

Streaming Video & MPEG4IP

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- **Why should I care when I already have DVD, Digital Cable, DV camcorders, etc.?**

Precedent of the benefits of the Web

Ubiquity and flexibility!

Streaming Video Applications

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Video is not just TV and movies!

Education and training

Conferences

Organizational meetings

Personal streaming (webcams++)

Remote data gathering

Security surveillance

Remote robot operation, aka telepresence

- **Why don't I have this now?**
Video Challenges
Network Challenges

Video Challenges – Raw Video

Format	Resolution	Bitrate	Storage
QCIF	176 x 144 @ 15 fps	9 Mbps	68 MB/min
CIF	352 x 288 @ 30 fps	73 Mbps	548 MB/min
NTSC	720 x 480 @ 30 fps	249 Mbps	1.9 GB/min
HDTV	1920 x 1080 @ 30 fps	1.5 Gbps	1.1 TB/min

Video Challenges – Raw Video

- **Need for compression to achieve manageable bitrates and storage**
- **Hence need for significant video processing**

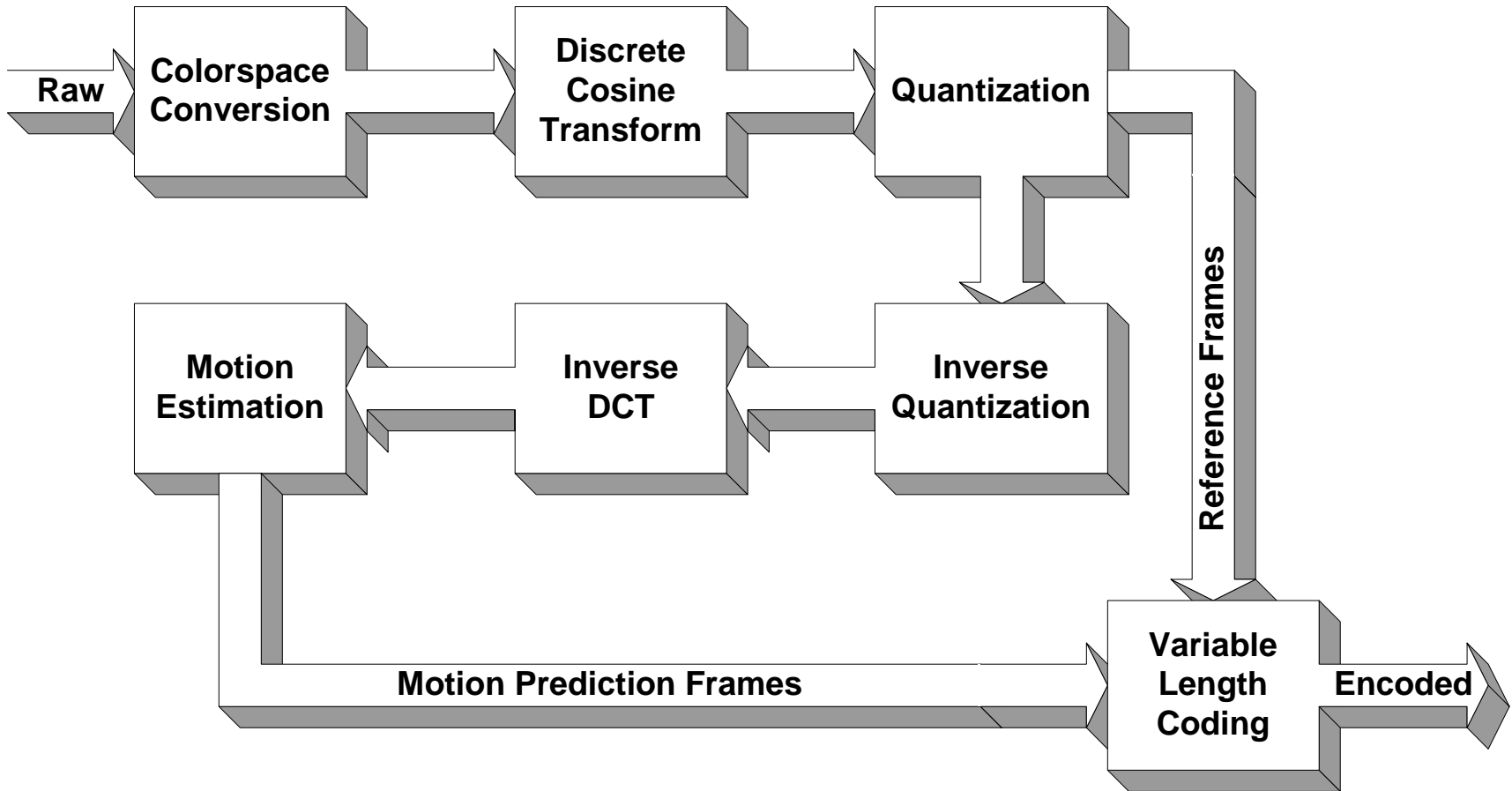
Video Compression

Format	Codec	Bitrate	Storage
QCIF	MPEG-4 Simple	50-300 kbps (9 Mbps)	400-2400 KB/min (68 MB/min)
CIF	MPEG-4 Simple	500-1000 kbps (73 Mbps)	4-8 MB/min (548 MB/min)
NTSC	MPEG-2 Main	2-6 Mbps (249 Mbps)	15-45 MB/min (1.9 GB/min)
HDTV	MPEG-2 High	15-30 Mbps (1.5 Gbps)	113-225 MB/min (1.1 TB/min)

Video Codecs

- **Authoring - DCT only**
Motion-JPEG, DV
- **Distribution - DCT + MV**
MPEG-1, MPEG-2, MPEG-4
H.261, H.263
Real & WMT
- **Challengers**
2D Wavelet + MV, 3D Wavelet, Fractal
Research or proprietary
Have yet to dramatically exceed DCT + MV

DCT + MV Video Encoder

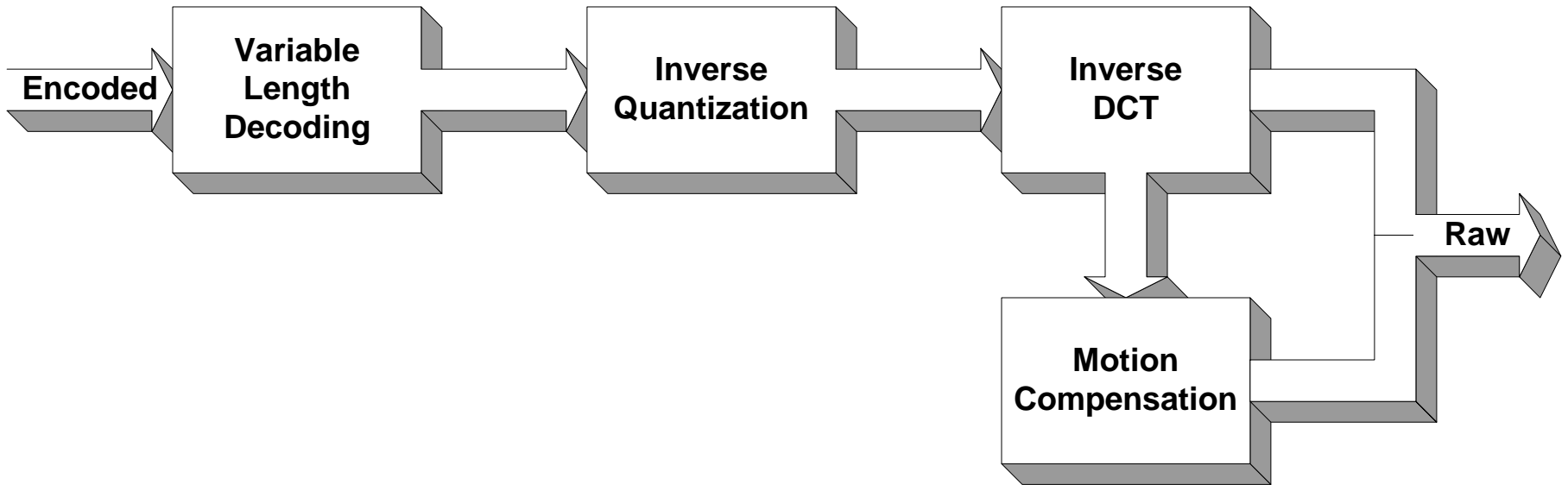


DCT & QUANT

- **DCT by itself doesn't compress, it just changes the representation of the data.**
- **However once the DCT is quantized, compression is dramatic, 10:1 – 64:1**

PIXELS	DCT	QUANT
104 100 92 75 67 63 62 56	714 126 27 8 3 -2 -6 -8	720 120 24 0 0 0 0 0
108 107 88 80 73 65 64 59	-55 20 4 3 -9 -2 -1 9	-56 24 0 0 0 0 0 0
123 112 99 83 78 72 70 64	-4 -12 -2 -9 -4 2 0 -1	0 0 0 0 0 0 0 0
115 124 95 89 80 75 67 66	-11 -3 -2 2 6 4 5 6	0 0 0 0 0 0 0 0
122 106 91 92 83 79 72 69	-5 -1 -2 1 -2 0 -1 -7	0 0 0 0 0 0 0 0
127 105 99 97 91 82 76 78	3 3 1 -8 -7 -7 -1 1	0 0 0 0 0 0 0 0
112 119 104 99 88 83 82 88	5 2 1 5 4 7 7 4	0 0 0 0 0 0 0 0
117 115 99 108 88 92 86 89	-1 -2 2 0 -1 4 3 3	0 0 0 0 0 0 0 0

DCT + MV Video Decoder



Network Challenges

- **Bandwidth**
The last mile chasm
- **Real-time Quality of Service (QoS)**
Bounded packet loss, jitter, & latency
- **Multicast**
Scalable delivery

Network Tools - Bandwidth

- **Nirvana - Passive Optical Networking (PON)**
- **Radical - Convert Cable HFC network to IP**
- **AdHoc - 802.11a/b + Cable modem?**

Network Tools – Quality of Service

- **Multiprotocol Label Switching (MPLS)**
Core routing technology with classes of service
- **Resource Reservation Protocol (RSVP)**
Signalling technology for application QoS
- **Voice over IP (VoIP) is blazing this trail**

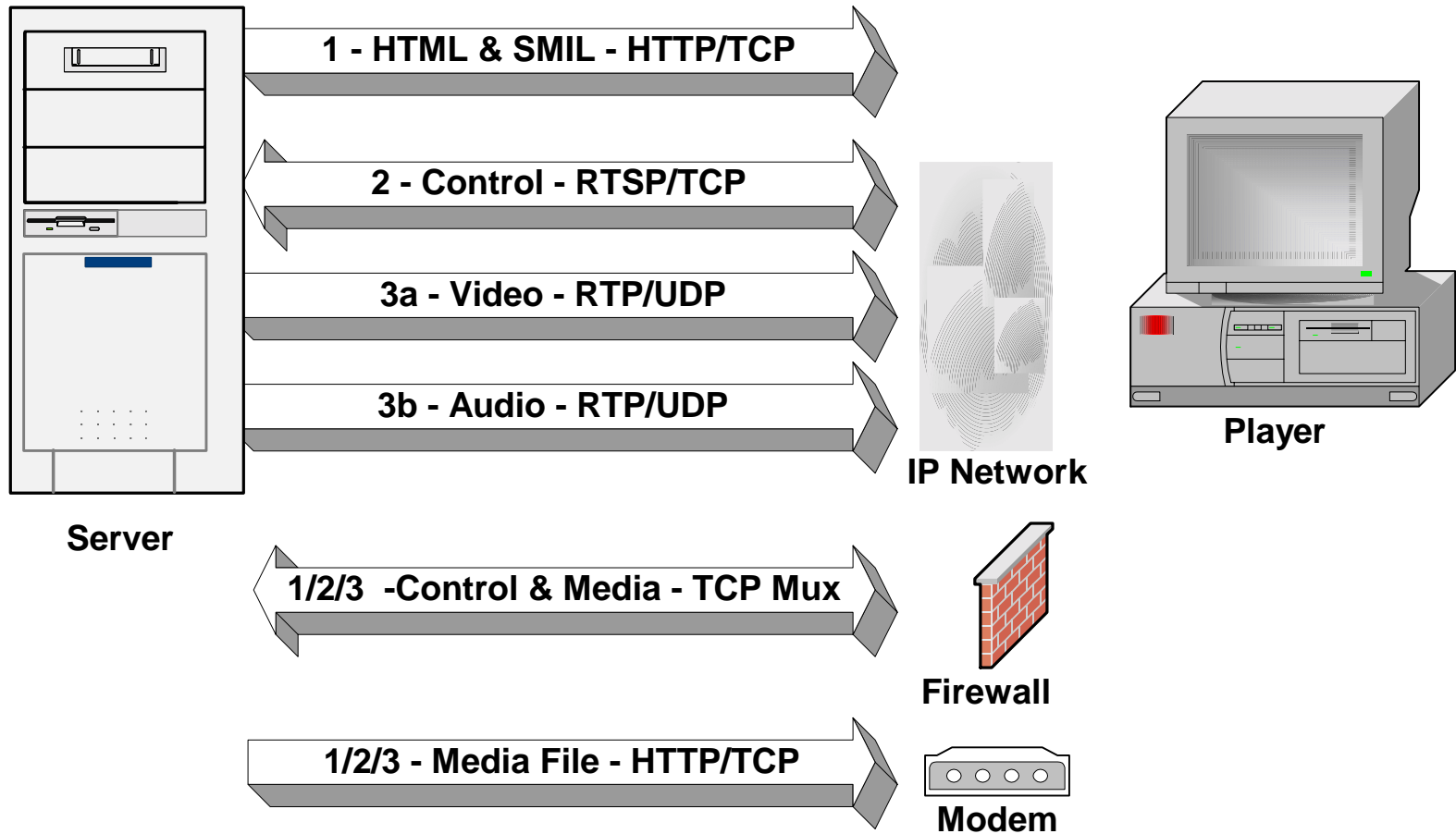
Network Tools – Multicast

- **IP Multicast originally aimed at few to few**
 - Required per user state in routers**
 - Fatal flaw for large audiences**
- **Internet Group Management Protocol (IGMP v3) & Single Source Multicast (SSM)**
 - Addresses router multicast scaling issues**
- **1 to Many, similar to traditional broadcasting**
 - Huge bandwidth savings over 1 to 1**

Network Tools - IETF Streaming Standards

- **Real Time Streaming Protocol - RTSP**
Control functions, RFC 2326
- **Real Time Protocol - RTP**
Transmission, RFC 1889 & others
- **Session Description Protocol – SDP**
Announcement, RFC 2327

IETF Streaming Video Model



Streaming Video Today

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	Protocols	Codecs	File Formats
Real Networks	RTSP RDT, RTP HTTP	Proprietary version of H.263++	RM
Microsoft WMT	MMS HTTP	Proprietary version of MPEG-4	ASF
Apple Quicktime	RTSP/RTP HTTP	Sorenson MPEG-1	QT MP4
ISMA	RTSP/RTP HTTP	MPEG-4	MP4

What is ISMA?

- **Internet Streaming Media Alliance**
- **Commercial consortium to reach agreement on common set of IETF and MPEG standards to implement in products to achieve interoperability**
- **Established in late 2000, 33 members today**
- **Cisco is a founding member**
- **September 2001, 1.0 Specification finalized**
- **More info at <http://www.isma.tv/>**

What is MPEG-4?

- **Next stage of evolution for MPEG-1/2**
- **Considerably more ambitious**

From mobile devices to HDTV & Digital Cinema

Synthetic audio and video, in addition to natural audio and video

Rich multimedia presentation capabilities

MPEG-4 Misconceptions

- **It solves all multimedia problems**
It is another piece of the puzzle
- **It is monolithic**
It is a toolbox of technologies
- **It is much better/worse than <XYZ>**
Evolution not revolution. Implementation counts.
- **It is object based video**
That is an option for high complexity implementations

What is MPEG4IP?

- **Open source project**
Our code and 13 other packages
- **Standards-based / Interoperable**
IETF & MPEG
- **End-to-end**
Encoding, transmission, & playback
Real-time streams and off-line files

MPEG4IP Platforms

- **Linux**
RedHat, Debian, SuSE, Slackware
- **FreeBSD & BSD/OS**
- **Mac OS X**
- **Solaris**
- **Windows**
Pentium & StrongARM

- **Server**

mp4live - Real-time encoding, recording and transmission

mp4encode – Off-line encoding

Darwin Streaming Server - On-Demand streaming

mp4 file utilities

- **Client**

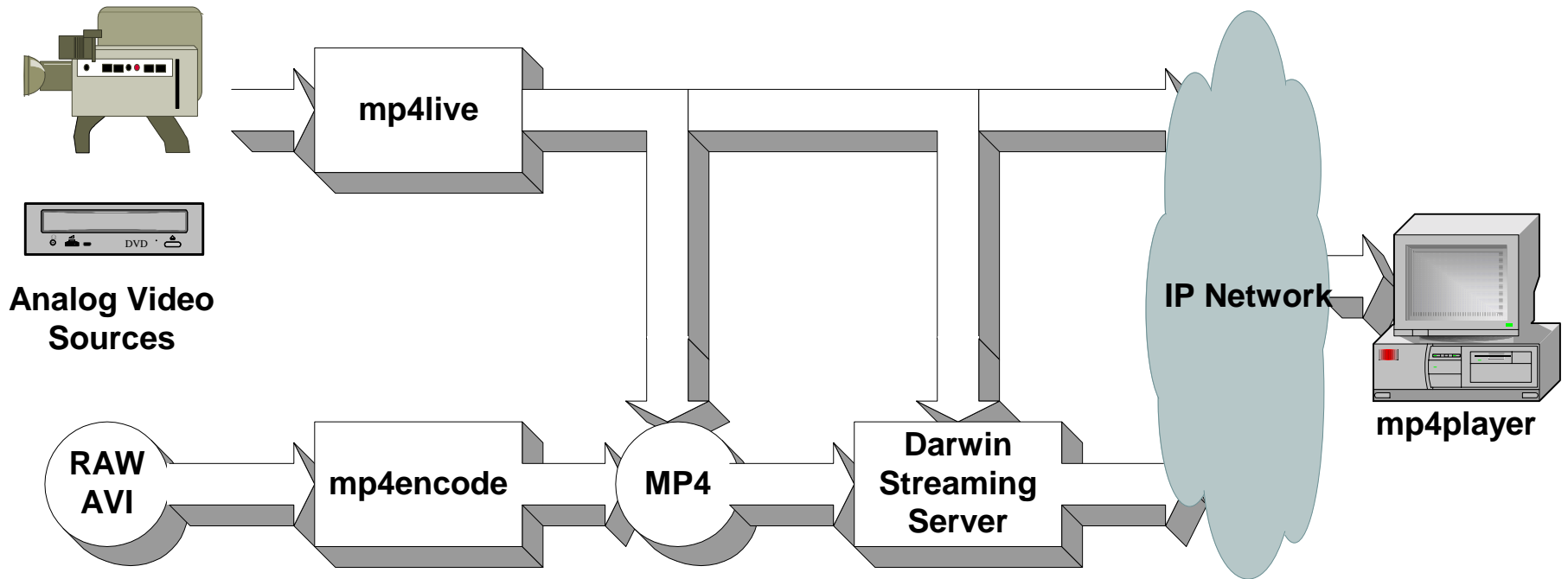
mp4player –

Basic UI

Streaming via RTP/UDP or RTP/RTSP/TCP

Local playback of MP4, MP3, AVI, WAV, AAC, DIVX

MPEG4IP Overview



MPEG4IP Standards

Leveraging IETF & MPEG

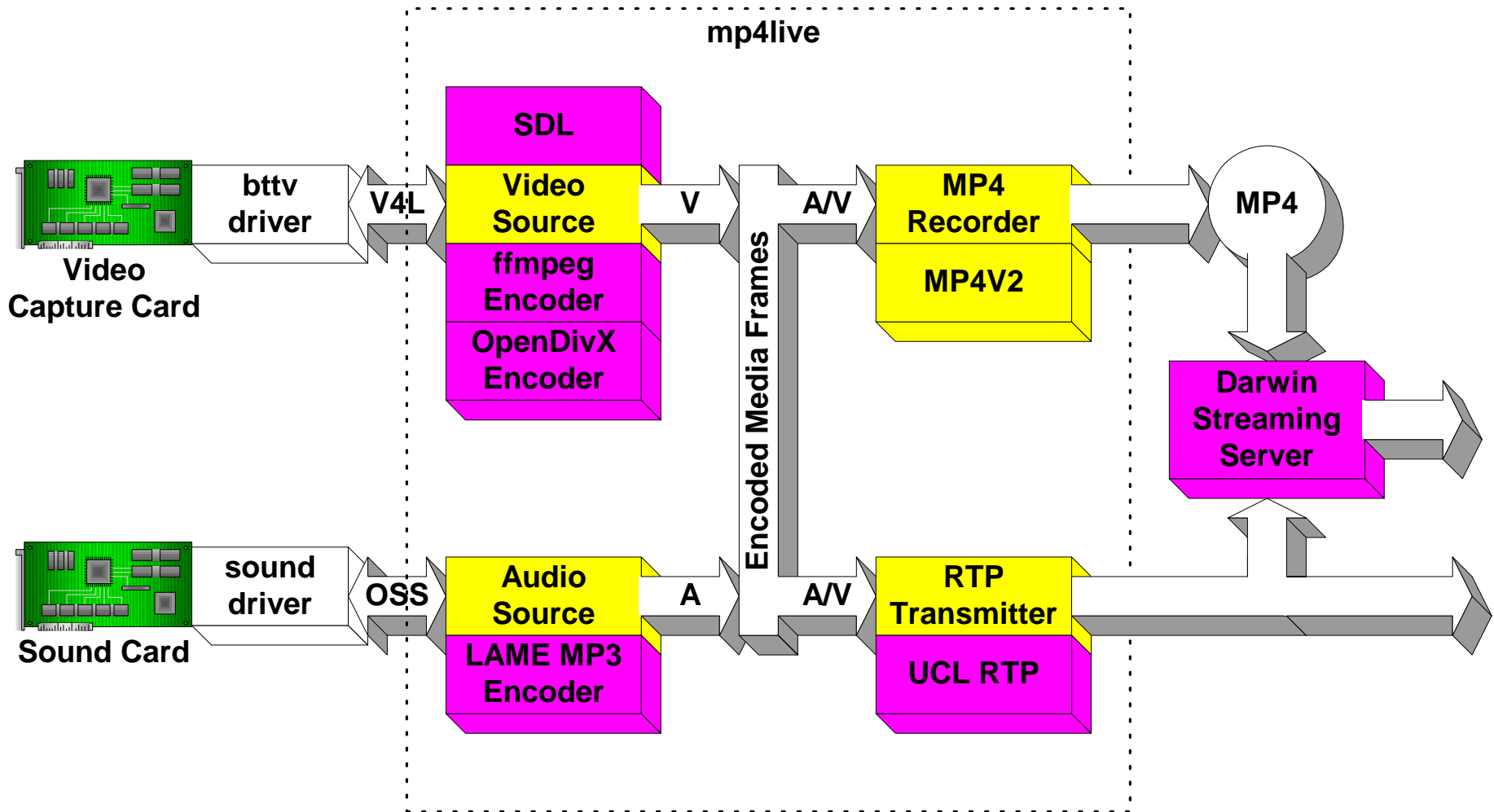
- **On-Demand - RTSP, SDP, RTP or TCP**
- **Live – RTP, SDP**
 - Unicast or Multicast (including SSM)**
- **Video - MPEG-4 Simple Profile**
- **Audio - MP3 & AAC**
- **File - MP4 (QuickTime derived)**

MPEG4IP Demo

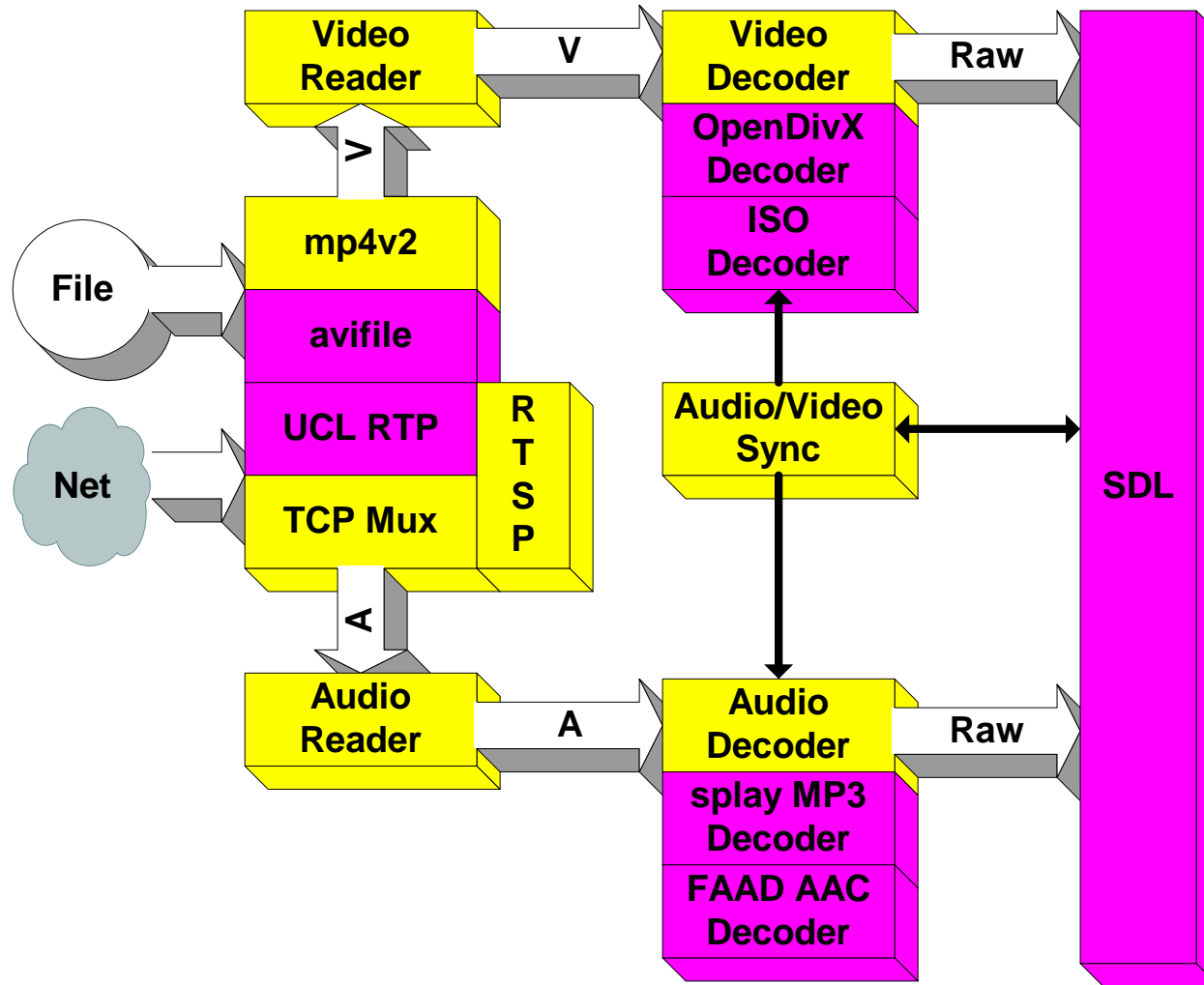
- **Camcorder**
- **To Analog Video Capture Card**
 - Capture Cards \$50-\$200**
 - Audio to sound card line in**
- **To mp4live**
 - 2GHz P4 \$1000 w/o monitor, RedHat 7.2 Linux**
 - Encoding to MPEG-4 video, MP3 audio**
- **To mp4 file and/or RTP network transmission**
- **To mp4player**

- <http://mpeg4ip.sourceforge.net/>
- Project went public in February 2001
- 9 releases to date
- ~200 downloads/day – 44000 to date
Typically in the top 100 projects on SourceForge.
- Public forum – ~10 messages/day

MPEG4IP Server Components



MPEG4IP Client Components



MPEG4IP Future Work

- **Pentium 4 optimizations**
- **Xvid MPEG-4 video codec**
- **DV Camcorder input**
- **MPEG-2 input**
- **H.26L video codec**
- **Suggestions...**
- **Contributions...**

Video Futures – H.26L

- **ITU follow up to H.263**
- **Attempt to improve on previous DCT+MV standards by offering encoder more options**
- **DCT is replaced by a similar, but less complex transform on 4x4 blocks**
- **Applicable to wide range of bitrates from mobile devices to digital cinema**
- **Drafts and reference implementation at**
<http://standards.pictel.com/ftp/video/h26l>

Video Futures – H.26L / MPEG-4 JVT

- **Specification originally due by end of 2002**
- **Announcement in Dec 2001 to merge effort with MPEG-4 video group**
- **Results of joint group will be released as joint ITU/MPEG spec**
- **Goal is for “baseline” to be free of patent royalties**

Other Developments

- **Mozilla and gStreamer**
- **SourceForge Multimedia Foundry?**
- **SMIL 2.0 (HTML for Multimedia)**
RealOne Player, IE 6.0
- **Envivio MPEG-4 Plugin for RealOne & Quicktime**

Video Driving Forces

- **Fast CPU's, Big Disks**
- **Cheap CD-R, Affordable DVD-R soon**
- **Flat panel displays**
- **Digital video devices – MPEG-2, DV**
DVD's, Camcorders, PVR's, STB's, Webcams, ...
- **Home networking**

Glimpses of the Future

- **Precedent of MP3 & JPEG appliances**
- **Network PVR's**
 - SonicBlue Replay TV PVR (MPEG-2 & Enet)**
 - ATI Radeon All-In-Wonder boards**
- **Network Camcorders**
 - Sony IP7BT MPEG-2 & BlueTooth Camcorder**
- **Network Webcams**
 - Panasonic KX-HCM10 Ethernet Webcam**
 - Digital Illusion MPEG-4 Ethernet Webcam**

Vision of the Future

- **Open Standards**
 - **Open Source**
 - **Open Streaming**
- Ubiquitous & flexible**

Questions?

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EMPOWERING THE
INTERNET GENERATION