

## MPEG Surround: Additional features and functionality

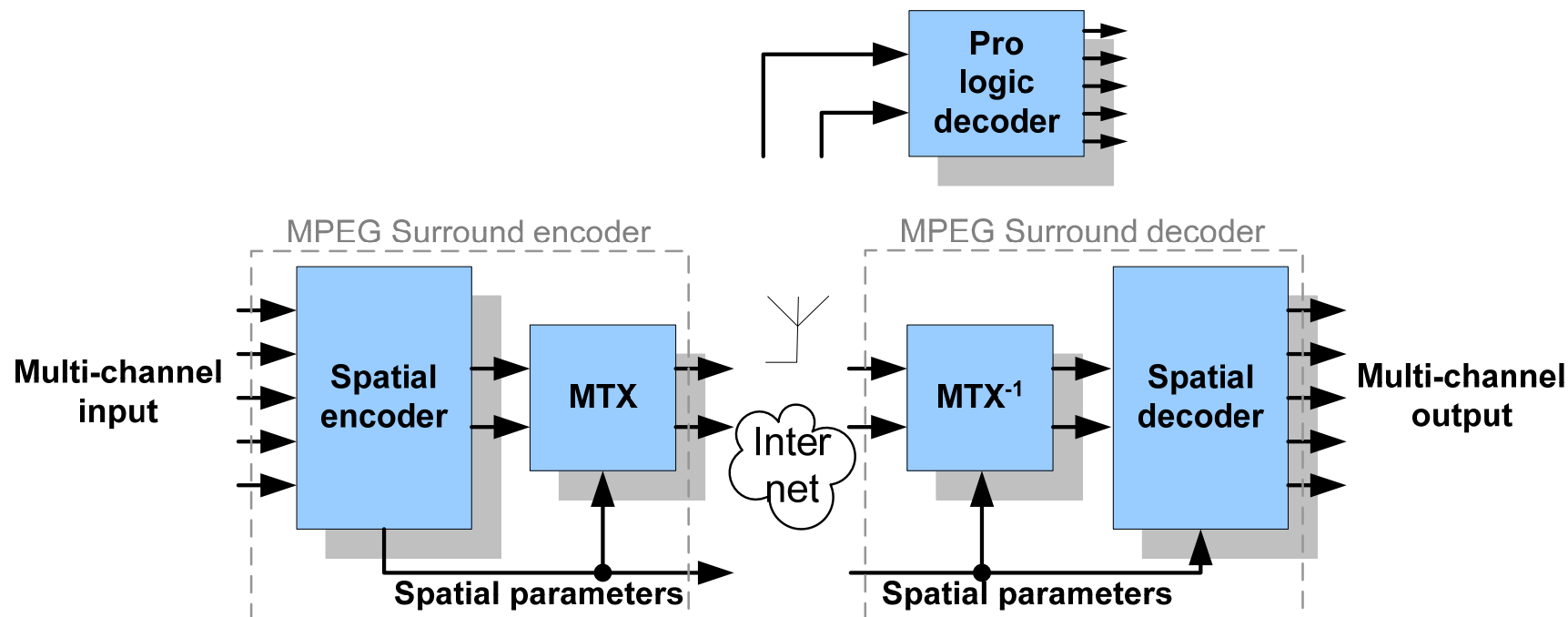
*Jeroen Breebaart, Philips Research, The Netherlands*  
121 AES convention, San Francisco, 2006

# Outline

- Down-mix features
  - Matrixed-surround compatibility
  - External down mix support
- Rendering features
  - Enhanced matrix mode
  - Binaural rendering

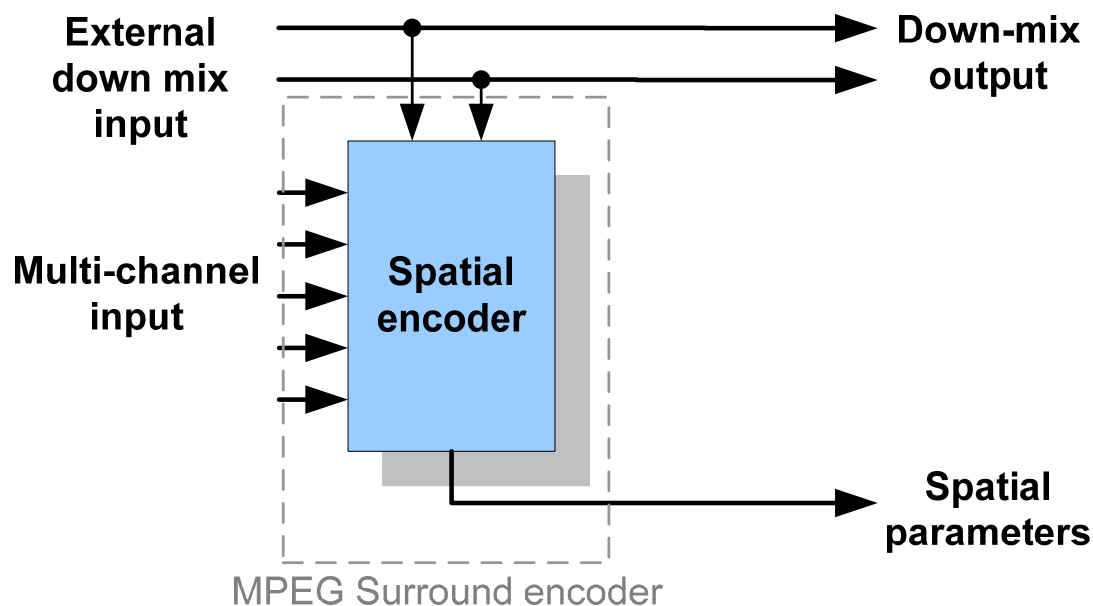
## Down-mix features ▶ *Matrixed surround compatibility*

- MPEG Surround features an automated down mix mode
  - Dynamic, signal-dependent process
  - Mono, stereo, 5.1 etc
  - Matrixed-surround compatible stereo



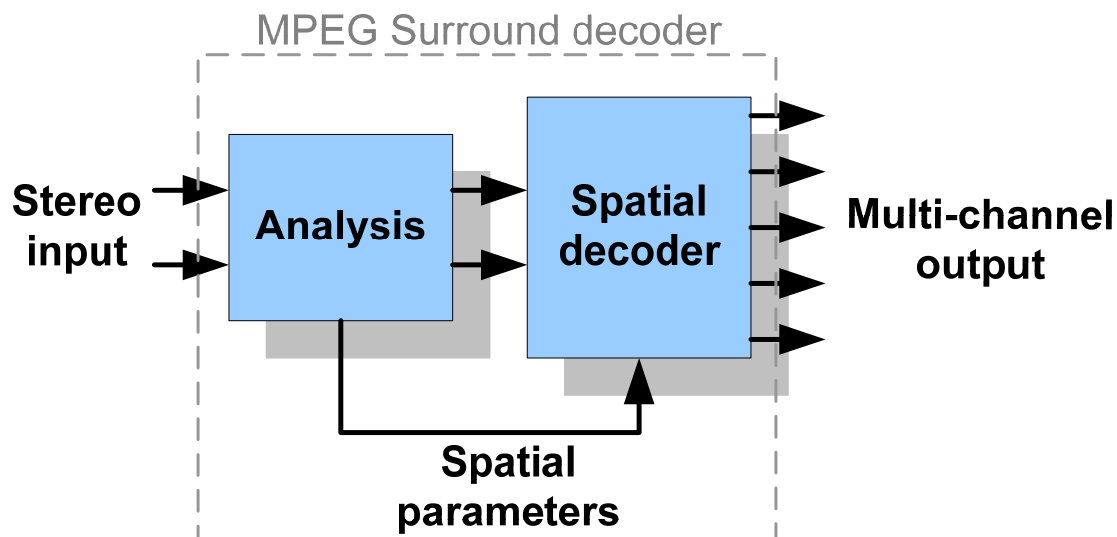
## Down-mix features ▶ *External down mix support*

- Support for externally provided down mix
  - Hand-crafted stereo and 5.1 mix by studio engineer
  - External stereo down mix transmitted by core coder



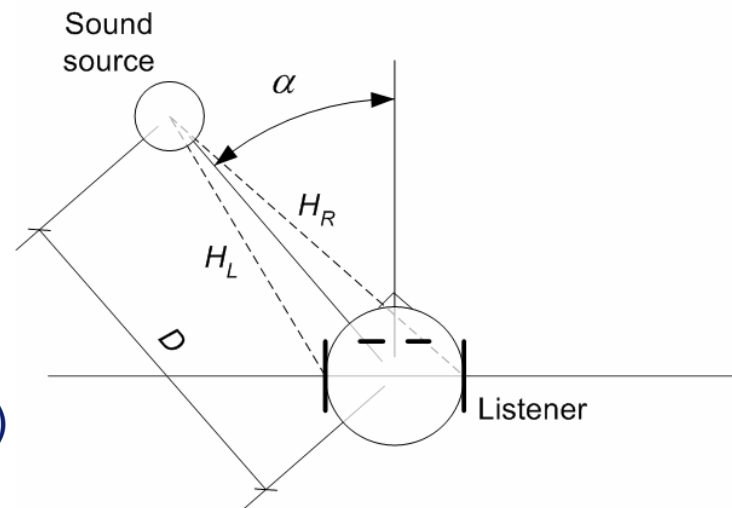
## Rendering features ▶ *Enhanced matrix mode*

- Up-mix of legacy stereo or matrixed-surround stereo to multi-channel
  - Parameters estimated from transmitted down mix
  - Decoding by standard MPEG Surround spatial decoder



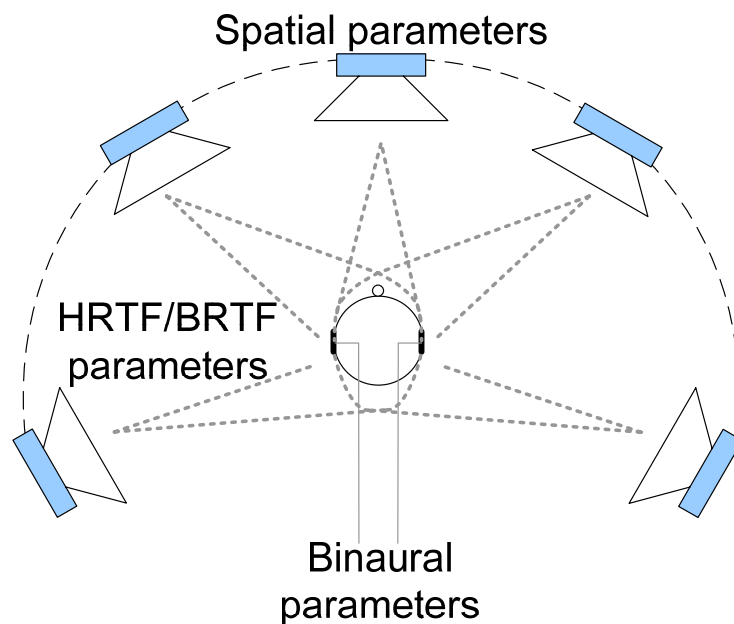
## Rendering features ▶ *Binaural rendering*

- 3D/binaural rendering for headphones
- Evoke a multi-channel experience on legacy stereo headphones
- Conventional methods for 3D/binaural:
  - Multi-channel decoding
  - 3D synthesis of each channel by means of convolution with a pair of Binaural Room Transfer Functions (BRTFs)
  - Not feasible on mobile platform



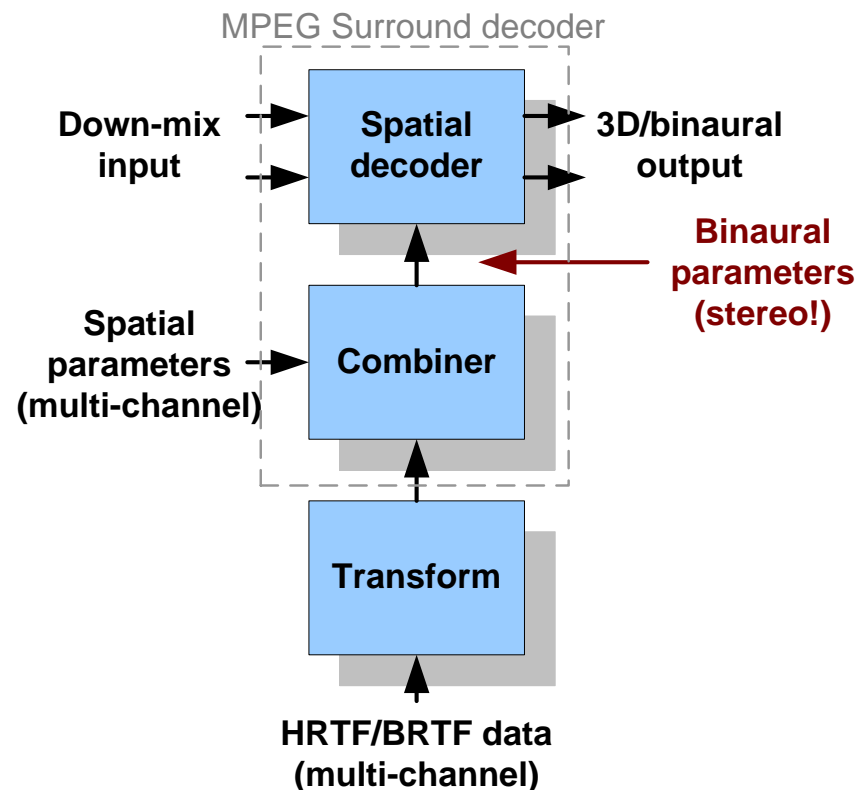
## Rendering features ▶ *Binaural rendering*

- MPEG Surround solution:
  - HRTFs/BRTFs transferred to the *parameter* domain
  - Estimate 'binaural' parameters as the combined effect of spatial decoding *and* BRTF convolution



## Rendering features ▶ *Binaural rendering*

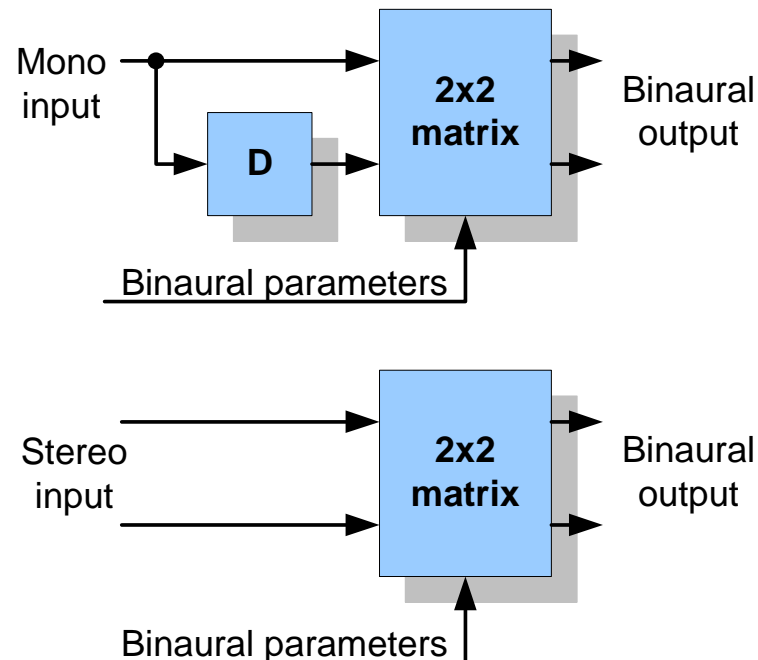
- MPEG Surround solution:
  - HRTFs/BRTFs transferred to the *parameter* domain
  - Estimate ‘binaural’ parameters as the combined effect of spatial decoding *and* BRTF convolution
  - Binaural parameters defined in *down-mix* domain
  - Complexity largely independent of number of virtual audio channels
  - HRTF/BRTF data customizable by consumer or manufacturer





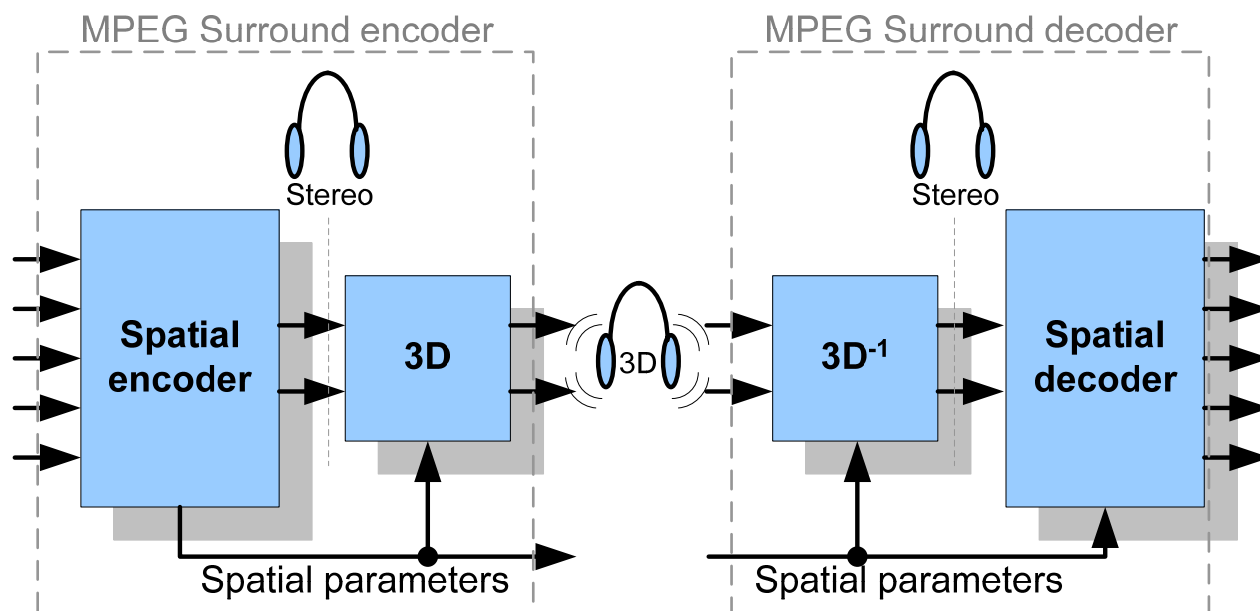
## Rendering features ▶ *Binaural rendering*

- MPEG Surround solution:
  - 3D/binaural synthesis without multi-channel as intermediate step
  - Synthesis step only comprises a 2x2 matrix
  - Low complexity and high-quality modes
  - High-quality mode extends 2x2 matrix in time direction
  - Significant complexity reduction compared to conventional methods
  - Subjective quality better than HRTF/BRIR convolution applied on 5.1 output



## Rendering features ▶ *Binaural rendering*

- MPEG Surround solution:
  - 2x2 matrix can also be applied at *encoder* side
  - Backwards-compatible 3D/binaural mode
  - Decoder-side *inversion* to ensure maximum quality for loudspeaker playback



## Conclusion

### MPEG Surround:

*“One codec fits all”*



