Video Coding IPR Issues

Developing China's standard for

HDTV and HD-DVD

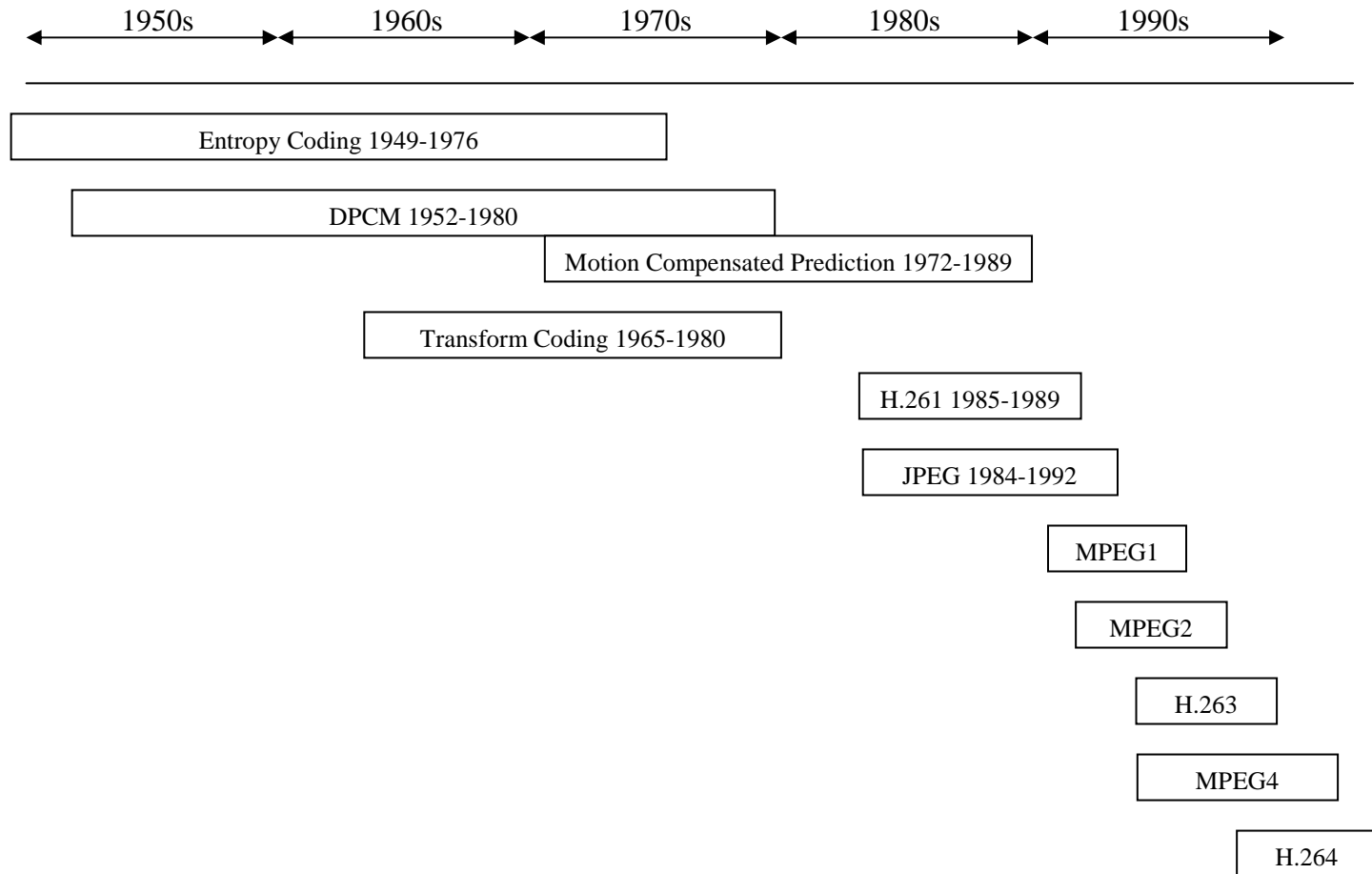Cliff Reader, Ph.D.

www.reader.com

Agenda

- Which technology is patented?

- What is the value of the patents?

- Licensing status today.

- How to minimize impact of patents.

- Progressive DTV Standard for China
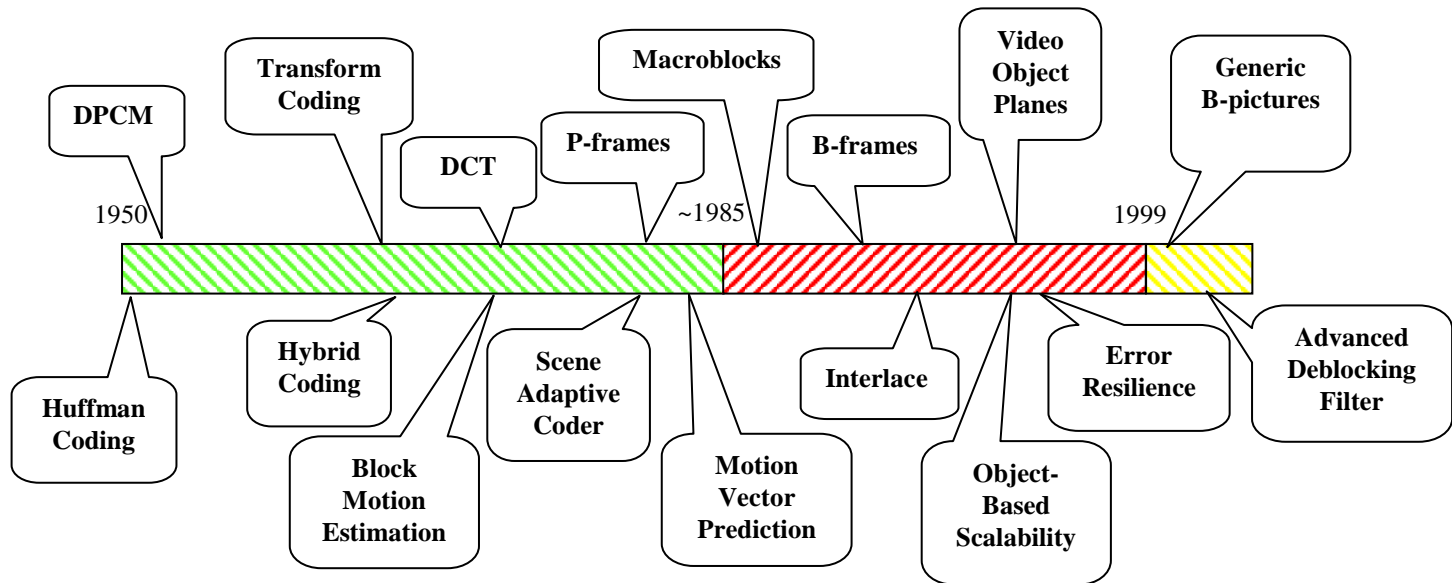
History of Video Compression

JVT-E066

- H.26x and MPEGx algorithms are built from a set of coding tools:
- Three main coding tools:
  - DCT coding to remove spatial redundancy
  - DPCM coding to remove temporal redundancy
  - Entropy coding to remove statistical redundancy
- Small coding tools:
  - Removal of residual redundancy
  - Coding of side information
  - Formatting the syntax of the coded bitstream
- Most of these tools were invented 20-30 years ago

Main Tools & Standards

| 1950s | 1960s | 1970s | 1980s | 1990s |

Entropy Coding 1949-1976

DPCM 1952-1980

Motion Compensated Prediction 1972-1989

Transform Coding 1965-1980

H.261 1985-1989

JPEG 1984-1992

MPEG1

MPEG2

H.263

MPEG4

H.264

Periods of IPR

C Reader, 2002

Periods of IPR

- ## Up to 1985:
    - Many coding tools were never patented.
    - Patents that were granted have largely expired.
    - The coding tools in this period contribute most of the basic performance.
    - Some important tools were invented that have not been used until very recently.

Periods of IPR

- **1985 to 1999:**
  - Many small coding tools were patented.
    - The small coding tools only provide small improvements in performance.
  - Interlaced coding tools were heavily patented.
  - B-frame coding tools were heavily patented.
  - Some tools from the early period were reinvented and patented.
    - These tools were too complex to implement originally and had been forgotten.
  - Some patents were filed without adequate prior art search and are not original.

Periods of IPR

- ## **After 1999:**
    - New tools have been invented
    - These offer significant performance
    - Most are offered royalty-free to the H.264 baseline algorithm (RFB).

Performance

- Most of the performance comes from tools that are free from IPR

- Alternatives exist for patented tools (except interlaced coding)

- Much of the performance comes from "smart encoding"
  - MPEG2 performance today is much higher than 10 years ago

Conclusion

- Most IP today is low value; alternatives exist

- Exceptions are interlaced coding tools and B-frames

- Recent improvements are included in H.264-RFB

Licensing Status

- Licensing terms for MPEG4-Visual have been rejected by most of the market
  - Too late
  - Too complex
  - Fees on content and service are unacceptable
  - Different fees for different applications and different delivery networks are unacceptable

Licensing Status

- Representatives of many companies from many industries around the World met to present their opinion of licensing for H.264 (Main and Extended profiles)
  - Very consistent opinions that the license must be fast, simple, inexpensive, consistent across applications and networks
  - Most people rejected content and service fees

Licensing Status

- Competition in coding algorithms!
  - Now there are proprietary alternatives
  - Performance is very high in tests despite not using patented coding tools
- Competition in licensing!
  - Via Licensing is competing with MPEGLA
- MPEGLA is meeting this week
  - Many feel this is their last chance to offer reasonable terms for MPEG4 and H.264

H.264 IPR Policy

- Main and Extended profiles must have "RAND" licensing (Reasonable And Non-Discriminatory)
- The royalty free baseline is in the Terms of Reference for JVT.
  - All proposals to JVT must include a Patent Disclosure Form.
  - Clause 2.2.1 of this form, says companies will license royalty free for the baseline if all other companies do so.
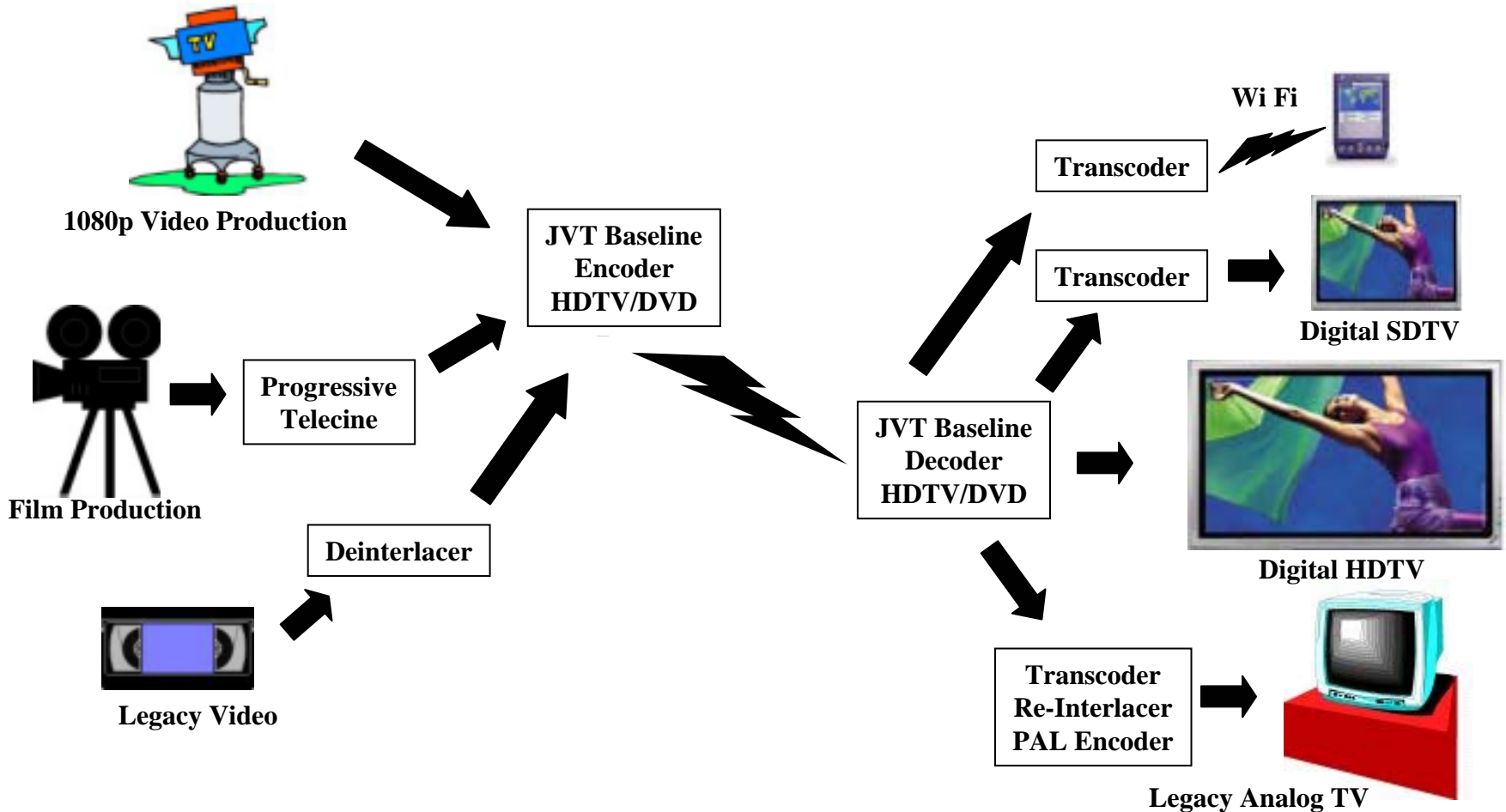
H.264 Status for RFB

- Most companies provided 2.2.1 statement
- No new technology without 2.2.1 is in baseline
- Interlace was removed from baseline
- One company joined the RFB to avoid removal after a redesign was submitted
- Technical and legal review has determined the RFB goal has been achieved

How to proceed?

- Base AVS video coding on H.264 Baseline
  - Royalty-free
  - Performance somewhat less than Main

- Enhance the performance with additional coding tools that are free from patents
  - Document the origin of these tools in detail as a defense against IPR claims

- Utilize smart encoding to achieve nearly optimum performance

Progressive TV/DVD Standard

1080p Video Production

Film Production

Progressive Telecine

Legacy Video

Deinterlacer

JVT Baseline Encoder HDTV/DVD

JVT Baseline Decoder HDTV/DVD

Transcoder

Wi Fi

Transcoder

Digital SDTV

Digital HDTV

Transcoder Re-Interlacer PAL Encoder

Legacy Analog TV

Video Formats

- Decouple the formats for:
  - Production – make a fixed format
  - Distribution – H.264 coding with adaptive spatial and temporal resolution (video slices)
  - Display – make several options based on:
    - Cost
    - Network connection

Proposal – Progressive Standard

- Highest Quality – Lowest Bitrate encoding
  - HDTV at 8Mbits/s or less; SDTV at 1.5Mbits/s
  - Progressive displays can have Kell factor close to unity
- Decouple display from distribution
  - Advanced displays can have frame storage
  - Provide a range of resolutions at different prices like PC Monitors:
    - Wide versions of SVGA, XGA, SXGA, etc.
  - Down-sample, re-interlace and PAL-encode for legacy TVs in digital settop converter

Proposal – Progressive Standard

- Progressive Production:
  - Progressive telecine for film: highest quality, lowest noise
  - 1080p digital film cameras and 24p production is now becoming the new standard
  - 60p production needed for sports
  - CCD cameras, webcams, security cameras are all progressive (internally at least)
- Legacy interlaced video:
  - Motion-compensated de-interlacing is now available
  - Convert to progressive before encoding with JVT

Summary

- MPEG4/H.264-Main profile licensing situation is very uncertain:
  - Schedule? Cost? Terms?
- Close to optimum performance can be achieved without patented coding tools
  - H.264 Baseline + extensions
  - Progressive-scan format
- China can be the global leader:
  - Progressive HDTV superior to MPEG2
  - World's first standard for HD-DVD