

Mastering Windows Media



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Steep Learning Curve!

Mastering Internet video requires an understanding of:

- Offline video production terminology
- Information/compression theory
- A myriad of file formats
- Network transport issues
- Encryption

These are very different subjects!

Today's Schedule

10-11am *Windows Media Creation and Capture*

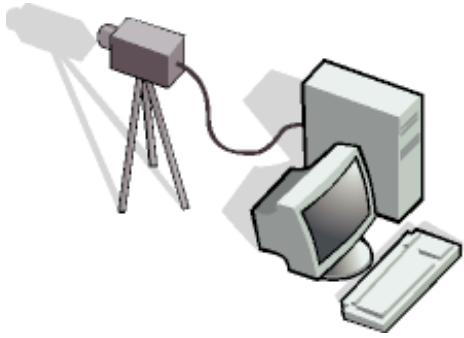
11:15am-12pm *Windows Media Compression*

12-1pm lunch

1-2pm *Distribution Methods: Streaming,
Downloading, Burning*

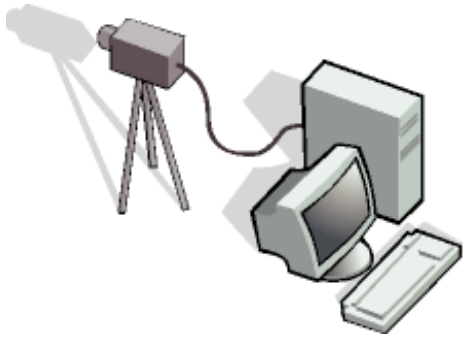
2:15-3:15pm *Digital Rights Management*

3:30-4pm *Audience Use Cases and General
Questions*



Part 1: Video Creation and Capture

- Topics:
 - Understanding TV, film, web, standard, and HD resolutions
 - Choosing a camera
 - Capturing it all
 - Shooting good content
 - Applications
 - Q&A/Break

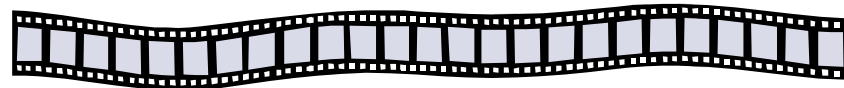


Getting Video Into the Computer

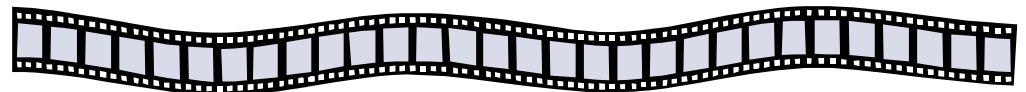
- Three primary video sources
 - Traditional television
 - Film
 - High definition television
- Newer sources
 - Digital cameras
 - Digital camcorders
 - Synthetic/rendered



film (24 fps)



European video (25 fps)

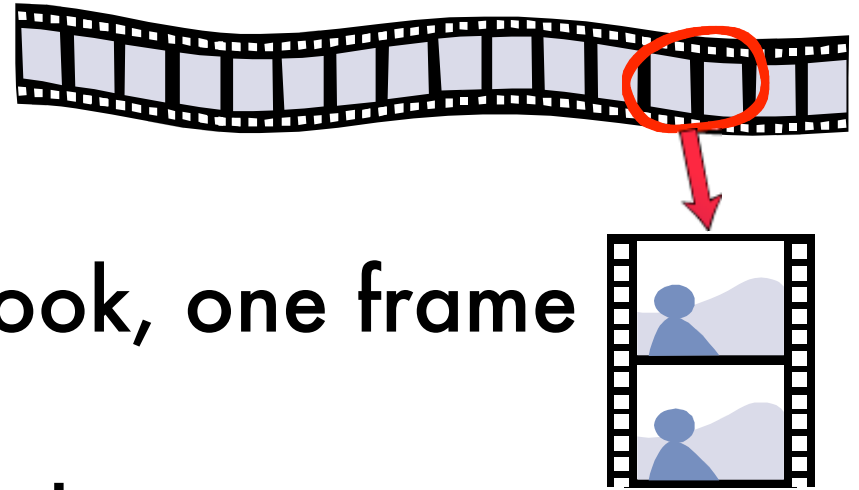


North American video (30 fps)

Video Vital Stats

- Resolution - how many dots
 - Measured in horizontal by vertical, or by megapixels
- Aspect Ratio - shape of the video.
 - Widescreen, TV shaped, Cinema shaped?
- Frame rate - how many pictures per second
 - Two parts to this - frames per second, and type of frames
- Pixel shape - are the pixels rectangular or square?

Film



- Simple - like a flip book, one frame after another
- 24 frames per second
- In digital form, very high resolution -
Film: 2k or 4k (2048 or 4096 across),
usually 2:1
- This is the equivalent of 2 Megapixels and 8
Megapixels

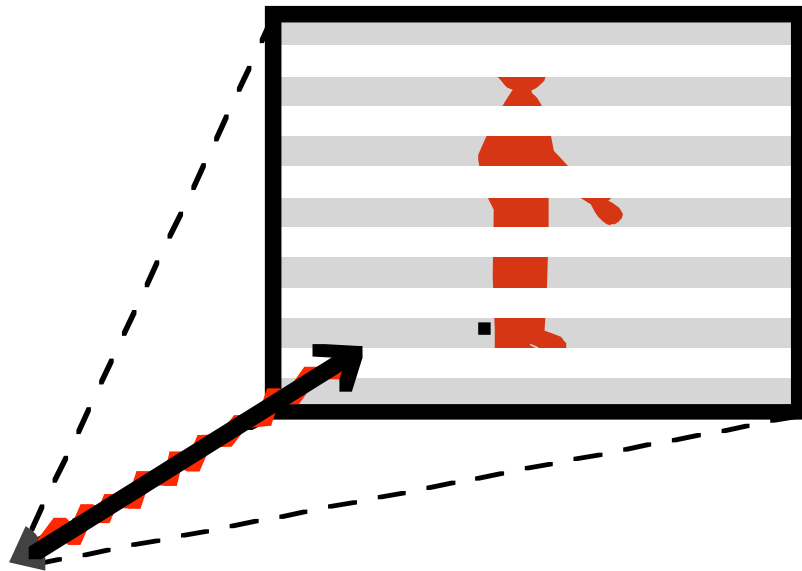
Television

Standard Definition Television: NTSC (US) and PAL (Europe)

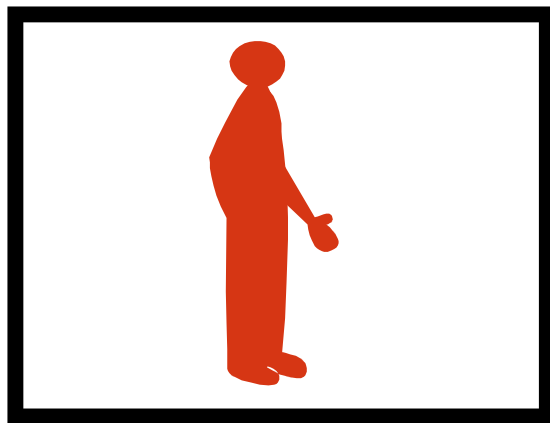
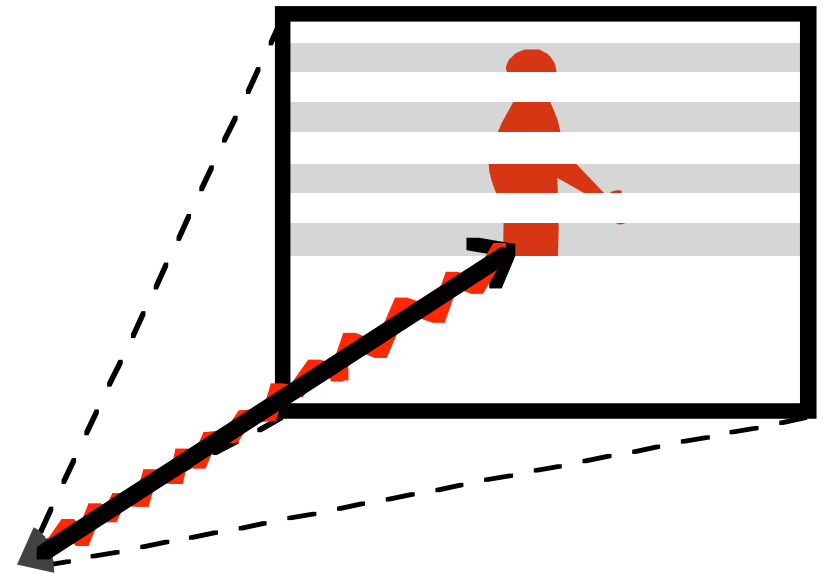
- Uses interlaced frames called *fields*
- Twice as many pictures, half as many lines
- Good for showing motion
- Creates a jagged effect when paused
- Old - late 40s to early 60s design
- 50 fields per second (PAL), 60 fields (NTSC)

Interlacing

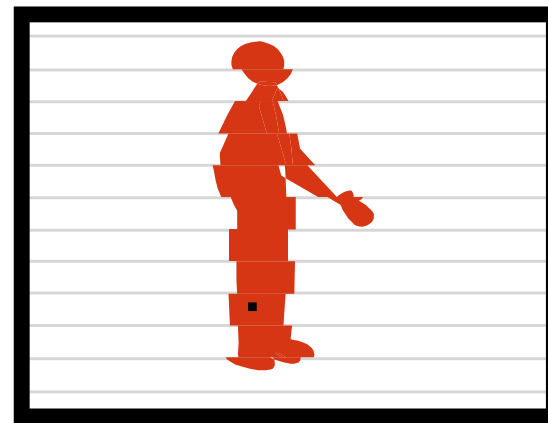
odd field



even field



progressive video (film)



interlaced video (television)

Video Terminology

(height)/(pictures per second)(frames or fields)

"480", "720", "1080" indicate the *height* in pixels, or *lines*

- p = progressive, i = interlaced
- Width is implied - 720x480 or 1280x720 or 1920x1080
- 1080/60i = sixty interlaced frames of 1080-pixel tall images

HDTV

High-Definition Television

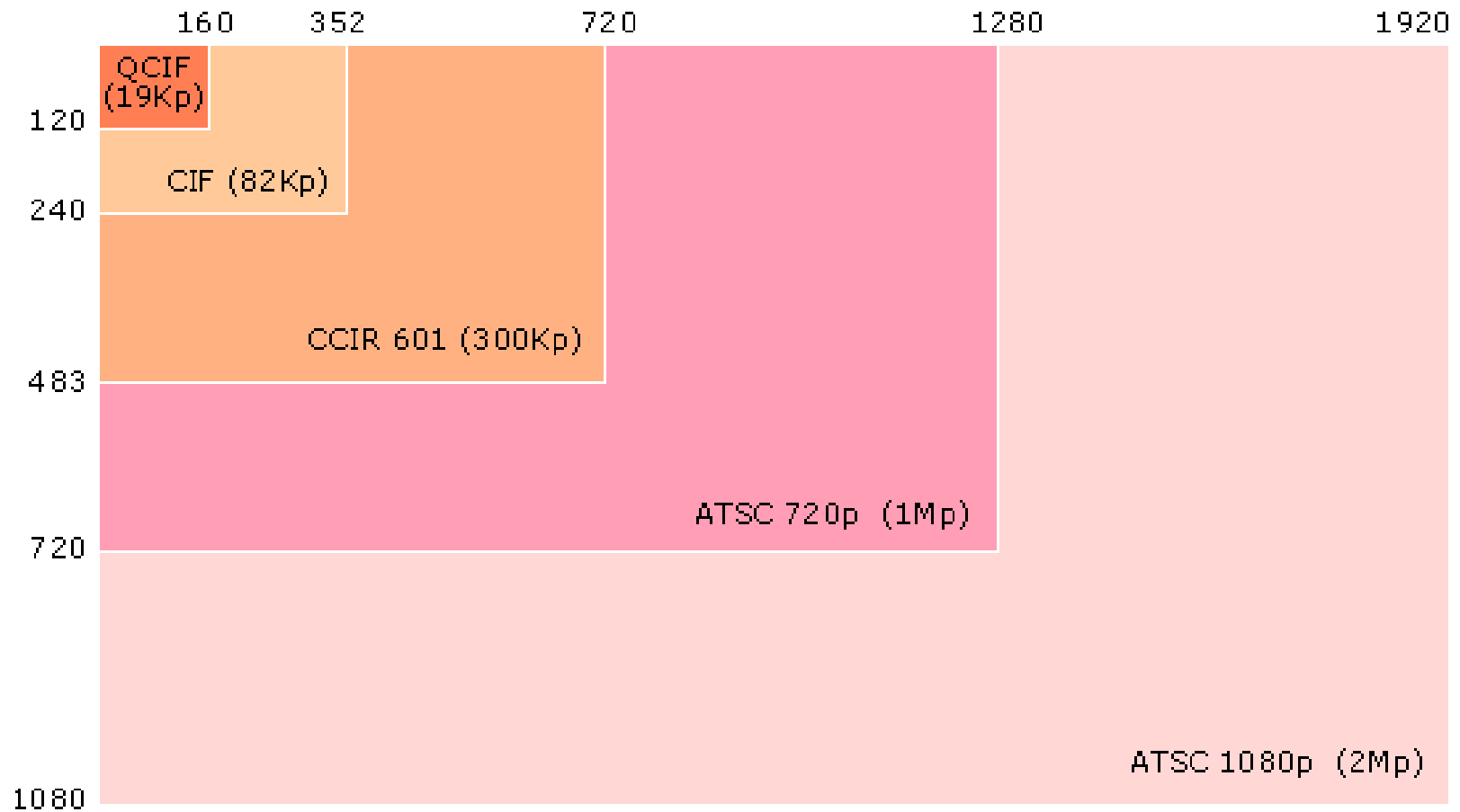
- **Compromised, chose all the standards**
- **All the frame/field rates: 24p, 25p, 30p, 50i, 60i, perhaps 60p in the future**
- **Standard definition resolutions: 640x480, 720x480**
- **High definition resolutions: 1280x720, 1920x1080**

Common Standard and Hi-Def Resolutions

- 480/60i = 480 lines (720 across), 60 interlaced fields - SDTV
- 720/30p = 720 lines (1280 across), 30 progressive frames - HDTV
- 1080/60i = 1080 lines (1920 across), 60 interlaced fields - HDTV
- SD = 0.3 megapixels
- HD = 1-2 megapixels

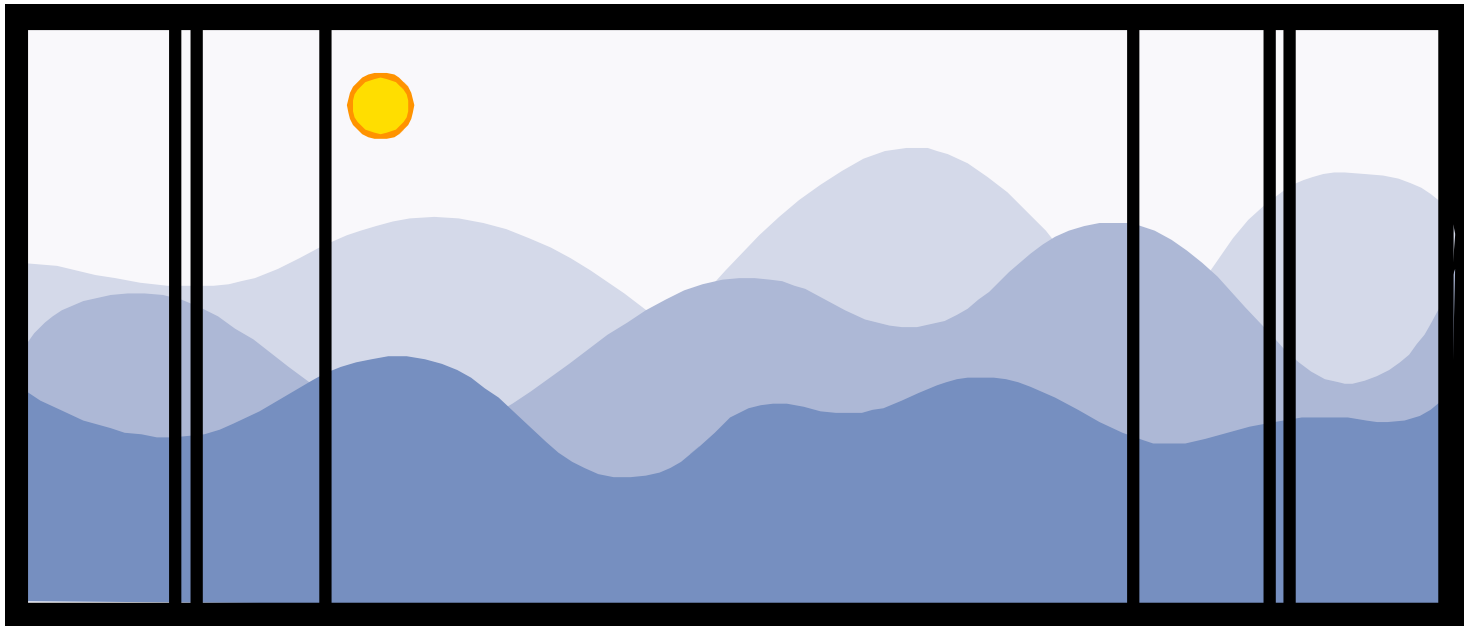
HD resolutions illustrated

(from Ben Wagoner on Microsoft.com)



Aspect Ratio

- SD standard of 4:3
- HD standard of 16:9
- Film varies from 4:3 to 2:1



2.35:1
1.85:1
1.78:1 (16:9)
1.33:1 (4:3)

Capturing Video

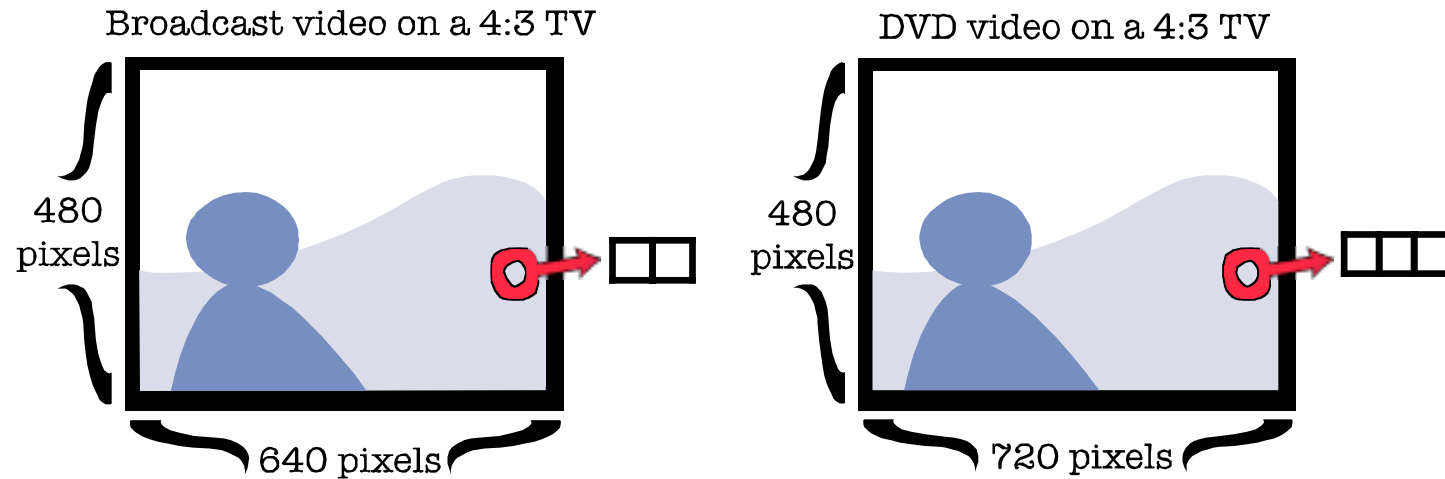
- Primary methods
 - Analog capture card - S-Video or composite (yellow cable) input
 - Firewire (DV) input
 - USB input
 - SDI (Serial Digital Interface) Raw HD input
 - Component (analog) input
 - Straight to hard drive taping
 - Film scanning

Cameras

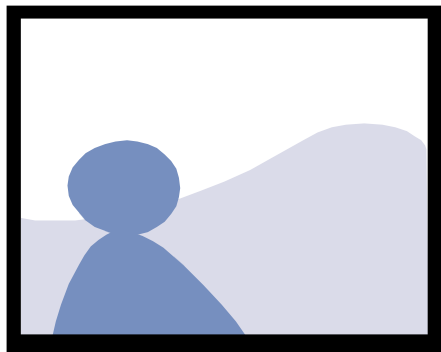


- DV - 480/60i, Standard Definition
 - Your conventional "DV" camera
 - Pro versions less susceptible to glitches
- HD - 720p and higher
 - Uncompressed video is huge, so these normally compress it somewhat, or make compromises on resolution

Non-Square Pixels



TV



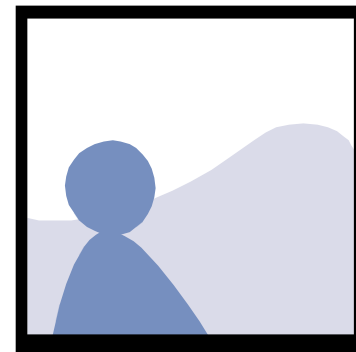
4:3 video

stored at



480 x 480

Monitor



1:1 video

Capture: Get the Video Into The Computer

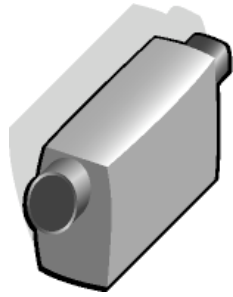
- Progressive (HD) capture will be best when it becomes widely available - 1920x1080
- Higher quality input always helps compression steps
- Capture with high quality cameras and microphones
- Use digital capture always if possible
- Don't use composite (yellow RCA) video capture if possible

Making Good Video Happen: Plan Ahead



- Script the content well, make it as compelling as possible
- Edit it well, maximize signal-to-noise ratio (i.e. use the strengths of video to deliver information efficiently)
- Don't overuse bandwidth for a talking head
- Mic on each subject so it can be re-mixed later

Making Good Video



Happen: Shooting

- High quality equipment
- Digital, not analog equipment
- Progressive, not interlaced equipment if possible
- Maintained equipment
- Well placed light, and lots of it
- Microphones on subjects

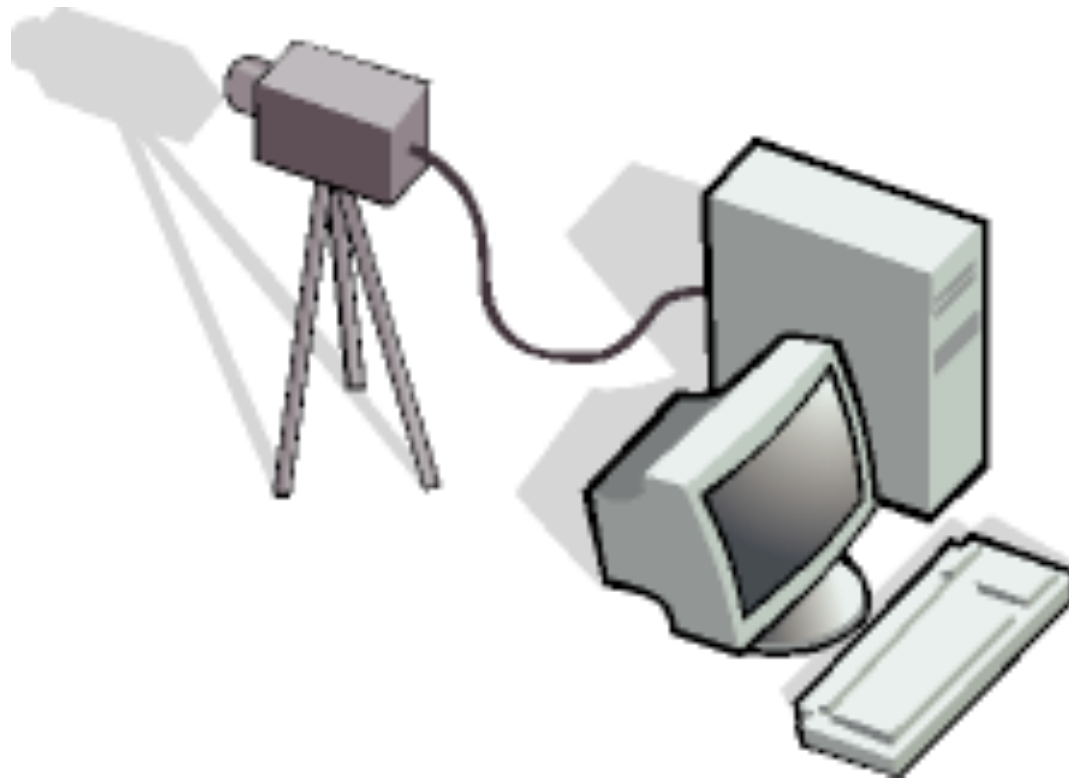
Microsoft Applications: Video Capture

- Windows Movie Maker 2 - consumer
- Windows Media Encoder - pro

Many perfectly acceptable non-MS apps here, but these handle most needs.

Questions/Break (:15)

Topic: Cameras / Capture



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Part 2: Compressing Video

- Topics:
 - Getting a feel for audio/video compression
 - File Formats vs. Containers
 - WMV and VC-1, Windows Codecs
 - Factors affecting compression
 - Long term storage
 - Applications



Compression

- Audio compression makes a file 1/10th to 1/20th its original size, i.e. a CD
- Video compression does the same thing, but we don't have a strong intuitive sense of the "size" of an hour of video



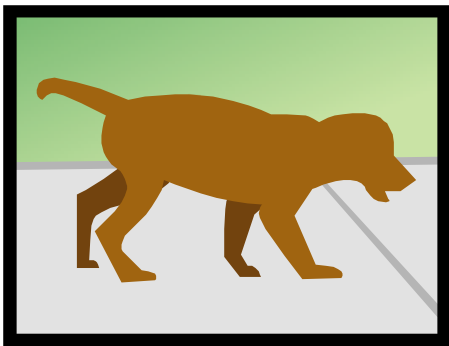
Compression: Shrink the Audio/Video to Fit the Bandwidth

[http://www.microsoft.com/windows/windowsmedia/
howto/articles/codecs.aspx#chart](http://www.microsoft.com/windows/windowsmedia/howto/articles/codecs.aspx#chart)

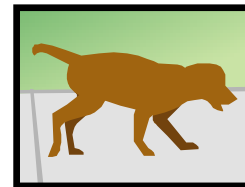
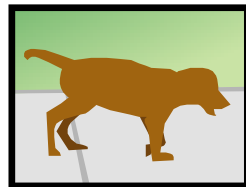
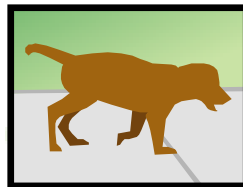
Codecs 101

Important Compression Terms

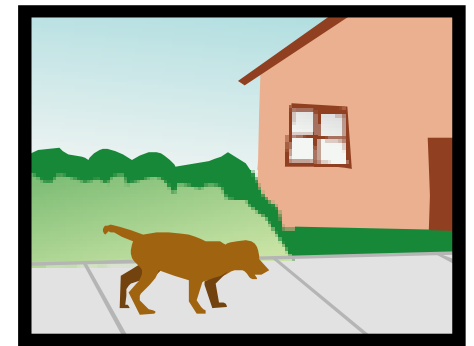
- CODEC - Compressor/Decompressor
- Bitrate - essentially, how much data to allocate to each momentary slice of audio or video
- Key frames - the frames that are sent complete, like jpegs. The rest of the frames are reconstituted based on key frames, using the unique mathematical approach of that codec



keyframe

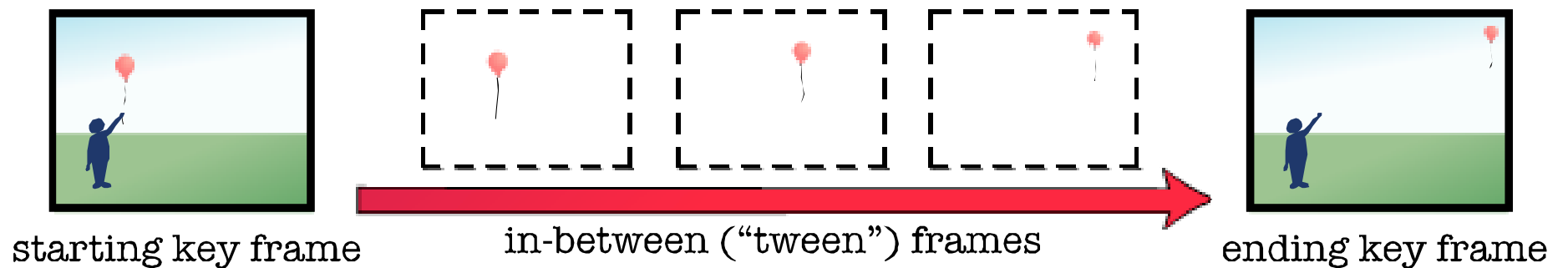


intermediate frames



keyframe

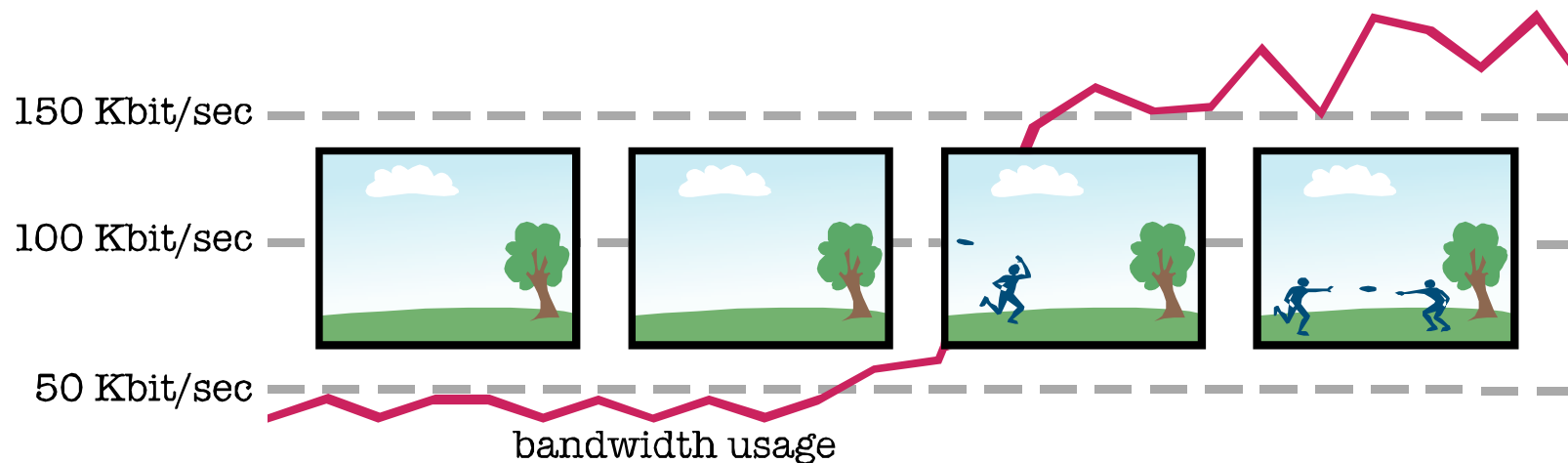
Video Compression at its Simplest



Don't send the in-between frames; simply describe to the media player what changed.

Variable vs. Constant Bitrate

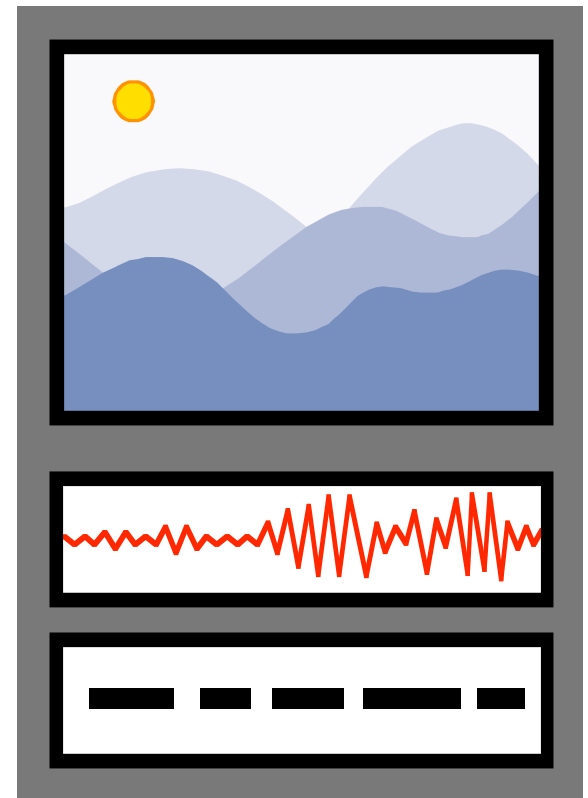
- Constant bitrate - use same amount for each frame or slice of time
- Variable bitrate - use more data for more complex frames, but keep average as specified



File Formats

(the box the video is stored in)

- Containers are not video formats
- Box types: ASF, AVI, WAV, AIFF,
(compare MOV, MP4, SWF, and FLV)
- Packing materials: WM9, WMA,
Lossless, Uncompressed/Raw
(compare MPEG-4, Flash, Quicktime,
RealMedia)
- Contents: instructions, text, subtitles,
still pictures, animations, audio,
video!



Windows Media Codecs

- Windows Media Video - VC-1
- WM9 - Microsoft's *implementation* of VC-1
- WMA - improvement on MP3 in terms of storage
- Windows Media Center format is not WMV, MPEG-2 based
- Windows Media Lossless audio allows 50% size reduction



Windows Media and Related Files

- .ASF = advanced streaming format. Old now; use .WMA or .WMV
- .ASX = ASF index files, i.e. a list of pointers to other files. Use .WMX now
- Variety of other lesser-seen .AS? files as intermediate stages of editing
- .DV = digital video, as in DV cameras. Light compression. Suitable
- .WAV = usually means uncompressed. Not a codec, but a container format
- WMA Lossless = 50% savings for audio. Can be restored to original form.

Bandwidth considerations

- Basic two experiences are: Watch it now, watch it later
- Compression should be geared to deliver this experience
- Next section (streaming) will cover bandwidth in detail

Processing Power Considerations

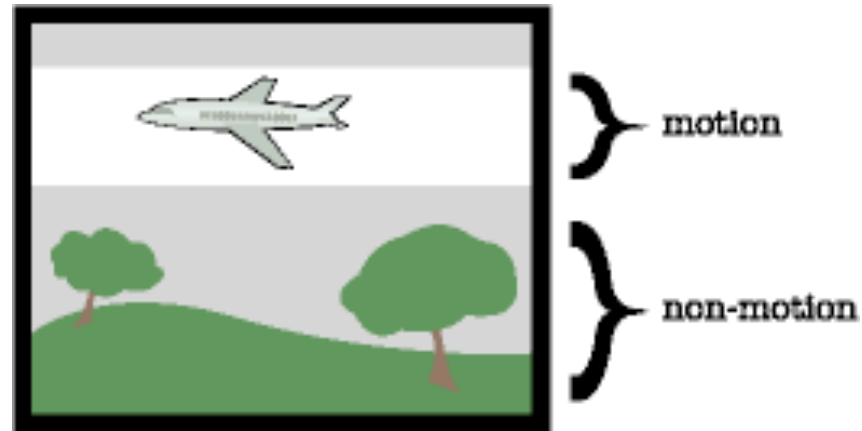
- On portable devices, such as portable media players and DVD players, CPU power is the limiting factor instead of bandwidth
- For example, a 733Mhz Celeron can't always decompress WM9 in software
- Specialized hardware for WMV and WMA keeps power and cost and heat down
- CBR is gentler to hardware than VBR; variable bitrate maximizes quality for size; CBR minimizes computing power

Long term video storage

- What format should you archive video in?
 - With enough storage, the source IS the archival format
 - Any well-compressed format isn't going to be re-editable
 - Capture, then deliver in another format - return to source when re-editing.



Shooting Easily Compressible Video



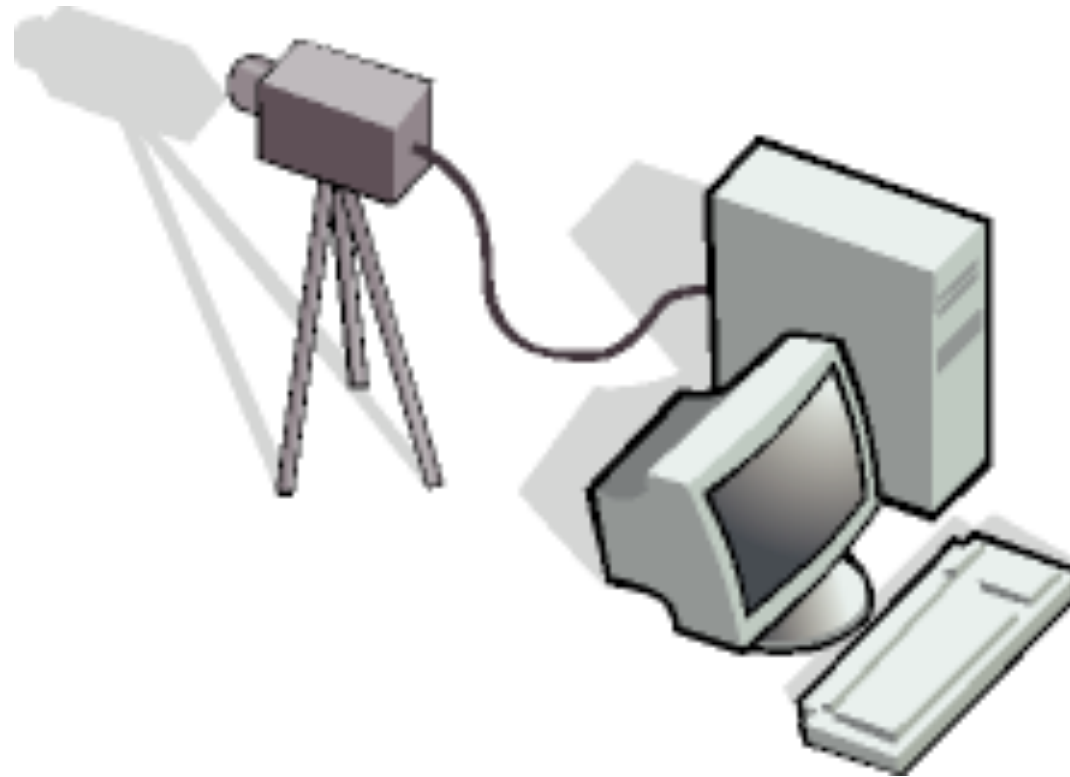
- Hold still!
- Motion costs bandwidth, make it matter
- Use VBR for motion, CBR for stabler playback and network demands
- Shoot in high resolution
- Use lots of light

Microsoft Applications: Compression and Media Prep

- Windows Movie Maker 2
- Windows Media Encoder - Compression and Live Broadcasting
- Windows Media Profile Editor - set up your encoding preferences
- Windows Media Stream Editor - Create multi-bitrate streaming files
- Windows Media File Editor - trim files, add metadata, add scripts and
- WavAVIMux.exe - combines mono files into 5.1/6/1/7.1 surround

Questions/Break (:15)

Topic: Audio and Video Compression



Part L: Lunch



Part 3: Streaming and Downloading

- Topics:
 - Overview and definitions
 - Streaming
 - Downloading
 - Web Integration
 - Hardware integration





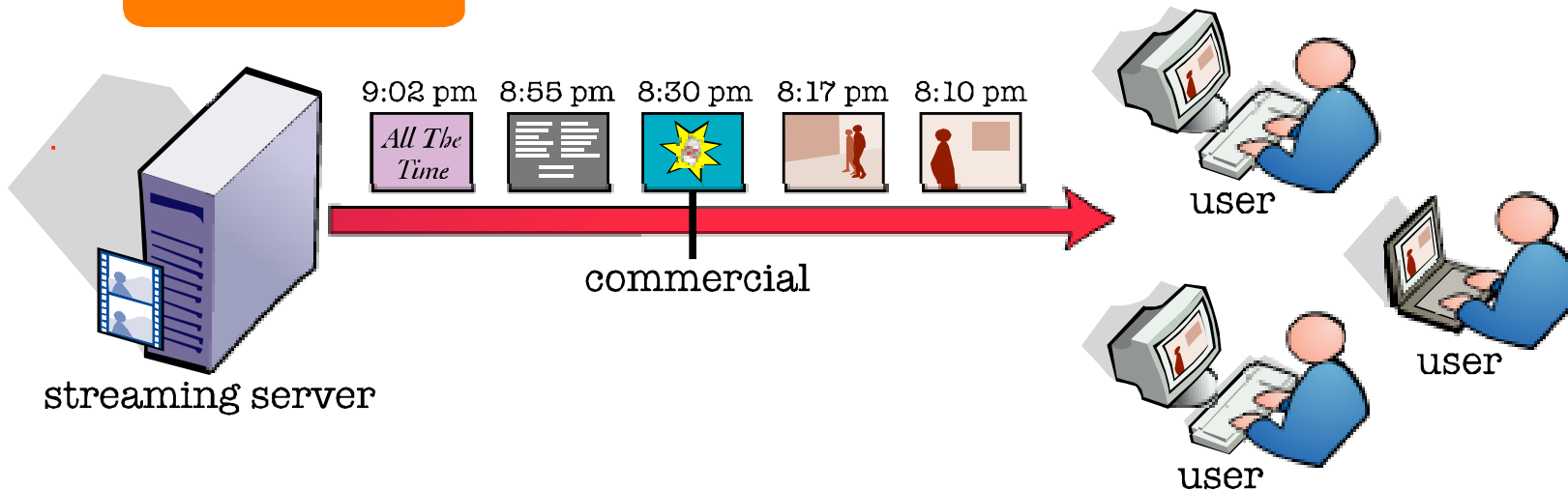
Streaming Servers

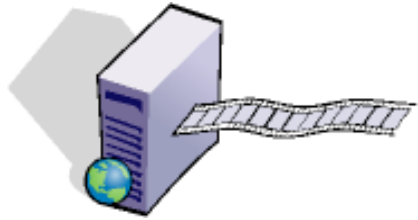
Like web servers, but for video. They're designed to:

1. Minimize technical problems of video delivery over Internet
2. Maintain control over the experience and location of the content

PLAYLIST

8 PM	My World
9 PM	All the Time
10 PM	Go Figure
11 PM	Best of Yesterday

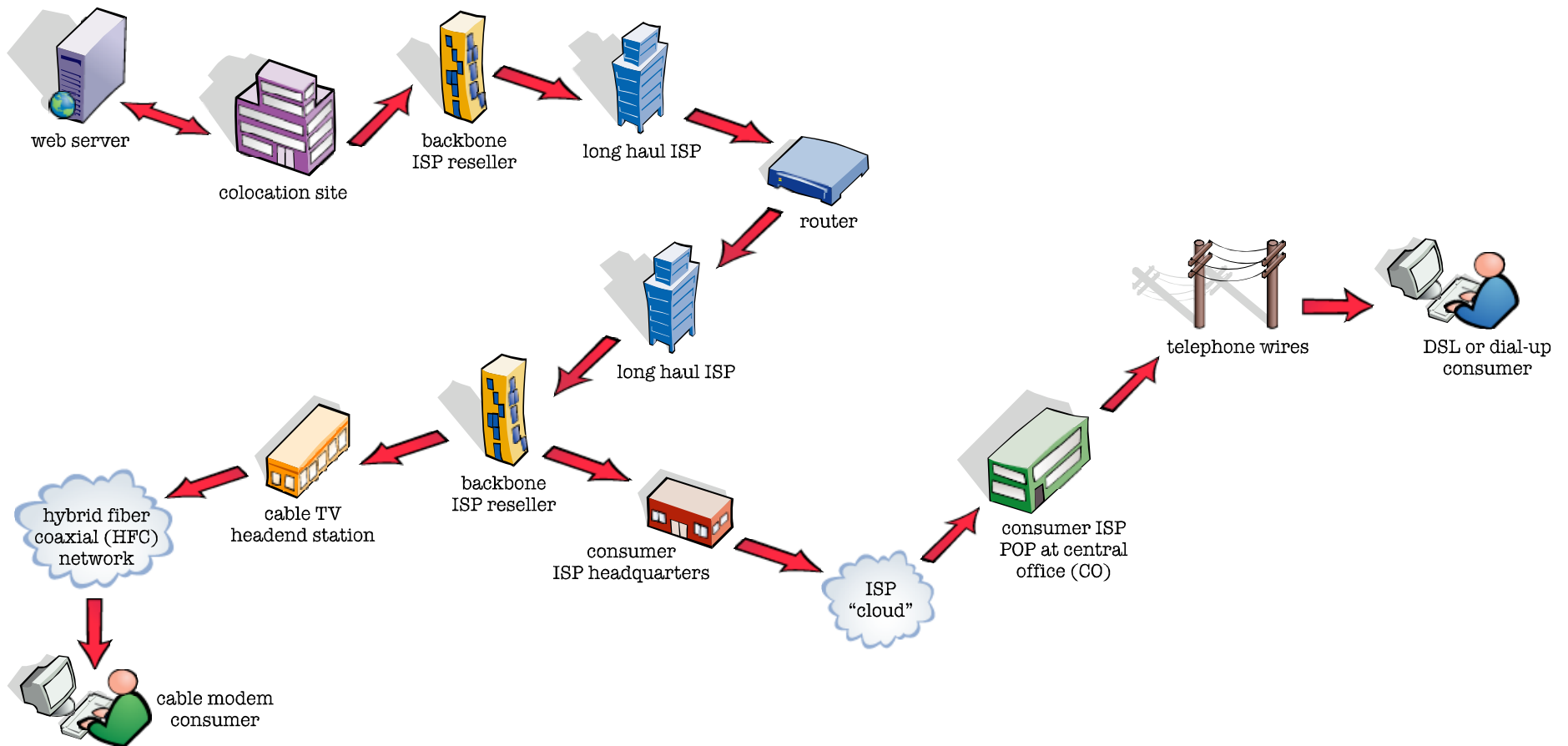




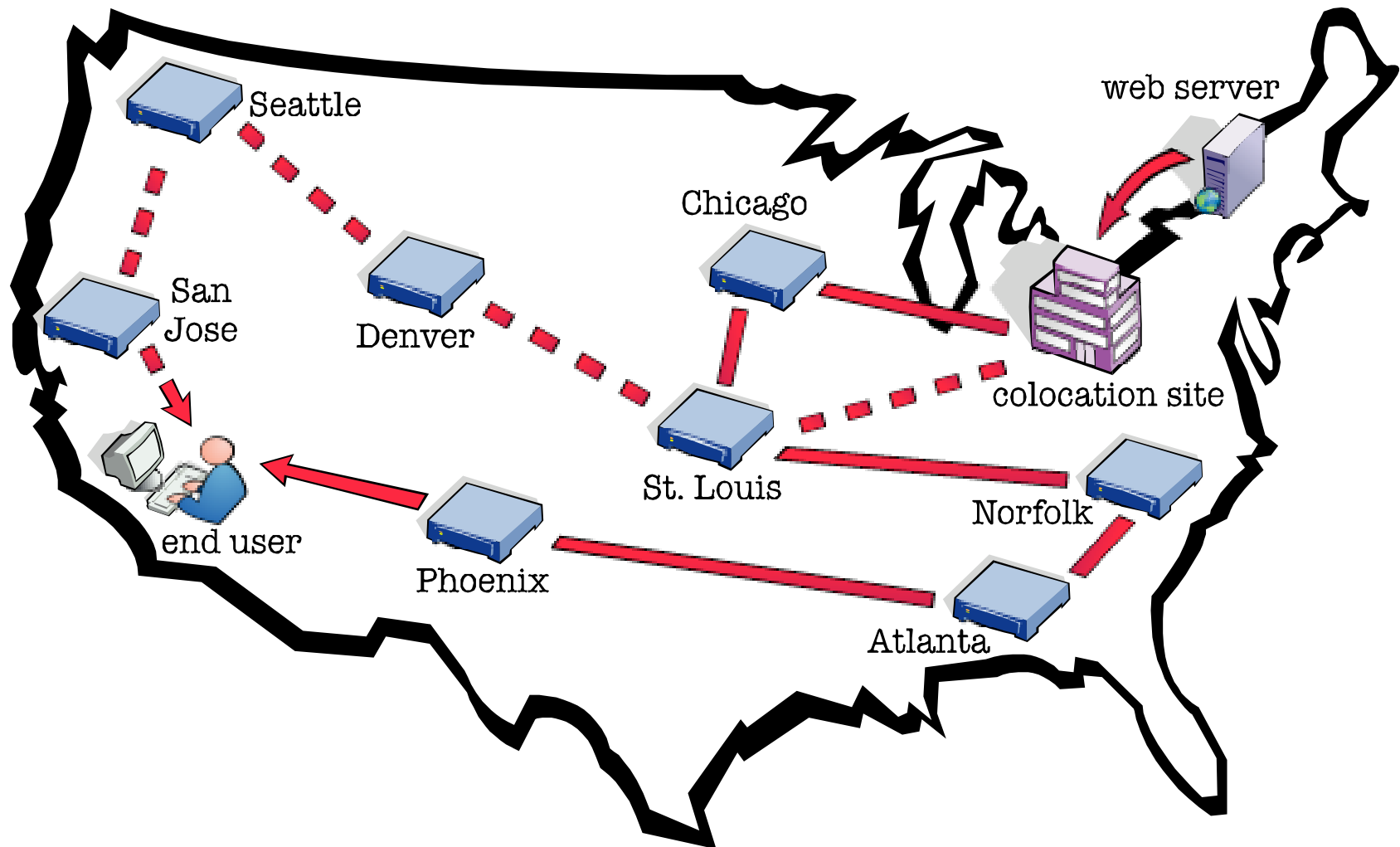
The Arch-Enemies Of Internet Video

- **Packet loss**
 - When data gets lost in transit
- **Latency**
 - How much delay between the viewer and the server
- **Buffering**
 - How much additional delay the client program needs to store to ensure smoothness

A circuitous path through the Internet



Multiple paths through the Internet

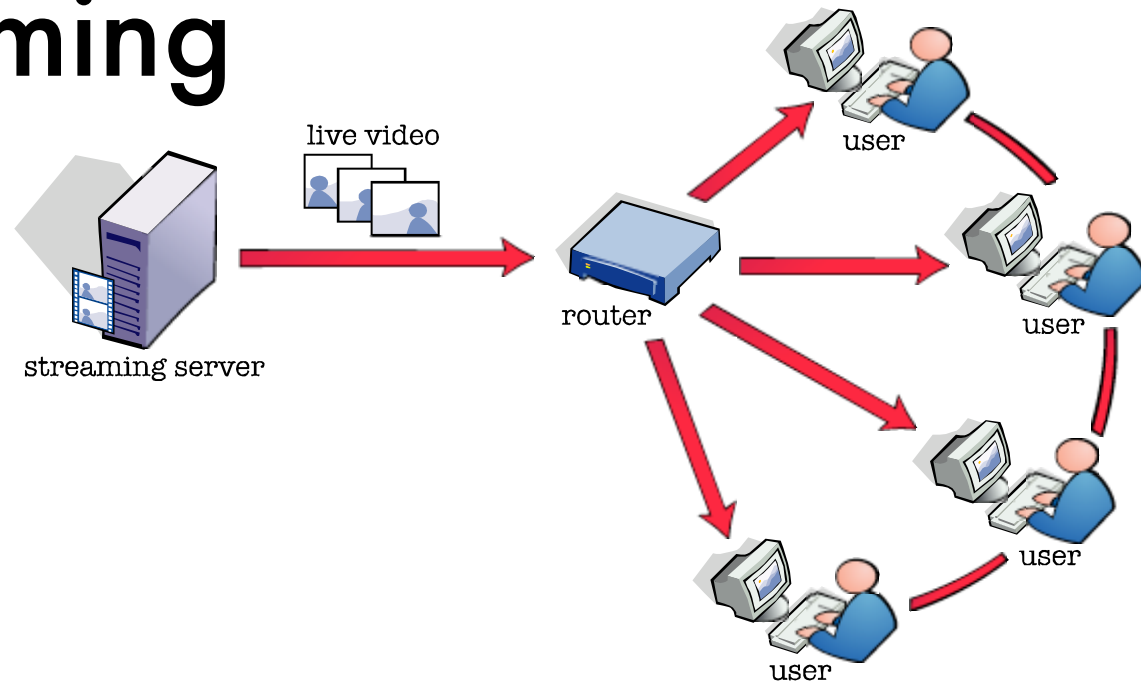




When to Download vs. Stream

- Play remotely, or locally?
- TV or “TiVo” experience?
- Security, bitrate, network quality are the criteria for whether to stream or DL
- Streaming servers required for centralization of the content, keeping it at the source

Streaming



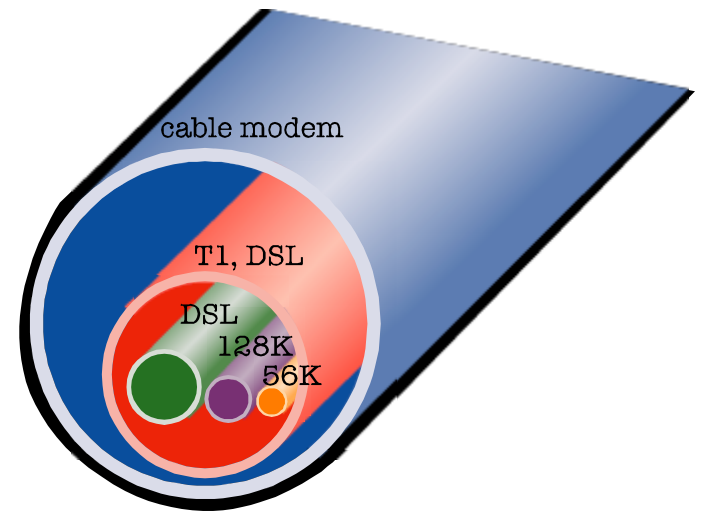
- In marketing-speak, means “delivering video over a network”
- Downloading is clearly moving that content to the client computer
- Streaming technically means keeping control of the content and not storing it on client computers
- TiVo, peer-to-peer networking, caching, all serve to blur these lines



Streaming on Closed Networks

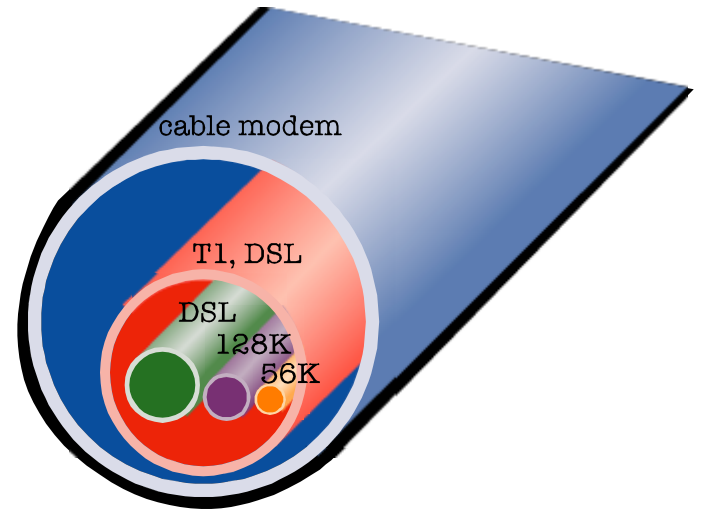
- Multicast is like broadcast TV for a company network
- Companies usually have much more bandwidth “inside”
- Good for corporate training and internal communications

Bandwidth



- Bandwidth is measured in Kbps (kilobits per second)
- Files, Hard drives are measured in kiloBYTES (or megabytes or gigabytes)
- File transfer often measured in kiloBYTES per second
- A T1 = 1544Kbps, which is about 150KB/second (kiloBYTES per second)
- A DSL connection @ 384Kbps gets around 40KB/second (40 kilobytes/second) download speed

Broadband

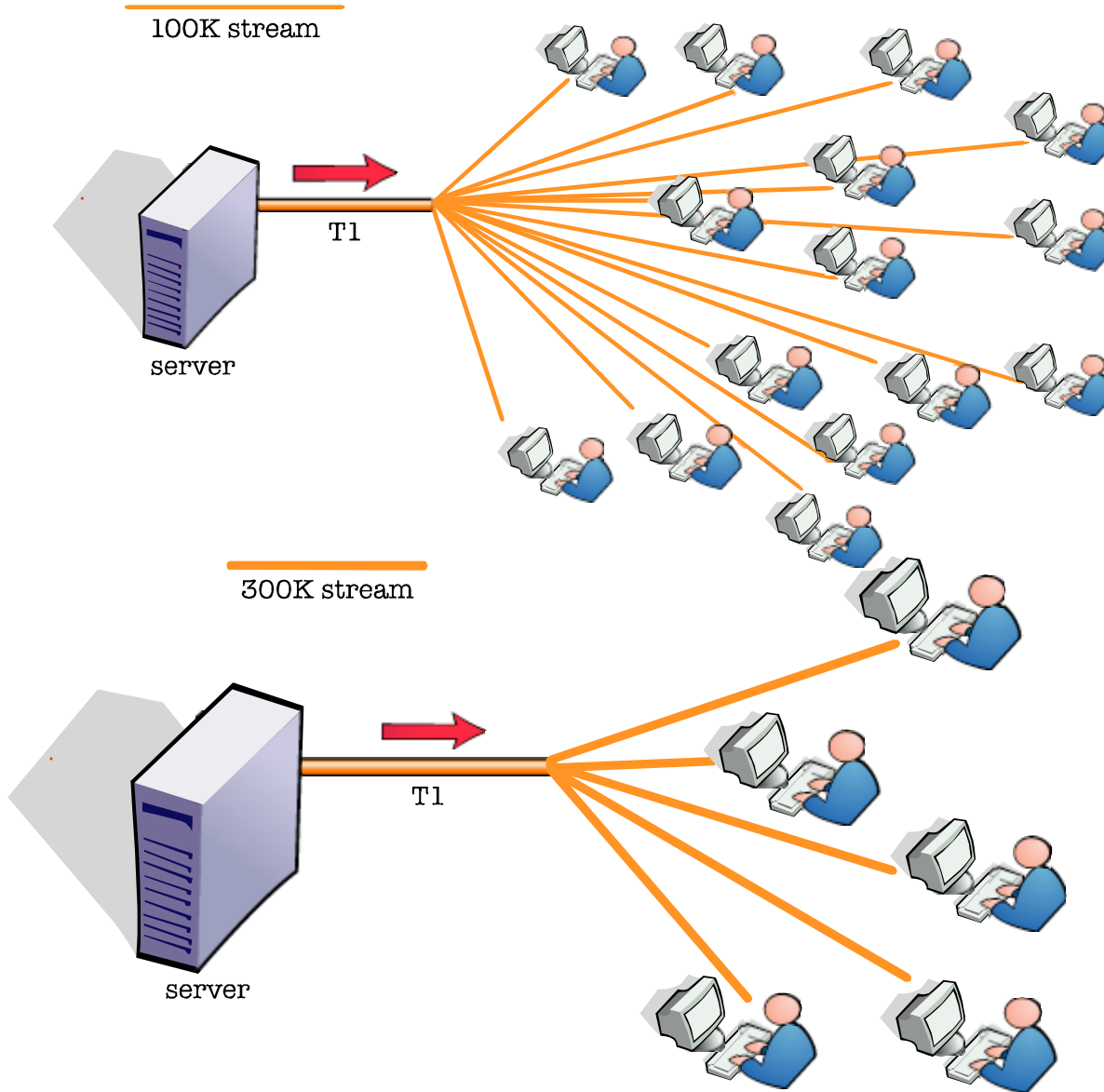


- DSL, Cable, Fiber to the home all have different concepts of "broadband"
- Generally, broadband is 384kbps and up (~40KB/second)
- Cable modems can go up to 2000-5000Kbps (2-5Mbps) downstream
- Upstream is usually limited to 128-384Kbps for consumers on cable and DSL
- Fiber to the home can get in the 20MBps range
- Companies are at 100Mbps to 1000Mbps range

Bandwidth: Streaming

- Overhead needs to be factored in
- 50Kbps modem connection can support 30-40Kbps stream (but target 20-30Kbps for audio over modem)
- 384Kbps broadband should support \leq 300Kbps stream
- 1.5Mbps connection should support 1Mbps video stream
- An 80Kbps WMA audio stream can fit nicely into even a 128Kbps broadband connection

Streaming

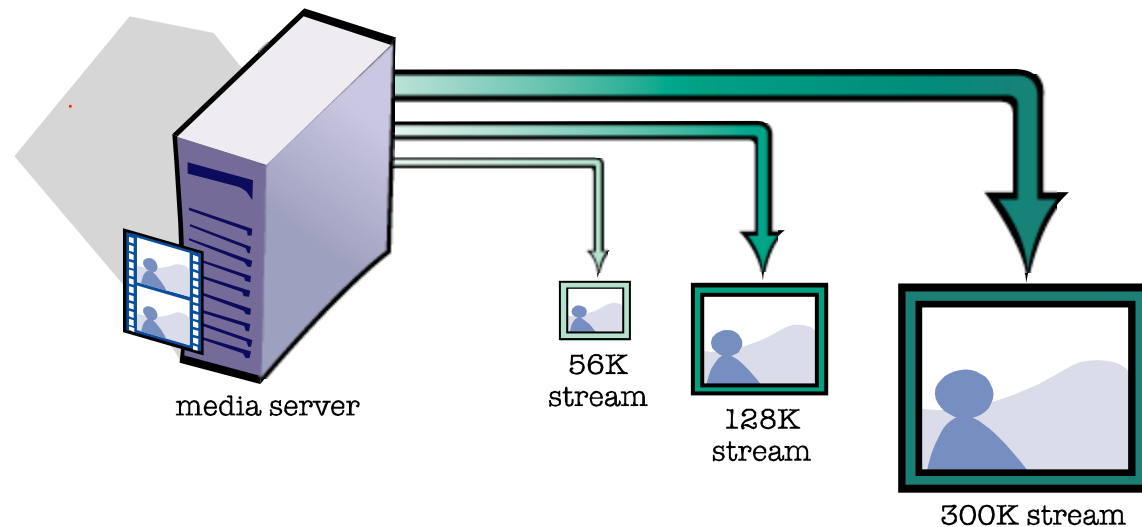


Bandwidth: Downloads

- People will wait for downloads.
- On 384Kbps, at 2 megabyte WMA file takes about $2000/40 = 50$ seconds to download
- On 1.5Mbps this same file will come down in about 15 seconds
- On 5Mbps this same file will take 4-5 seconds

Multi-bitrate and Localized Streaming

- WMA and WMV files can contain different bitrates, languages, and subtitles in the same file
- The Media player settings (including detected bandwidth, language, and user preferences) will cause the media player to request the right file from a media server



Online Distribution: Stream vs. Download Revisited



- Long-form content: stream it
- Random access content: stream it
- Live content: stream it
- Short-form high quality content: progressive download it
- Tiny clips: embed it or download it

Offline Distribution: Portables, Mobile phones

- Need to maximize quality for low hardware specs
- Usually half frame rate, quarter video resolution

Offline distribution: HD

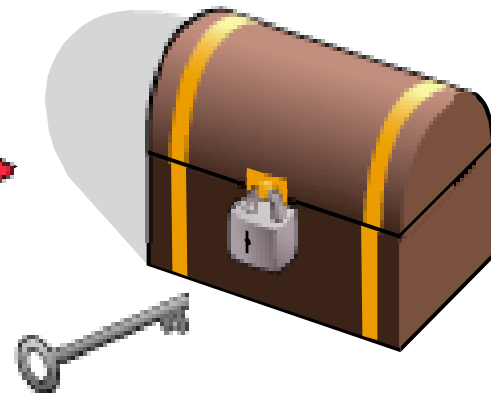
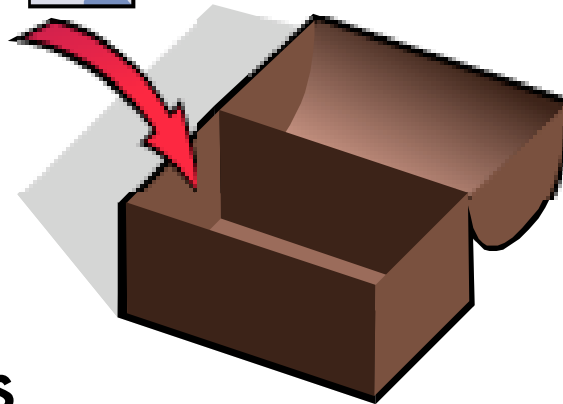
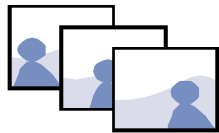
- HD DVD vs. Blu-Ray
- Both next-generation formats, 30GB vs. 50GB
- Ultimately both will play back VC-1 and MPEG-4/AVC
- Producing HD DVD content now is possible (T2 Extreme)

Questions/Break (:15)
**Topic: Video Transport -
Streaming Servers,
Downloads, HD DVD**



Part 4: Digital Rights Management and Content Control

media file



encryption system

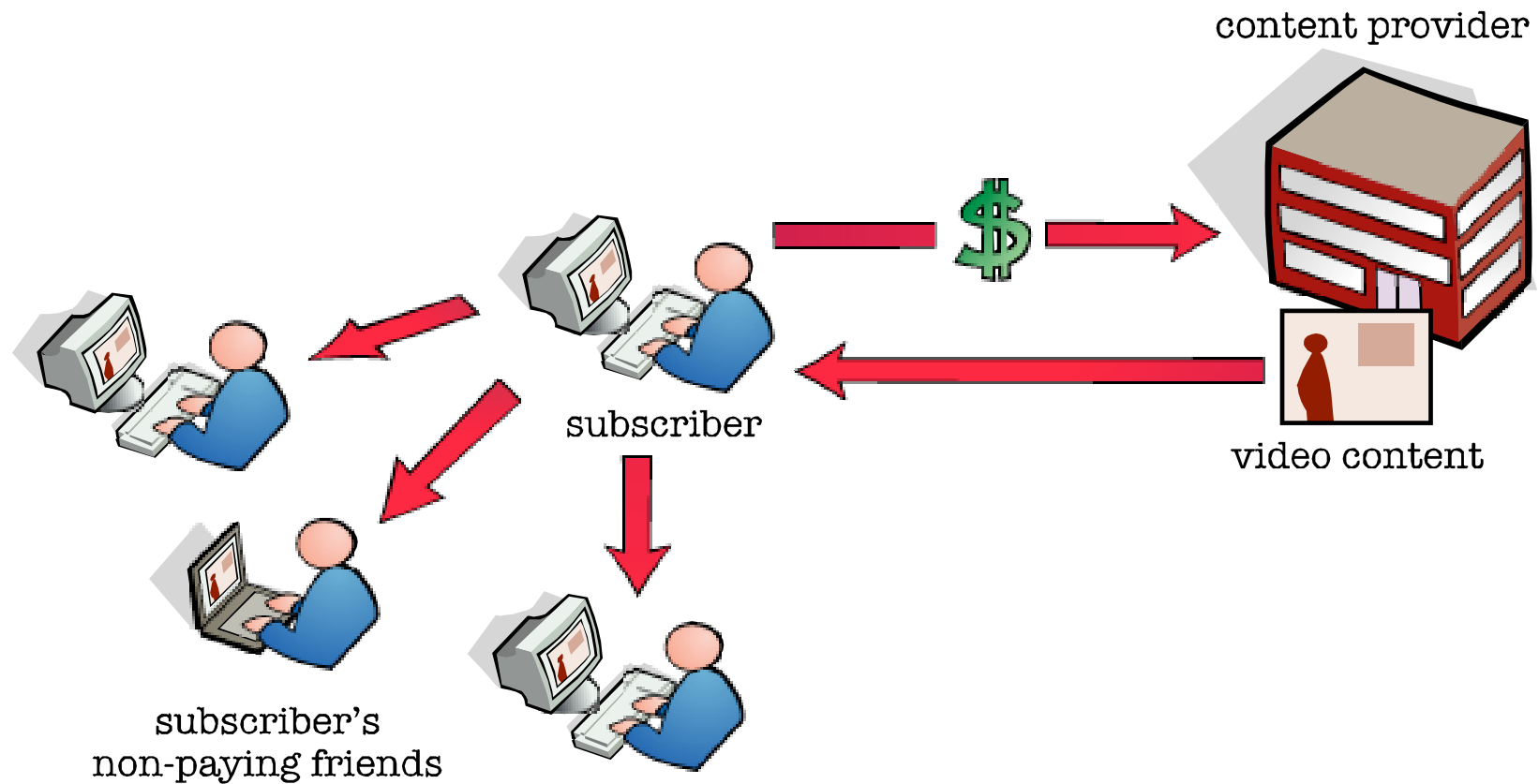
- Topics
 - What is it
 - Can it really work
 - MS DRM overview
 - MS DRM 10 for devices
 - Q&A/Break



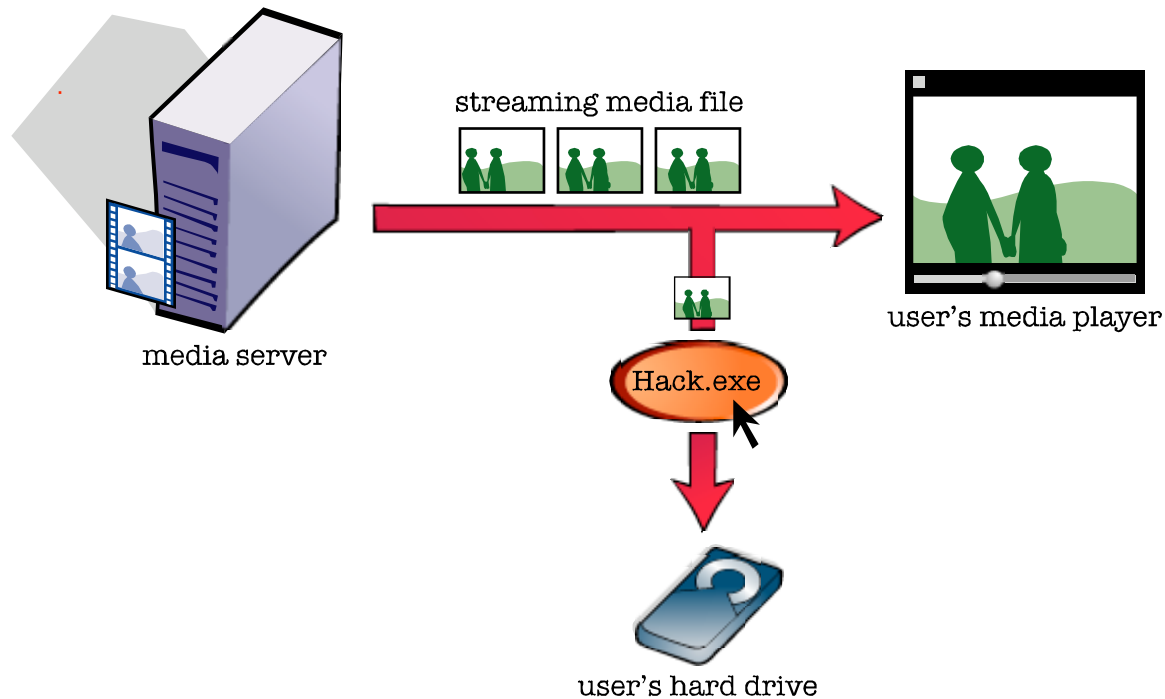
Making sure people pay for video

- Consumer DRM is about controlling access the content
- To implement it requires vigilant monitoring of every device in the chain
- The DRM system is as weak as its weakest link

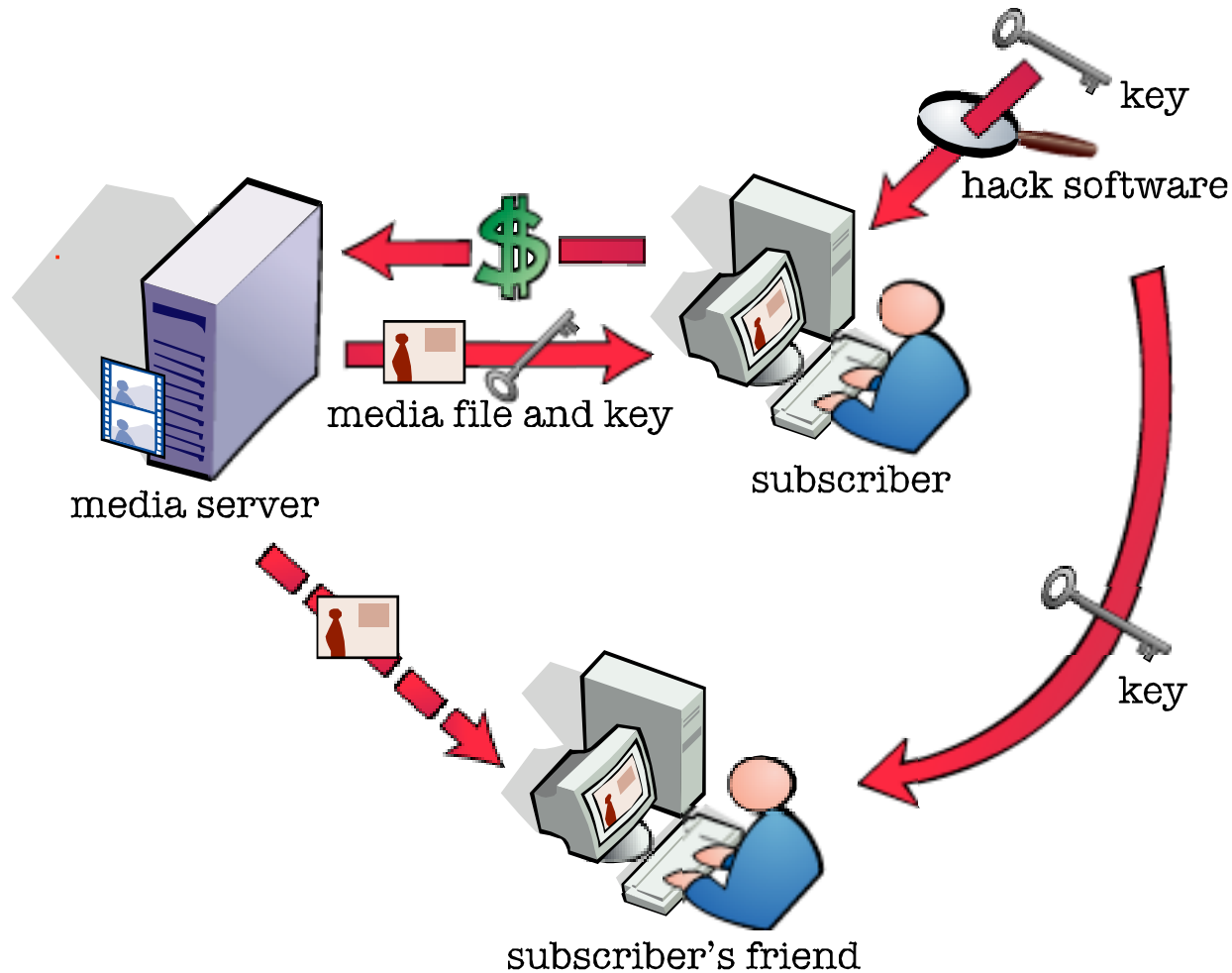
Hack 1 - Simple Download and Copy



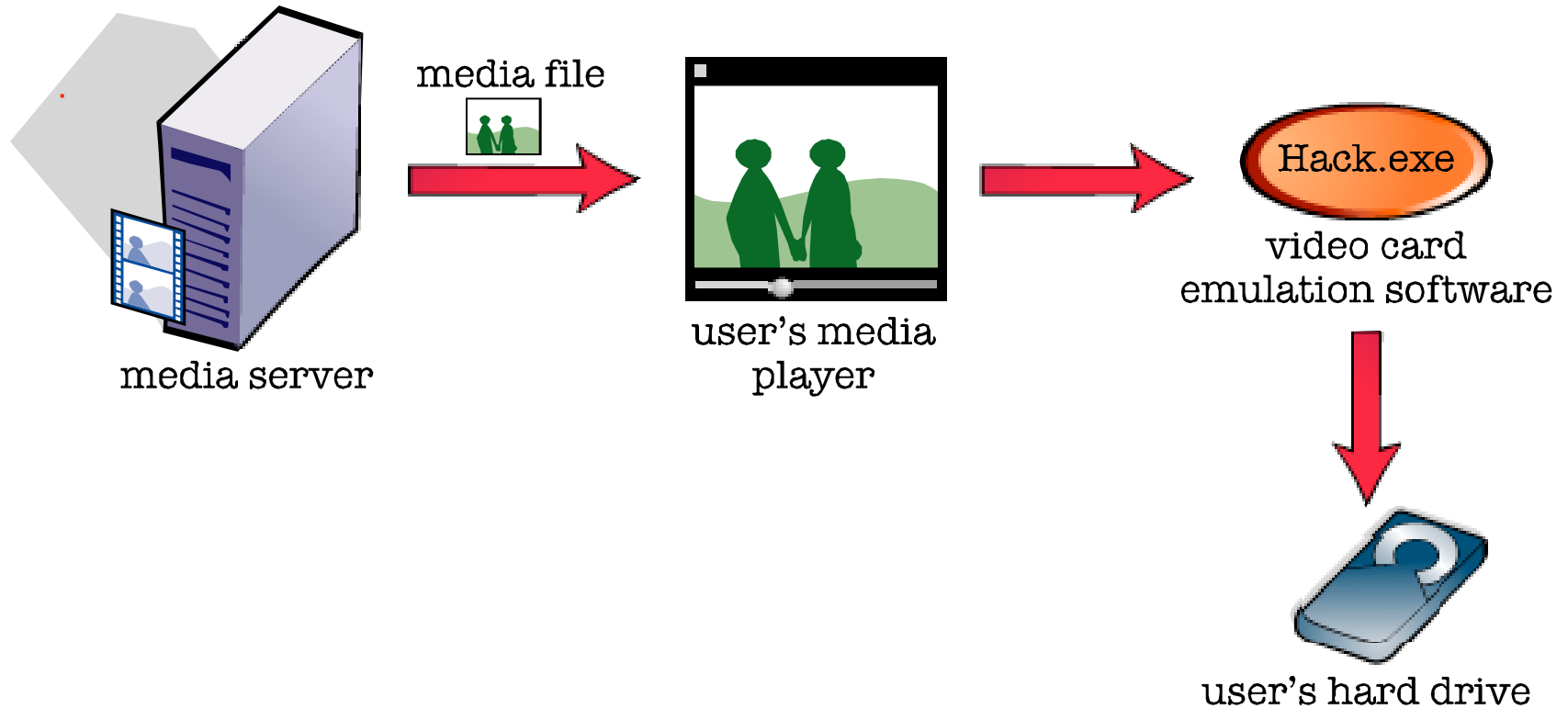
Hack 2 - Save to disk programs - Stream Rippers



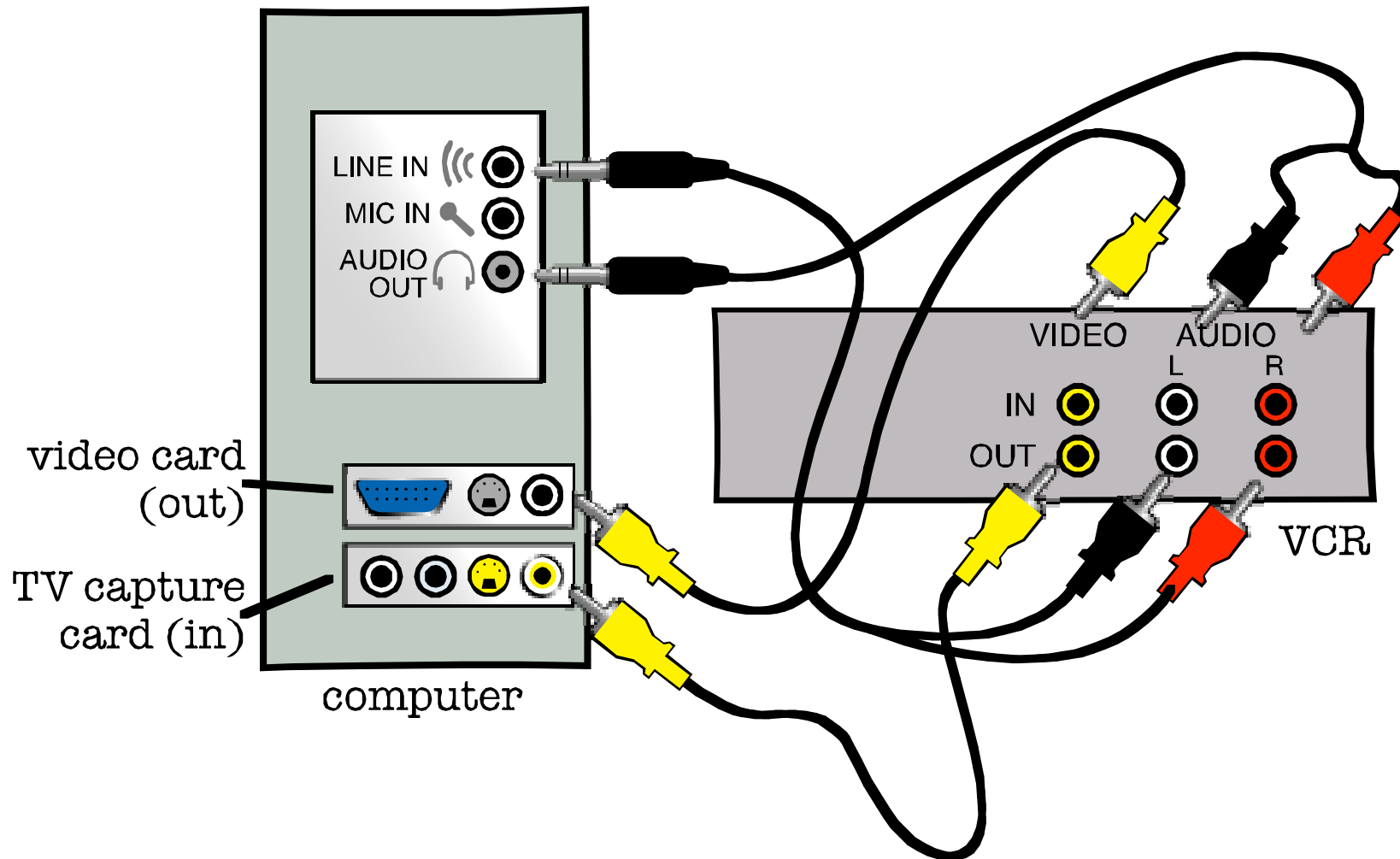
Hack 3 - Finding the Single Encryption Key



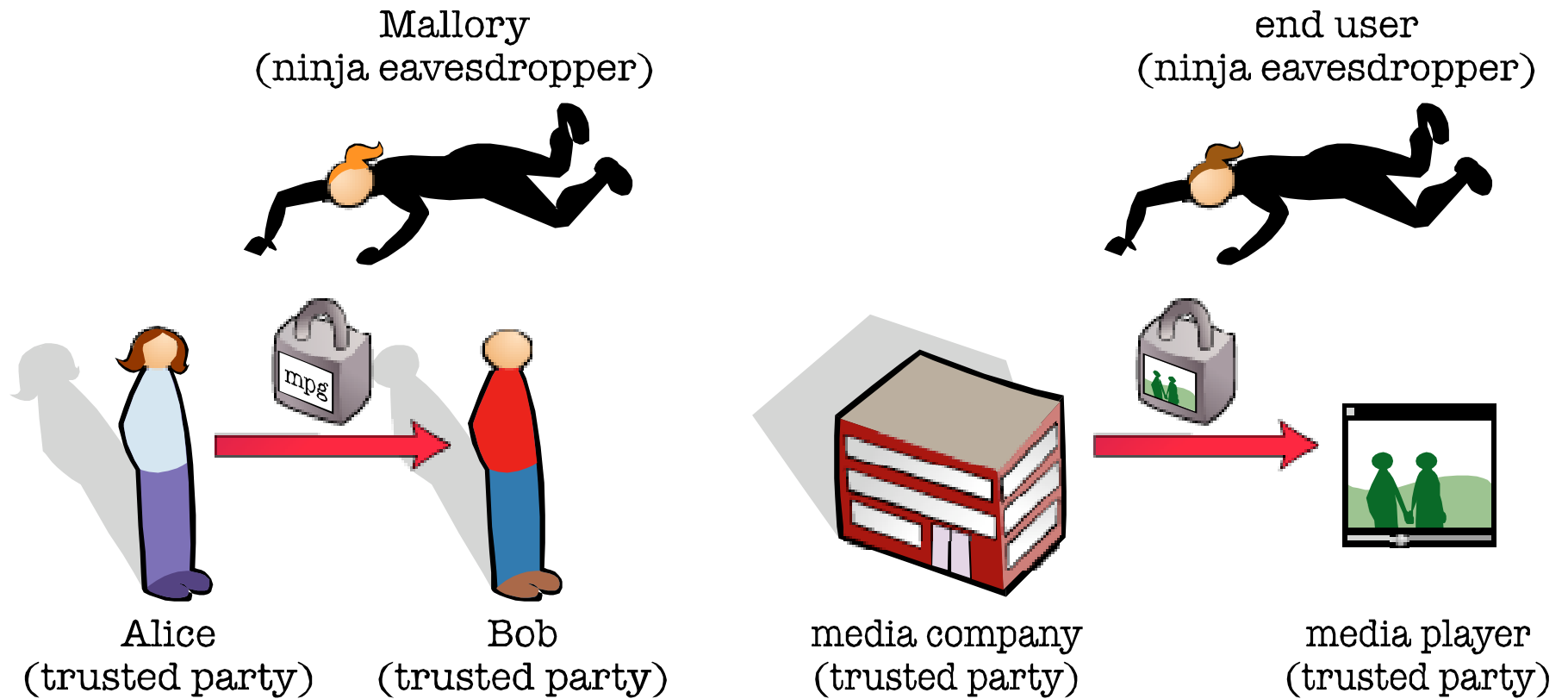
Hack 4 - Screen Capture



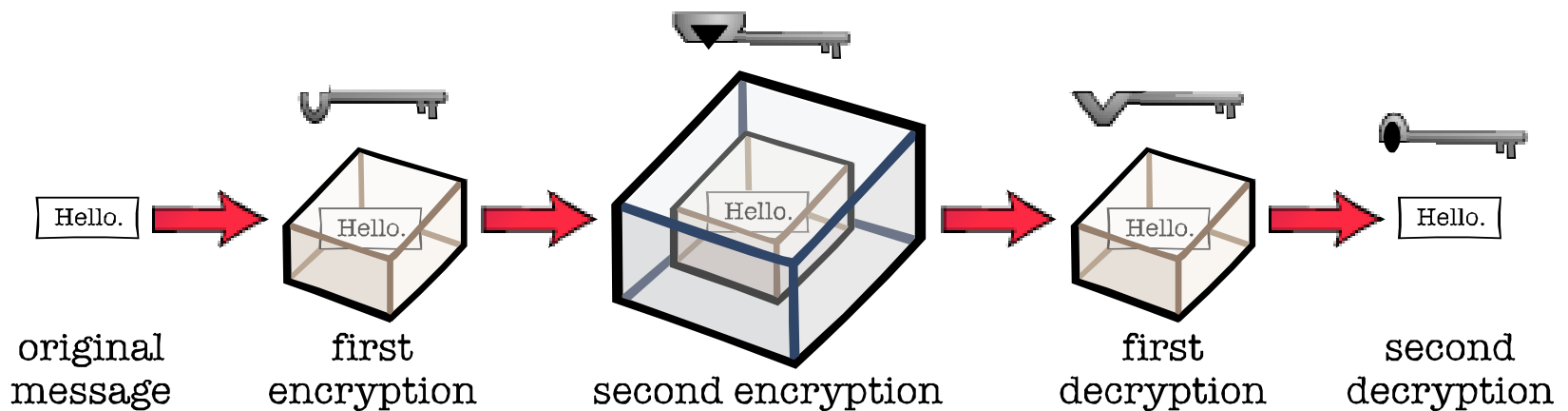
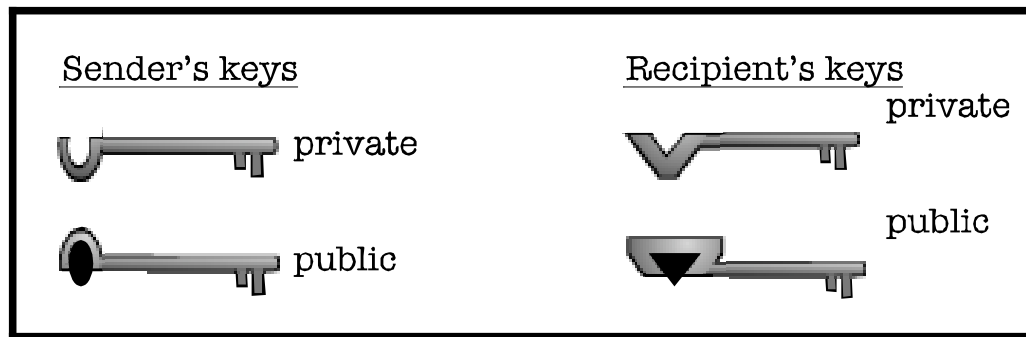
Hack 5 - Analog Hole



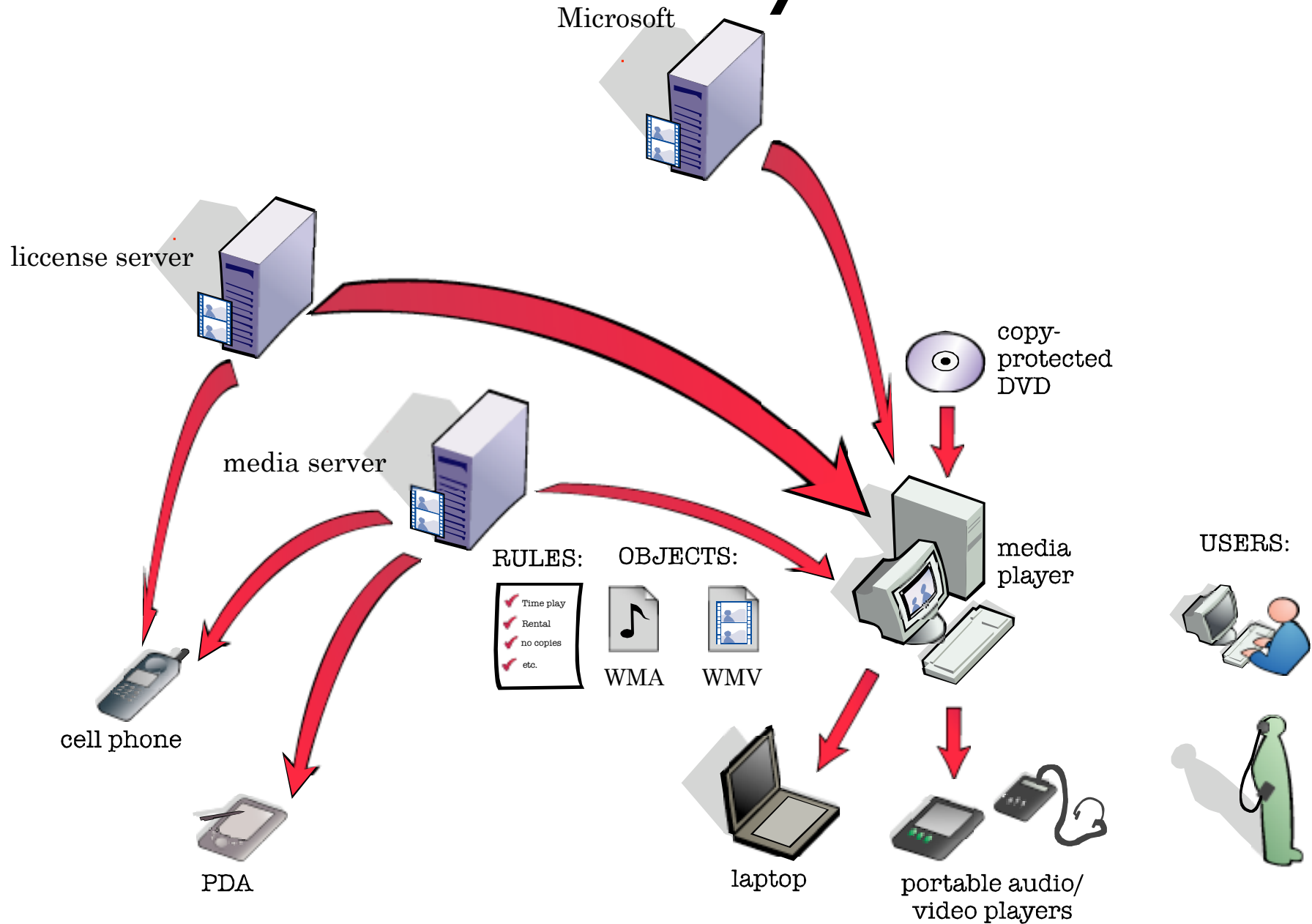
Encryption vs. DRM



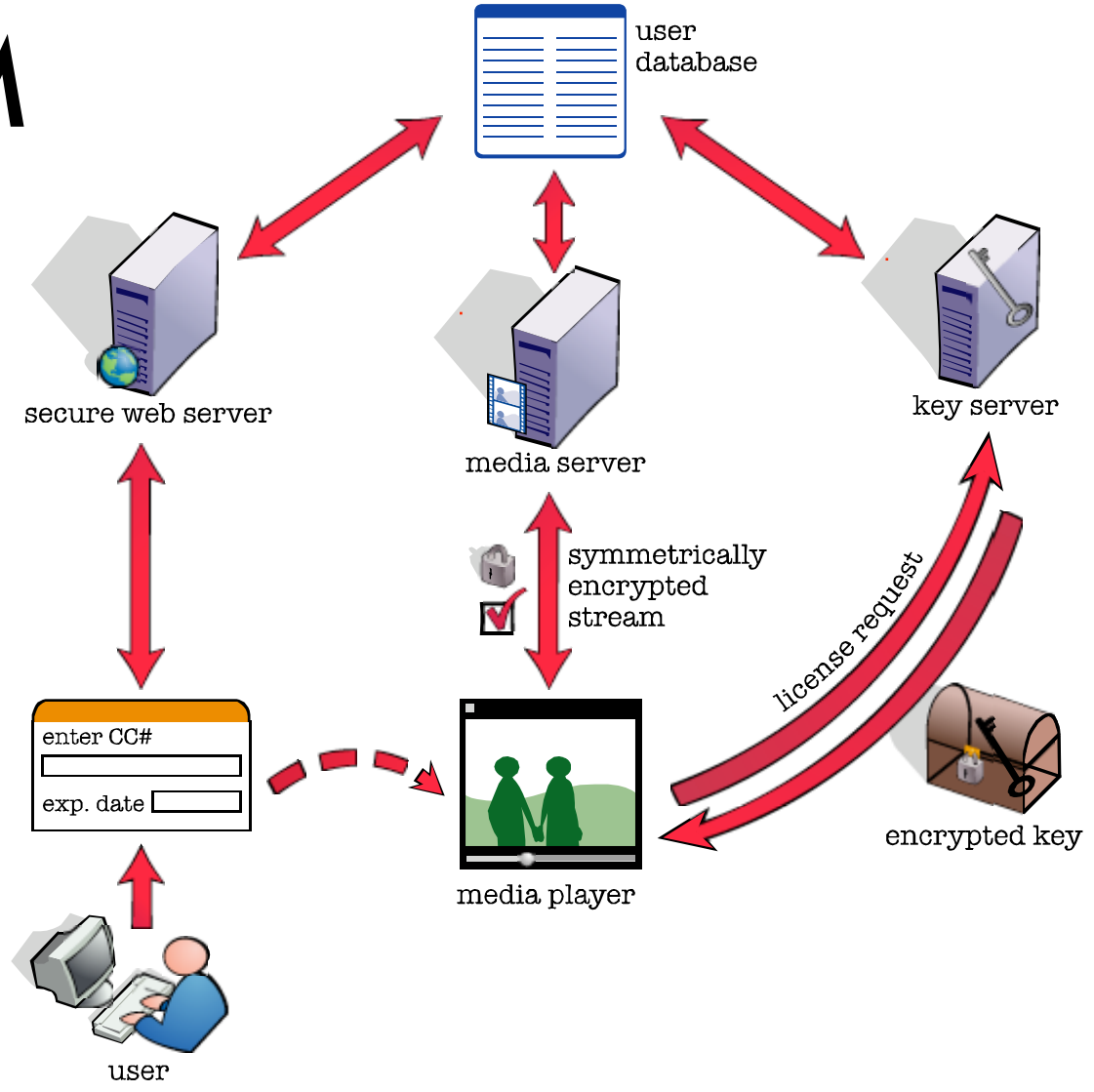
Keys & Encryption



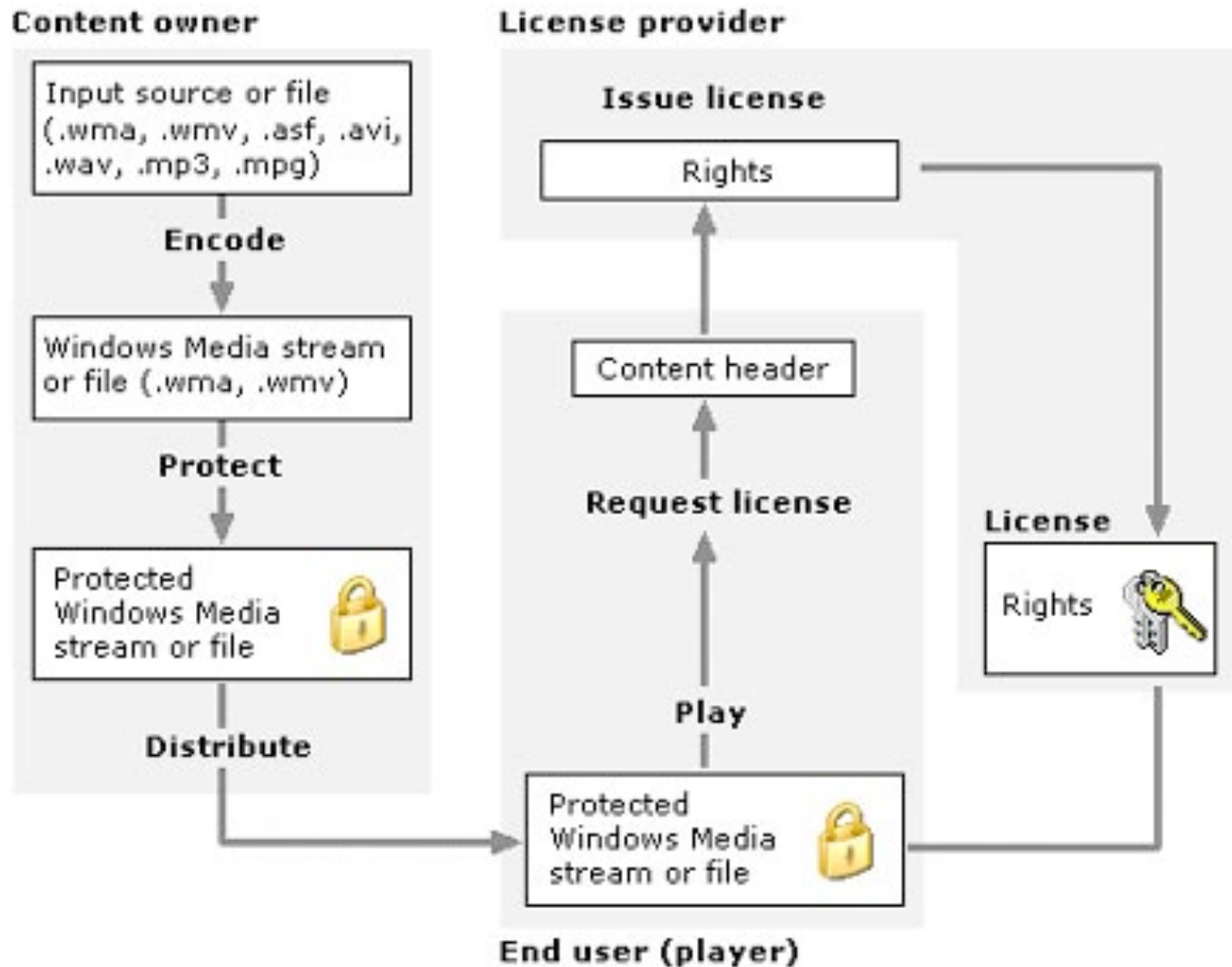
DRM Ecosystem



DRM



Microsoft DRM Sequence



Rights Examples

- Single viewing.
- Single viewing within limited time frame
- Unlimited viewing on the computer used to purchase the movie
- Limited number of copies to other devices
- Unlimited copying to other devices
- No right to copy.

MS DRM Requirements

(Excerpted from MS “A Technical Overview of WM DRM 10 for Devices”)

Devices must:

- Support the ASF file format.
- Be able to communicate using IP and HTTP technologies, as well as any other protocols required by the network connection between the server and the network device.
- Support Universal Plug and Play registration.
- Support the following encryption standards:
 - Advanced Encryption Standard (AES) with 128-bit keys, ...
 - 1024-bit RSA cryptography, with the ability to store and protect the private key.
 - MACs using SHA-1 with 1024-bit RSA encryption, as well as AES OMAC1.
- Be able to store their device certificate and any certification authority certificates.
- Support Universal Plug and Play-based HTTP downloads.
- Support whatever playback codecs are needed for the content.
- Be able to parse the binary XMR policy and enforce the specified rights. XMR is a proprietary binary format; the format documentation, the definition of all the rights, and example policy parsing code will be included with the licensing agreement.
- Be prepared to support any specific output security schemes that specific licenses may require. Examples of security requirements include Copy Generation Management System (for analog video) or Secure Audio Path (for audio).

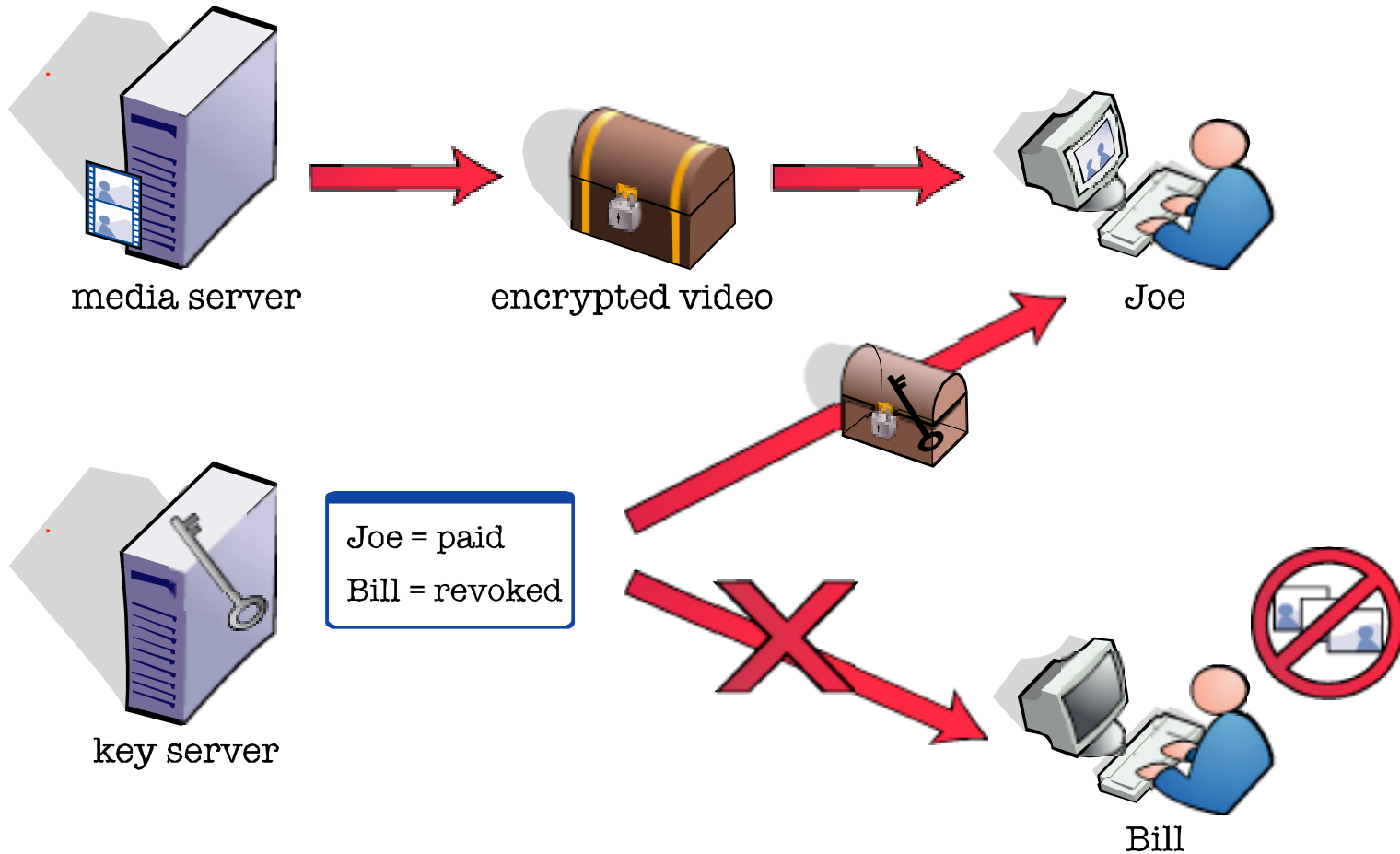
License Revocation and Exclusion

Revocation is when a license issuer tells a computer requesting a license to invalidate the license for a particular piece of content or a component. Revocation is enforced by license issuers. Revocation is used for different reasons, including a breach of licensing agreement by a component designer, or a compromise of a DRM component. In order for revocation to occur, a portable device must visit a license server or attempt to update a license.

Exclusion is the process of denying a license to a requesting device, because it has been identified as being

Object	Revocation	Exclusion
Portable and network devices	Yes, by Microsoft	No
DRM security components	No	Yes, by content licensor. Alternative may specify that a component needs to a more current, secure version.
Content	Yes, by content licensor	No
Applications	Yes, by Microsoft	Yes, by content providers
Video drivers supporting Certified Protection Protocol (COPP)	Yes, by Microsoft	No

License Revocation



Guidelines For Effective DRM

- Look at and talk to existing customers
- “Keep the family jewels offline” – Whatever you put online, don’t put up anything that, if bootlegged, *would destroy your business*.
 - (That said, you may be highly overestimating the impact of content piracy on your business, and reactionary fear should not overshadow your sober analysis of where the technology will ultimately take your market and business.)
- Test so-called “better mouse traps” with good cheese

A vendor stating that their system has been “deployed for years” or “worked with tens of thousands of pieces of content” is no good if it hasn’t been tested with good content. Look for a system that has been tested with high value content that many people actually want, and use that as a benchmark for whether the DRM system can survive the notoriety.
- Evaluate DRM solutions as a whole system, of which encryption technology and security products are only one component.
 - There are so many low-tech ways to compromise security – many of the movies that are uploaded to the Internet were leaked for personal use by people internal to the studio or post-production organizations. DRM accomplishes nothing if the entire chain of people securing the content cannot be trusted.

“Safe” Online Distribution Models

- Distribute low quality versions, with moderate protection but no encryption (such as streaming without allowing save to disk).
- Distribute high quality versions, with lock box encryption. Allow redistribution because the content has to be unlocked on every machine or device.
- Distribute only teaser, filler, or “exclusive” content that is not provided on other media channels. Disincentives people from copying it by freely distributing it. Use it to promote the sale or consumption of other similar or related media.
- Distribute a small subset of the high quality media unlocked; use it to advertise a greater body of media that is locked with stronger encryption.

Questions/Break (:15)
**Topic: Digital Rights
Management, Content
Security**



Part 5: Audience Use Cases

- **Topics**
 - Survey of Audience
 - Discussion of speaker experiences
 - Discussion specific audience use cases
 - General Q&A

Should I use Windows Media?

Windows, Real, MPEG-4, Flash Video honest assessment

- **WM9** - better, faster, cheaper. Very high performing
- **Real** - best transport, and service solution, mobile and subscription services, good hold on the audio market
- **QuickTime / MPEG-4** - portable, compatible, mobile
- **Macromedia** - polished, well integrated user experience. Quickly becoming the low-friction way to do streaming. Excellent foothold in web advertising (banner ads)

Example: Akimbo

- Sells a Video-on-demand set top box
- Downloadable content delivered to the network-connected box

Example: AccessMedia

- Web-based previews
- Extensive video catalog
- Web based, with thumbnail previews of content
- Uses MS DRM to ensure payment and prevent copying of downloaded movies

Audience-Driven Use Case Discussion



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