

マルチメディア配信システム

- No.12 同期・多重化 -

渡辺 裕

Multimedia Distribution System

- No.12 Synchronization and Multiplexing -

Hiroshi Watanabe

システム化技術

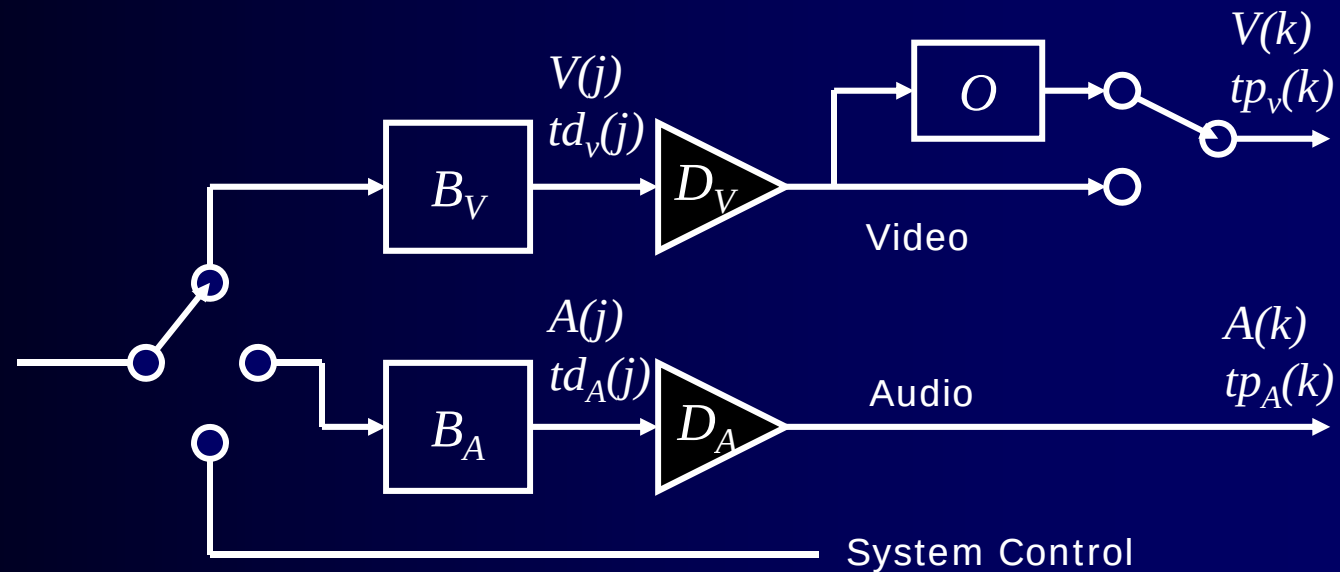
- 同期
- 多重
- バッファ制御
- 遅延制御
- スケーラビリティ
- シーン合成

Technology for System

- Synchronization
- Multiplexing
- Buffer Control
- Delay Control
- Scalability
- Scene Composition

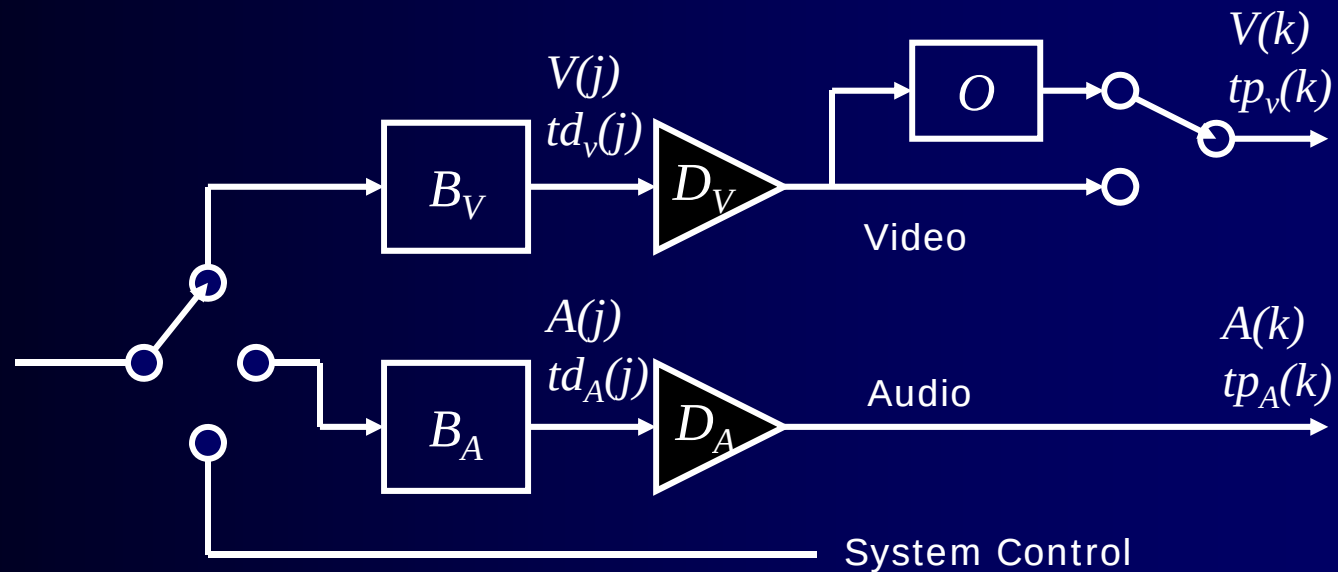
デコーダモデル

- **STD** モデル (System Target Decoder)
 - 複数の Elementary Stream (符号化データ) の分解
 - それぞれのデータのビットレート、復号タイミング、表示タイミングを複数のデコーダに伝える



Decoder Model

- **STD Model** (System Target Decoder)
 - Decompose of Elementary Stream (coded data)
 - Inform bitrate, decoding and presentation time stamp to each decoder



同期

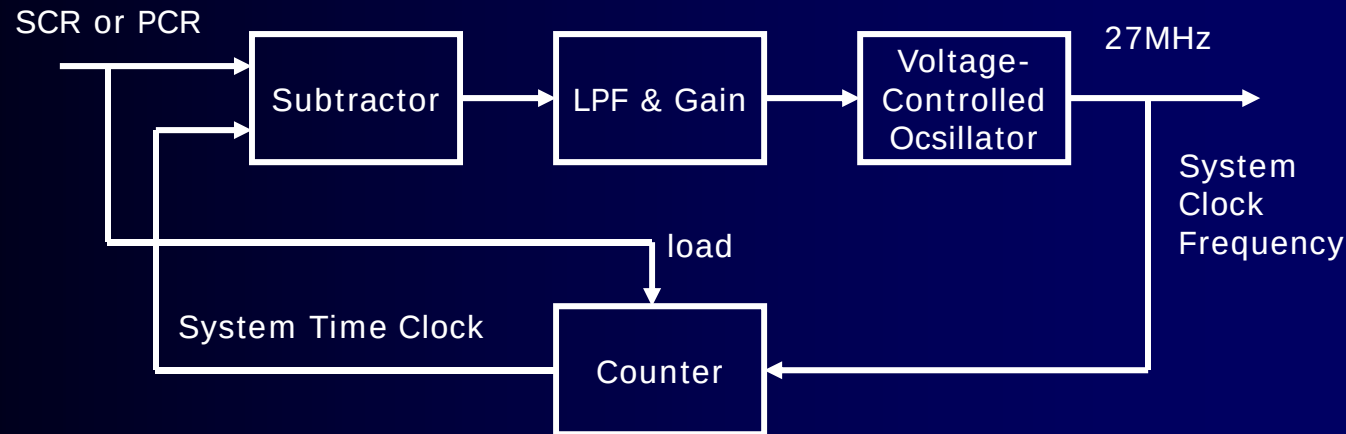
- 共通クロックの設定
 - Video, Audio の両方のクロックをもとに、許容範囲を設定
 - **STC** (System Time Clock) を Clock Reference データを用いて PLL (Phase-Locked Loop) により補正
- **PTS** (Presentation Time Stamp)
 - 表示/再生タイミングを示すデータ
 - STC により駆動
- **DTS** (Decoding Time Stamp)
 - 復号タイミングを示すデータ
 - STC により駆動

Synchronization

- Common Clock
 - Based on video and audio clock, define tolerance
 - Correct **STC** (System Time Clock) by PLL (Phase-Locked Loop) using clock reference data
- **PTS** (Presentation Time Stamp)
 - Data indicating presentation/replay timing
 - Drive by STC
- **DTS** (Decoding Time Stamp)
 - Data indicating decoding timing
 - Drive by STC

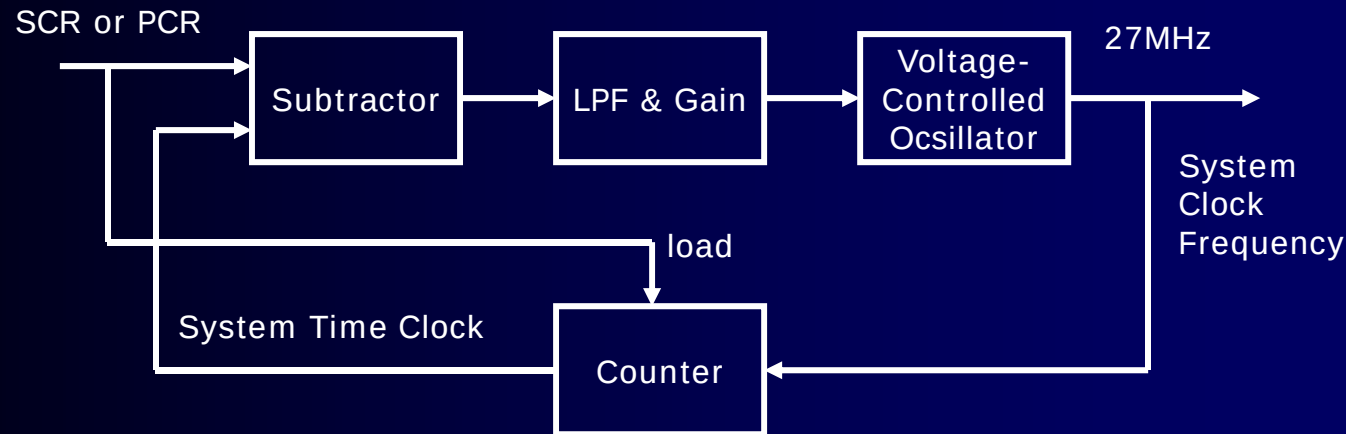
同期(2)

- **SCR** (System Clock Reference... in Program Stream),
PCR (Program Clock Reference... in Transport Stream)
 - System clock frequency を修正するために用いる



Synchronization(2)

- **SCR** (System Clock Reference... in Program Stream),
PCR (Program Clock Reference... in Transport Stream)
 - For correction of System clock frequency



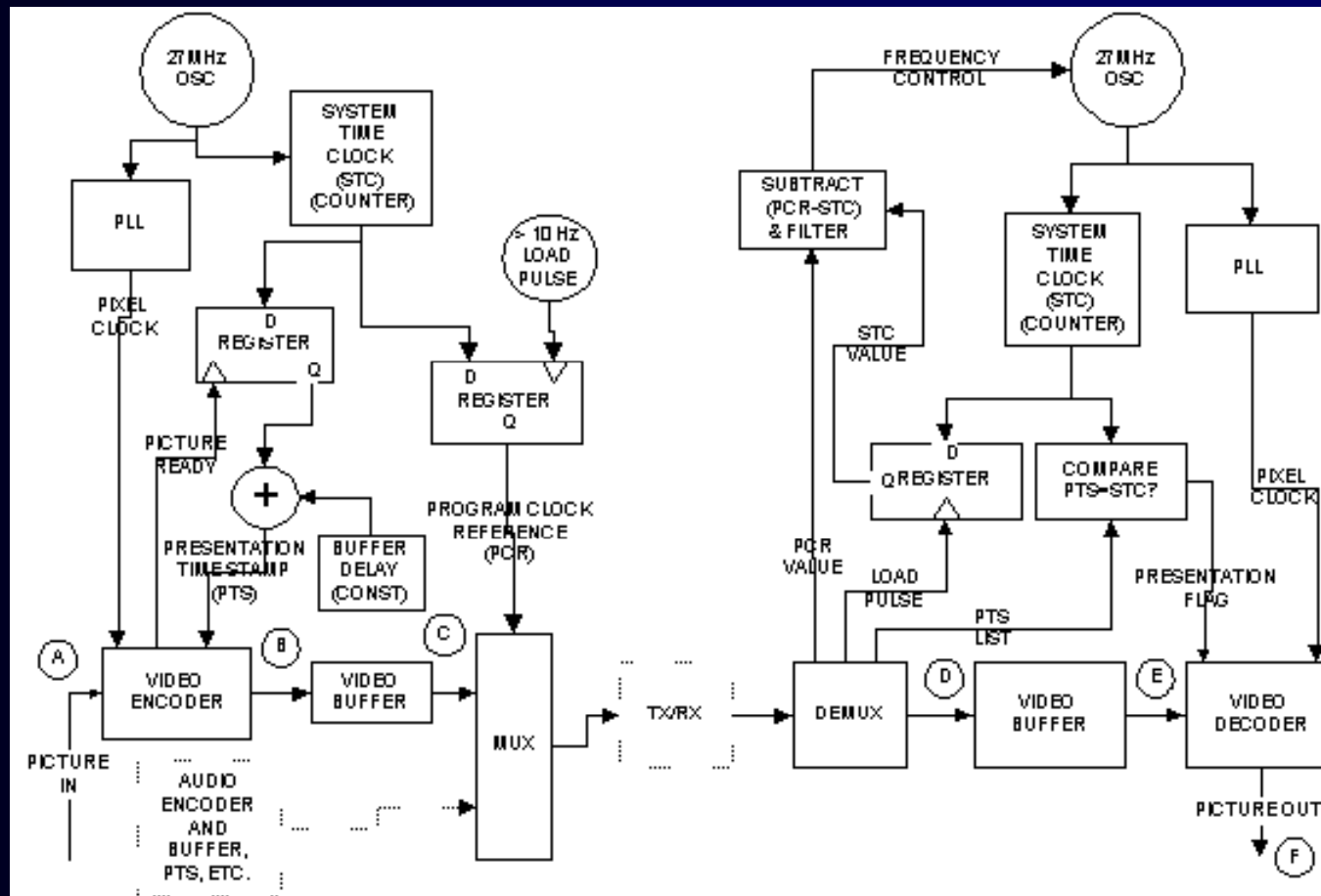
同期(3)

- Transport Stream では複数の Elementary Stream を伝送する場合があります、System全体ではなく、Program ごとに Clock Reference を与える場合があるため、“System Clock Reference”ではなく“Program Clock Reference”を使用する

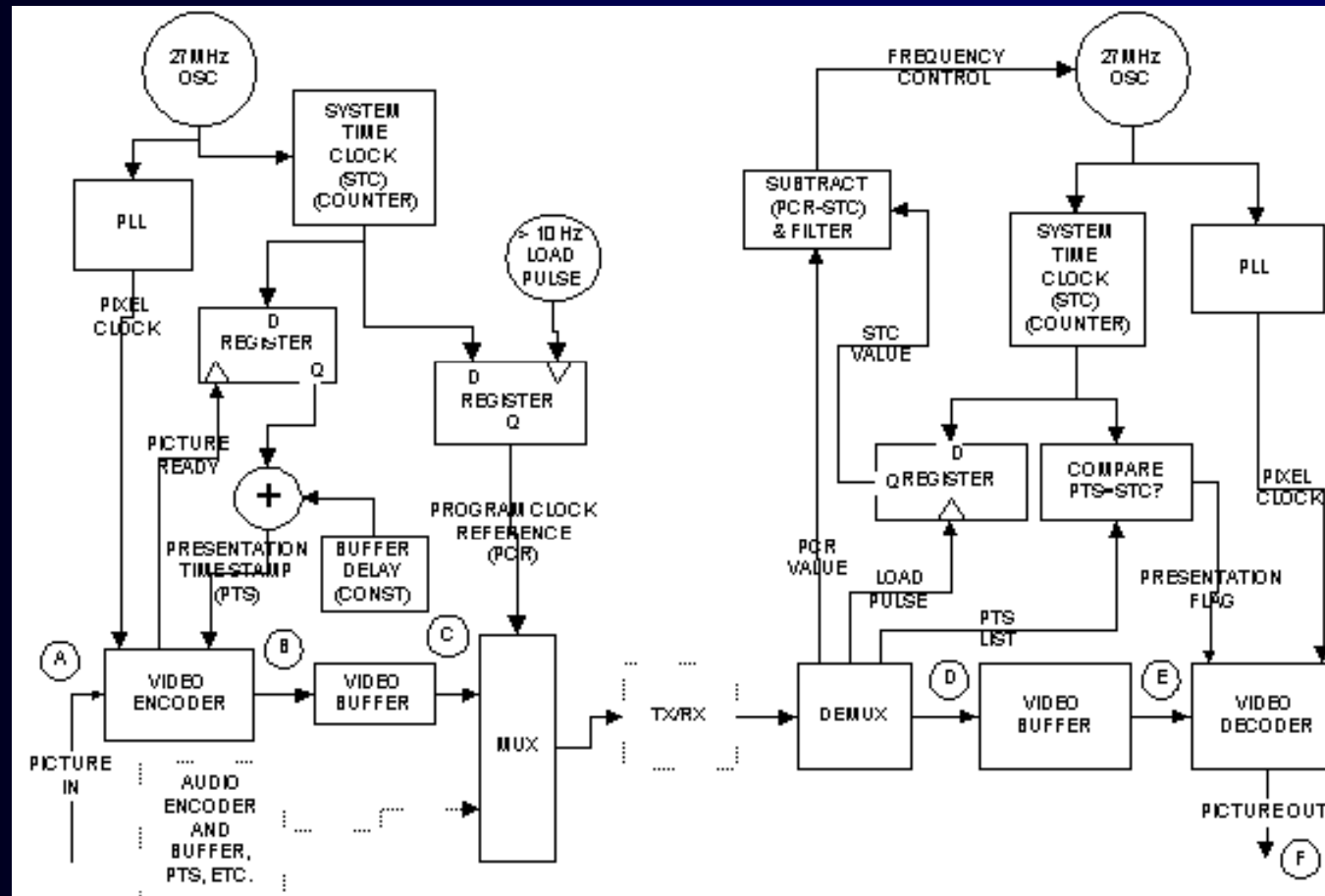
Synchronization(3)

- For transport stream, multiple elementary streams may be transmitted. In this case, it is required to provide clock reference to each program, not to entire system. Thus, “Program Clock Reference” is used instead of “System Clock Reference.”

同期 (4)

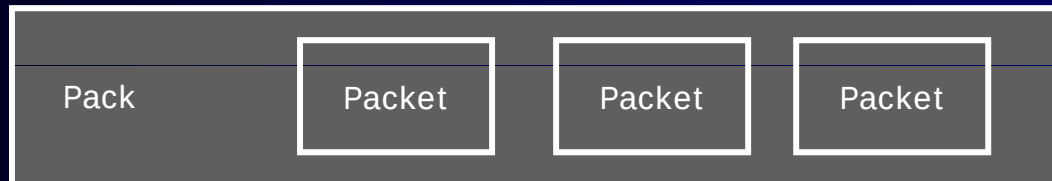


Synchronization (4)



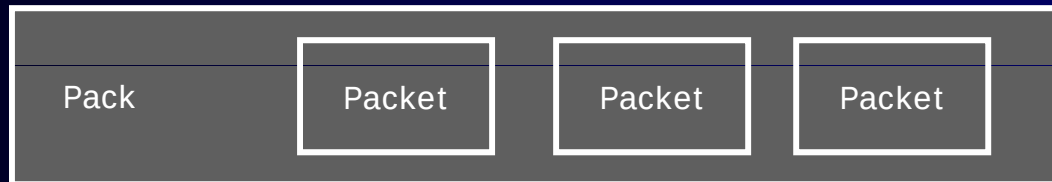
多重化

- Packet
 - Video Packet, Audio Packetなど
 - 固有のビットレート、ストリームID、表示タイミング、復号タイミングを持つ
- Pack
 - 複数の Video, Audio が多重化された状態での最大ビットレートを指定
 - Video Bitstream 数、Audio Bitstream 数などを指定



Multiplexing

- Packet
 - Video Packet, Audio Packet
 - Specific bitrate, stream ID, presentation time stamp, decoding time stamp
- Pack
 - Specify the maximum bitrate for multiplexed video and audio
 - Specify the number of video and audio bitstream

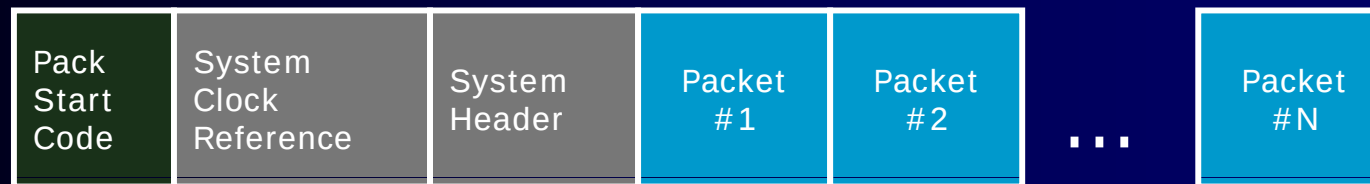


多重化(2)

■ System Layer の構成



■ Pack Layer の構成

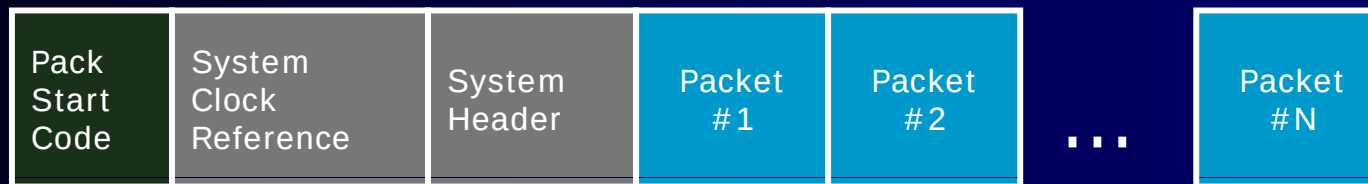


Multiplexing(2)

■ System Layer Structure

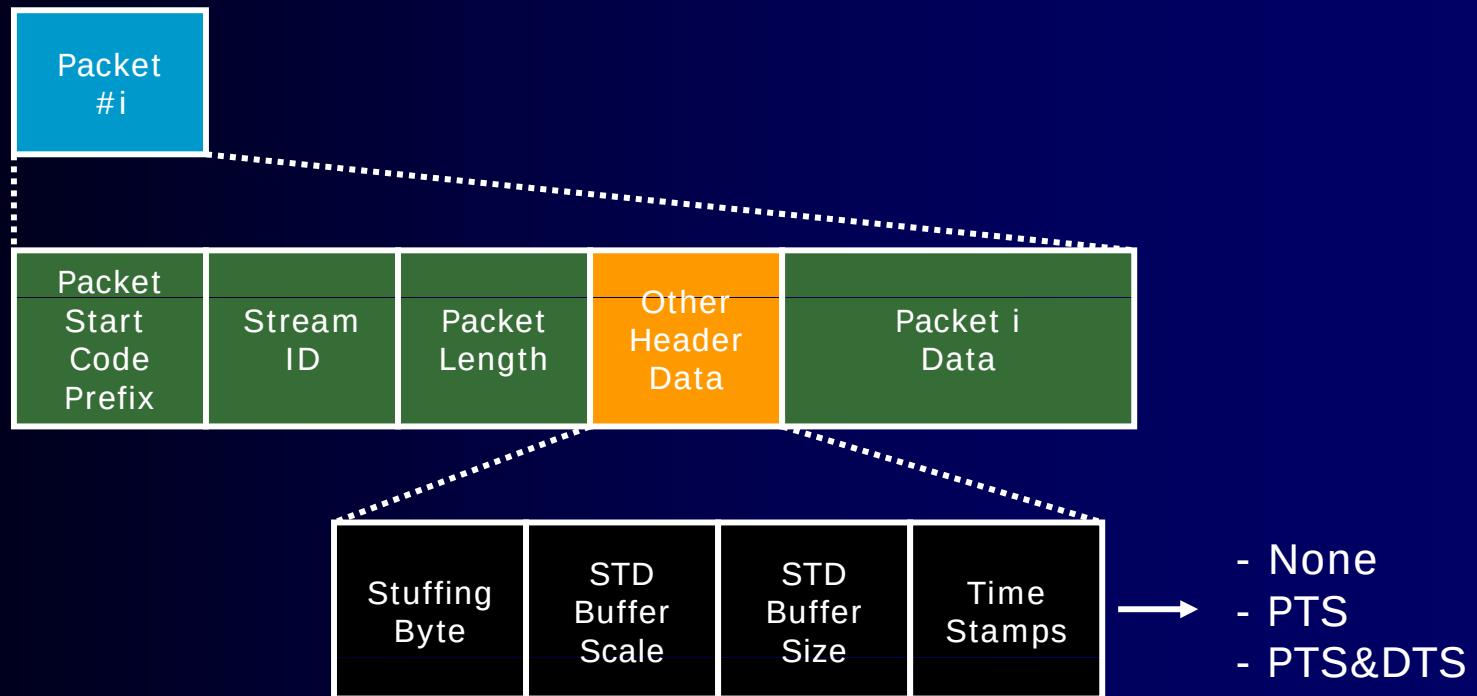


■ Pack Layer Structure



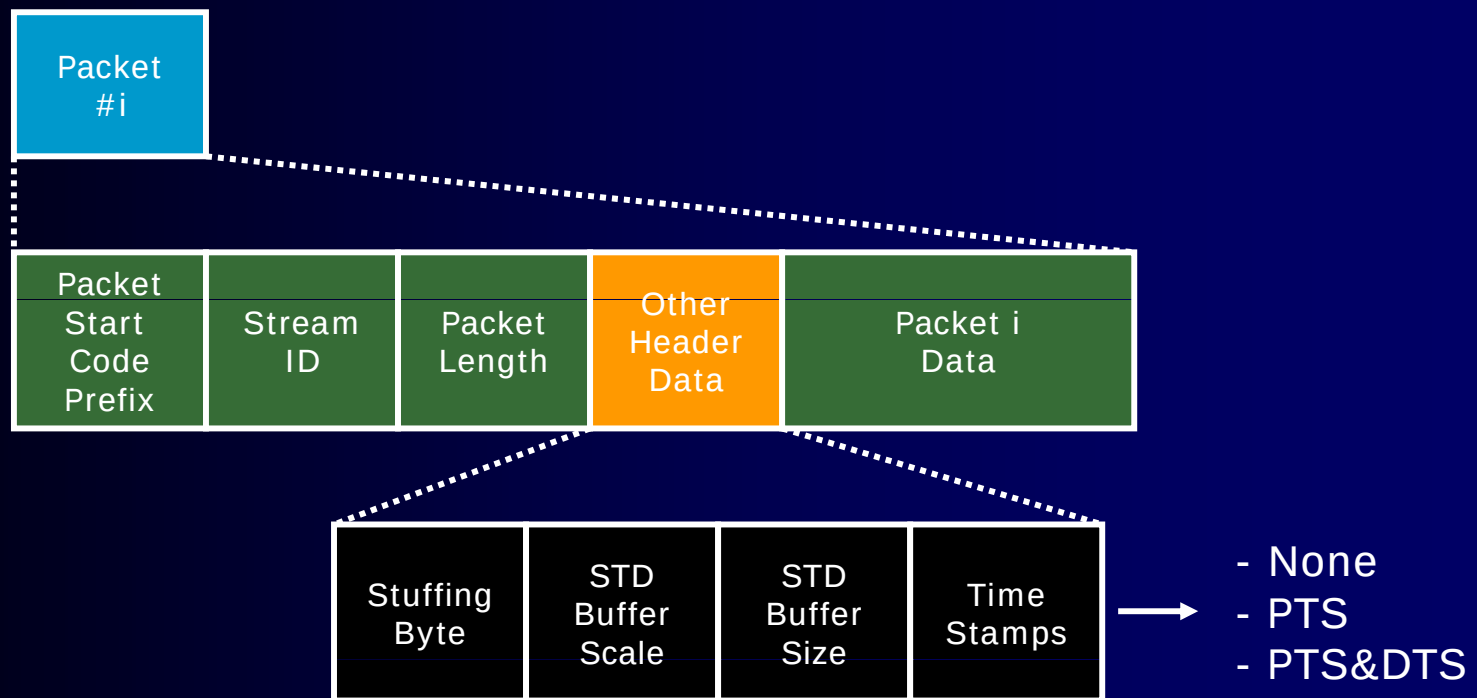
多重化(3)

■ Packet Layer の構成



Multiplexing(3)

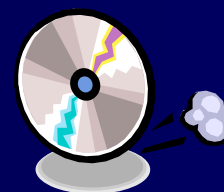
■ Packet Layer Structure



PSとTS

■ PS (Program Stream)

- 蓄積メディア用の Audio/Visual 多重化ストリーム
- 複数の **PES Packet** (Packetized Elementary Stream) からなる Pack に Pack Header を付加
- 異なったサイズの PES Packet を処理



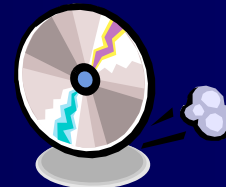
■ TS (Transport Stream)

- 通信、放送メディア用の Audio/Visual 多重化ストリーム
- Header と Payload からなる(188byte)
- Payload は PES Packet を分割したもの
- 低遅延



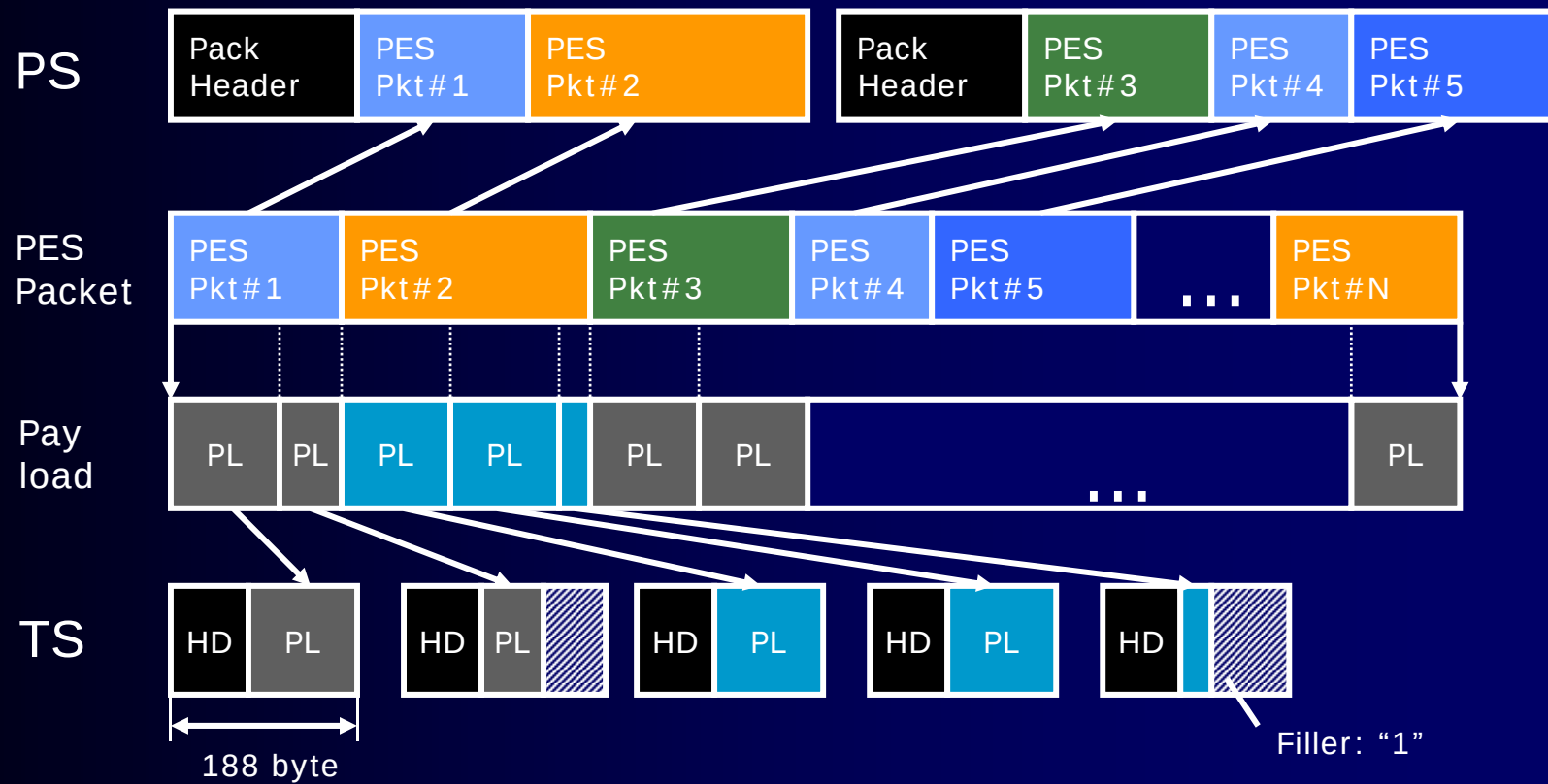
PS and TS

- **PS** (Program Stream)
 - Audio/Visual multiplexed stream for storage media
 - Pack, which consists of multiple **PES Packets** (Packetized Elementary Stream), added by Pack Header
 - Process different size of PES Packet
- **TS** (Transport Stream)
 - Audio/Visual multiplexed stream for communication and broadcasting
 - TS consists of Header and Payload (188byte)
 - Payload is a segment of PES Packet
 - Low delay



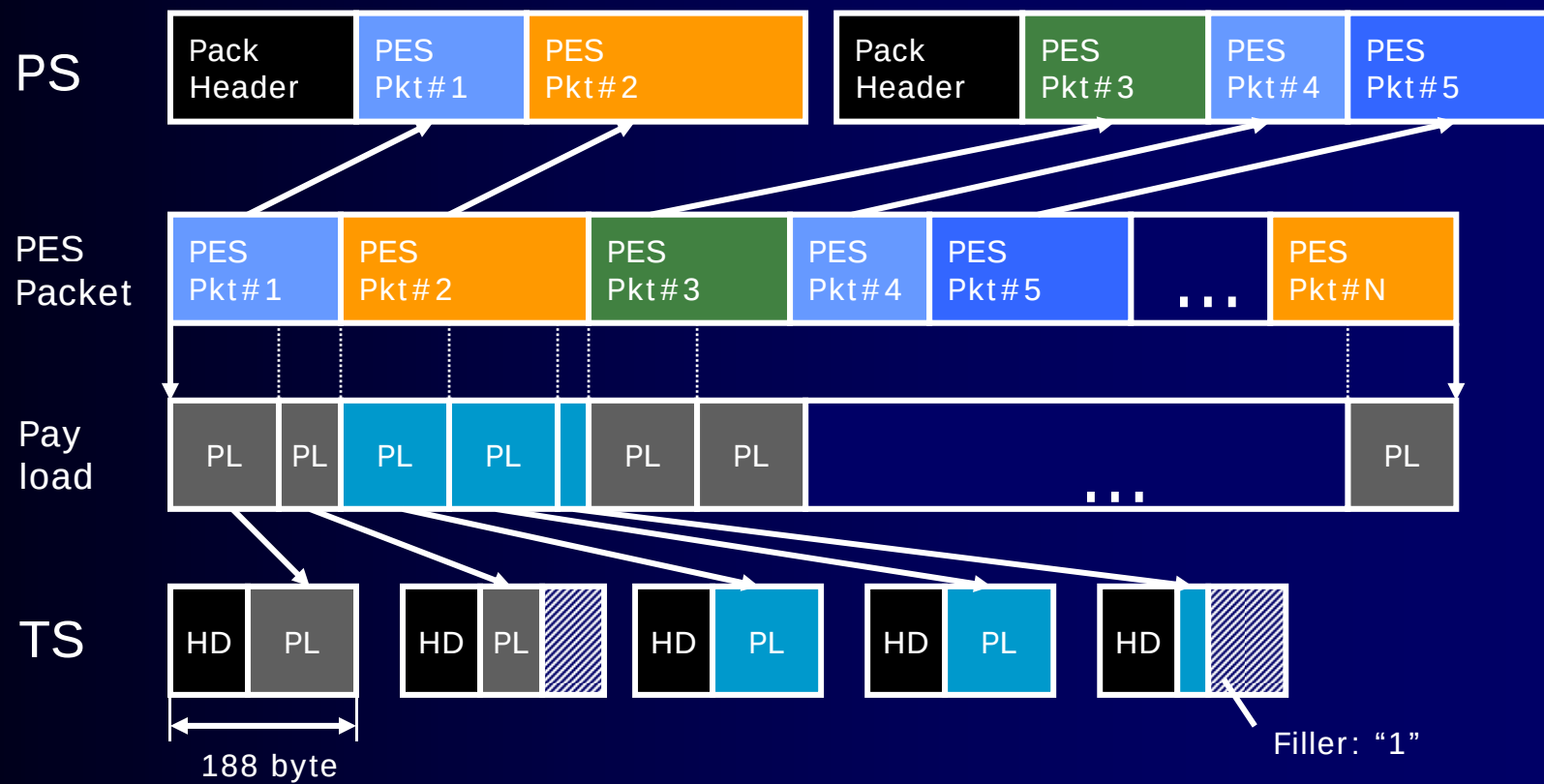
PSとTS (2)

■ ストリームの構成

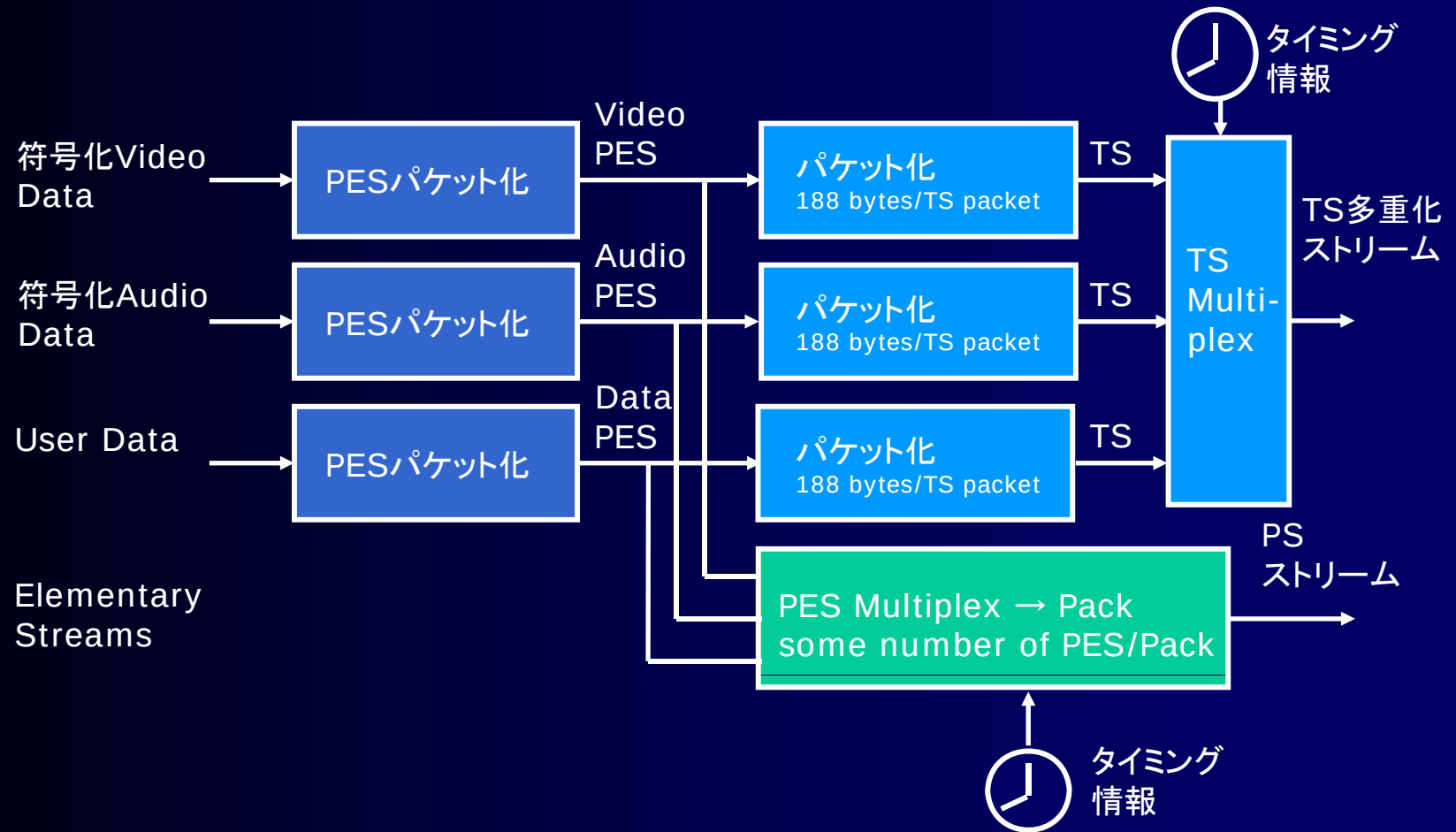


PS and TS (2)

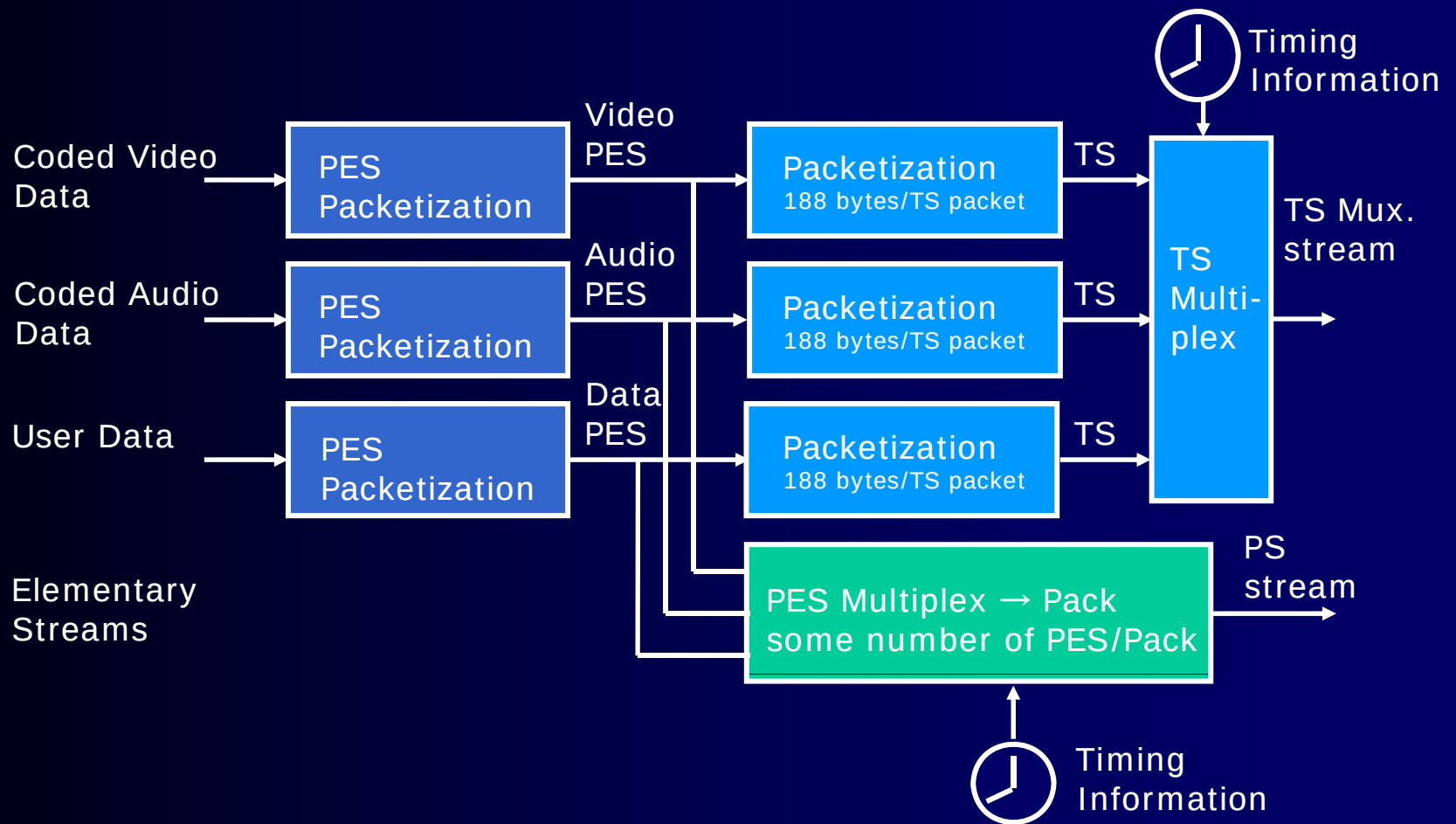
■ Stream structure



PSとTS (3)

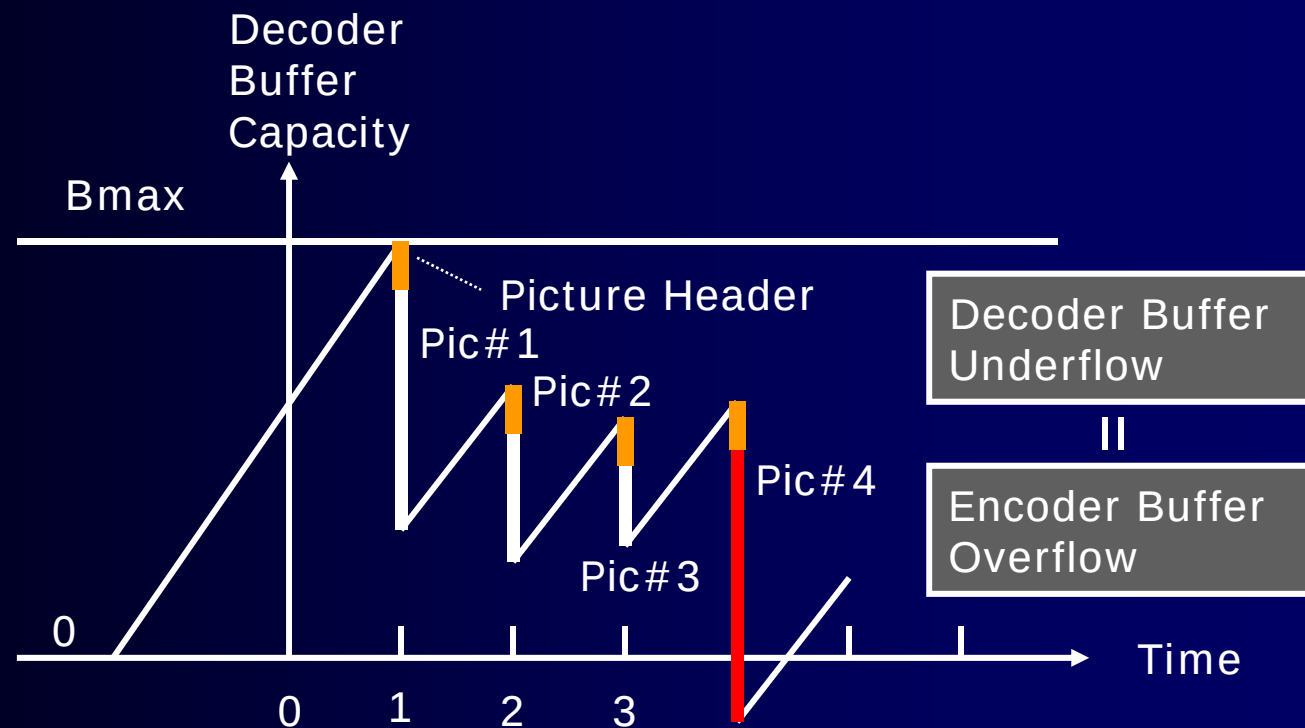


PS and TS(3)



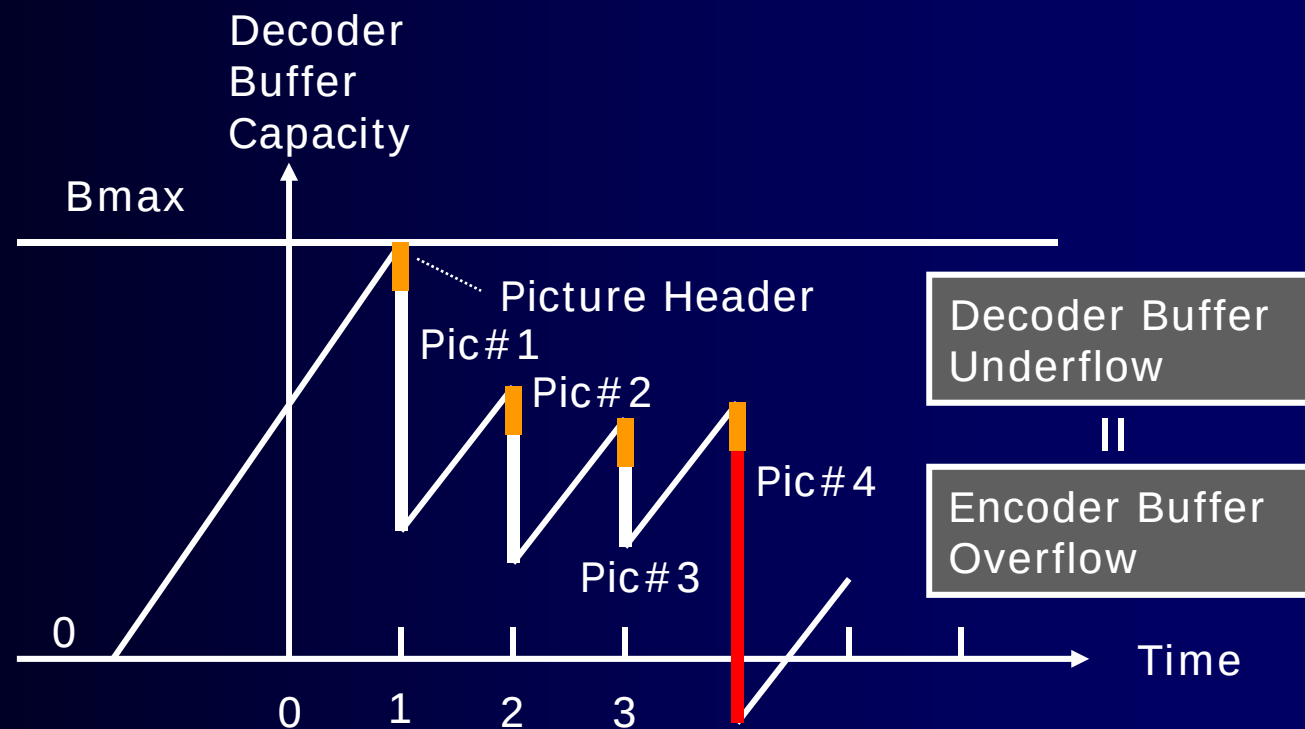
バッファ制御

■ VBV (Video Buffer Verifier)



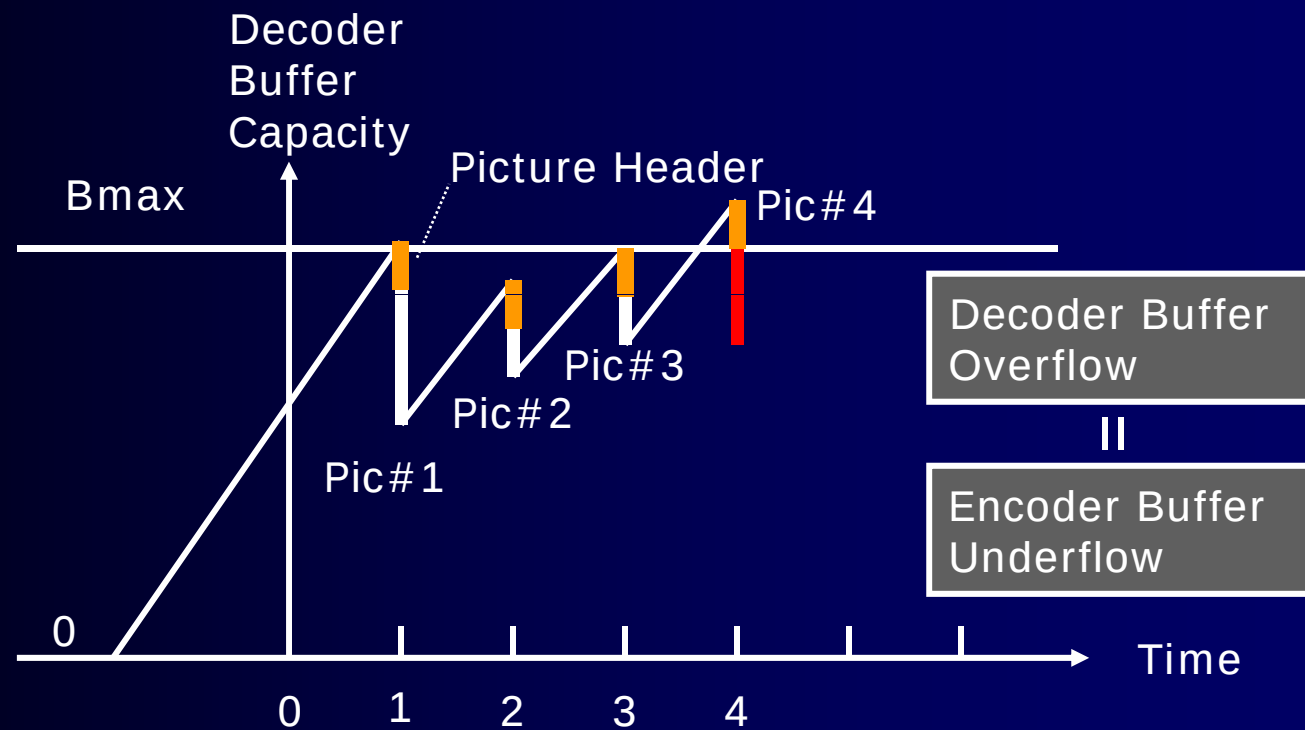
Buffer Control

- VBV (Video Buffer Verifier)



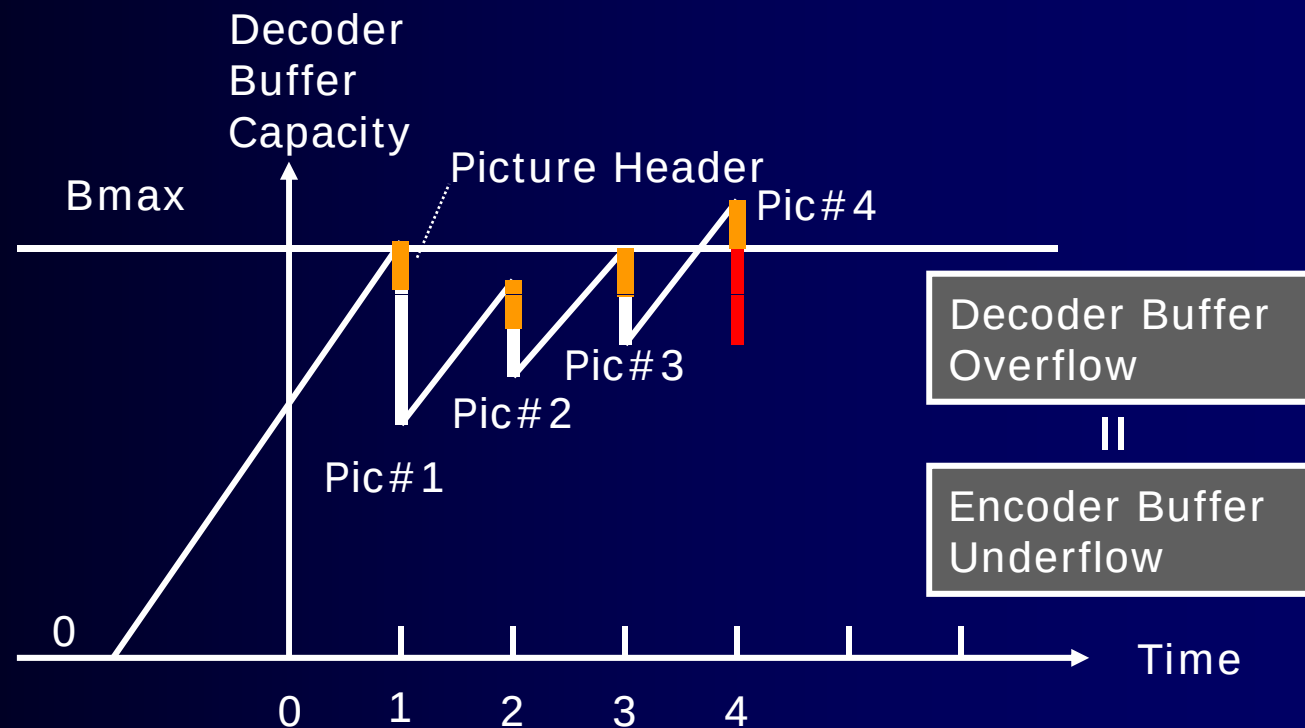
バッファ制御 (2)

■ VBV (Video Buffer Verifier)



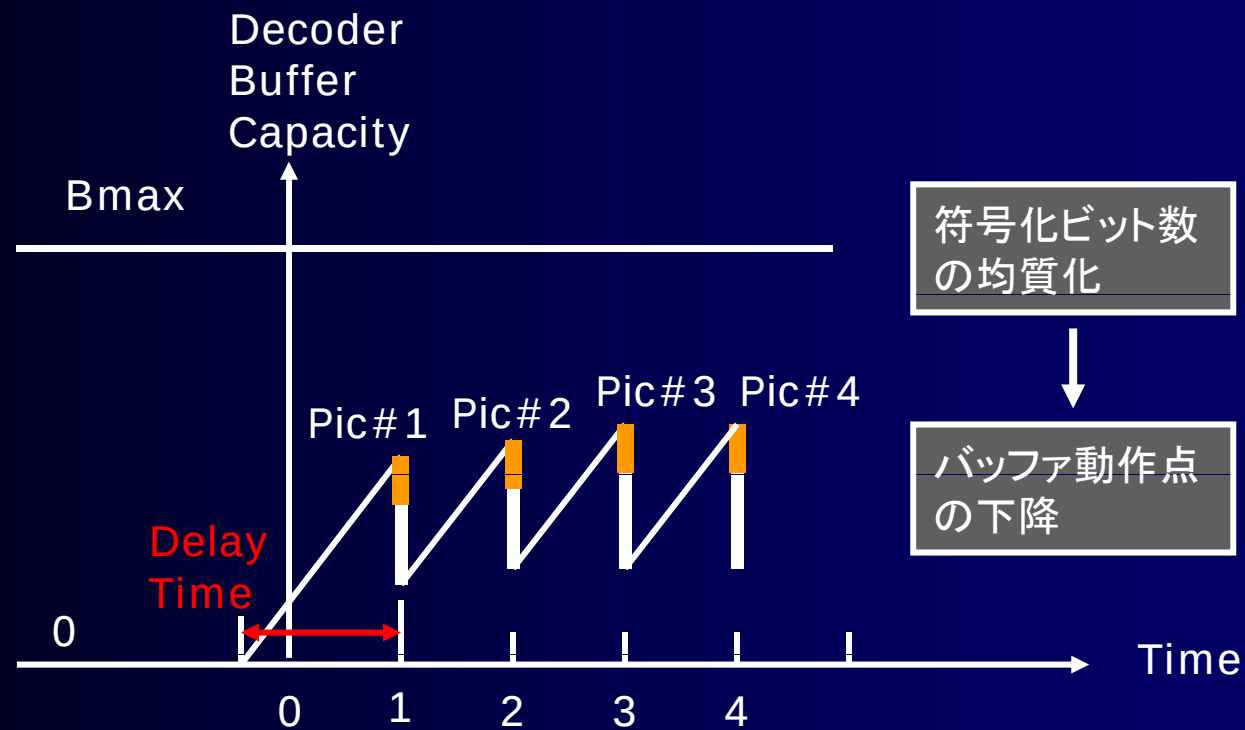
Buffer Control (2)

- VBV (Video Buffer Verifier)



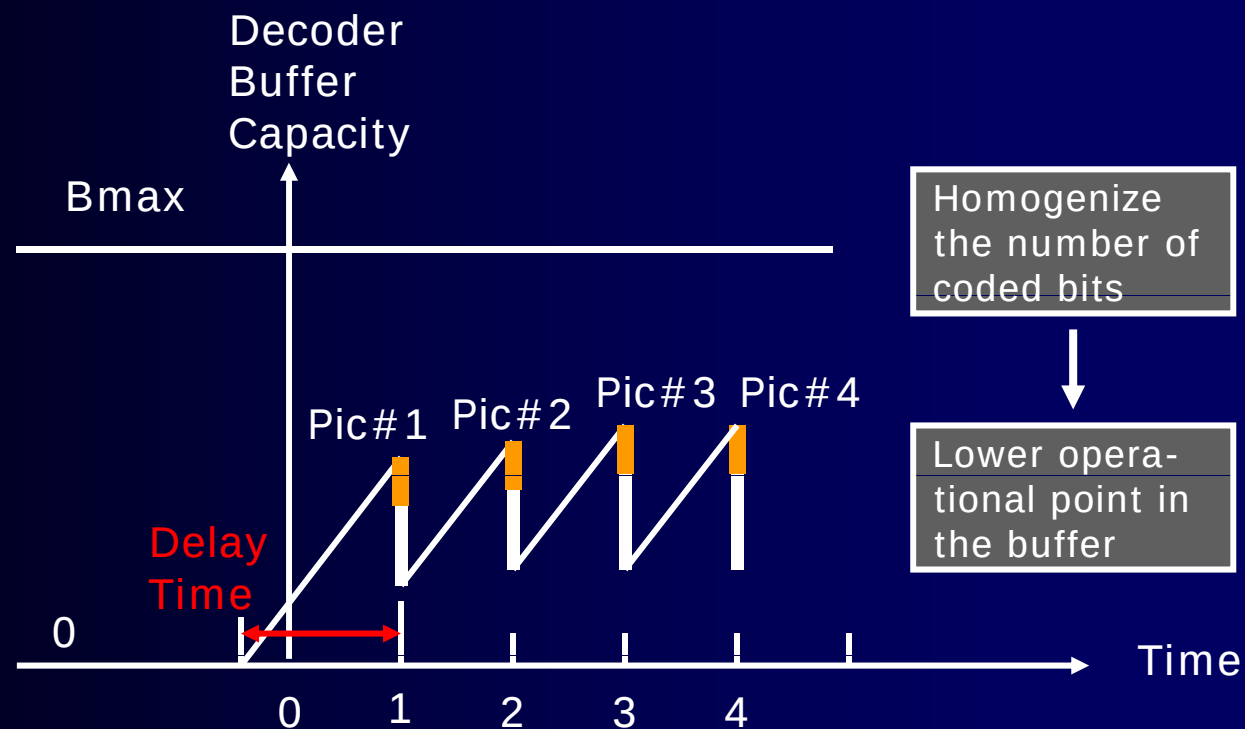
遅延制御

■ 低遅延符号化におけるVBV



Delay Control

- VBV at low delay mode



Playback制御

- DVD Region Code
 1. U.S., Canada, U.S. Territories
 2. Japan, Europe, South Africa, and Middle East (including Egypt)
 3. Southeast Asia and East Asia (including Hong Kong)
 4. Australia, New Zealand, Pacific Islands, Central America, Mexico, South America, and the Caribbean
 5. Eastern Europe (Former Soviet Union), Indian subcontinent, Africa, North Korea, and Mongolia
 6. China
 7. Reserved
 8. Special international venues (airplanes, cruise ships, etc.)

Playback Control

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Copy Protection

- DVD Copy Protection
 - Analog CPS (Macrovision)
 - Modulated color burst, AGCのレベル変動を引き起こす
 - CGMS
 - “serial” copy generation management system
 - Line 21にデータ埋め込み
 - **CSS** (Content Scrambling System)
 - data encryption and authentication scheme
 - deCSSに対して係争中 (LinuxによるPlayback問題)
 - Digital Copy Protection System (DCPS)
 - DTCP, 5C, XCA ... : flag and key system

Copy Protection

- DVD Copy Protection
 - Analog CPS (Macrovision)
 - Modulated color burst, cause AGC level change
 - CGMS
 - “serial” copy generation management system
 - date insertion to “Line 21”
 - **CSS** (Content Scrambling System)
 - data encryption and authentication scheme
 - law suit to deCSS (playback issue at Linux)
 - Digital Copy Protection System (DCPS)
 - DTCP, 5C, XCA ... : flag and key system

SMIL

- Synchronized Multimedia Integration Language
- World Wide Web Consortium (W3C) で勧告
 - SMIL 1.0
 - W3C Recommendation 15-June-1998
 - オーディオ、ビデオ、テキスト、グラフィックスを組み合わせたマルチメディアプレゼンテーションを構成
 - 画面のどの部分にいつ表示するかを正確に同期させるメカニズム
 - Webベースのマルチメディアプレゼンテーションの作成、レイアウト、表示を簡単化
 - シンプルで強力なマークアップ言語

SMIL

- Synchronized Multimedia Integration Language
- World Wide Web Consortium (W3C) recommendation
 - SMIL 1.0
 - W3C Recommendation 15-June-1998
 - Construct multimedia presentation combined with audio, video, text, and graphics
 - Exact synchronization mechanism when and where images can be displayed on the monitor
 - Simplify the creation, layout and display of web-based multimedia presentation
 - Simple and powerful markup language

SMIL(2)

- SMIL 2.0 (以前のSMIL Boston)
 - Working Draft 01-March-2001
 - 拡張機能
 - TV 放送との統合
 - XMLによるアニメーションの作成機能
 - プレゼンテーションのナビゲーションに対するサポートの向上
 - デジタルテレビ放送にマルチメディアオブジェクトを統合

SMIL(2)

- SMIL 2.0 (former SMIL Boston)
 - Working Draft 01-March-2001
 - Enhanced Function
 - Unification with TV broadcasting
 - Creation of animation by XML
 - Increased support for navigation at presentation
 - Unify multimedia object to digital television broadcasting

SMIL(3)

- 参加企業

- Canon, Compaq, CSELT, CWI/Oratrix, France Telecom, Gateway, GLOCOM, INRIA, Intel, Macromedia, Microsoft, NIST, Panasonic, Philips, RealNetworks

SMIL(3)

- Members
 - Canon, Compaq, CSELT, CWI/Oratrix, France Telecom, Gateway, GLOCOM, INRIA, Intel, Macromedia, Microsoft, NIST, Panasonic, Philips, RealNetworks

Site

- SMILでいこう
 - <http://www.smi.co.jp/web-cm/smil/index.html>
- SMIL 1.0仕様
 - <http://www.w3.org/TR/REC-smil/>
- SMIL 2.0仕様
 - <http://www.w3.org/TR/smil20/>
- ZDNet Japan, PC-magazine
 - <http://www.zdnet.co.jp/magazine/pcmag/9901/pt990127a.html>

Site

- Let's use SMIL
 - <http://www.smi.co.jp/web-cm/smil/index.html>
- SMIL 1.0 Specification
 - <http://www.w3.org/TR/REC-smil/>
- SMIL 2.0 Specification
 - <http://www.w3.org/TR/smil20/>
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システム化技術

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- 多重
- バッファ制御
- 遅延制御
- スケーラビリティ
- シーン合成

Technology for System

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- Multiplexing
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- Scalability
- Scene Composition

スケーラブル映像符号化技術

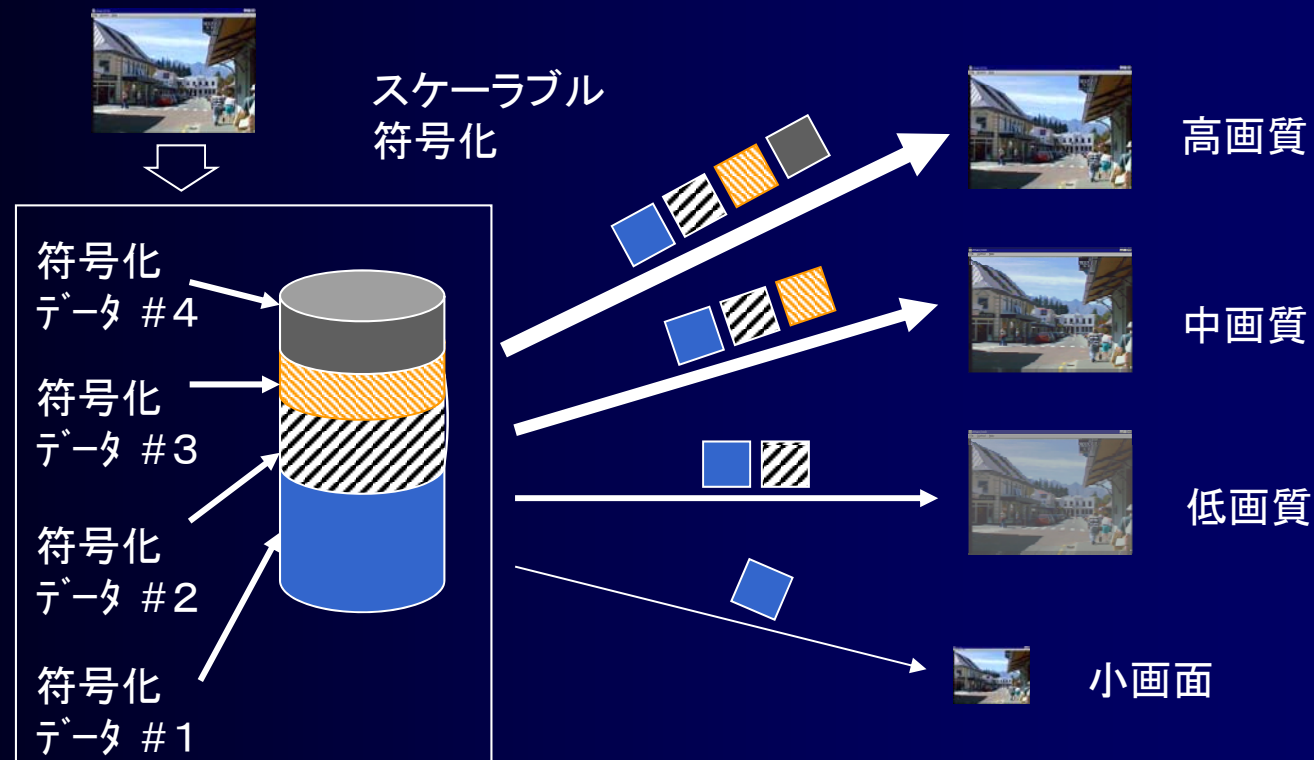
- 符号化データを階層化
- 階層データ中のいくつかを組み合わせることで種々の映像が再生可能
 - ー 異なる画質
 - ー 異なる画像サイズ
 - ー 異なるフレームレート
- ネットワークの帯域変動にフレキシブルに対応

Scalable Video Coding Technology

- Layering coding data
- Several Videos having different nature can be played back by combining some of layered coding data
 - different picture quality
 - different picture size
 - different frame rate
- Can correspond to bandwidth fluctuation in network flexibly

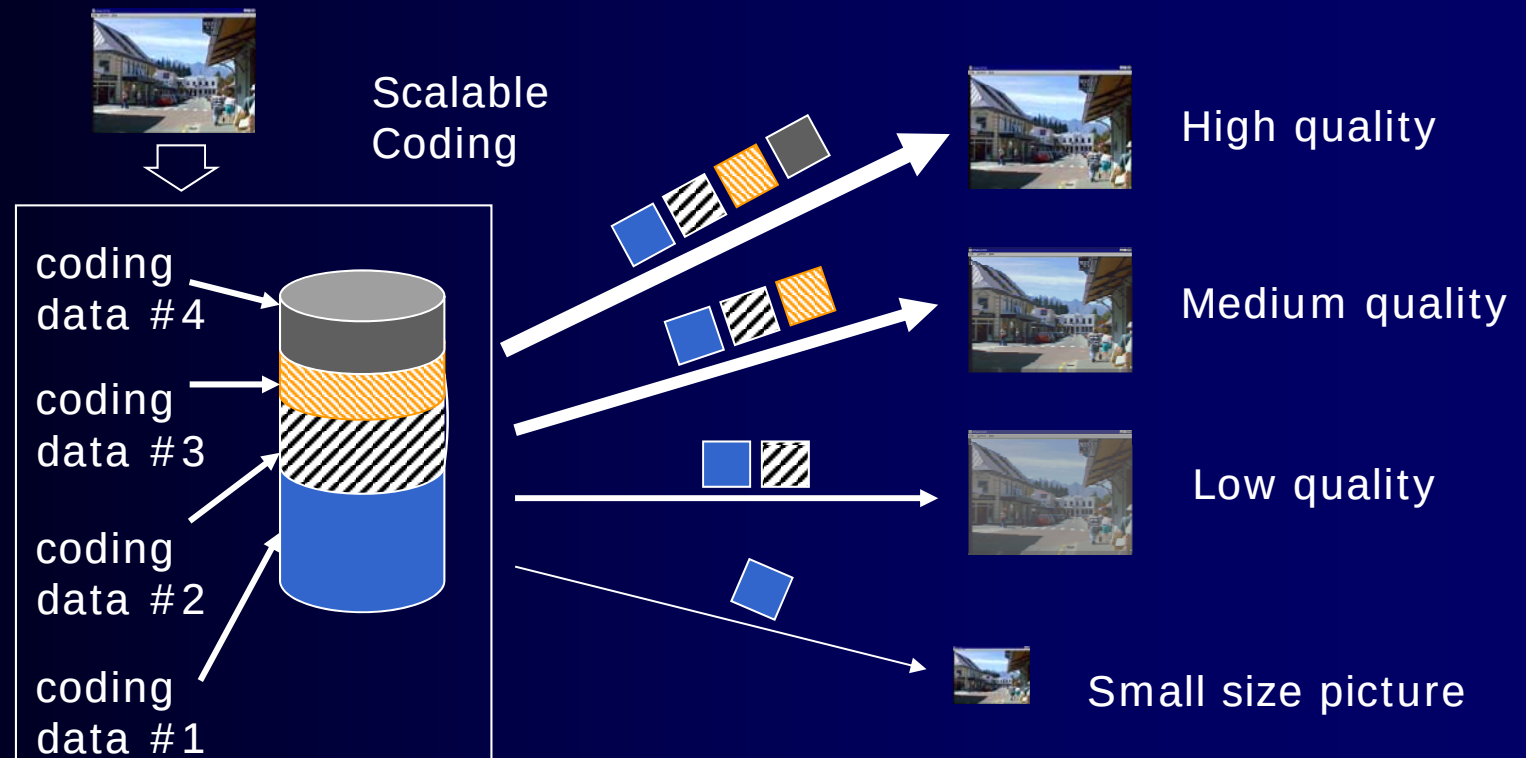
スケーラブル映像符号化技術(2)

■ 符号化データの階層化



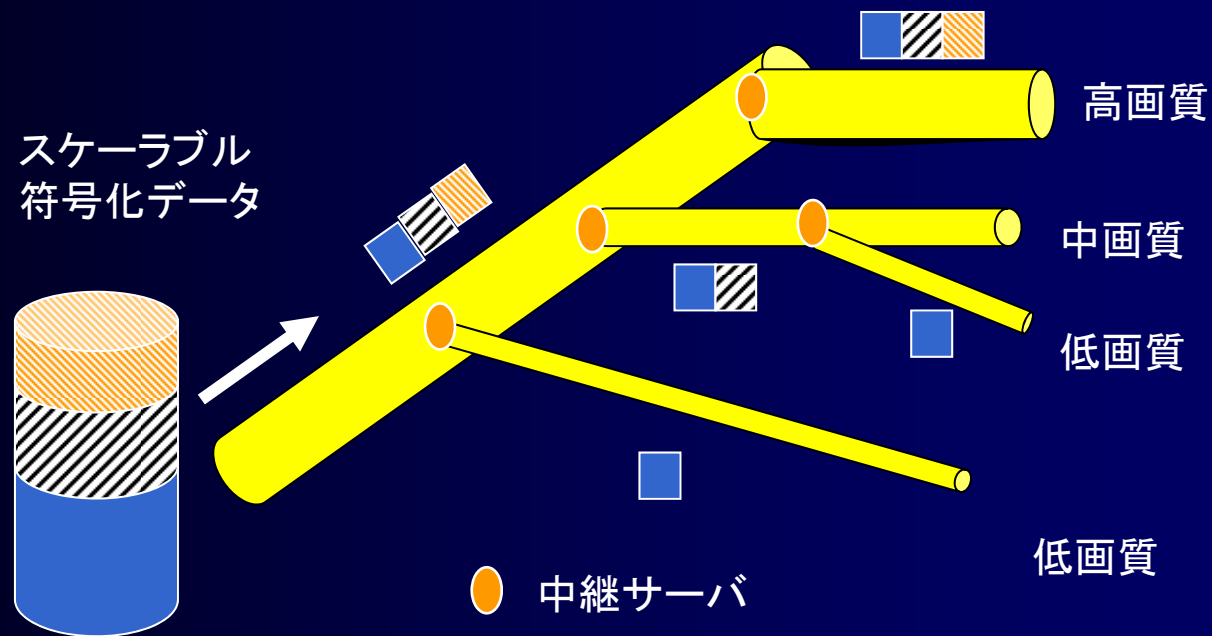
Scalable Video Coding Technology(2)

■ Layered coding data



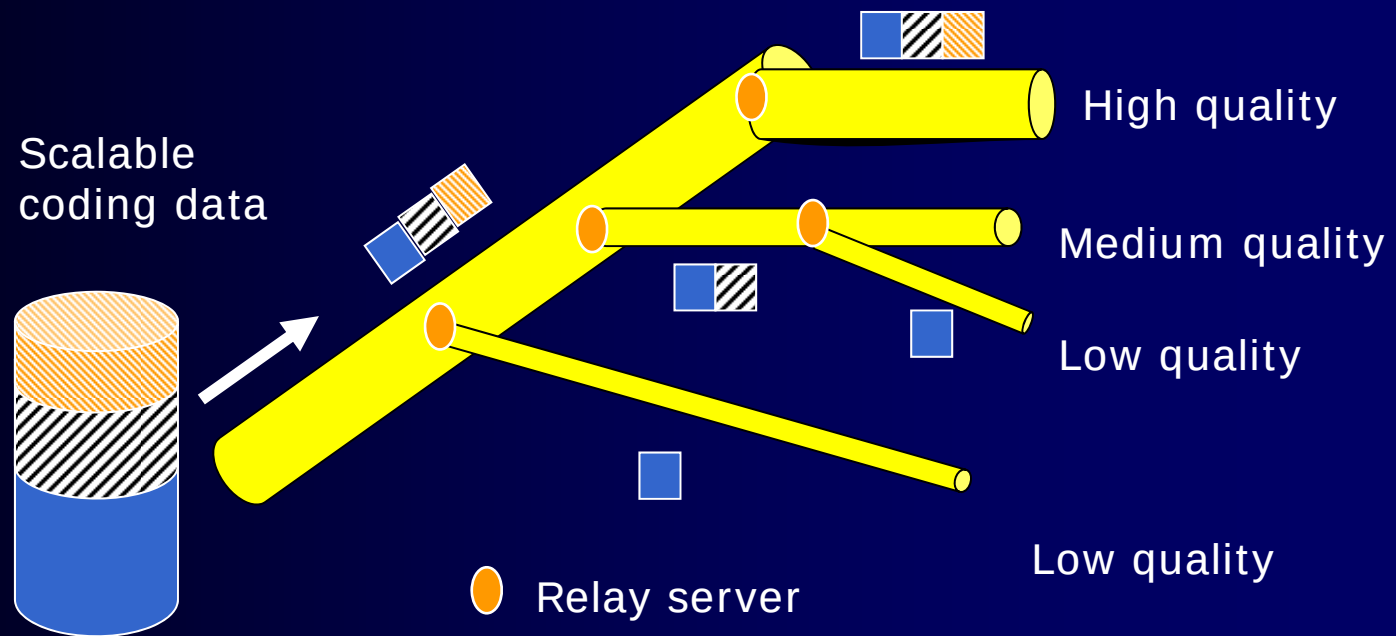
スケーラブル映像符号化技術(3)

- 通信速度の異なるネットワーク接続による映像配信の場合

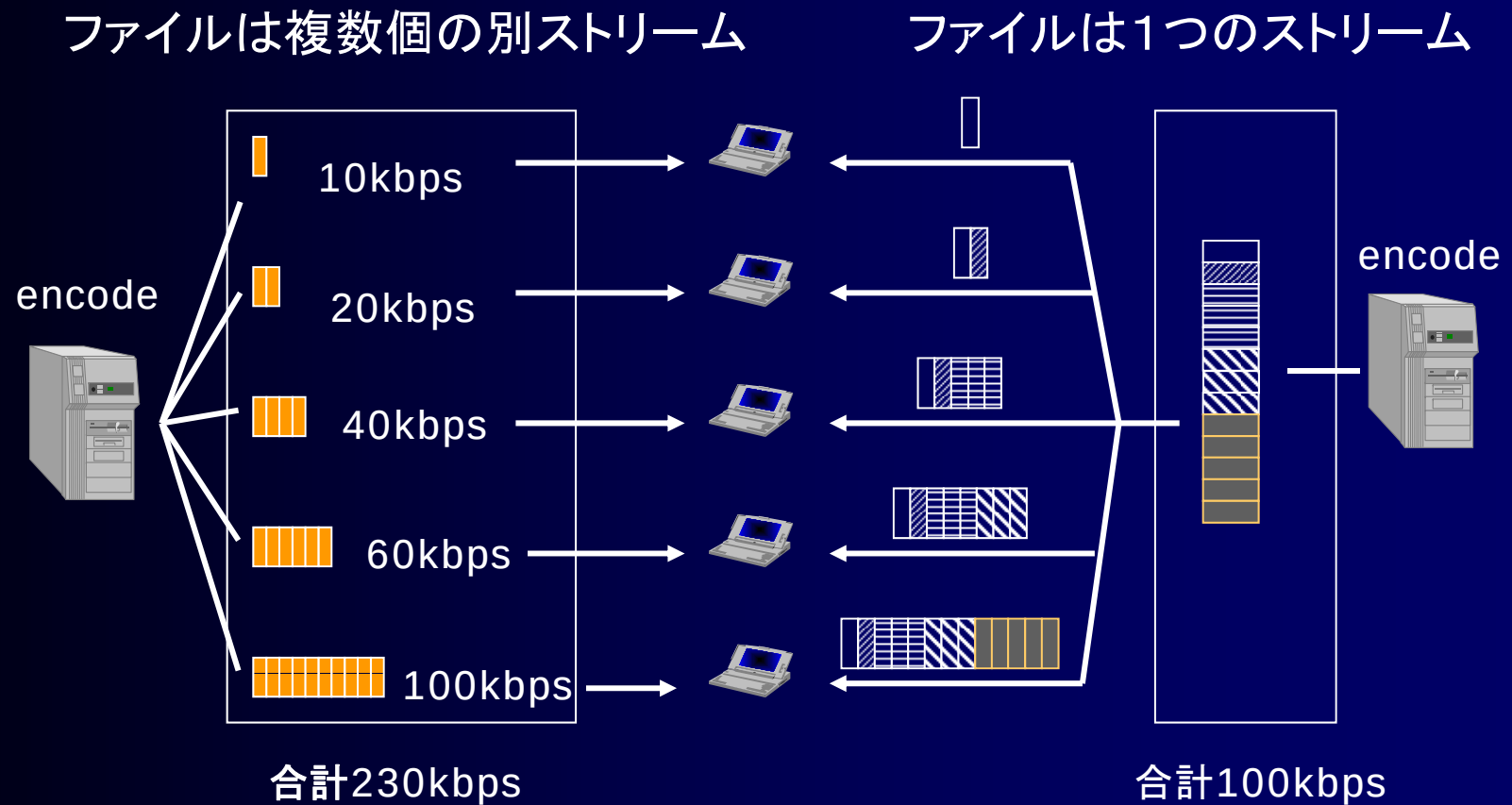


Scalable Video Coding Technology(3)

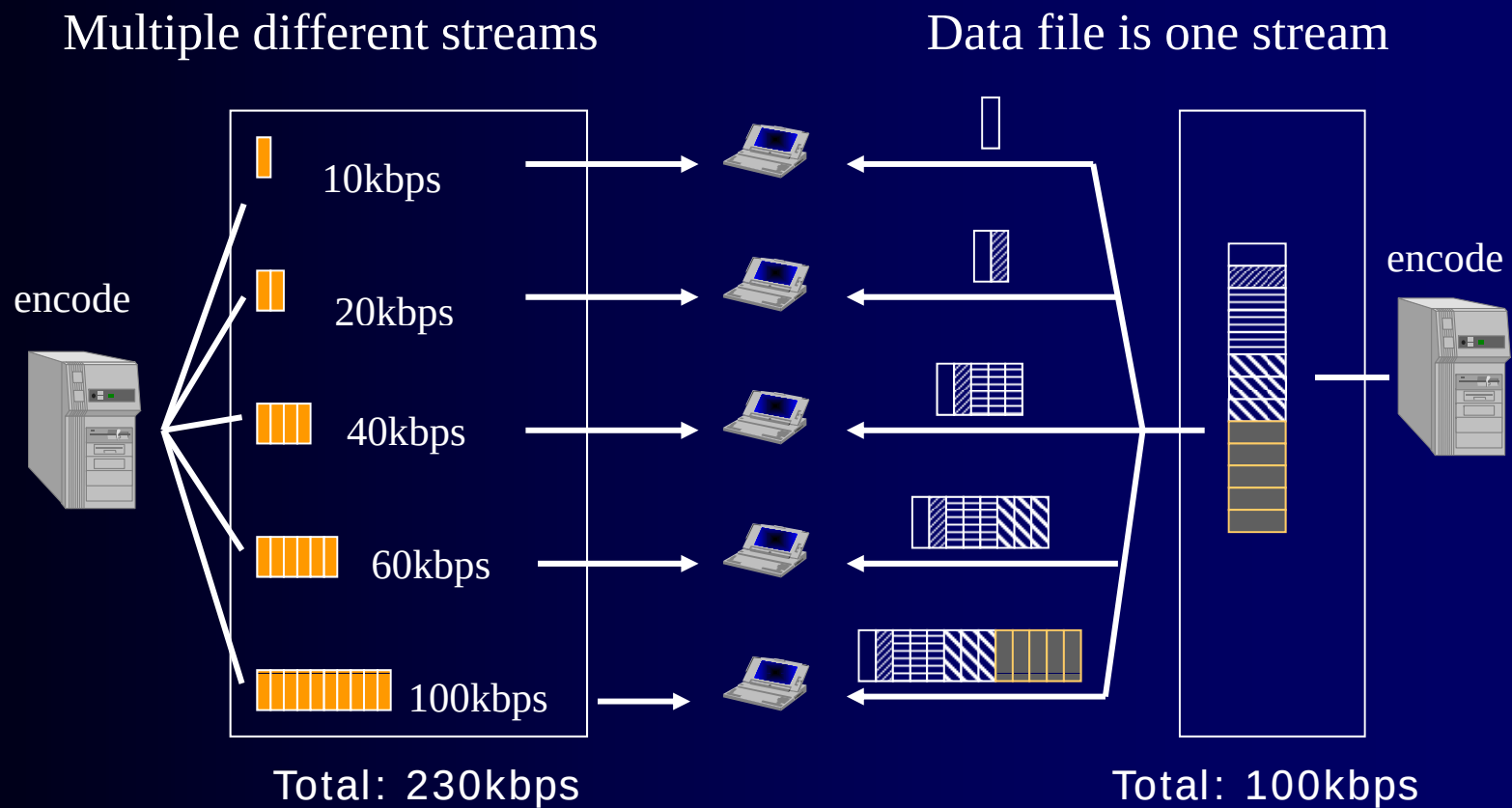
- In case of video distribution for connected networks with different rates



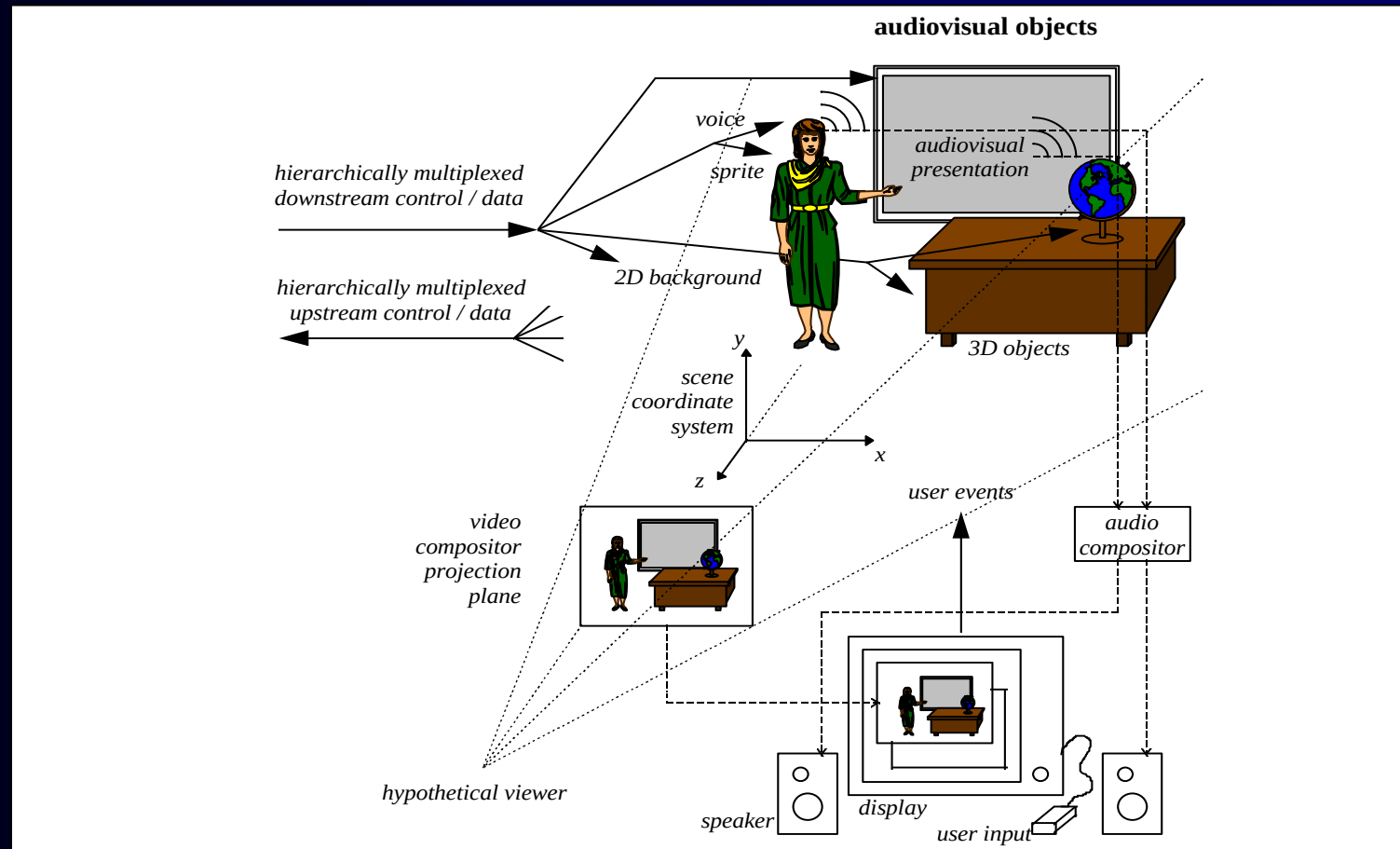
Simulcast vs. Embedded



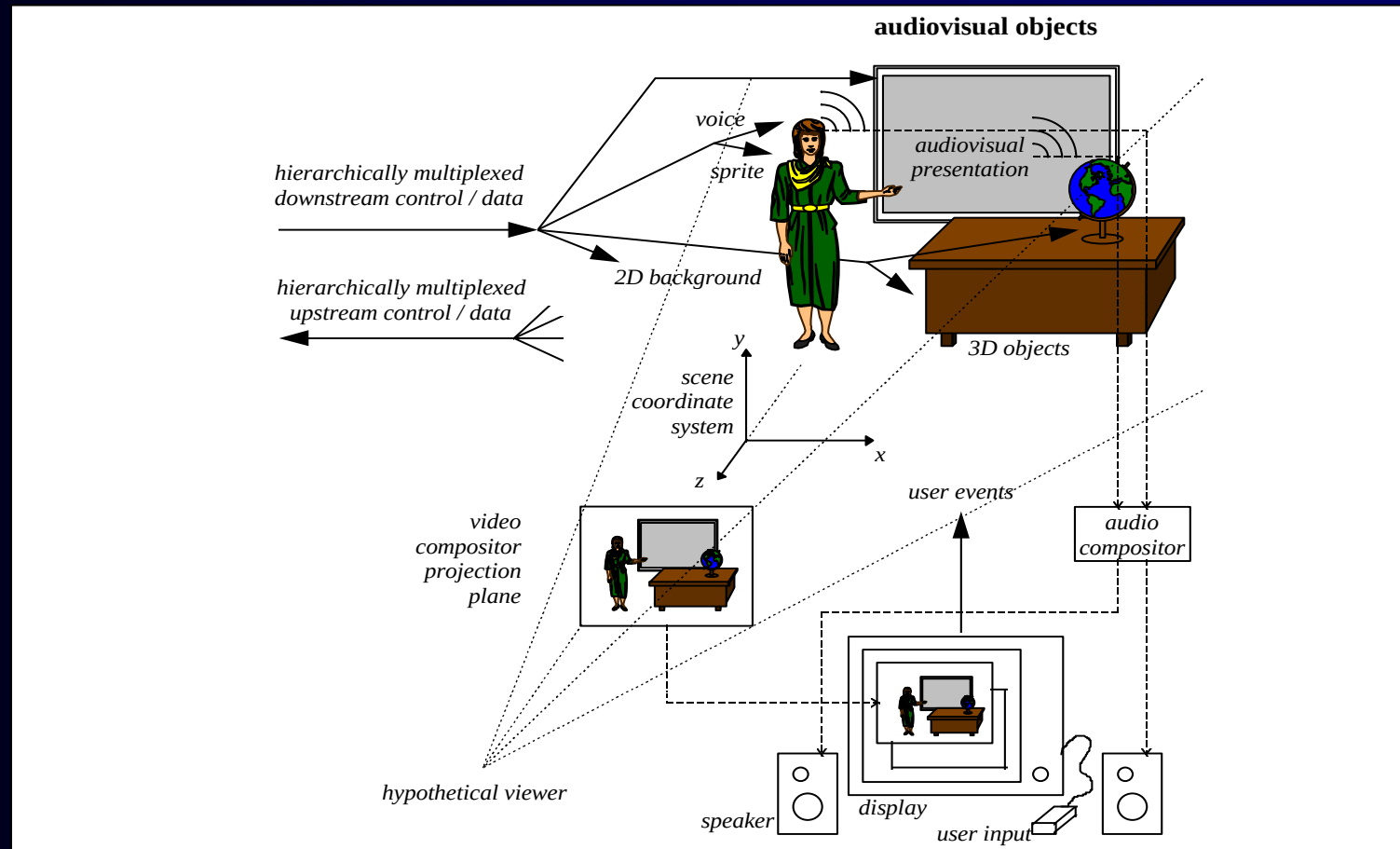
Simulcast vs. Embedded



MPEG-4におけるシーン合成



MPEG-4 Scene Decomposition



システムコンポーネント

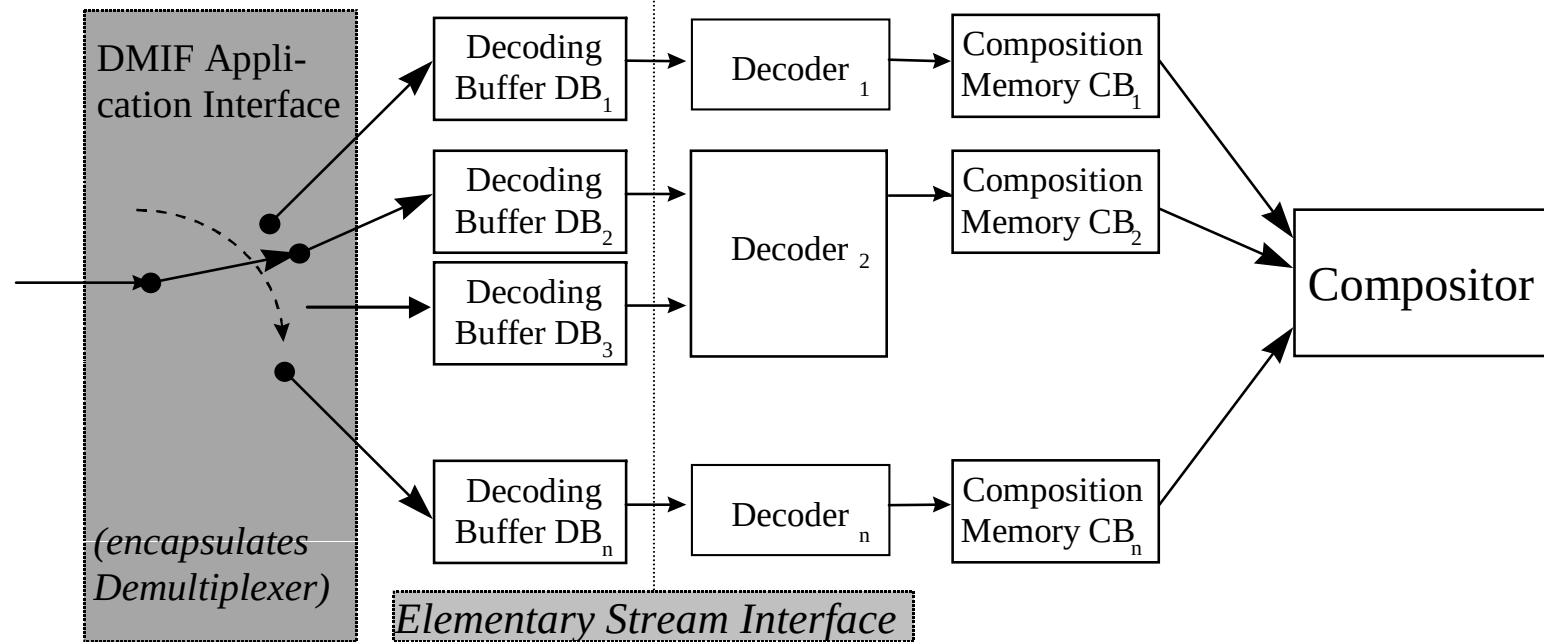
- Systems Decoder Model
- Sync Layer (Synchronization)
- FlexMux/TransMux (Multiplexing)
- Scene Description (BIFS), Animation
- Object Descriptors
- IPMP/OCI

System Component

- Systems Decoder Model
- Sync Layer (Synchronization)
- FlexMux/TransMux (Multiplexing)
- Scene Description (BIFS), Animation
- Object Descriptors
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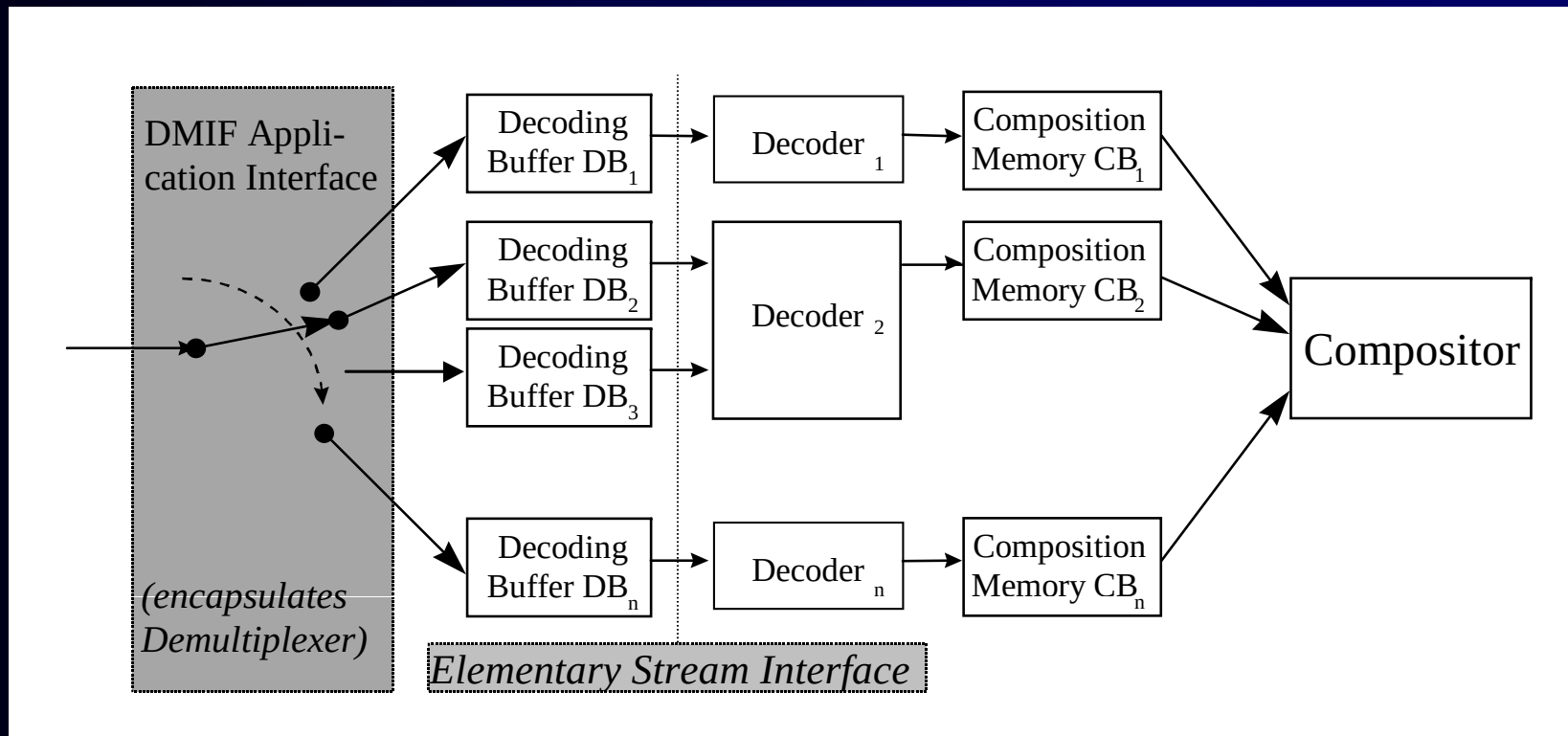
システムデコーダモデル

■ STD Model



System Decoder Model

■ STD Model



同期

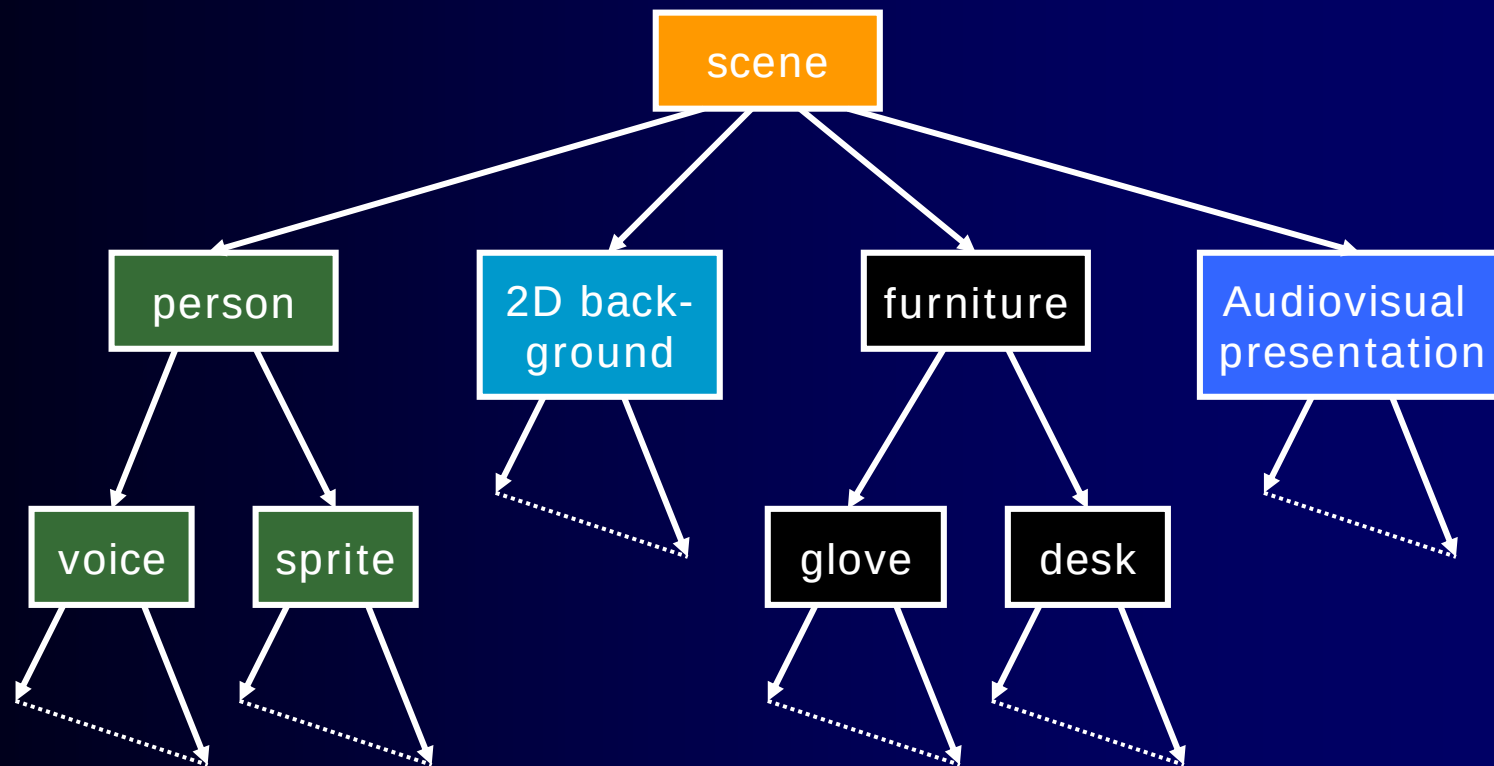
- Time Bases
 - System Time Base (implementation-dependent)
 - Object Time Base - Object Clock Reference (OCR)
- Timestamps
 - DTS/CTS
 - Rate-based
 - None
- Traditional Buffer Management

Synchronization

- Time Bases
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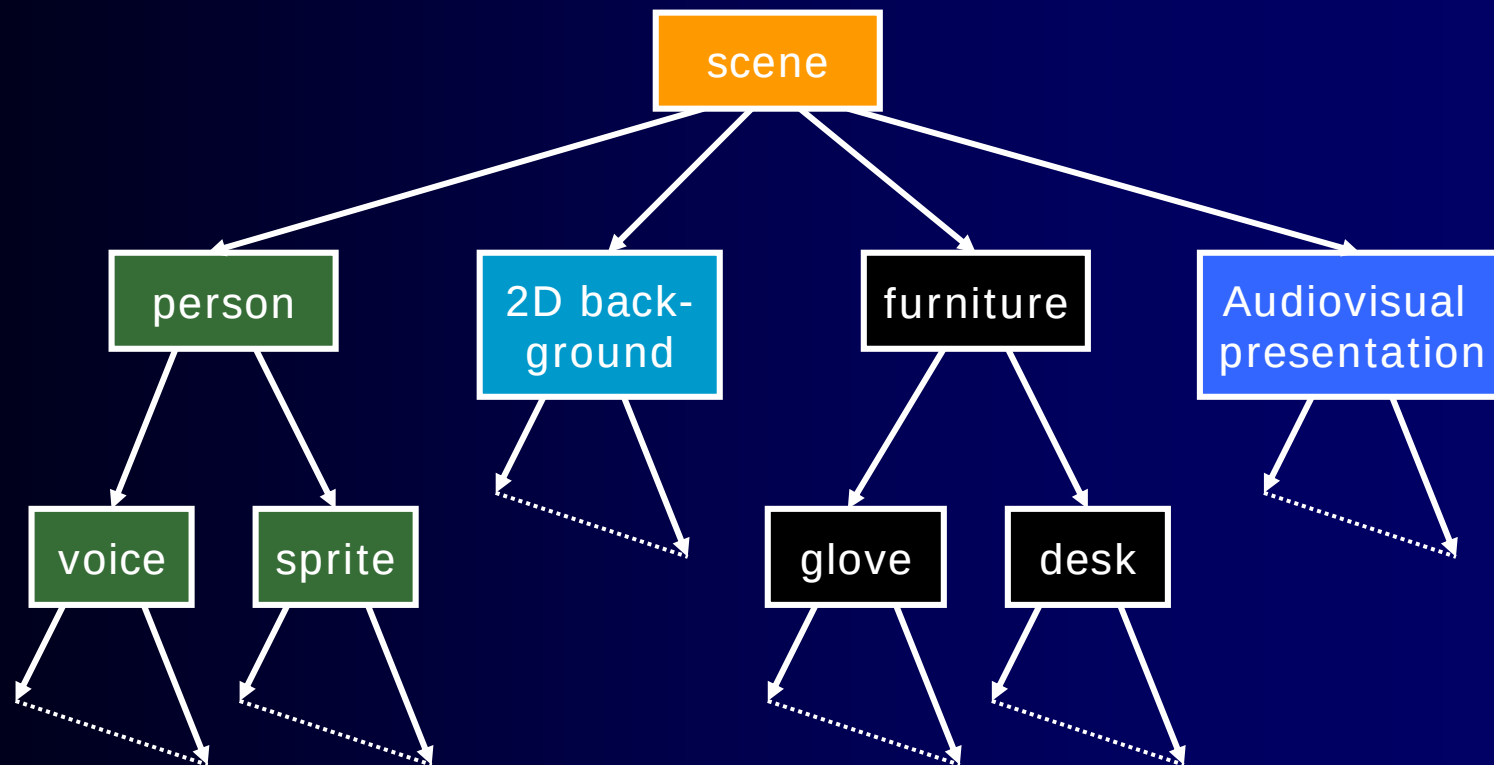
シーン記述

■ BIFS (Binary Format for Scene)

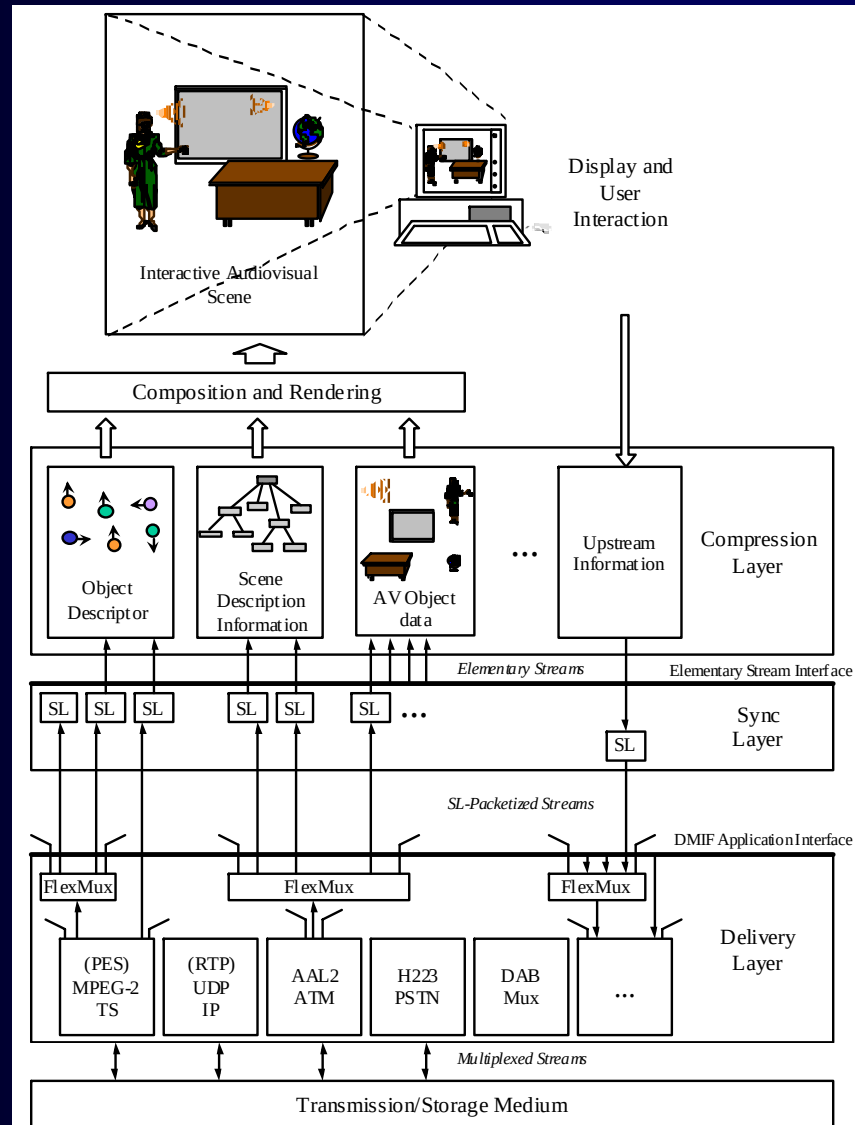


Scene Description

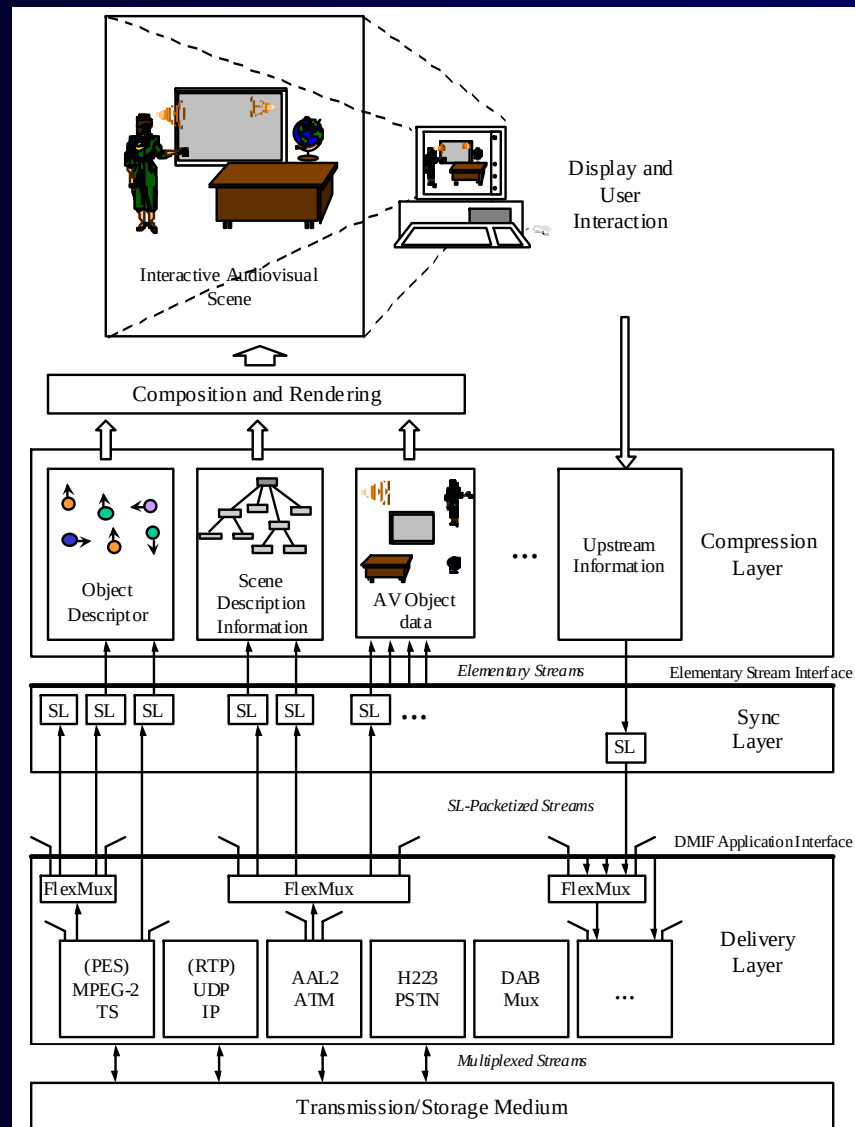
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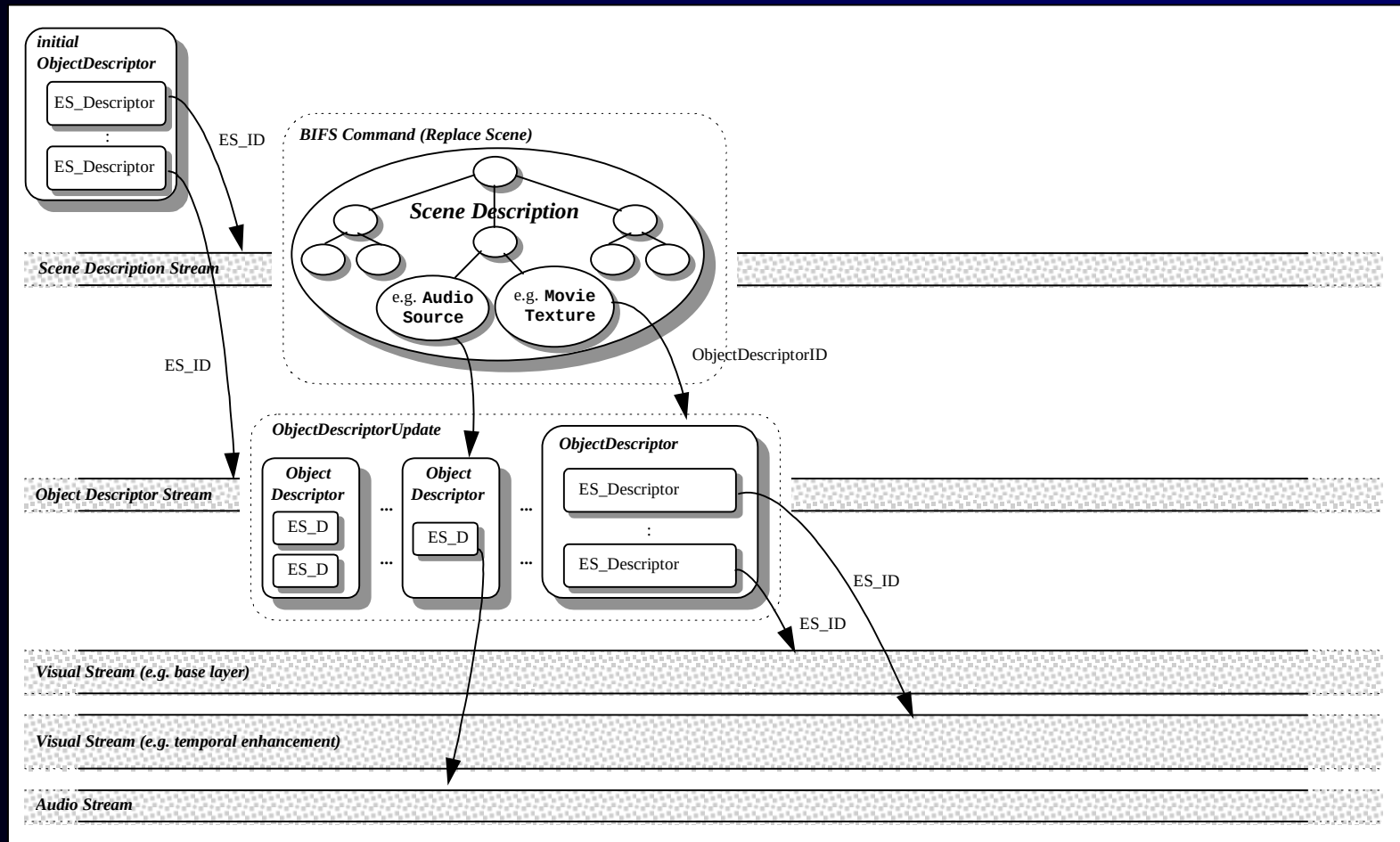
システム構成



System



オブジェクト記述子



Object Descriptor

