The New Audio-Visual Coding Guidelines

Advanced Compression in DVB

Ken McCann
ZetaCast

Who are ZetaCast?

Independent technology consultancy company

- Specialising in digital TV

ZetaCast directors have each over 15 years experience of digital TV, including

- Leading development of the world's first broadcast-quality MPEG-1 decoder
- Leading design team for the world’s first real-time MPEG-2 encoding system
- System integration and project management for digital terrestrial, cable and satellite systems

Overview of the Presentation

DVB A/V Specifications

- Revised specification for TS-based broadcasting

Advanced A/V Coding

- H.264/AVC Video

Conclusions

Role of DVB in A/V coding

DVB evaluates audio and video coding algorithms published by relevant standardisation bodies against commercial requirements

- Selects appropriate trade-off between compression efficiency and implementation cost
- DVB does NOT develop coding algorithms itself!

A/V codecs are accepted by DVB for inclusion in its specifications based on technical or commercial benefit

- Addition of features, functionality, quality, coding efficiency or market reach beyond that offered by the existing set of DVB supported codecs

One Size Fits All ?

- 10 years ago DVB had a one-codec approach
  - MPEG-2 video
  - MPEG-1 Layer II audio
- A single codec no longer meets the market needs of all DVB applications
  - Technology has advanced
    - Advanced A/V compression algorithms give significant improvement in coding efficiency
    - Move towards programmable decoders
  - DVB now addresses a broader range of markets
    - Different codecs are significant in different markets

Multi-Codec World

In addressing the multi-codec world, DVB had to balance two contradictory requirements

- Provide optimum solution for each DVB application
- Maximise commonality between DVB applications

Solution is to adopt a "toolbox" approach

- Applications can use most appropriate tool from the toolbox
- Common generic toolbox for all DVB applications

If IPR costs could have been ignored, it would have been useful to set a baseline functionality for all decoders

- MPEG-2 video and MPEG-1 Layer II audio

Not commercially viable due to IPR costs

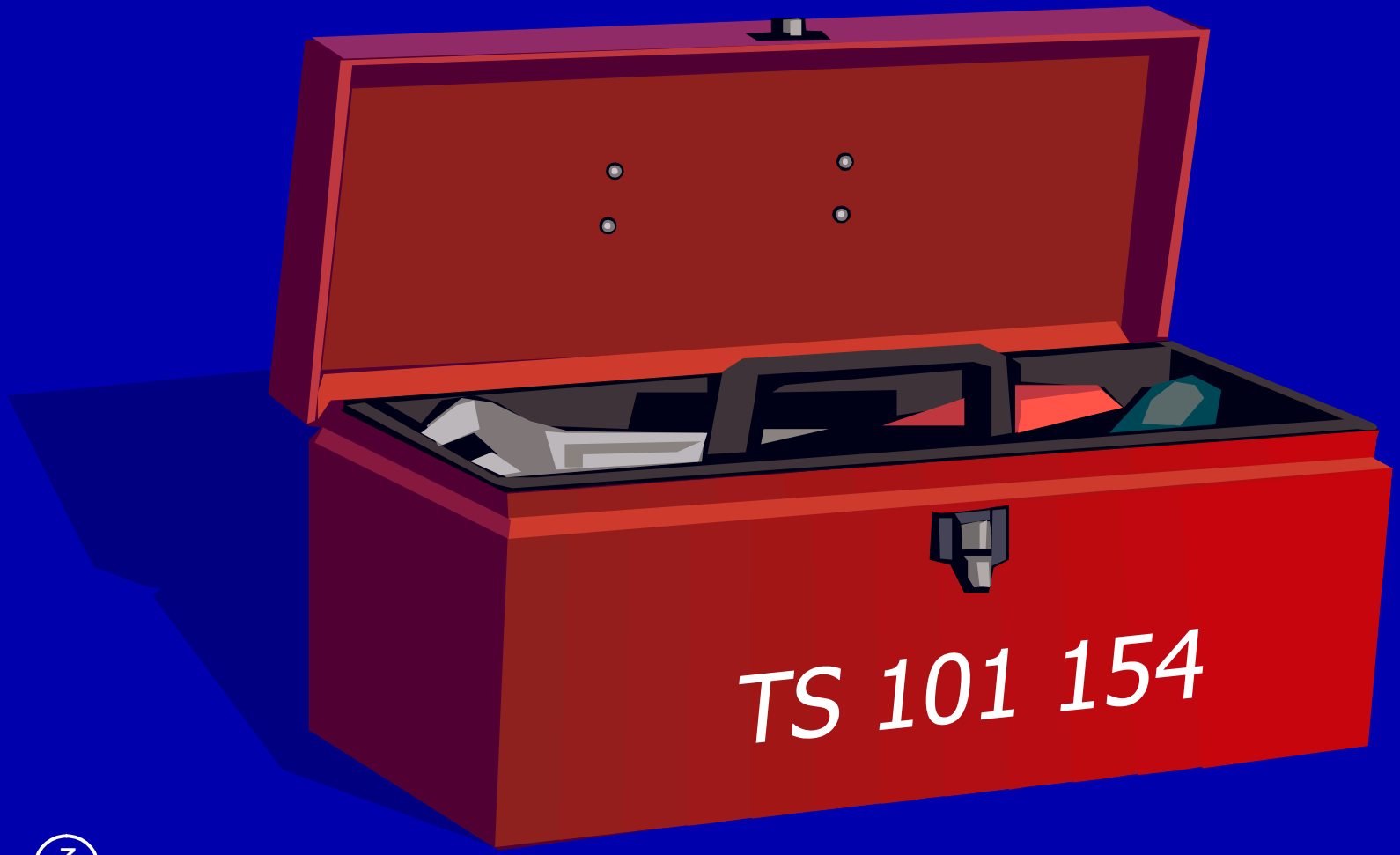
- No mandatory codec support required

The DVB Toolbox Approach

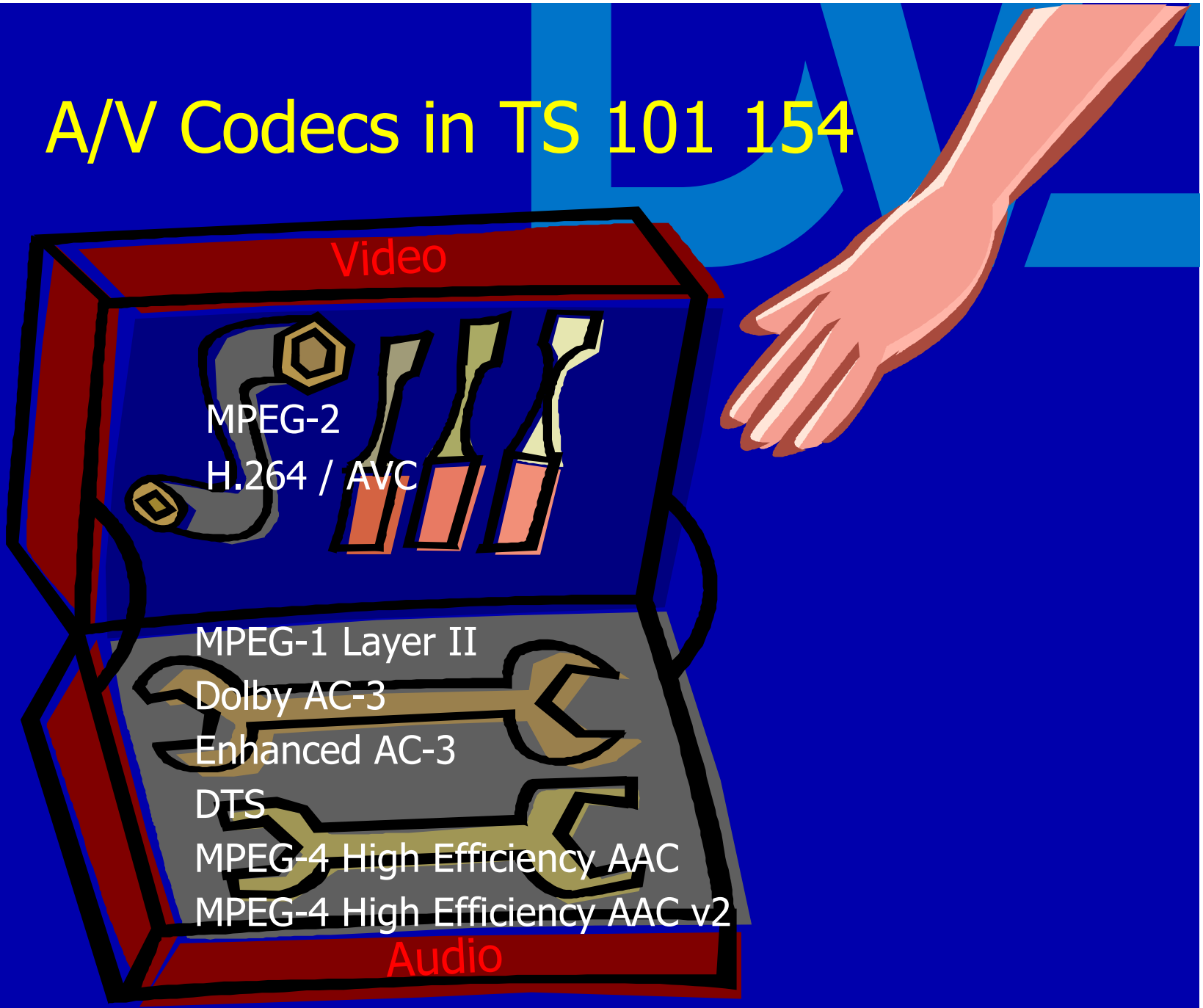
Criteria for Inclusion in DVB Toolbox

1. Significant market demand verified by CM-AVC based on:
   - Support from at least 5 DVB members from 2 constituencies
   - Evidence that a complete value chain will be in place
     - e.g. content provider, network operator and device manufacturer
2. Published by one of the international standardisation bodies that is recognised by DVB
   - e.g. ISO/IEC, ETSI, ITU, IETF, W3C, SMPTE
3. IPR available under fair, reasonable and non-discriminatory terms
4. Performance verified by TM-AVC based on:
   - A testing process conducted by a competent independent body
   - Results of such tests that demonstrate that the codec meets acceptable thresholds in terms of any claimed technical benefits

Toolbox for TS-based Broadcasting



A/V Codecs in TS 101 154



H.264/AVC Video Coding

H.264/AVC gives about a factor of 2 improvement in coding efficiency relative to MPEG-2 video

- Included in latest versions of DVB toolbox for both TS-based and IP-based applications

H.264/AVC was published in 2003 as:

- ITU-T Recommendation H.264
- ISO/IEC 14496-10

Fidelity Range Extensions added in 2004

Levels in H.264/AVC

Levels define constraints on parameter values

- Maximum video resolution, bit-rate, etc
- 16 Levels have been defined

Level number	Max macroblock processing rate MaxMBPS (MB/s)	Max frame size MaxFS (MBs)	Max decoded picture buffer size MaxDPB (1024 bytes)	Max video bit rate MaxBR (1000 bits/s or 1200 bits/s)	Vertical MV component range MaxVmvR
1	1 485	99	148.5	64	[-64,+63.75]
1b	1 485	99	148.5	128	[-64,+63.75]
1.1	3 000	396	337.5	192	[-128,+127.75]
1.2	6 000	396	891.0	384	[-128,+127.75]
1.3	11 880	396	891.0	768	[-128,+127.75]
2	11 880	396	891.0	2 000	[-128,+127.75]
2.1	19 800	792	1 782.0	4 000	[-256,+255.75]
2.2	20 250	1 620	3 037.5	4 000	[-256,+255.75]
3	40 500	1 620	3 037.5	10 000	[-256,+255.75]
3.1	108 000	3 600	6 750.0	14 000	[-512,+511.75]
3.2	216 000	5 120	7 680.0	20 000	[-512,+511.75]
4	245 760	8 192	12 288.0	20 000	[-512,+511.75]
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4.2	491 520	8 192	12 288.0	50 000	[-512,+511.75]
5	589 824	22 080	41 310.0	135 000	[-512,+511.75]
5.1	983 040	36 864	69 120.0	240 000	[-512,+511.75]

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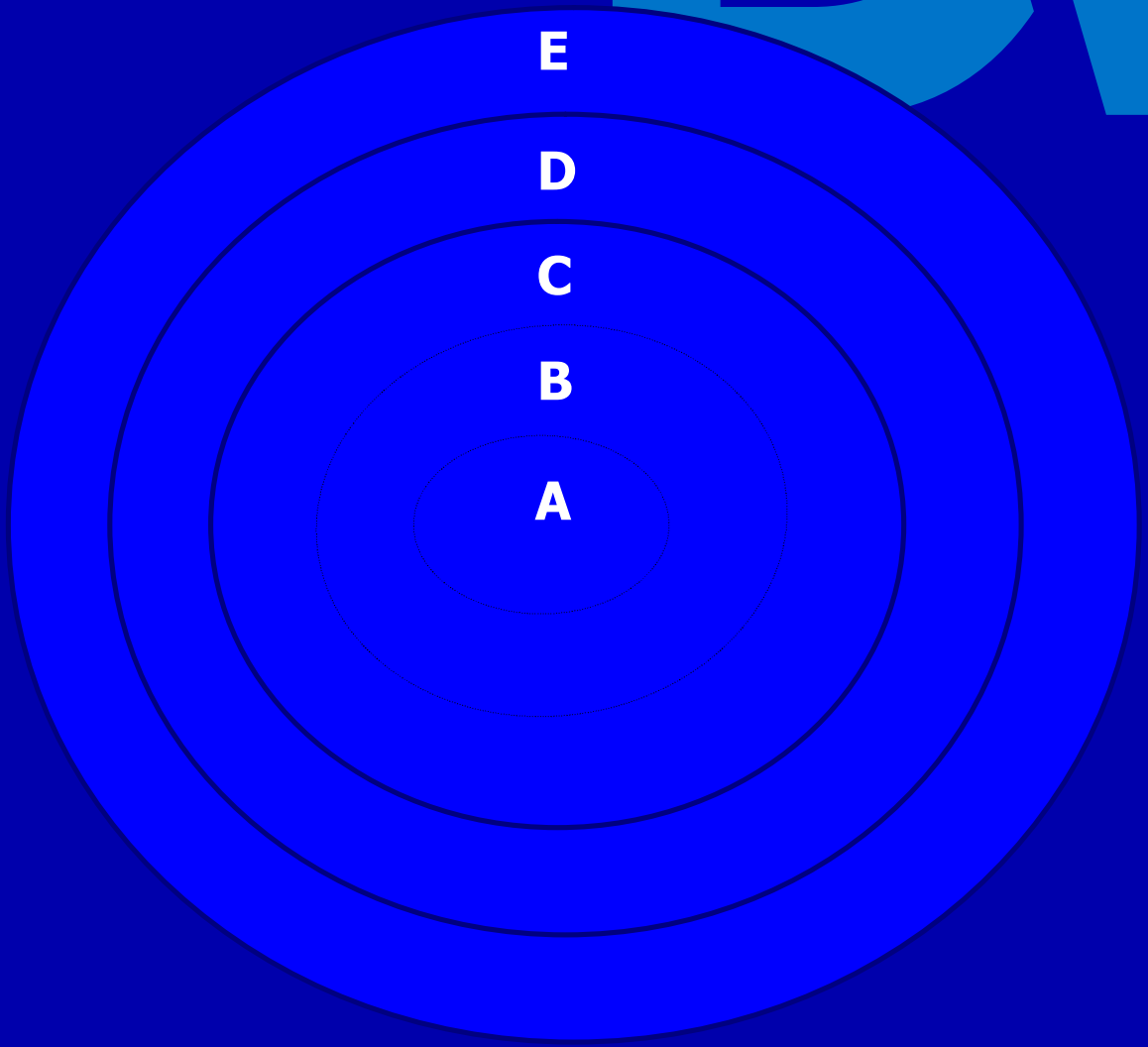
Defined Capabilities of DVB IRDs

DVB IRD Capability	H.264/AVC Level	Example of Max. Video Format	Maximum Bitrate	Typical Bitrate	Typical Implementation
A	1b	QCIF 15f/s	128 kbit/s	100 kbit/s	UMTS phone
B	1.2	CIF 15f/s QCIF 60f/s	384 kbit/s	200 kbit/s	PDA
C	2	CIF 30f/s	2 Mbit/s	768 kbit/s	mobile receiver PC
D	3	SDTV	10 Mbit/s	2 Mbit/s	Set-top box Integrated TV
E	4	HDTV 720p or 1080i	20 Mbit/s	8 Mbit/s	LCD, DLP or Plasma screen

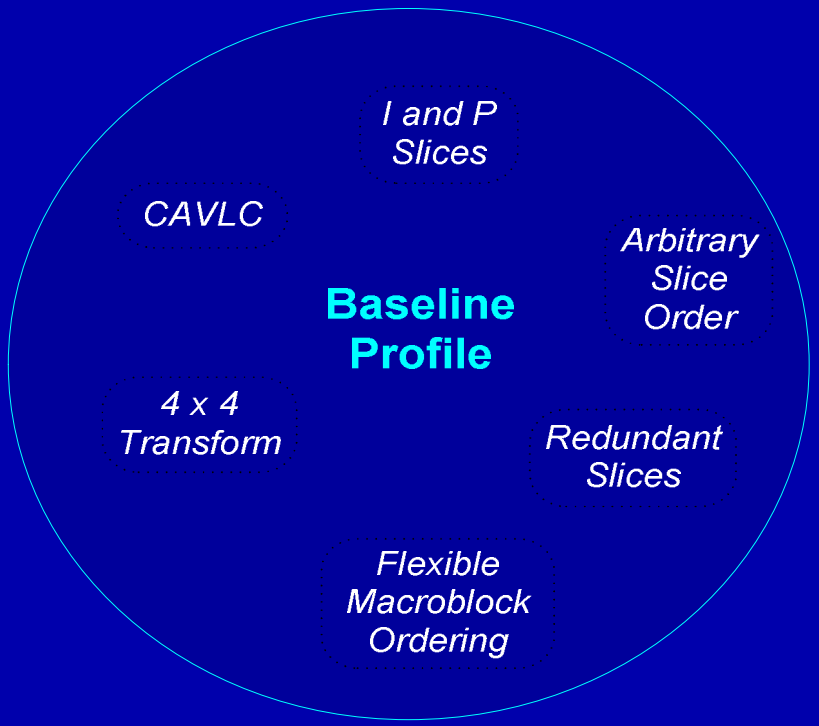
Relationship Between IRDs



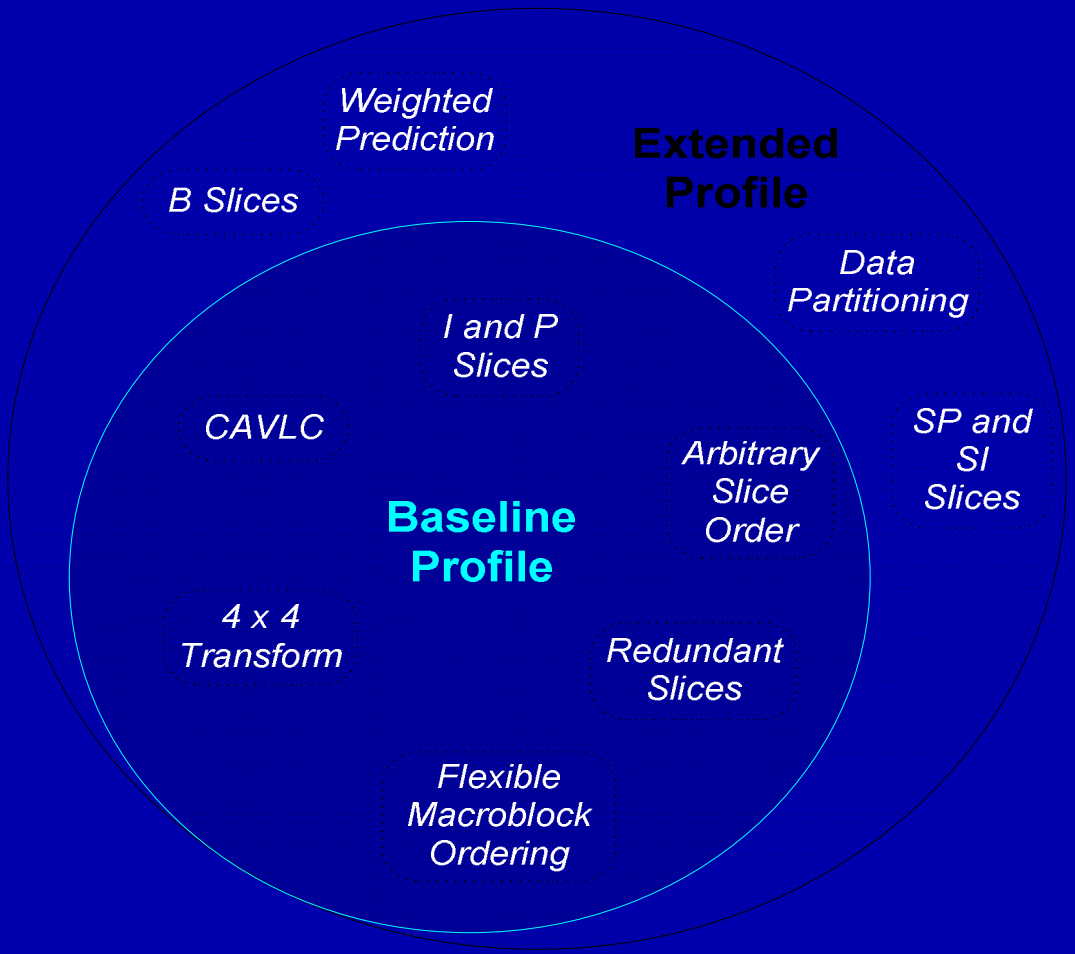
Profiles in H.264/AVC

- Profiles define subsets of the toolkit
  - allowed picture types, entropy coding scheme, etc.
- 3 Profiles were defined in the 2003 standard:
  - Baseline Profile
    - Targeted at Videoconferencing applications
  - Extended Profile
    - Targeted at Internet applications
  - Main Profile
    - Targeted at Broadcast applications
- 4 more were defined in the Fidelity Range Extensions
  - High Profile
    - Main Profile plus additional tools
  - High 10 Profile
  - High 4:2:2
  - High 4:4:4

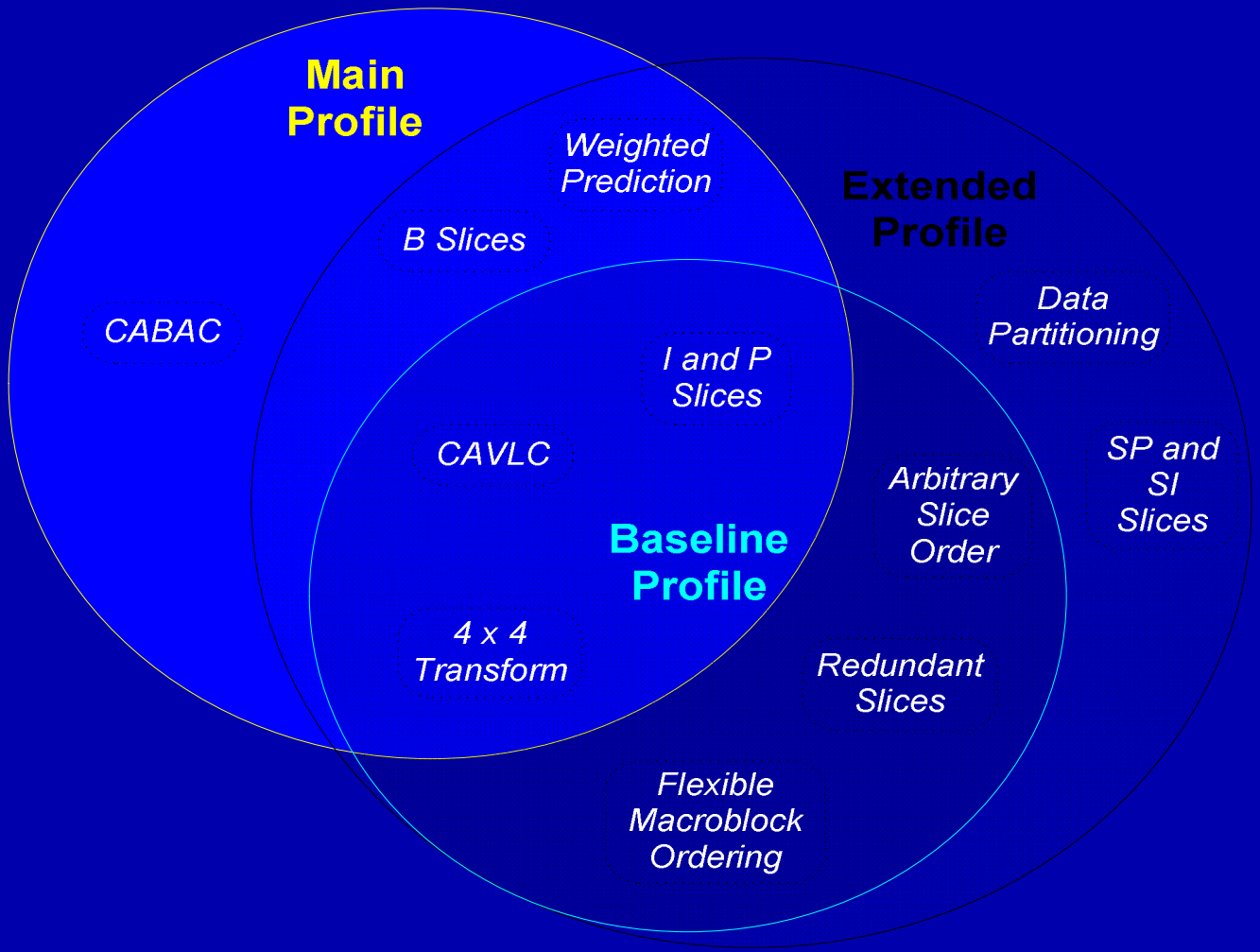
H.264/AVC Profiles



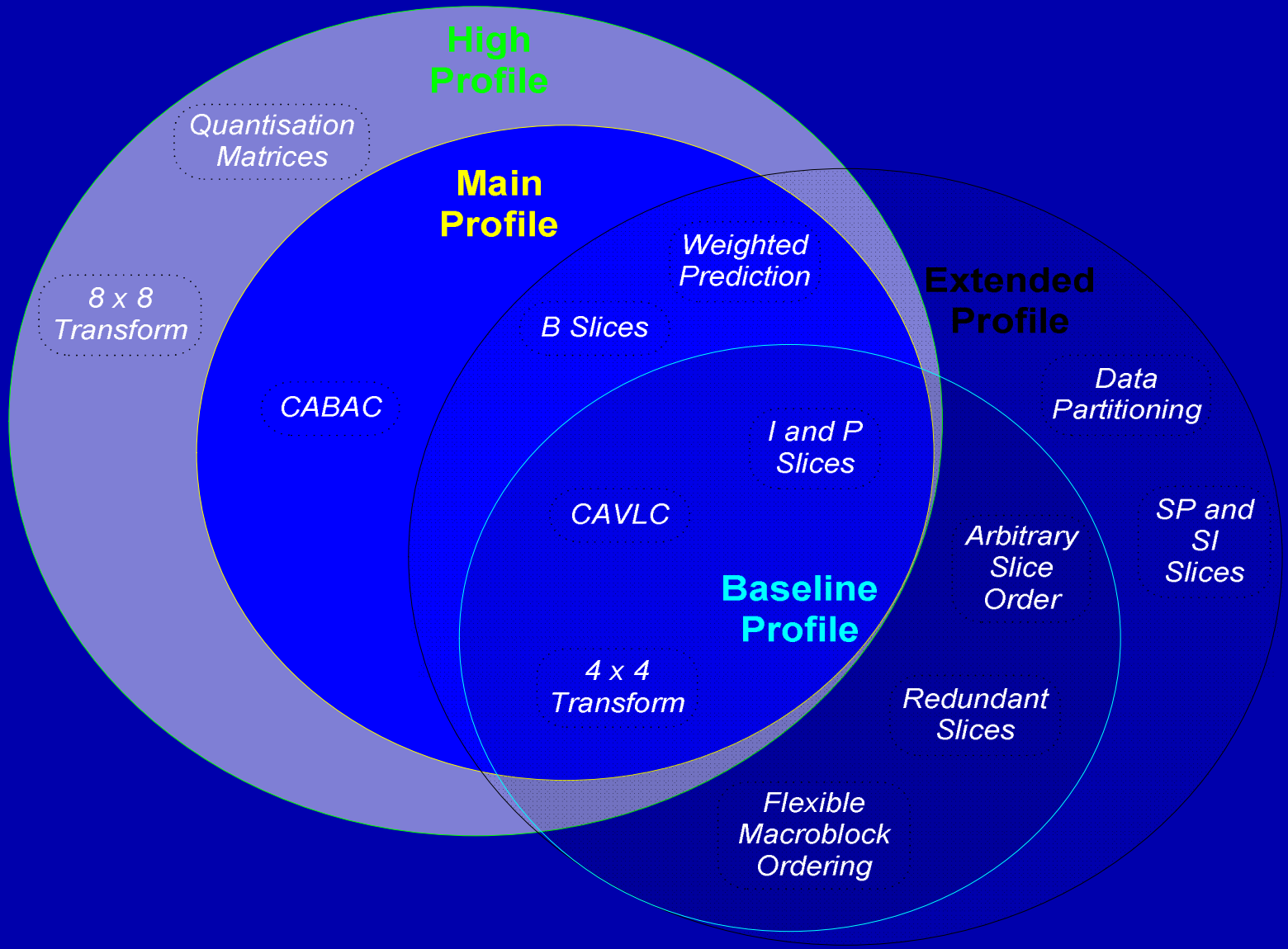
H.264/AVC Profiles



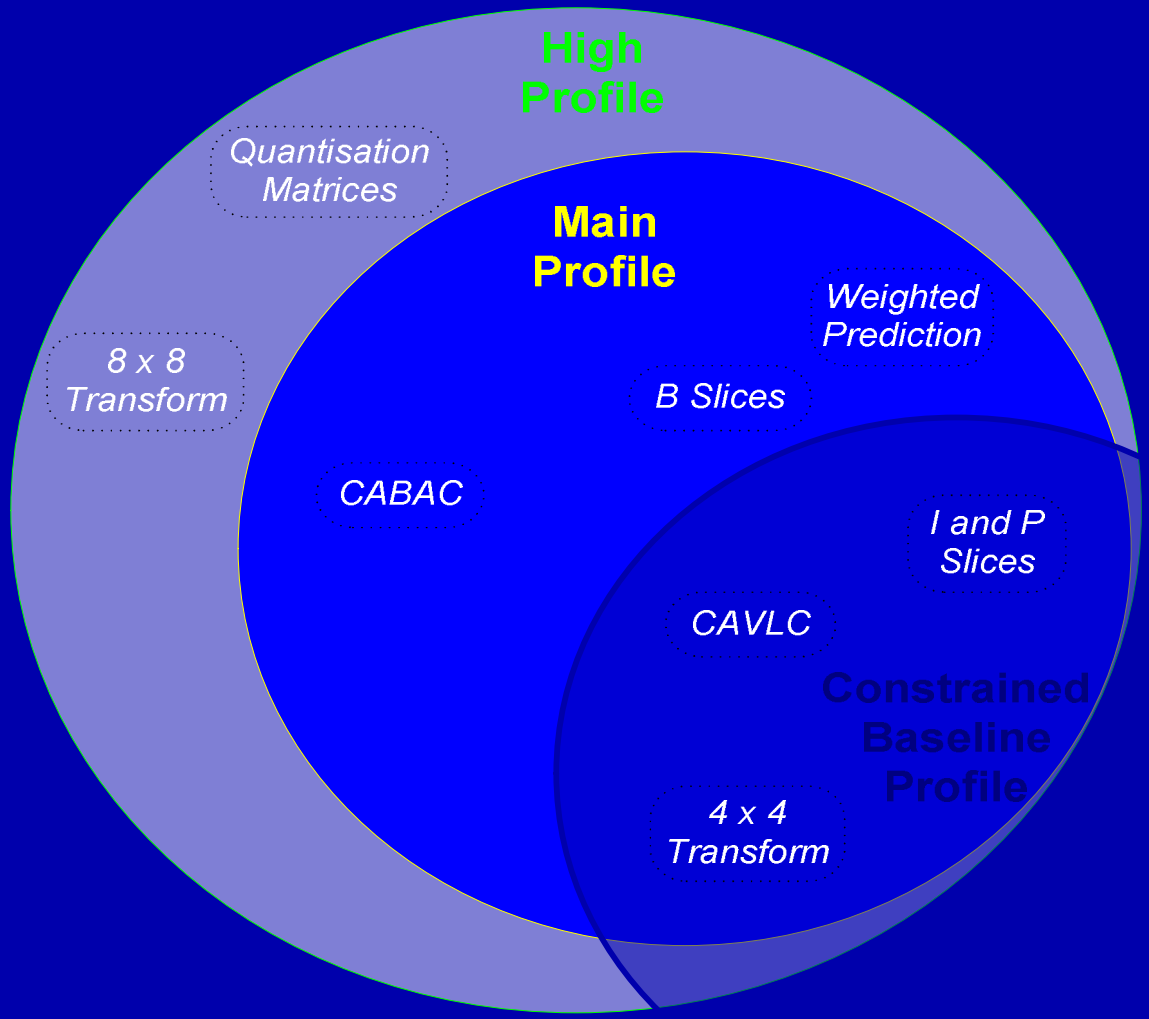
H.264/AVC Profiles



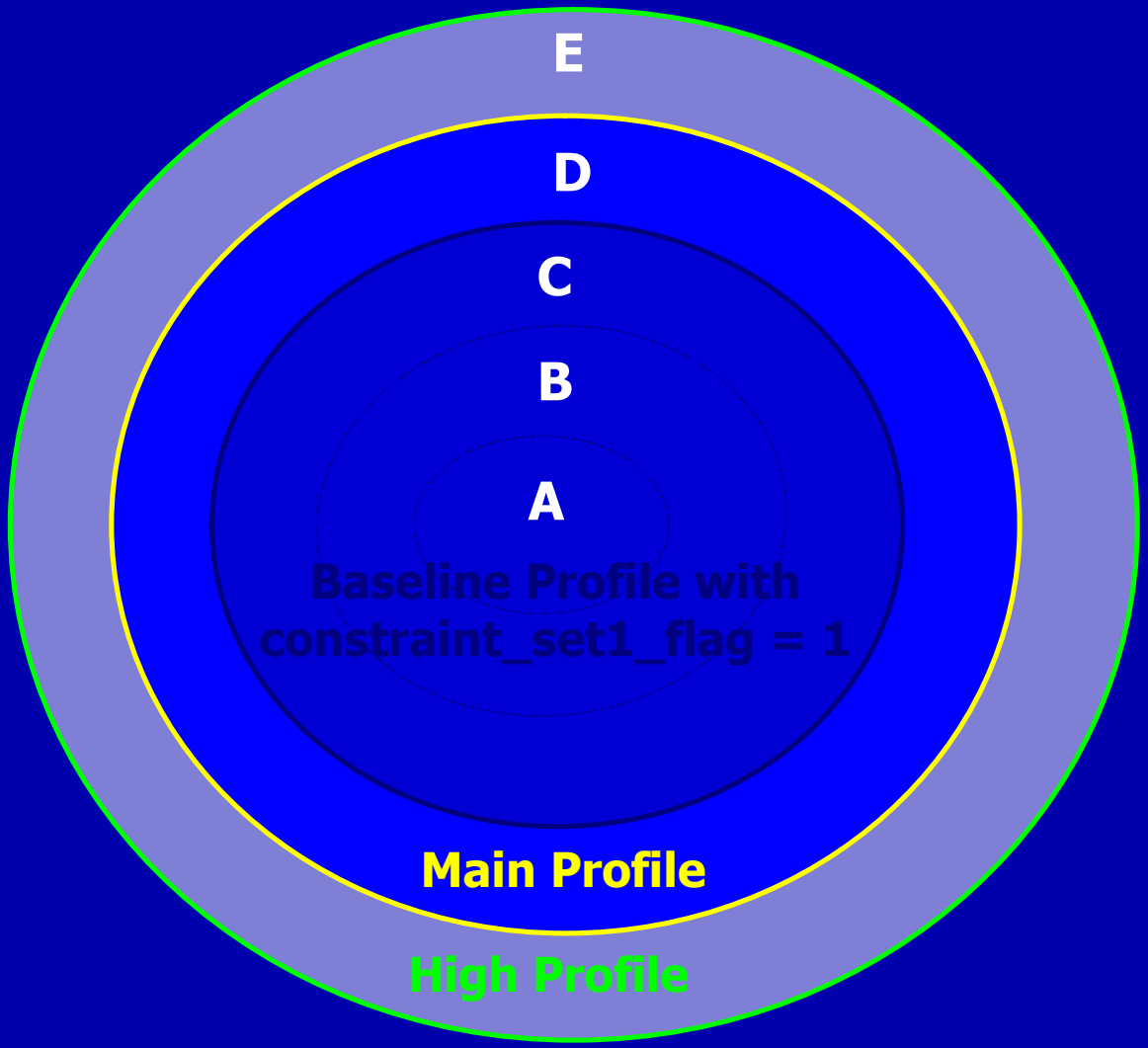
H.264/AVC Profiles



H.264/AVC Profiles



H.264/AVC Profile support required for Decoders



Examples of Initial H.264/AVC Applications

Transport Stream Based (TS 101 154)

- HDTV
  - Not a major legacy problem in the DVB world
  - New compression can be combined with DVB-S2
- SDTV
  - Where legacy is less of a concern
  - Phase 1.5 IPTV services (TS over IP)

IP-Based (TS 102 005)

- SDTV
  - Phase 2 IPTV services (directly over IP)
- Sub-SDTV Resolution
  - Mobile services over DVB-T or DVB-H

Conclusions

DVB A/V Coding Specifications have moved towards a toolbox approach

Toolboxes for both TS-based and IP-based applications include Advanced A/V coding

- about twice the coding efficiency of MPEG-2 video and MPEG-1 Layer II audio

Further work remains

- Consideration of additional audio and video tools
  - e.g. VC-1 video
- Application-specific constraints to IP-based toolset for the convergence of broadcast and mobile services
- Updating of Contribution Specification