

MPEG-4 Studio Profile

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Outline

- Introduction
- MPEG-4 Standard
- MPEG-4 Visual
- Studio Profile
- Summary

Introduction

- MPEG is a working group of ISO/IEC
 - JTC1/SC29/WG11
- Developed MPEG-1, MPEG-2, MPEG-4 standards
- Continued development of MPEG-4
- Forthcoming standards:
 - MPEG-7, MPEG-21

MPEG Line-up

MPEG-1

MPEG-4

MPEG-2

4:2:2P@ML

up to 50Mb I/GOP

BETACAM SX

MPEG IMX

MP@ML

4:2:0 -15Mb

MPEG-7

4:2:2P@HL

up to 300Mb I/GOP

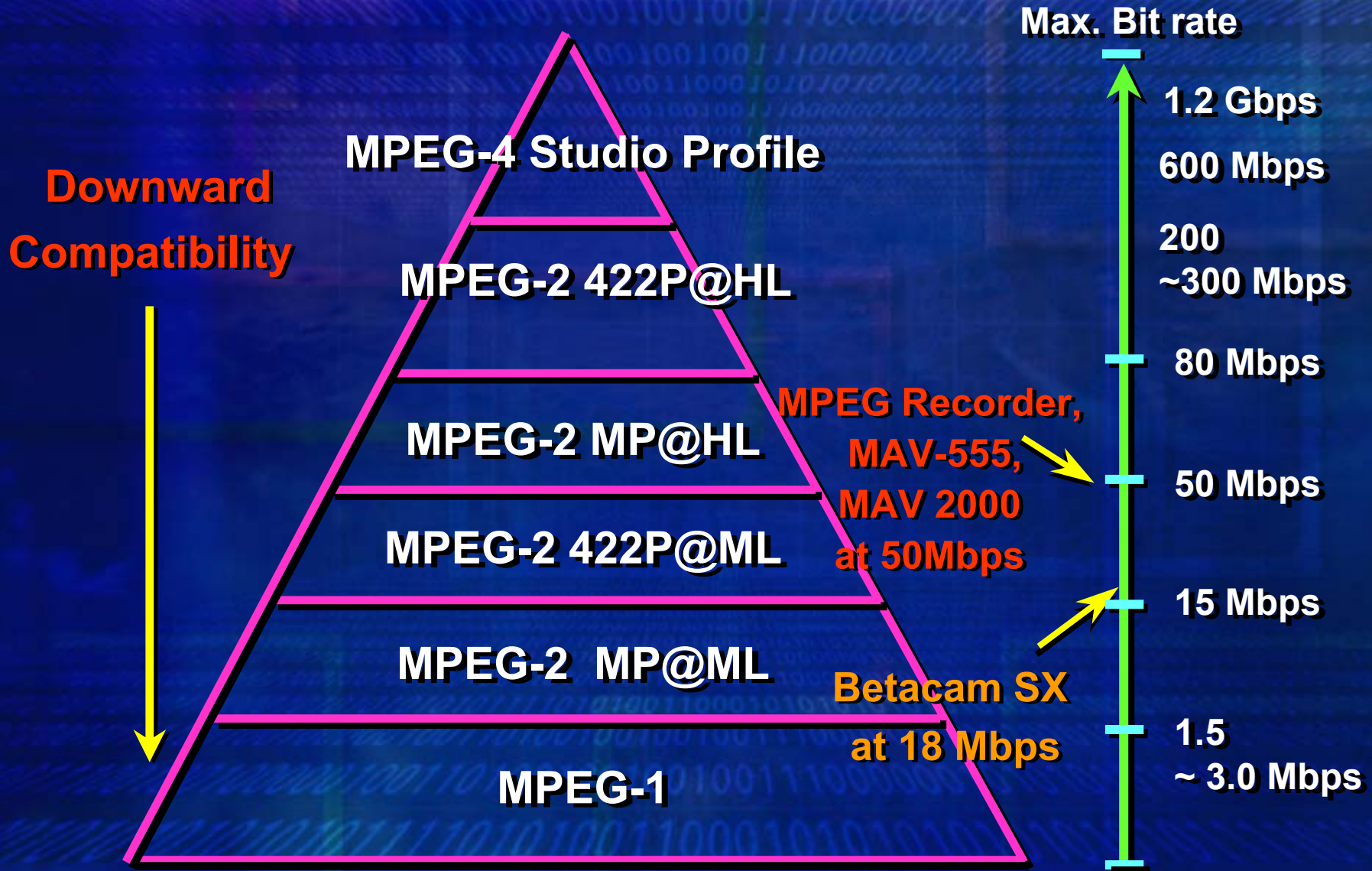
MPEG-2 Architecture

		PROFILE					
FRAME TYPES →		SIMPLE	MAIN	SNR	SPATIAL	HIGH	4:2:2
CHROMA SAMPLING →		I & P 4:2:0	I, P & B 4:2:0	I, P & B 4:2:0	I, P & B 4:2:0	I, P & B 4:2:2 & 4:2:0	I, P & B 4:2:2 & 4:2:0
LEVEL	HIGH Samples/Line Lines/Frames Frames/Sec Max Bit-Rate (Mbps)		1920 1152 60 80			1920 1152 60 100	1920 1080 60 300
	HIGH 1440 Samples/Line Lines/Frames Frames/Sec Max Bit-Rate (Mbps)	SDTV	1440 1152 60 60		1440 1152 60 60	1440 1152 60 80	
	MAIN Samples/Line Lines/Frames Frames/Sec Max Bit-Rate (Mbps)	720 576 30 15	720 576 30 15	720 576 30 15	720 576 30 15	720 576 30 20	720 608 30 50
	LOW Samples/Line Lines/Frames Frames/Sec Max Bit-Rate (Mbps)		352 288 30 4				

HDTV

SDTV

MPEG Hierarchy

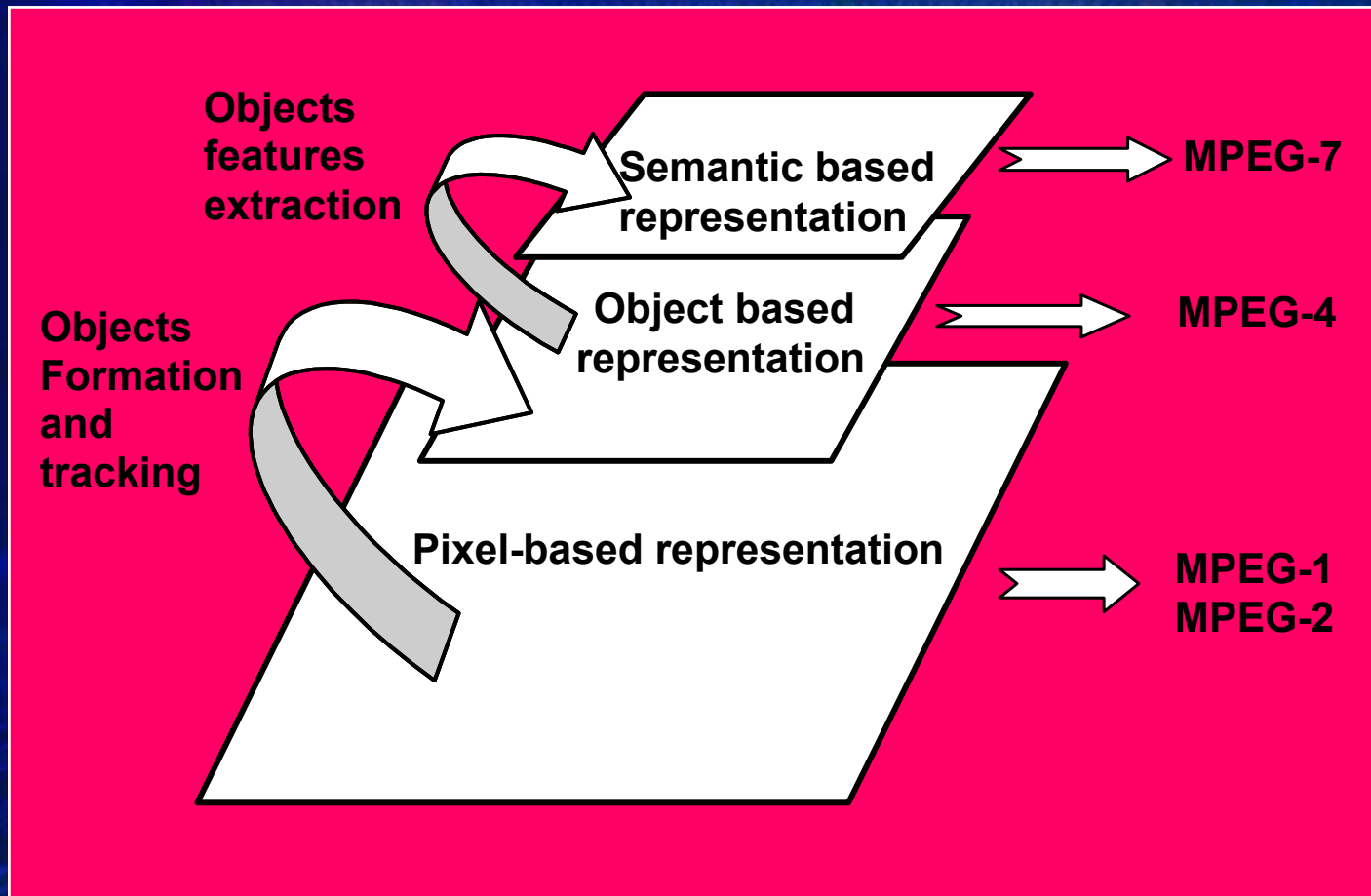


MPEG-4 Standard

- 6 parts:
 - Systems
 - Visual
 - Audio
 - DMIF = Delivery Multimedia Integration Framework
 - Reference software
 - Conformance

Relation between MPEG standards

- Data representation pyramid



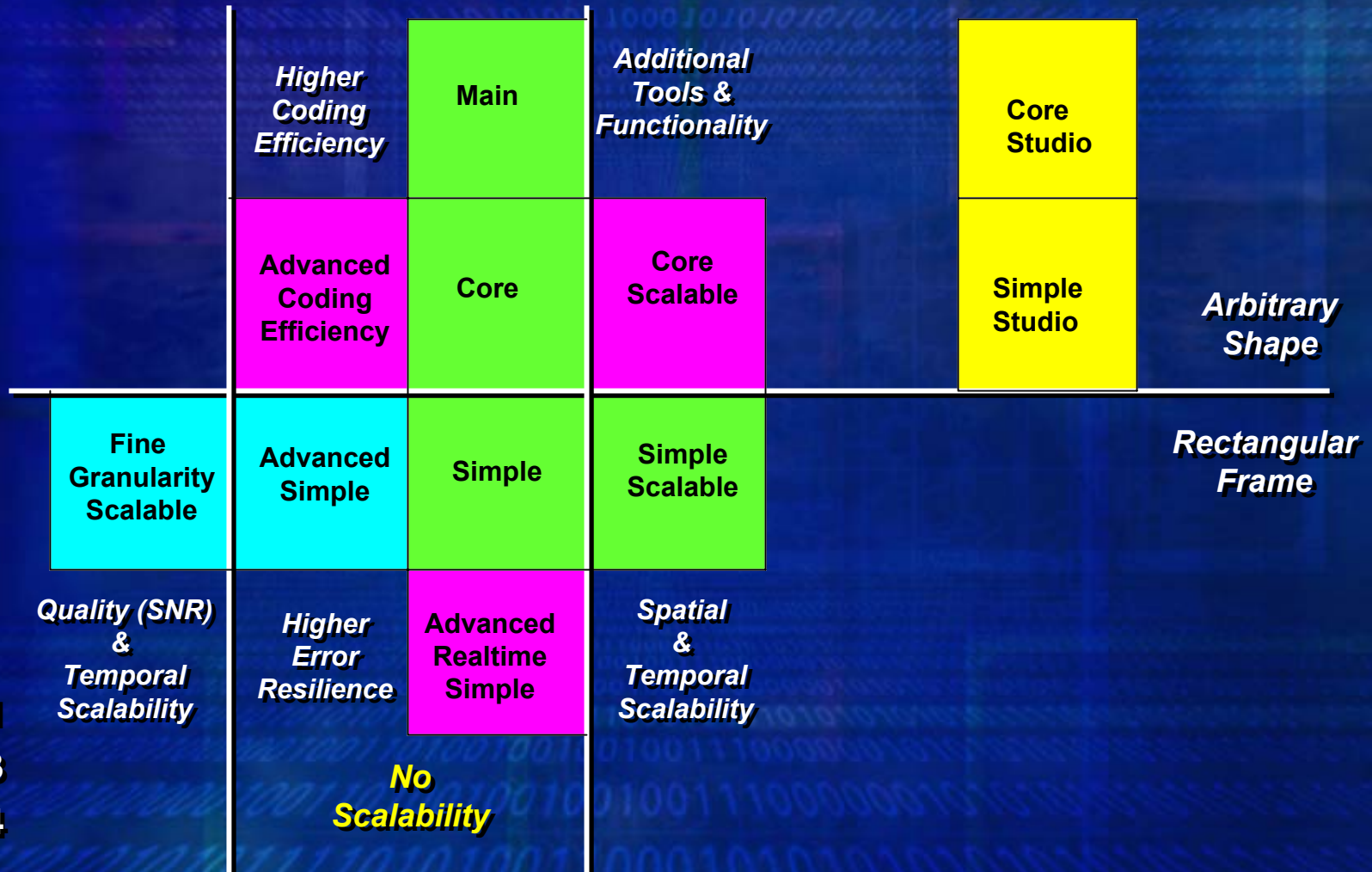
Development of a Standard

- MPEG-4 Defines a (very) large set of tools: one tool, one functionality
 - **Tools** -- basic normative elements
 - **Object Types** -- combinations of Tools
 - **Profiles** -- combination of Object types
 - **Levels** -- size/rate/complexity limitations
- Conformance Points are defined for “**Profile@level**” combination

MPEG-4 Application Design

- Combination of (subset of):
 - Visual profile (15+)
 - Audio profile (8+)
 - Graphics profile (3)
 - Scene description profile (4)
- MPEG-4 covers wide range of applications: hence the large number of tools

MPEG-4 Video Profiles



- IS
- AMD-1
- AMD-3
- AMD-4

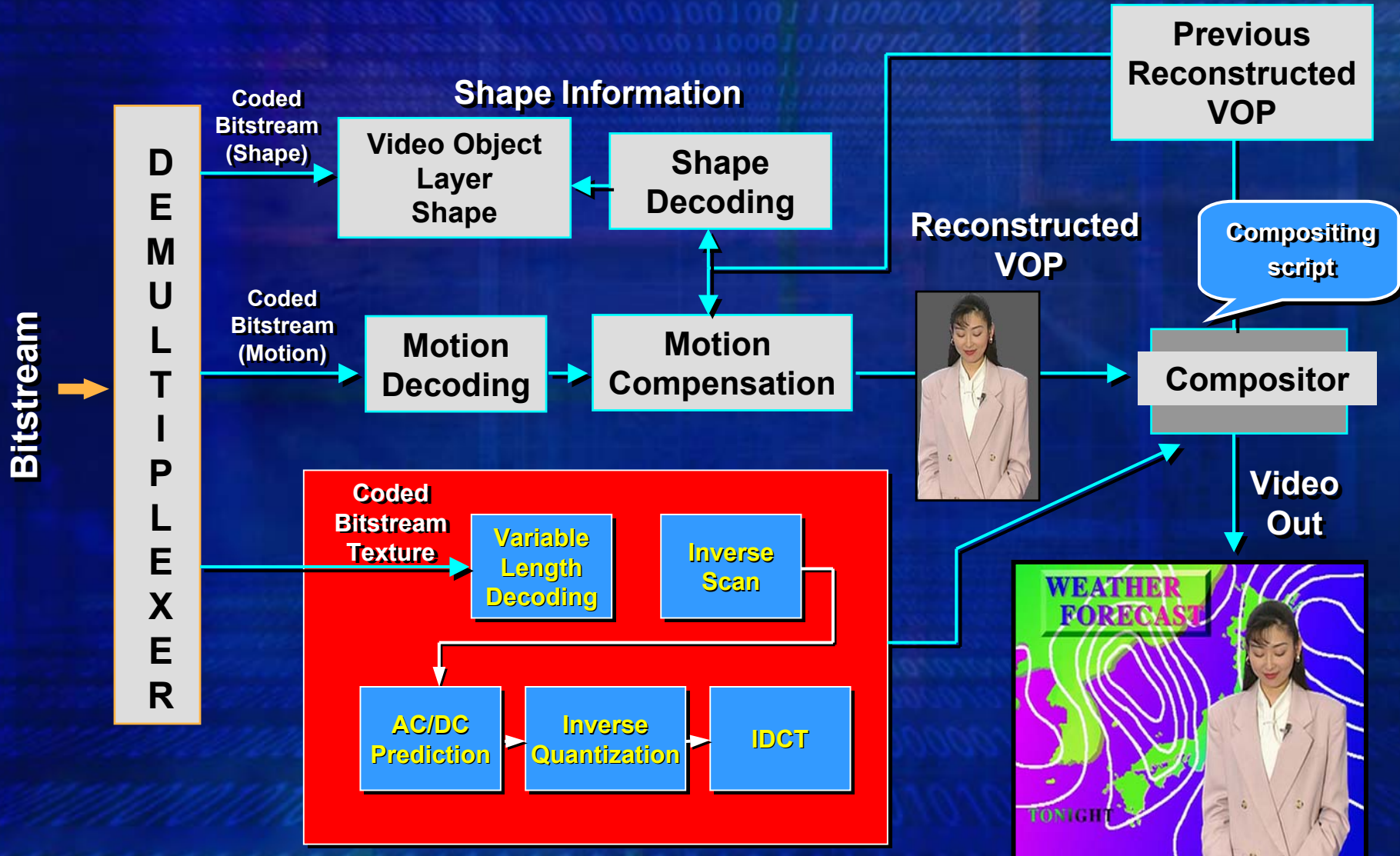
MPEG-4 Visual

- Diverse object types:
 - Video object
 - Sprite object
 - Face object
 - 2D mesh object
 - 3D mesh object
 - Still texture object

Video Object

- Texture components: Y,U,V
- New: **shape**
 - rectangular
 - arbitrary, binary
 - arbitrary, grayscale
- Frame referred to as **Video Object Plane**

Video-Decoding Process

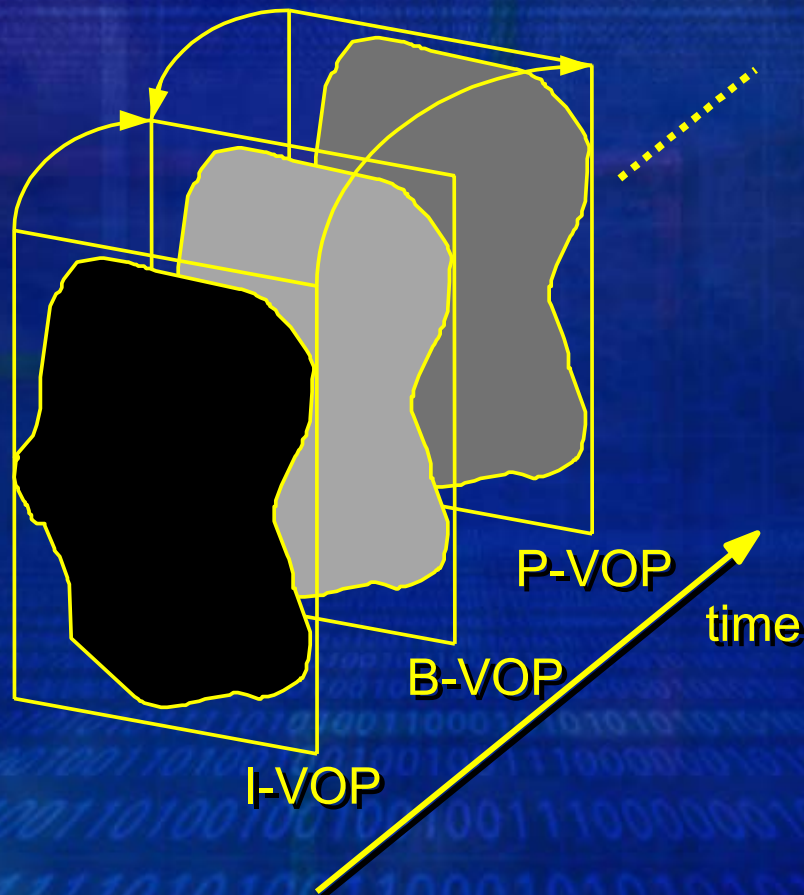


Coding Techniques - Compression

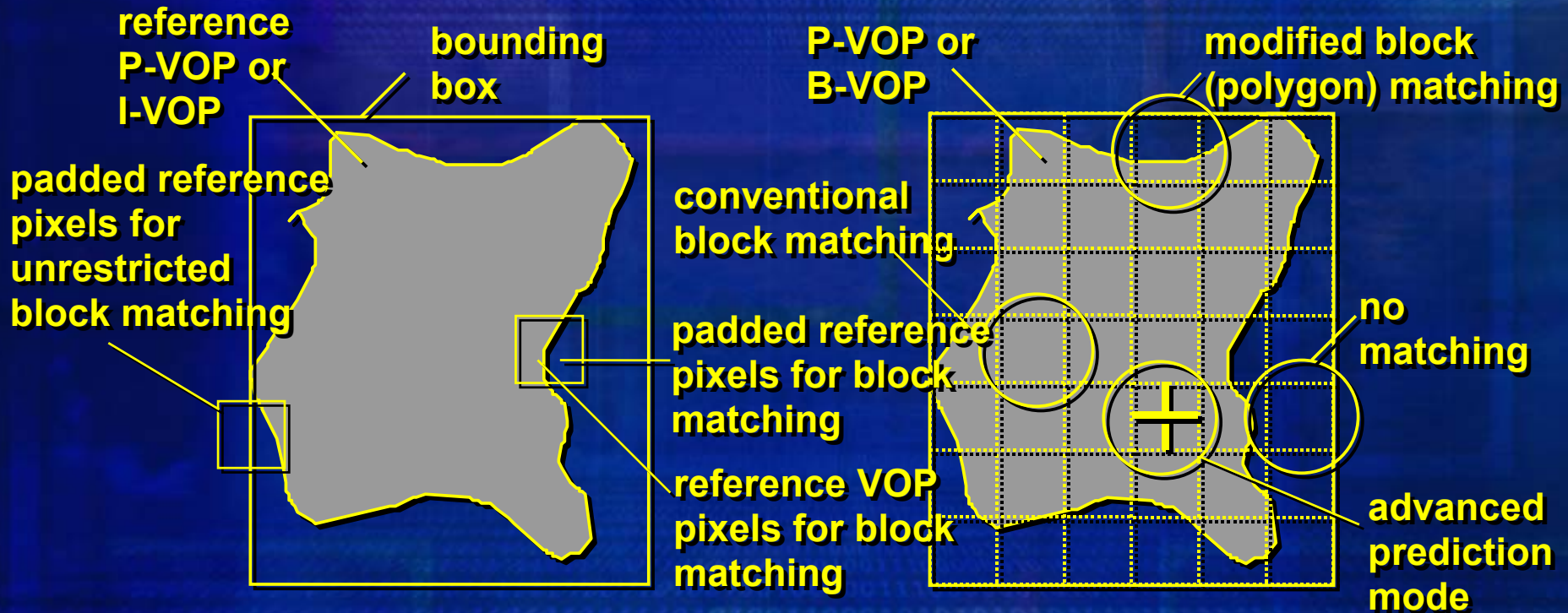
- Hybrid DCT approach
- Rectangular or arbitrary-shaped Video Object Planes (VOPs)
- I-VOPs, motion-compensated P- and B-VOPs
 - Improved INTRA coding (AC/DC-DCT prediction)
 - 8x8 Motion Vectors – Block overlapped MC
 - Interlace prediction

Motion compensation tools

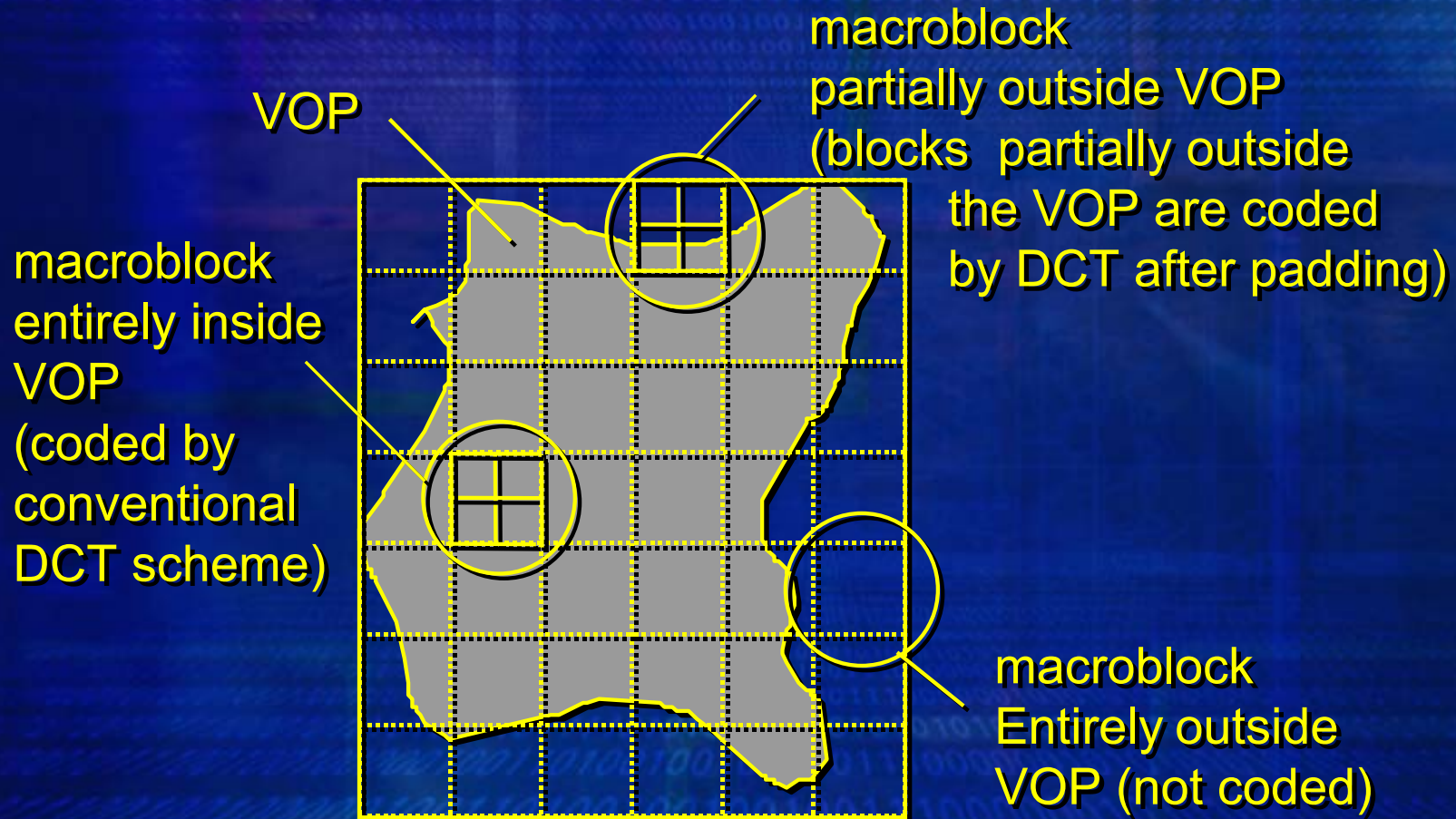
Motion compensated coding modes (I, B, P)



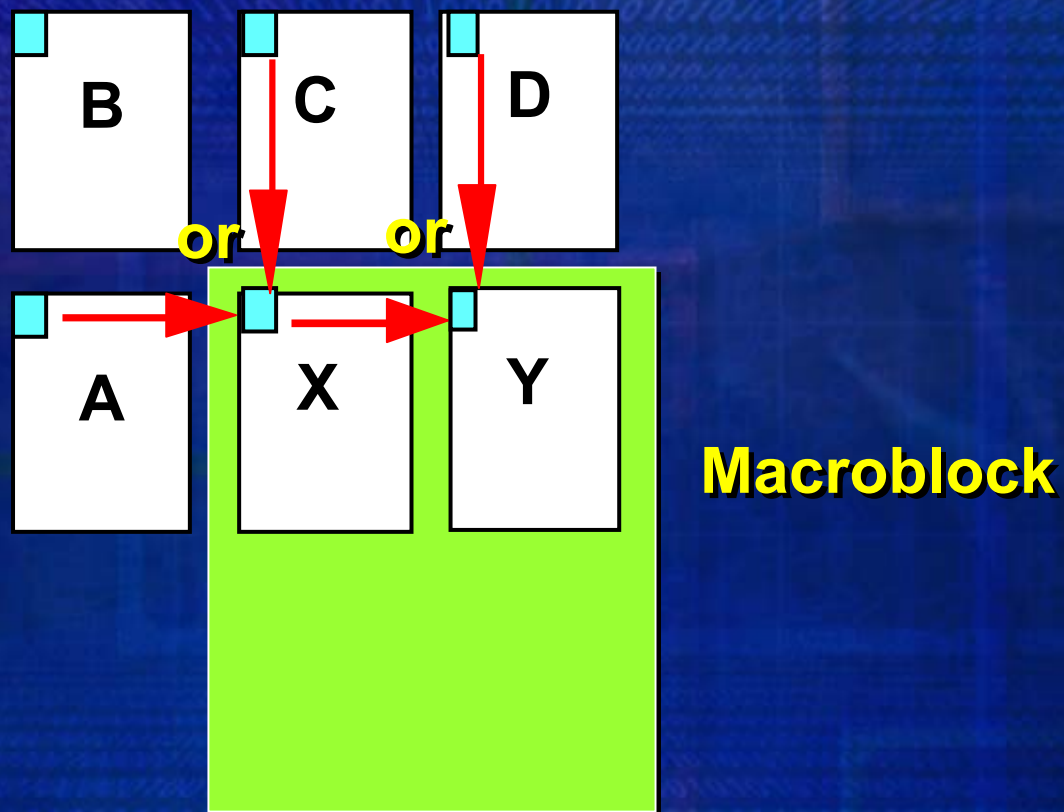
Motion vector computation



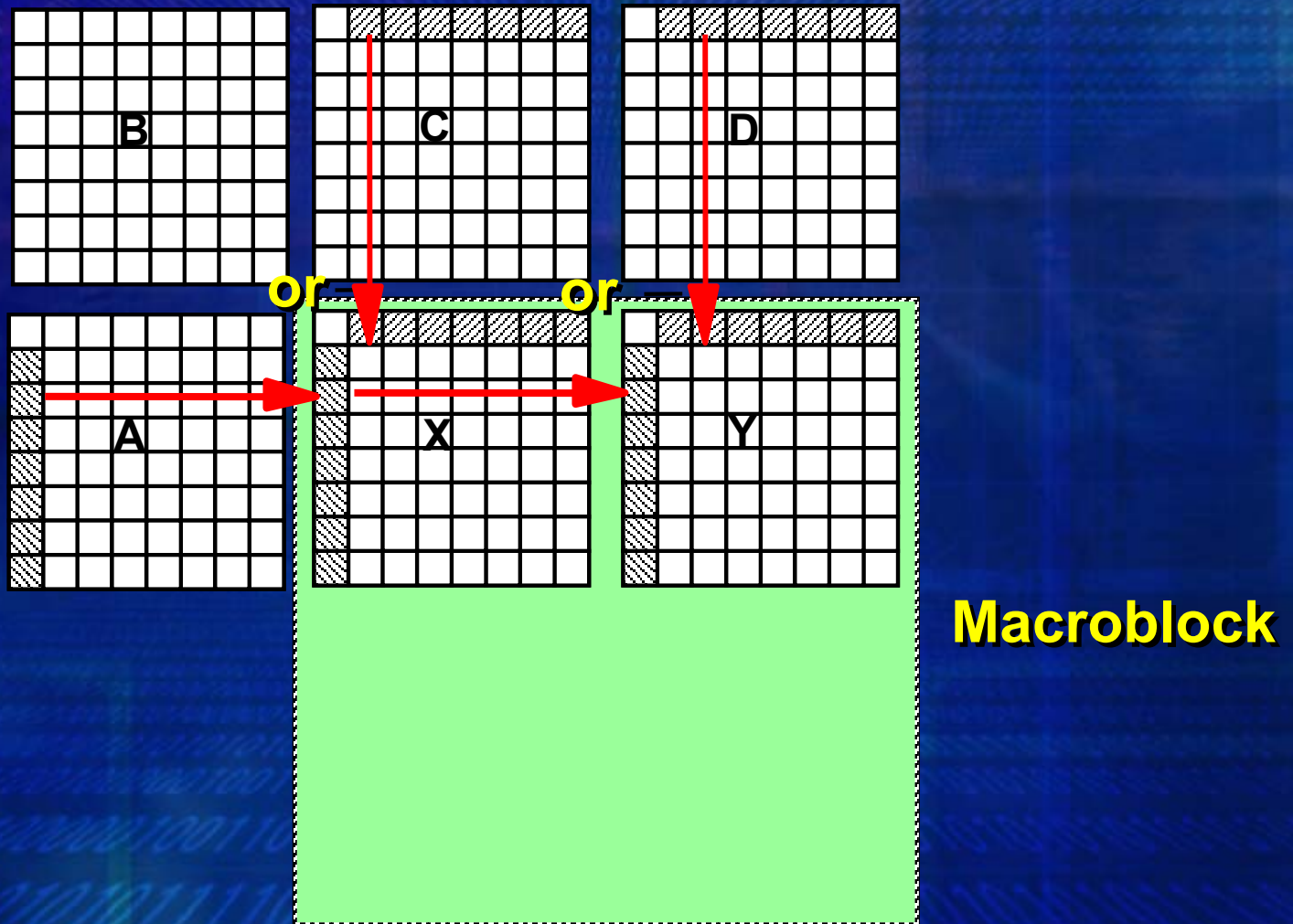
Texture coding tools



Adaptive DC prediction

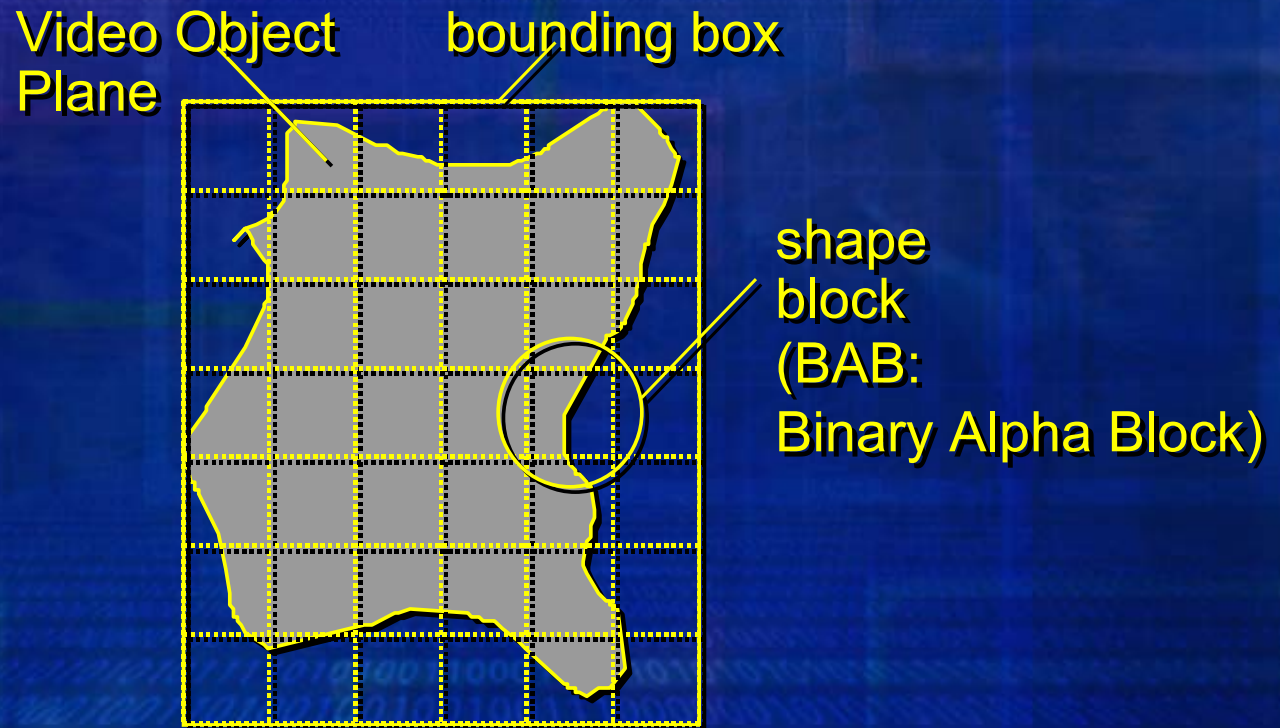


Adaptive AC prediction



Shape coding tool

Every VOP is coded by dividing it into smaller macroblocks



12-bit video coding tool

- Allows compression of video data with precision of up to 12-bits/pixel
- The syntax, semantics, and coding tools are extended:
 - bit-precision
 - extended DC VLC tables
 - extended quantization mechanism
 - Insertion of marker bits to avoid start code emulations

MPEG-4

Studio Profile

Studio Profile – Target

- Objectives

- Object-based techniques of MPEG-4 fit perfectly with “art of production“
- Higher coding efficiency of MPEG-4 can reduce cost in studio storage

- Applications

- Professional broadcast : Studio and post production, inter-studio transmission
- Digital cinema : Content creation, archives, distribution

SP – Requirements

- **General Requirements**
 - 22:11:11, 22:22:22 formats
 - Progressive and interlaced
 - Support up to 2048 by 2048 pixels
 - Support up to about 1.2 Gbps bitrates
 - Up to 12 pixel depth
 - Lossless compression mode
- **For some applications**
 - Arbitrary Shape, Sprites
 - Auxiliary signals like alpha, depth, displacement

SP – Conformance Points

- **Simple Studio Profile**

- To be applied for image acquisition and editing
- Only Intra coding for independent processing of frames
- Lossless transcoding from MPEG-2 4:2:2 Profile

- **Core Studio Profile**

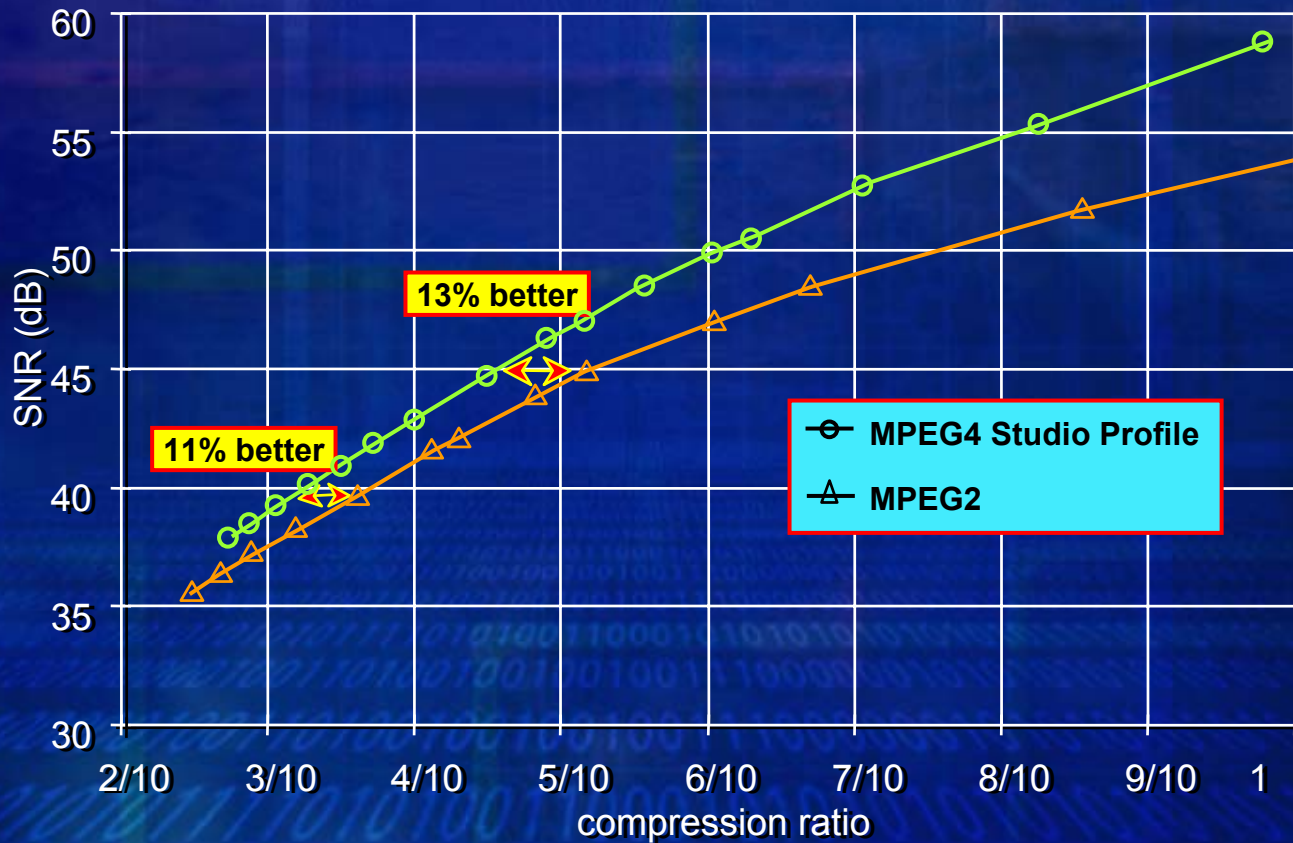
- To be applied for inter-studio transmission and digital cinema distribution
- Inter (P-VOP) coding for more efficient compression
- Support for Arbitrary Shape and Sprites

SP – New Tools defined

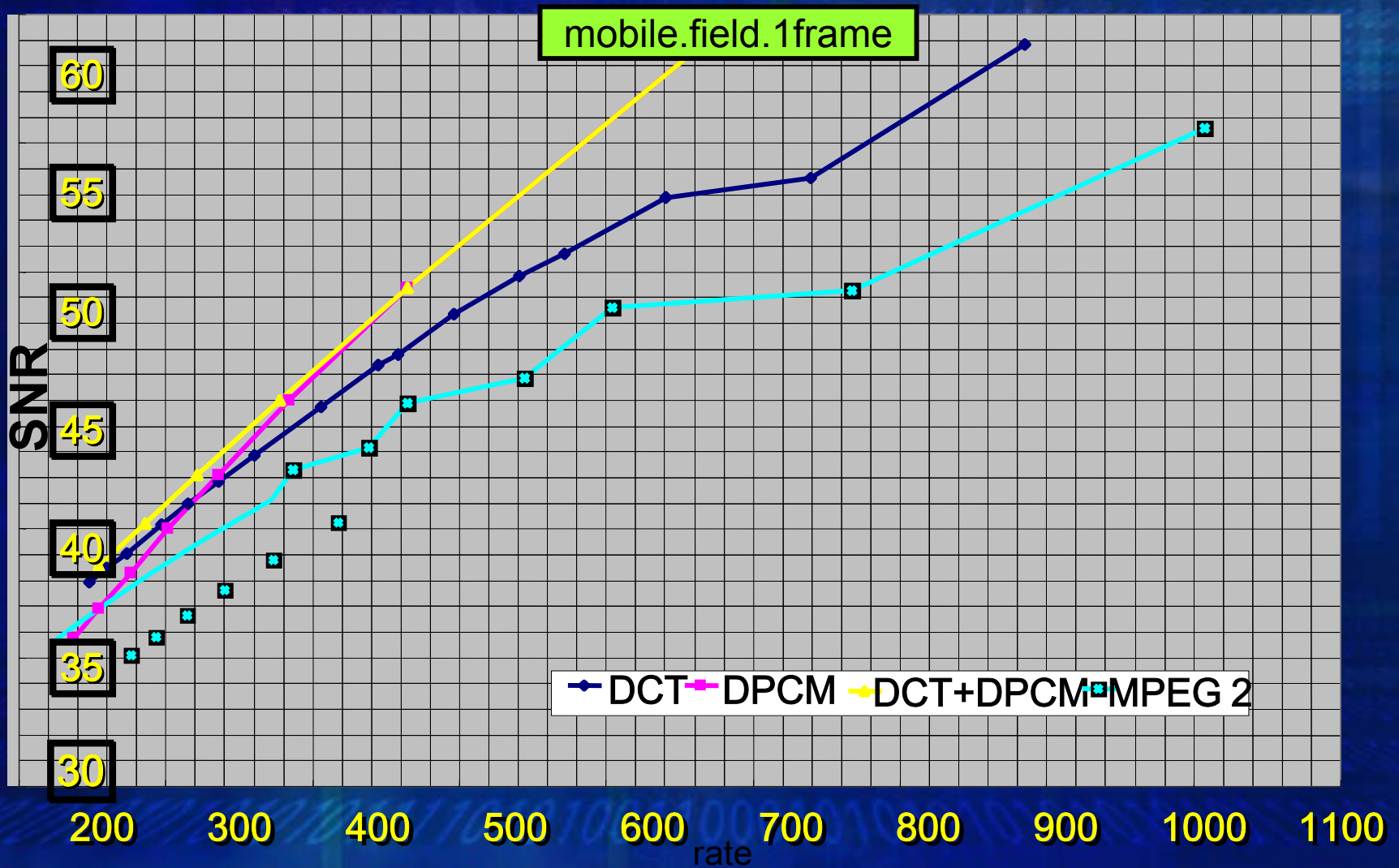
- **High efficiency VLC**
 - Grouping of DCT coefficients based on their values
 - Recursive selection of VLC table for groups of coefficients as function of previously coded group
 - Coded data = group indicator + fixed length code determining the actual value within the group
- **DPCM for Intra Coding:**
 - Lossless compression

SP – Compression Performance

- High efficiency by VLC optimized for high rates



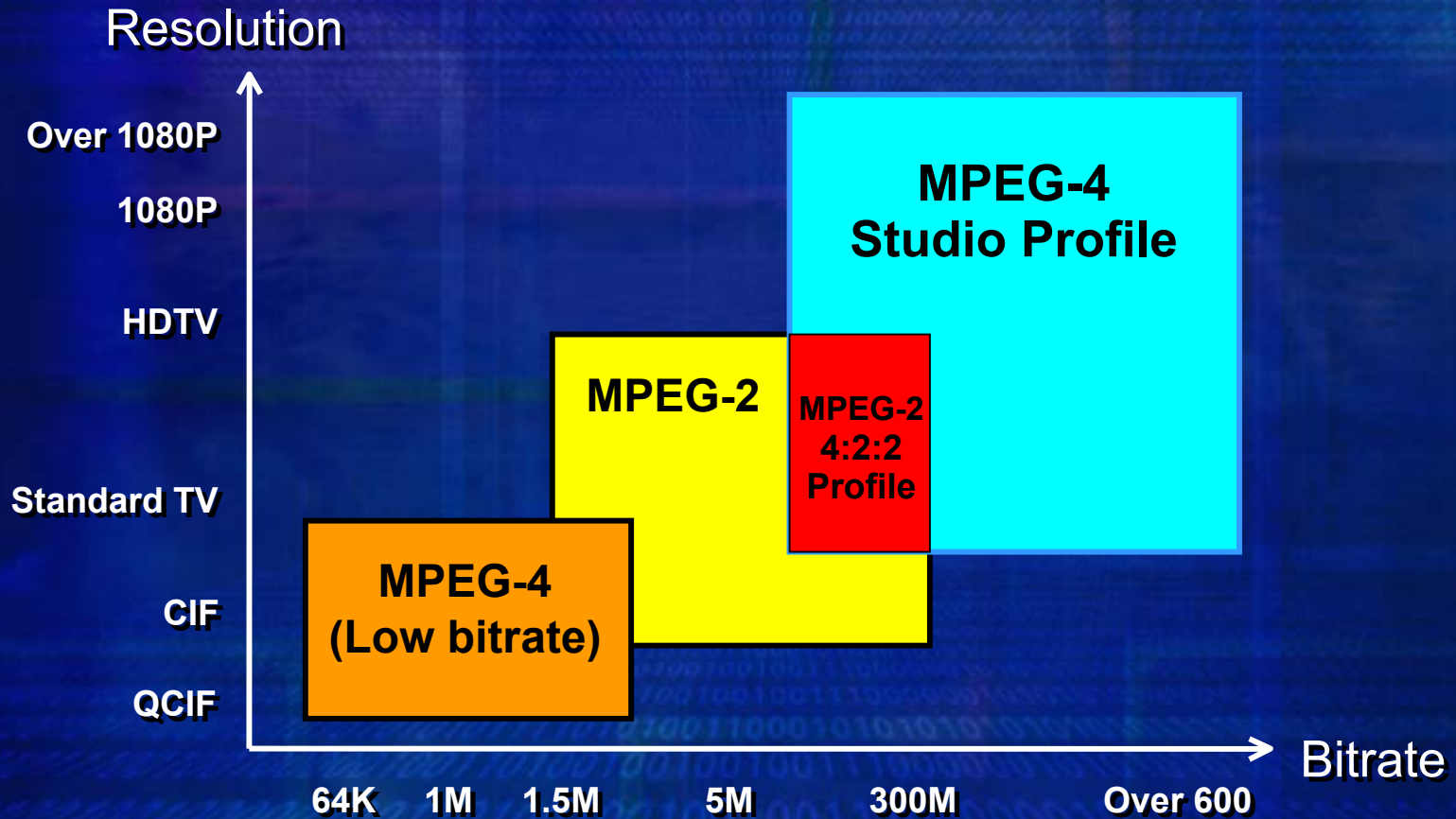
MPEG-4 Studio Profile



Simple Studio Levels

- 4 levels
 - SD@50Mbps, 60fps, 10bit
 - 2Mpix@300Mbps, 60fps, 10bit
 - 2Mpix@600Mbps, 60fps, 12bit
 - 4Mpix@1200Mbps, 60fps, 12bit
- 1 Simple Studio Object

SP – Resolutions & Bitrates



Transcoding

- Transcoding from/to MPEG-2 4:2:2 is straightforward
 - Huffman coding main difference
- From MPEG-2 4:2:2
 - lossless
- To MPEG-2 4:2:2
 - lossless

An MPEG-4 SP Mastering Platform

- 22:11:11 10/12 bit 24-30P recording with mild compression (MPEG-4); migration to 60P
- 22:22:22 10/12 bit with compression; migration to uncompressed recording
- 1920 x 1080 2K recording; migration to 4K x 2K
- Full editing capability (DT, Pre-read, audio x-fade, etc..)
- Legacy PB of HD and SD formats
- Built-in pull-down / format-converter boards
- 12 or more channels of Audio and Metadata
- HD-SDI and multi-Gbit Ethernet interfaces
- Affordable media cost
- Asynchronous handling of High-res. image data files

Summary

- MPEG-4 is a versatile standard
- Profiles define useful subsets
- Manufacturers' support for a number of applications
- Studio Profile targets high quality pictures
 - Added functionality over MPEG-2 4:2:2P@HL
 - Post-Production, Mastering, Electronic-Cinematography, Digital Cinema applications
 - Straightforward transcoding to/from MPEG-2