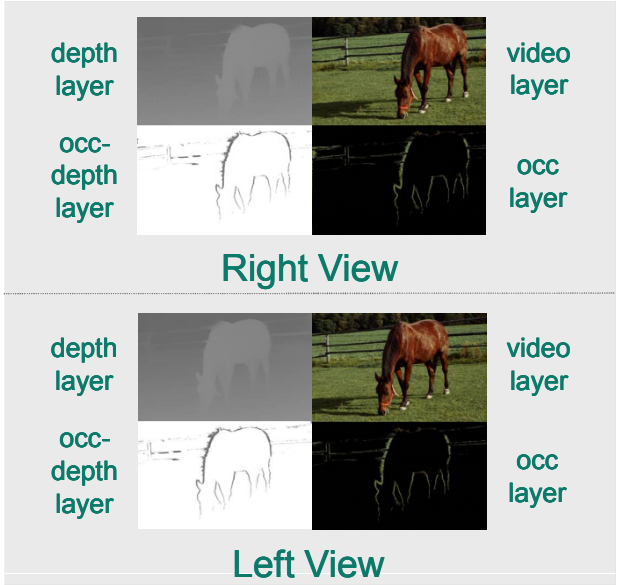
- **3D Media:**
  - Provision of scalability (remove parts of bit-stream): Graceful degradation
- **Prioritized Transport – PHYSICAL layer:**
  - Use of different QoS parameters as modulation, channel code…
- **Prioritized Transport – APPLICATION layer:**
  - Unequal packet loss protection schemes, prioritized retransmission…



[*ESA Project – 3D @ SAT*]

3D Video Formats

- **Different types of video coding and presentation**
  - 2D+Depth, Multi View Coding (MVC), Depth-enhanced Stereo (DES)
  - All have a *layered* approach
  - Suitable for layered transmission
  - Unequal treatment in error protection
- **Example: DES** → Hierarchy in layer importance



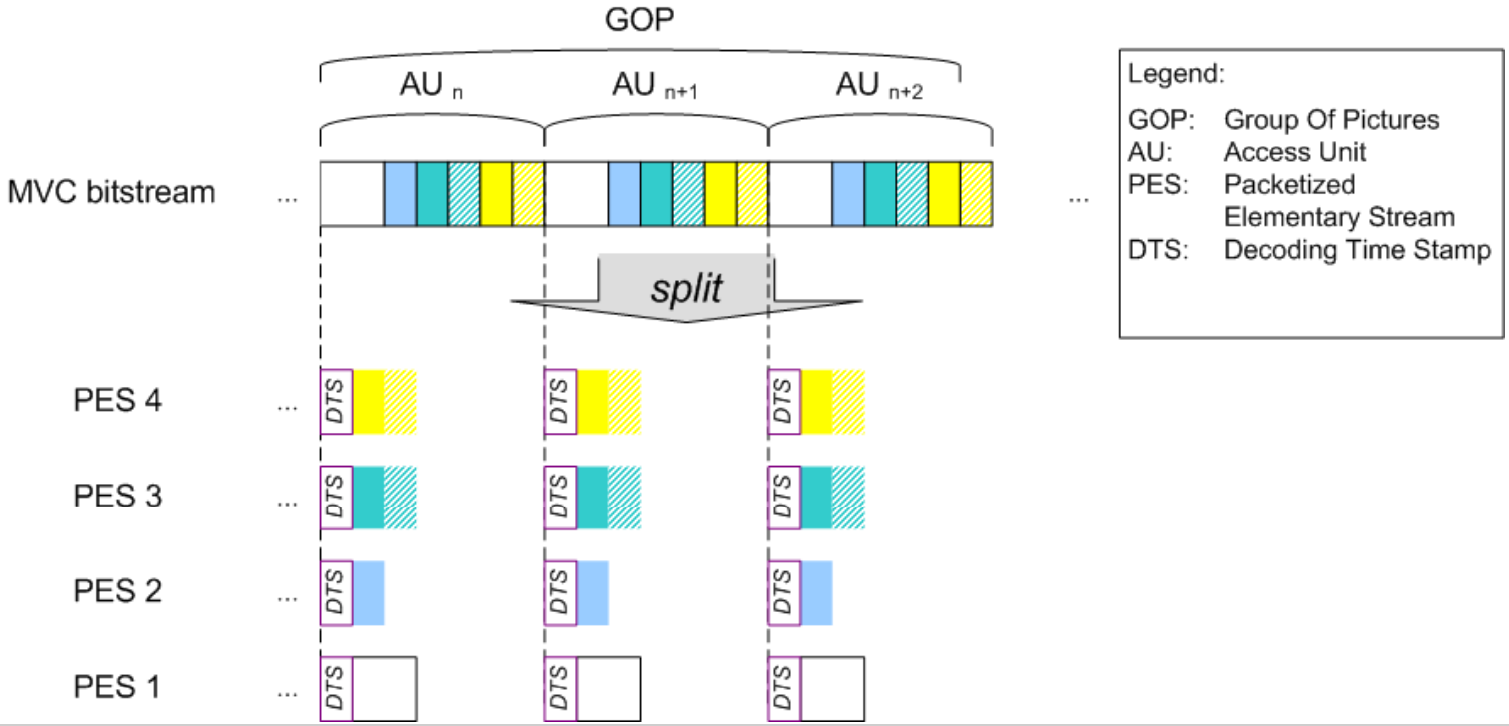
Outline

- **Adaptive 3D Multi-view Streaming**
  - Motivation: Varying Channel Conditions
  - Solution: Adaptive transport of 3D Video
  - **Technology: 3D Transport (Example: H.264 MVC)**
    - Broadcast transport
    - IP transport
  - Outlook: Fully scalable 3D

- **Use cases: 3D Multi-view over**
  - IPTV channels
  - Mobile Ad-hoc Networks
  - Mobile Broadcast Channels

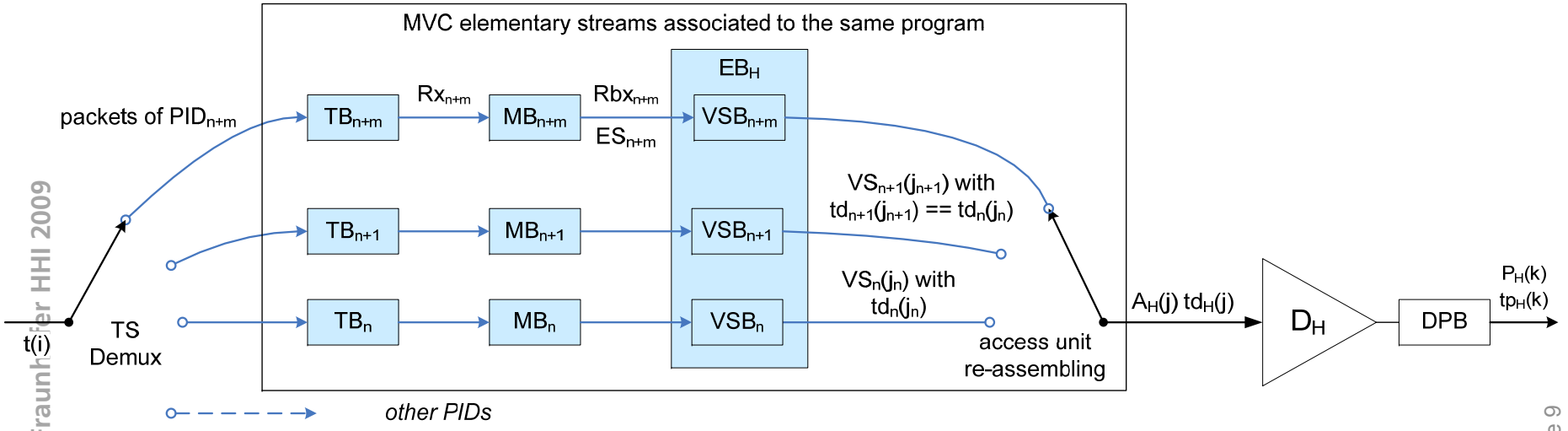
Broadcast Transport – MVC over TS

- **MVC over MPEG-2 Transport Stream (TS)** **[** *Schierl, Grüneberg* **]**
- **Goal: Visibility of view importance + prio. view de-multiplexing**
- **Layered Transmission of views in Elementary Streams**
  - synchronization via Decoding Timestamps (DTS)
  - backward-compatible introduction of 3D



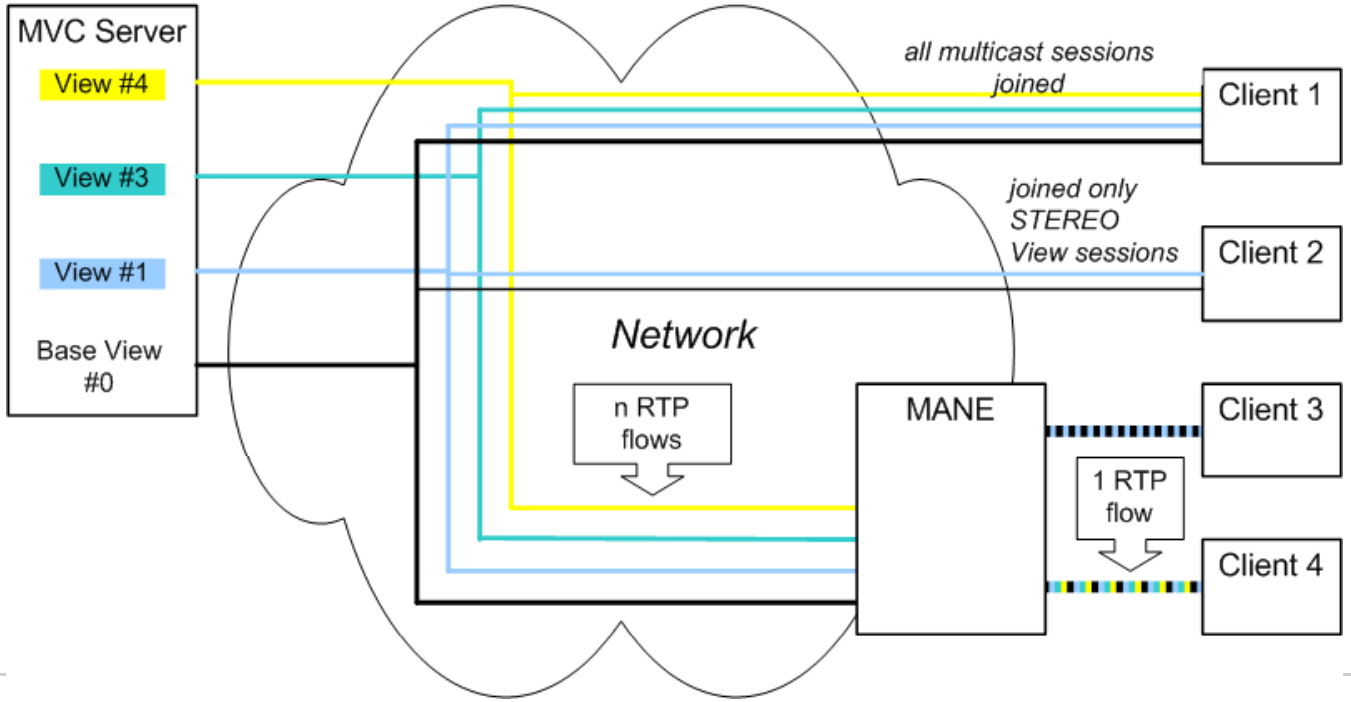
Broadcast Transport – MVC over TS (cont.)

- **New MPEG-2 Transport Stream (TS) receiver buffering model**
  - borrowed from SVC
- **<u>Per Media</u>: multiple streams and buffers**
  - up to one view per Elementary Stream / PID
  - requires synchronization before decoding
- **System Target Decoder model:**



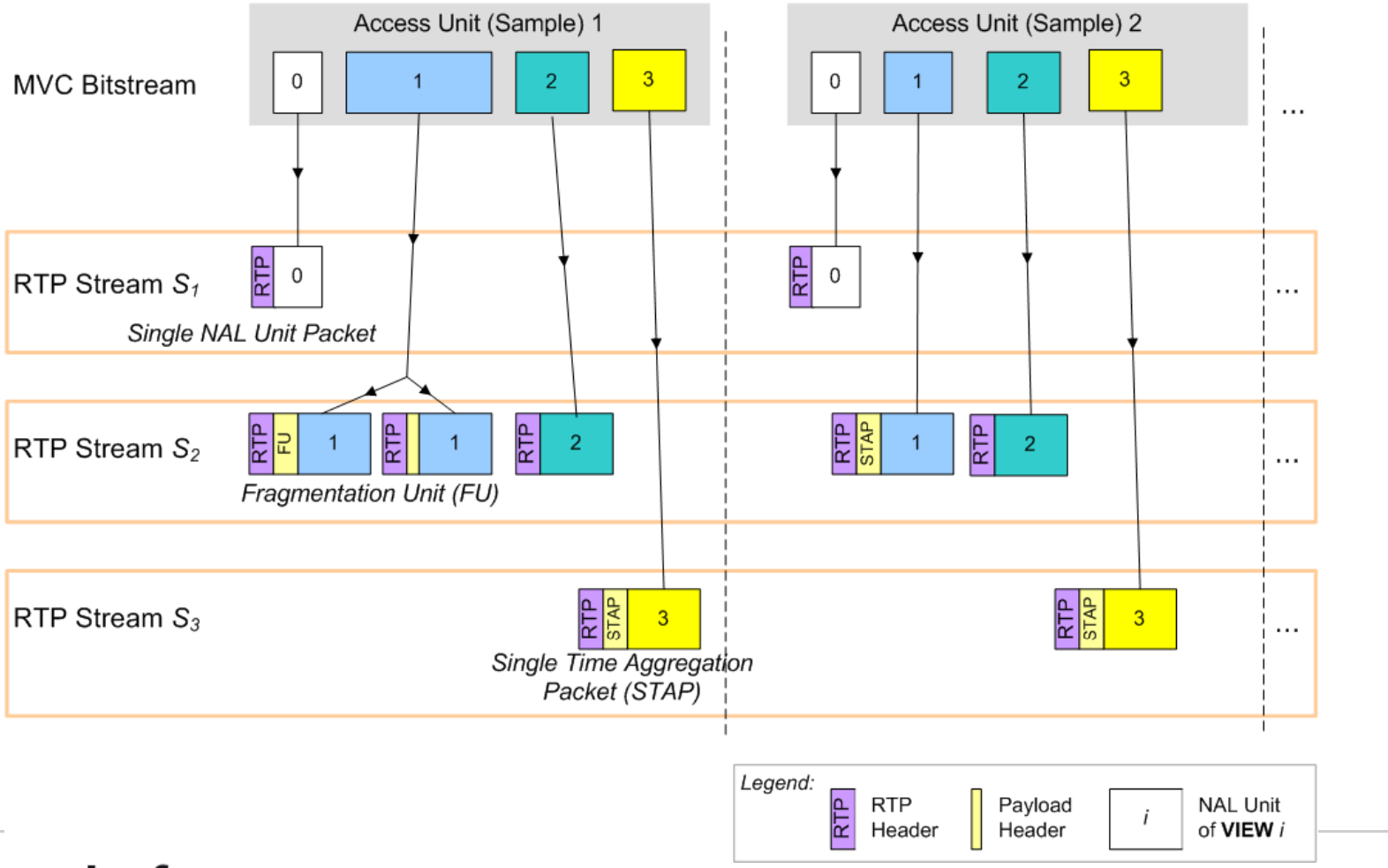
IP Transport – MVC over RTP

- **IEFT RTP Payload Format for MVC video** [*Wang, Schierl*]
- **Goal: Visibility of view importance + prio. view de-multiplexing**
  - RTP + SDP signaling -> e.g. Diffserv. and other QoS mechanisms
- **Layered Multicast + Media-Aware Network Element**
  - on-the-fly service (view) adaptation
  - backward-compatible 2D



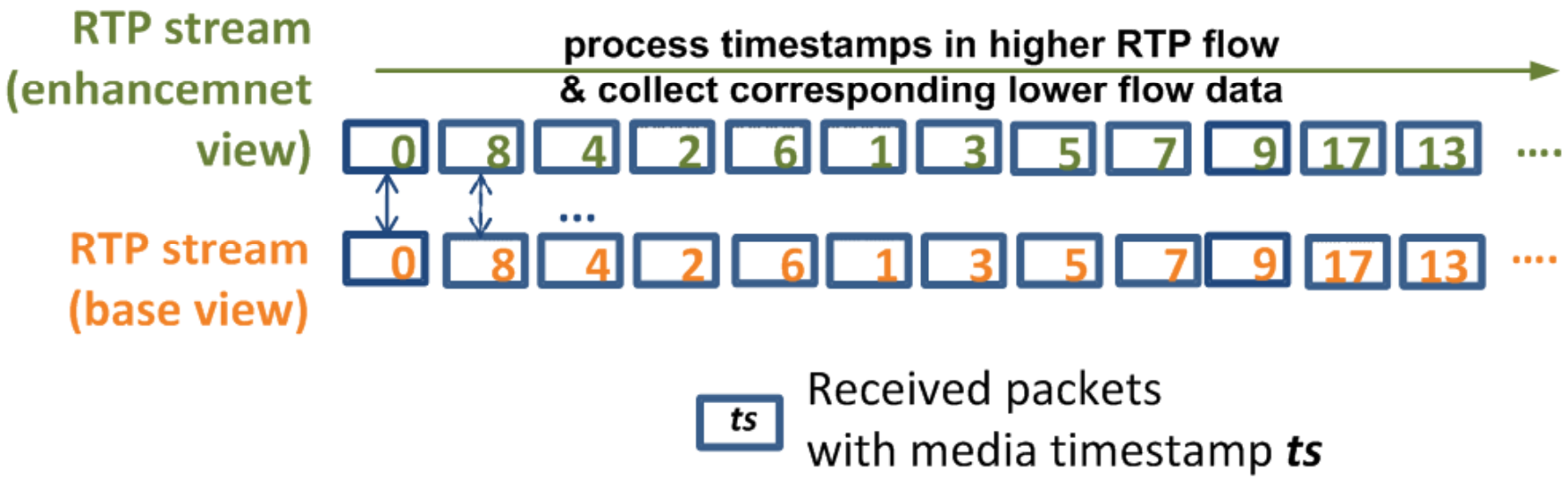
IP Transport – MVC over RTP (cont.)

- **MVC Multi Session Transmission – Media Packetization**
  - Views (Layers) are transported in different sessions



IP Transport – MVC over RTP (cont.)

- **RTP Multi Session Synchronization**
  - Different from Transport Stream
  - Synchronization based
    - on timestamps (presentation time)
    - and transmission order (decoding order)



Outlook – Fully scalable 3D Video

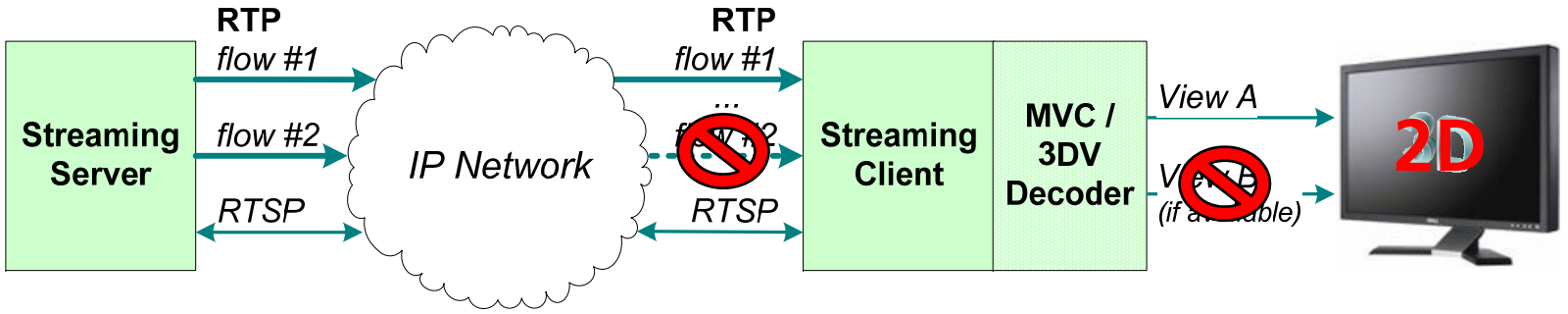
- **Scalable Multi View/3D Coding**
  - Scalability per View / Layer, e.g. SNR fidelity scalability
- **May be applied to depth and occlusion layers**
- **Combination of SVC and MVC**
  - Not possible due to high level syntax conflicts
- **May be part of a new 3D standard beyond MVC and 2D+D**
- **Needs further study!**
  - Unsolved problems in scaling vs. quality
  - Unsolved problems in transport

Outline

- **Adaptive 3D Multi-view Streaming**
  - Motivation: Varying Channel Conditions
  - Solution: Adaptive transport of 3D Video
  - Technology: 3D Transport (Example: H.264 MVC)
    - Broadcast transport
    - IP transport
  - Outlook: Fully scalable 3D

- **<u>Use cases: 3D Multi-view over</u>**
  - IPTV channels
  - Mobile Ad-hoc Networks
  - Mobile Broadcast Channels

View-scalable IPTV using MVC

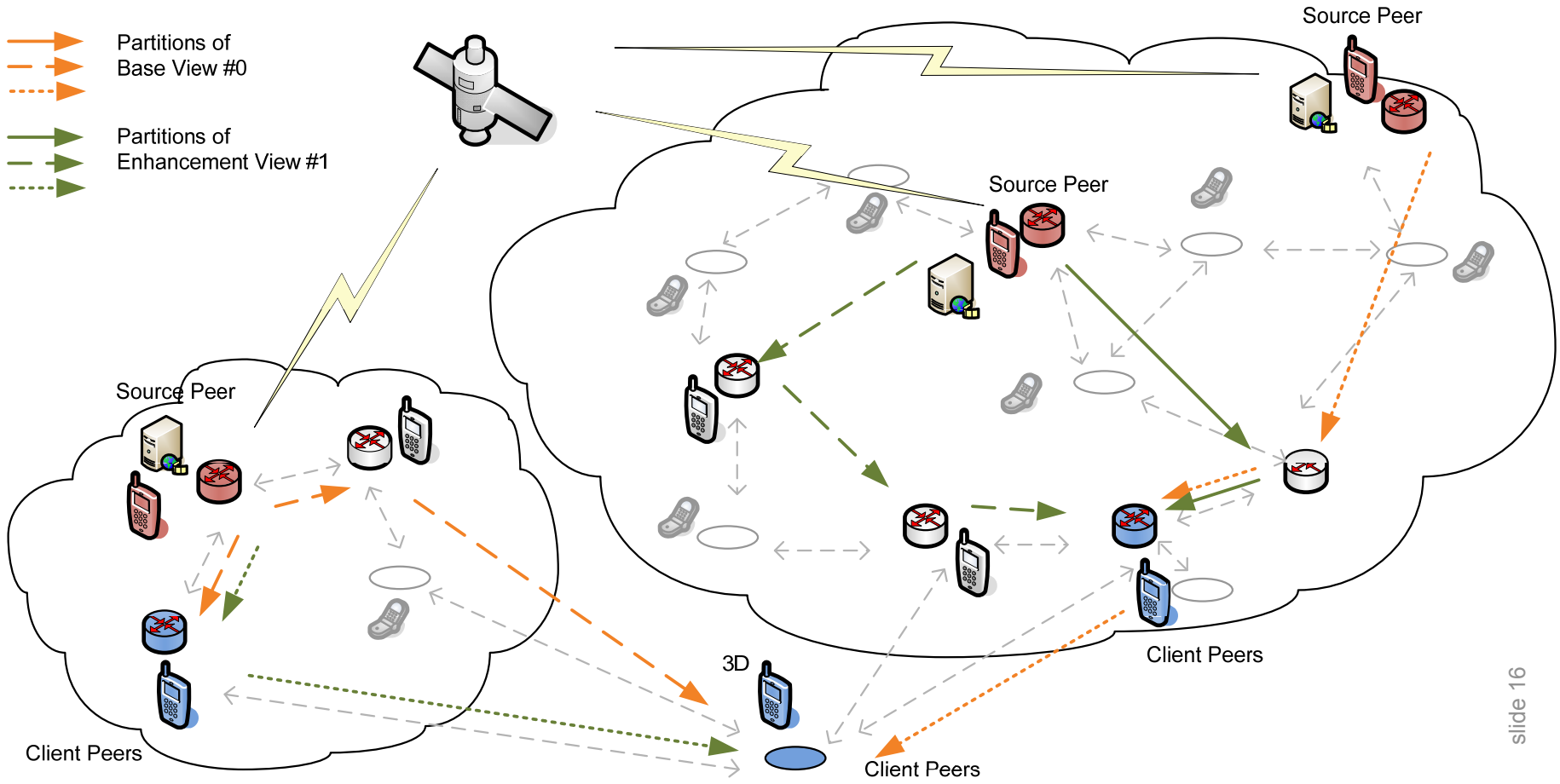


- **Two stereoscopic views in different network streams**
- **Using RTP Payload for MVC**
- **Dropping of 2nd network stream in case of congestion, e.g. at DSL Access, etc.**
- **Seamless switch to 2D rendering on display**

[*Schierl, Hellge, Mirta, George, Grüneberg***]**

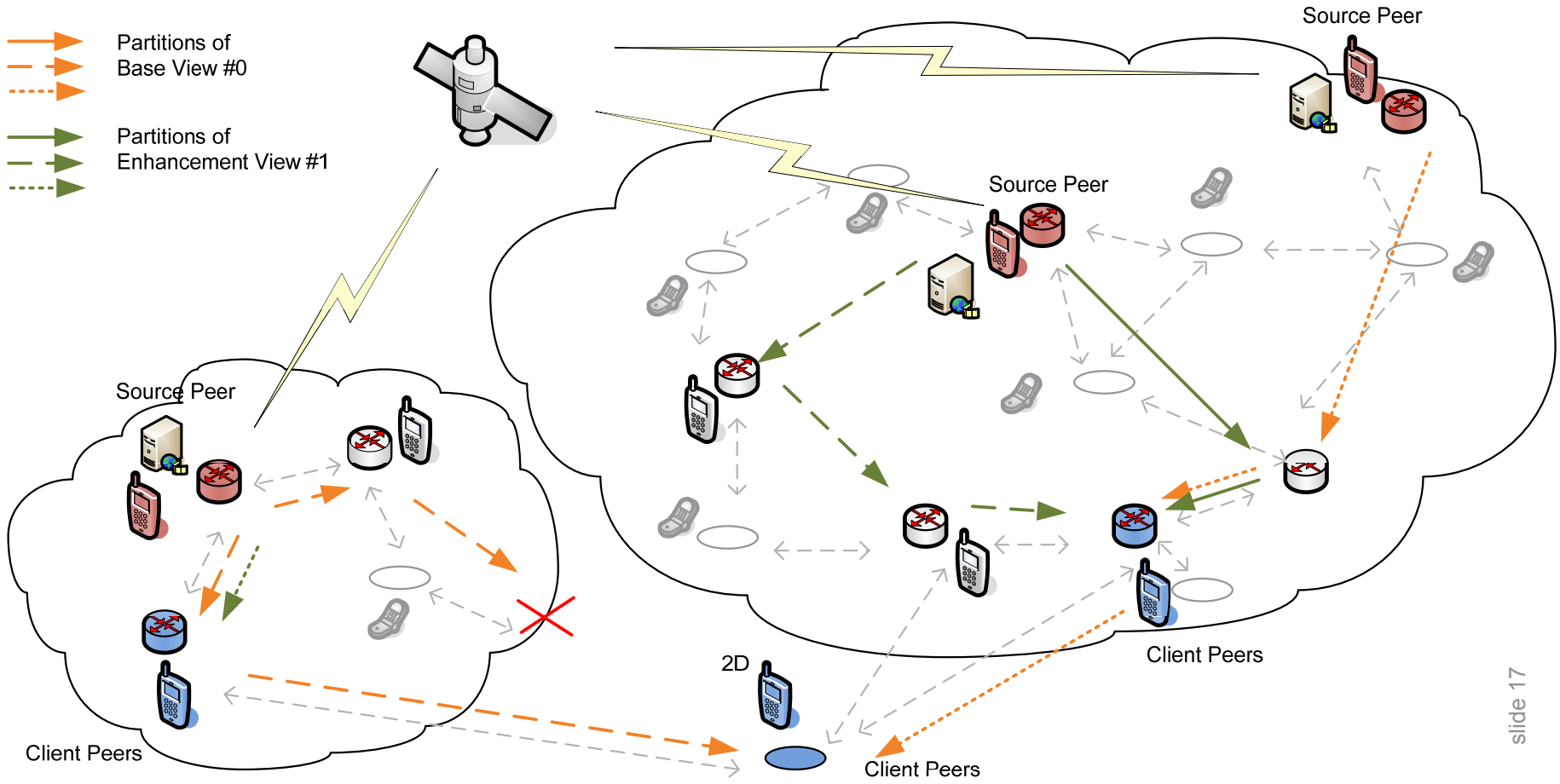
MVC over Mobile Ad hoc networks

- **Solution for route losses:** [*Schierl, Johansen, Hellge, Wiegand*]
  - Use of multiple sources
    + partitioned transport with rateless FEC



MVC over Mobile Ad hoc networks

- **Solution for route losses:** [*Schierl, Johansen, Hellge, Wiegand*]
  - Use of multiple sources
    + partitioned transport with rateless FEC



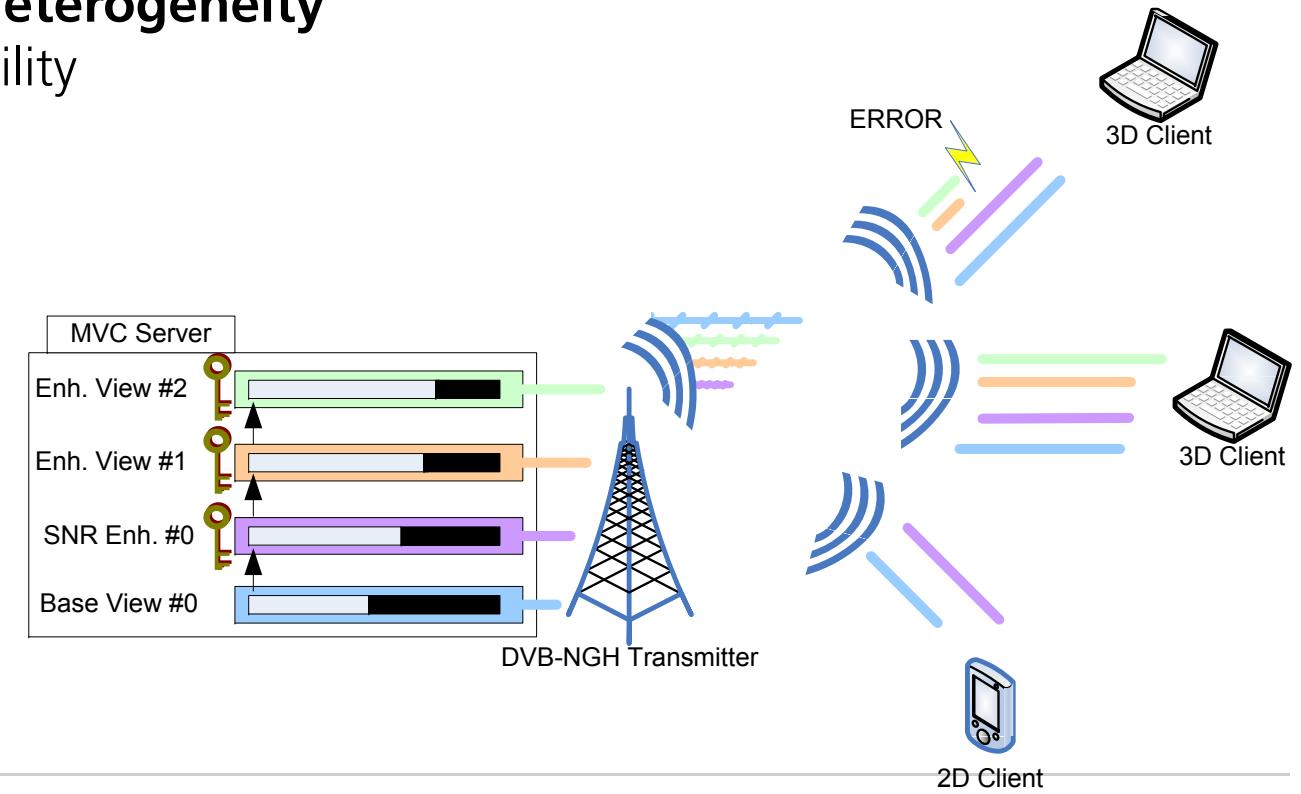
Mobile Broadcast Multi View

- **Layered Transmission**
  - may be included in DVB-NGH

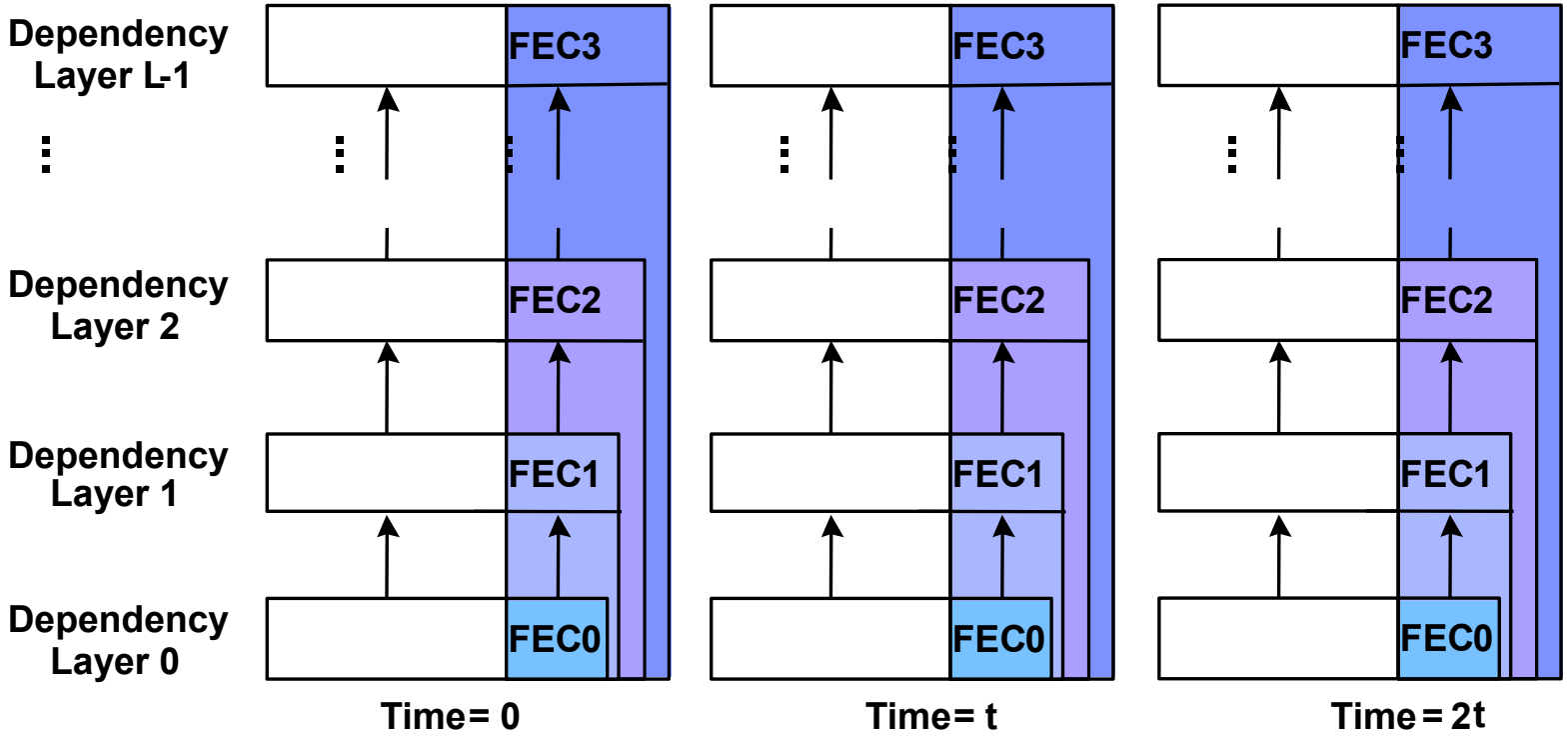
- **The approach:**
  - Combination of MVC and FEC following the media dependencies:

L-FEC *[Hellge, Schierl, Wiegand]*

- **Challenges: Heterogeneity**
  - Receiver capability
  - Channel state



Dependency structure – L-FEC



- **FEC generation follows the *dependencies* in the media**
  - Higher view/layer information is anyway useless, if a lower layer is lost
  - Allows independent decoding
  - Increases recovering probability for lower views/layers

Thanks for your attention!

Please visit also demonstration on
3D STREAMING

thomas.schierl@hhi.fraunhofer.de