

VWM Companies' Watermarking Technology

**A Presentation to the Analog
Reconversion Discussion Group by
Macrovision,**

**Licensing Agent for the Joint Solution of
the VWM Companies**

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Digital Watermarks Defined

Digital watermarks are data embedded within the content, not in the header, which electronic devices can read but humans cannot perceive



Original Image

Digital Watermark-enabled

Exaggerated view

- ✎ **Persistent digital identity for media content, that survives Analog to Digital and D to A transformations**
- ✎ **Watermarking has been broadly deployed and adopted**
 - **Images, Print, Audio, Video**
 - **Billions of watermarked objects and millions of readers in market today**

Some Relevant Watermarking Applications



Copy Control

- **Communicates desired behavior** of consumer's device
- **Conveys Copy Control Information** in a robust manner to control copying of **protected** digital commercial content



Forensic Tracking

- **Identify** unauthorized **leakage** to consumers from prerelease to manufacturing and promotion
- **No cooperation** required of consumer's devices
- Allows rights holders to take **legal or business** actions against sources of leaks
- Being used by most major record labels



Broadcast and Internet Monitoring

- Watermark **identifies where** the content has been **distributed** and reports back to content owner
- Adopted by **Reuters** and **NBC News Channel** for Video; **Coca Cola** for advertising; and commercial photographers, **Corbis**, and other stock agencies for Images



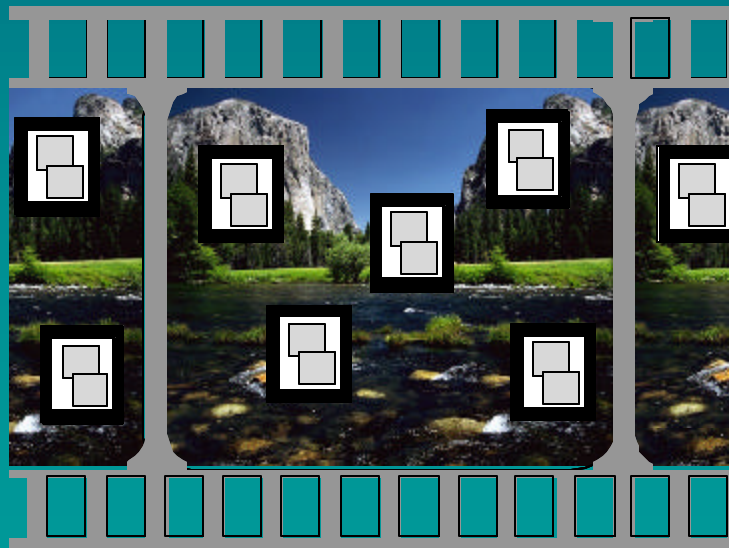
Content Identification and Asset/Rights Management

- **Communicate** copyrights and facilitate licensing
- Link to DAM, DRM, content enhancement and e-Commerce systems
- Has been widely deployed in **Adobe Photoshop** and other image editing applications and adopted by thousands of companies and imaging professionals

What is Video Watermarking?

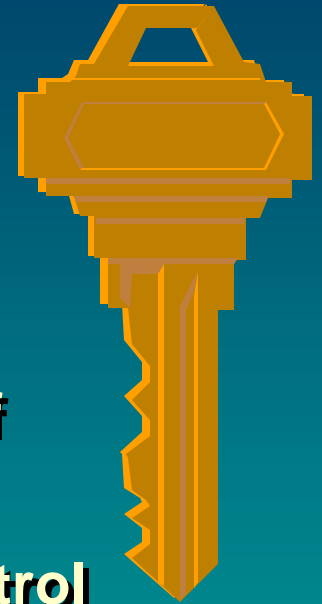
Robust & imperceptible information hidden within video content itself

- **Robust** – Survives common transformations that would be performed by a consumer or consumer equipment
 - Digital -to- analog video -to- digital conversion
 - MPEG compression for storage for time-shifting
 - VHS copying for time-shifting
- **Imperceptible** – Not visible in a consumer's viewing environment



Key Benefits of Video Watermarking

- ✍ **Survives format and interface changes**
- ✍ **Uses existing and emerging network infrastructure**
- ✍ **Minimal impact on existing workflow and production costs**
- ✍ **Can be effectively integrated with a variety of devices**
- ✍ **Plugs the Analog Hole by retaining copy control information (CCI)**
- ✍ **Security and enhancement layer**
 - **Analog and Digital content**



Watermarking Plugs the Analog Hole

“One way to plug the analog hole is through the use of watermarks.... some government action will be needed to require appropriate detection of and response to the watermark.”

**Richard Parsons, CEO, AOL Time Warner, Inc. Senate
Judiciary Hearing, March 14th, 2002**

“Watermarks may provide a means to ensure that protection rules survive as content transitions analog outputs.”

**Dr. Craig R. Barrett, President and CEO, Intel Corp. Senate
Judiciary Hearing, March 14th, 2002**

“We are developing a plan to plug the “analog hole” that includes harnessing watermarking technology that would prevent such conversions from being used to avoid content protection obligations”

**Peter Chernin, President and COO, News Corporation Senate
Commerce Committee Hearing, February 28th, 2002**

“Watermarking is one of the most promising techniques for protecting the content owner's rights of a digital good”

**Microsoft US Patent Application, 20030009671 Filed
April 23, 2001**

Watermarking Benefits for Content Protection Applications

Record Control

- **Prevent** recording of video that is sourced from DVD, or PPV (“**Copy Never**”)
- **Allow** recording of video for time-shifting from pay TV or subscription television services, such as HBO (“**Copy One Generation**”)
 - **Prevent** further copies of first copy (“**No More Copies**”)

Play Control

- **Prevent** playback of unauthorized copies of watermarked video

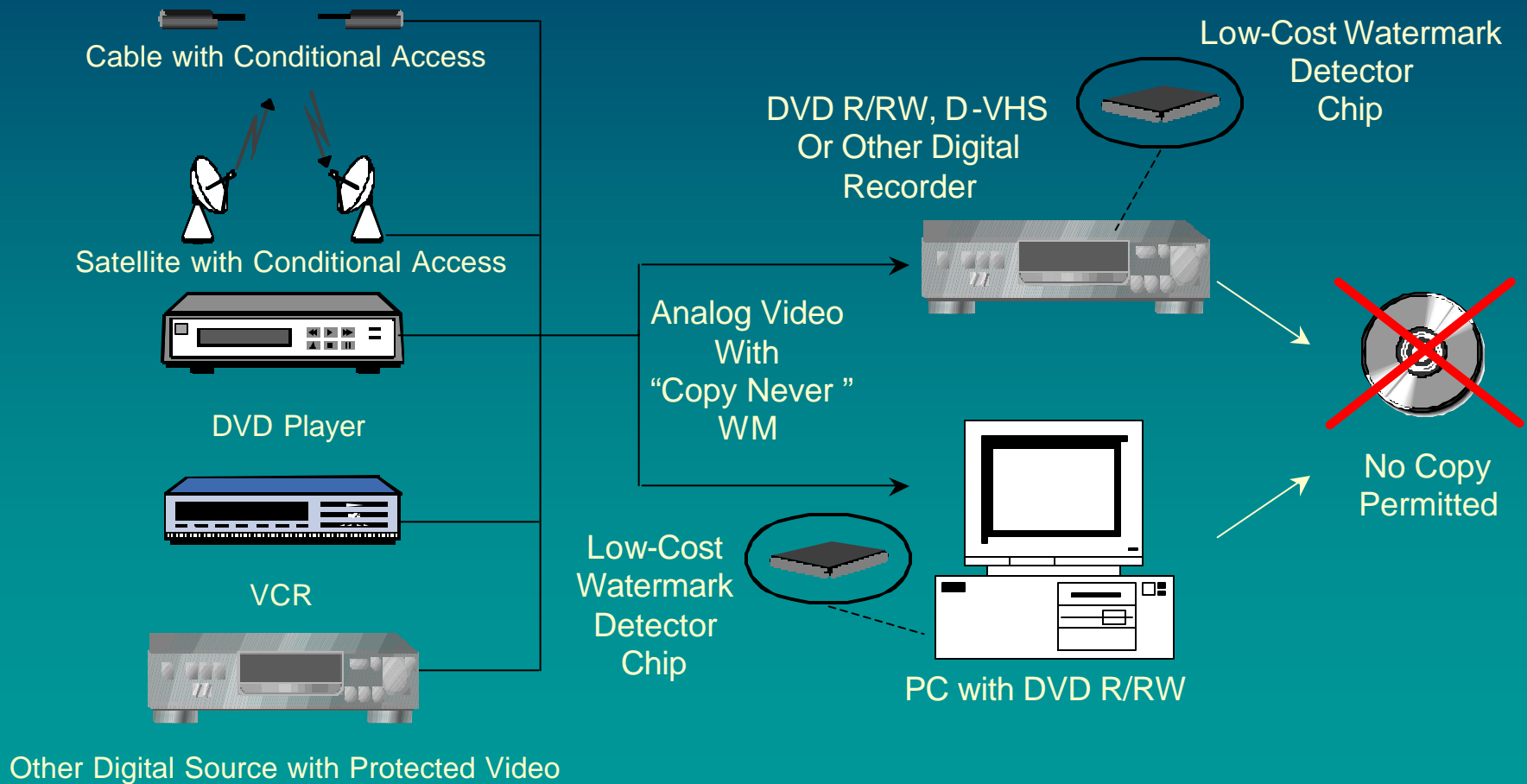
Communication of Restrictions on Redistribution

- **Identify** analog video that was derived from **protected** digital video

System Overview - Record Control with "Copy Never" Watermark

Program Source

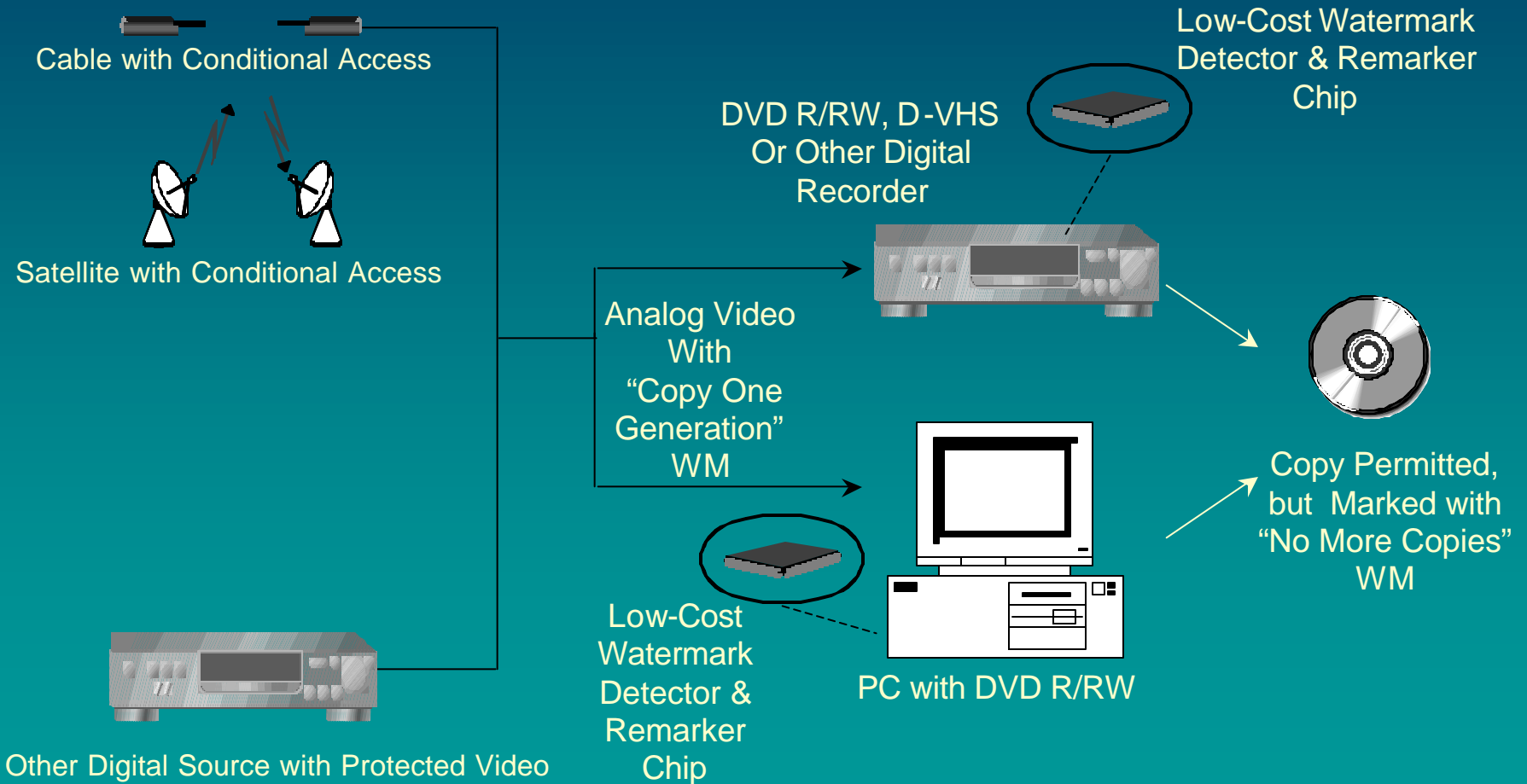
Recording Device



System Overview - Record Control with "Copy One Generation" – 1st Gen

Program Source

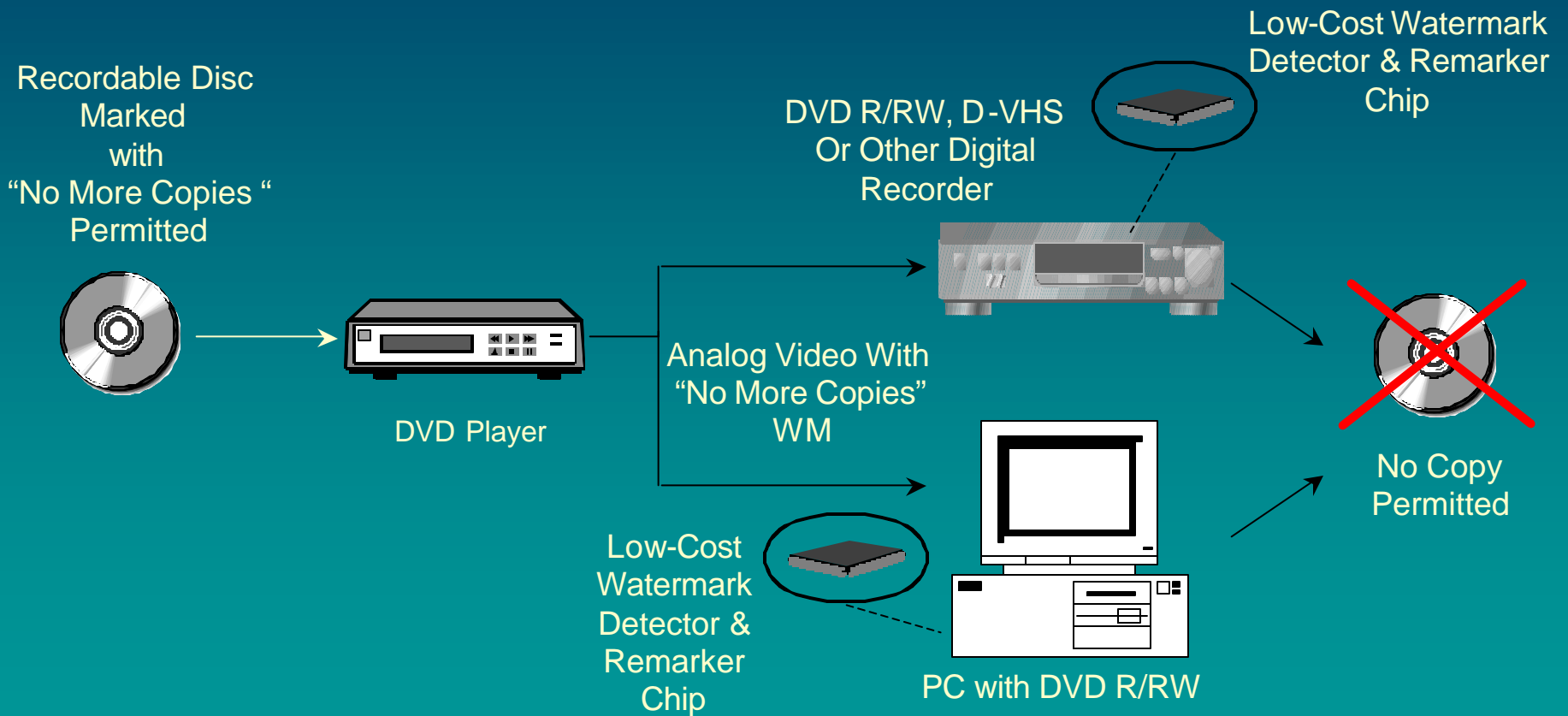
Recording Device



System Overview - Record Control with "Copy One Generation" – 2nd Gen

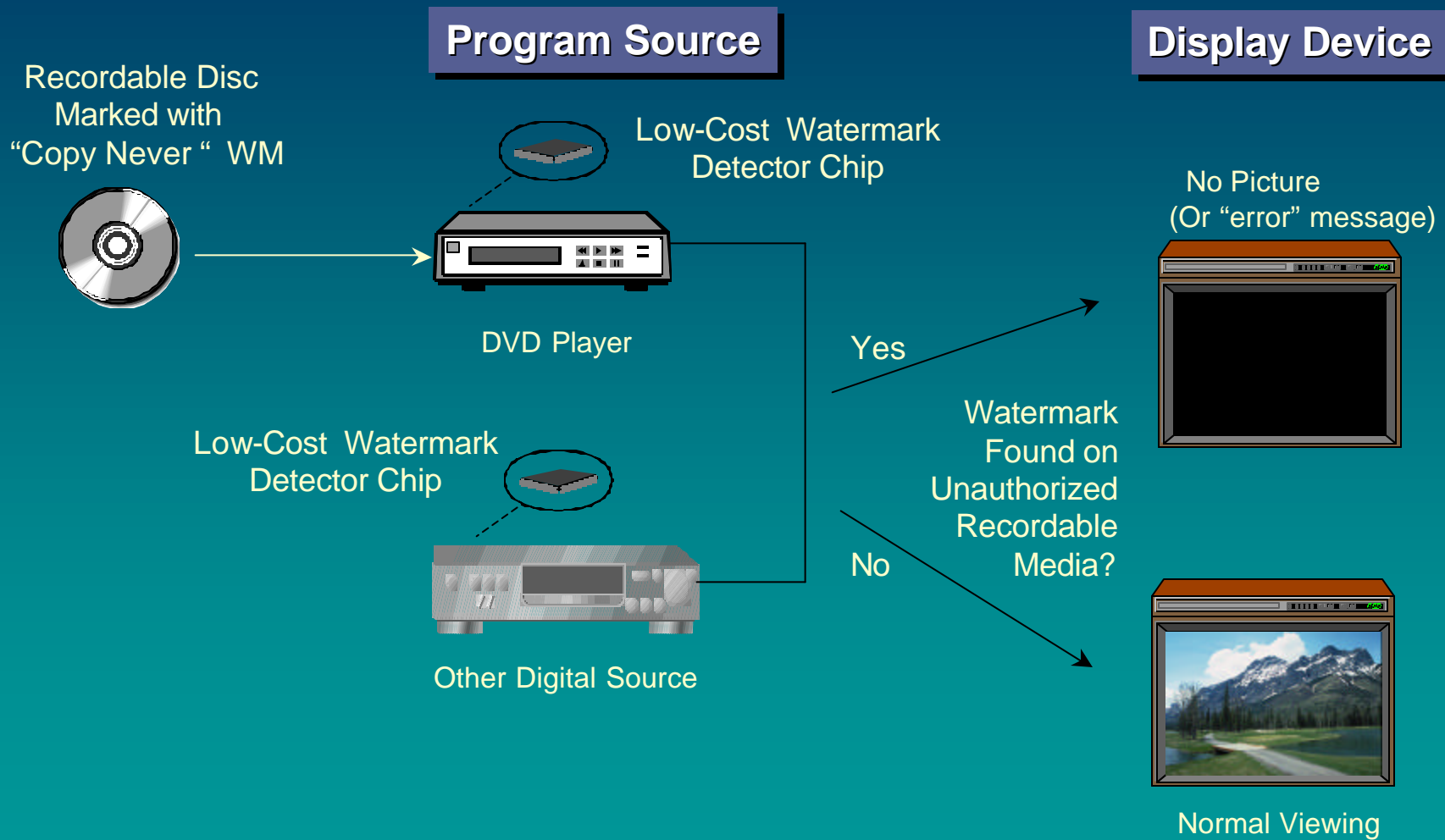
Program Source

Recording Device



System Overview - Play Control

Backup to record control

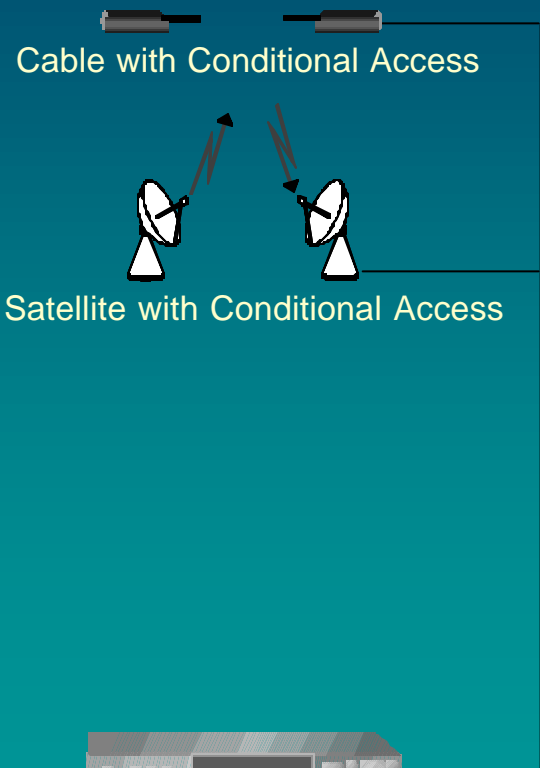


System Concept

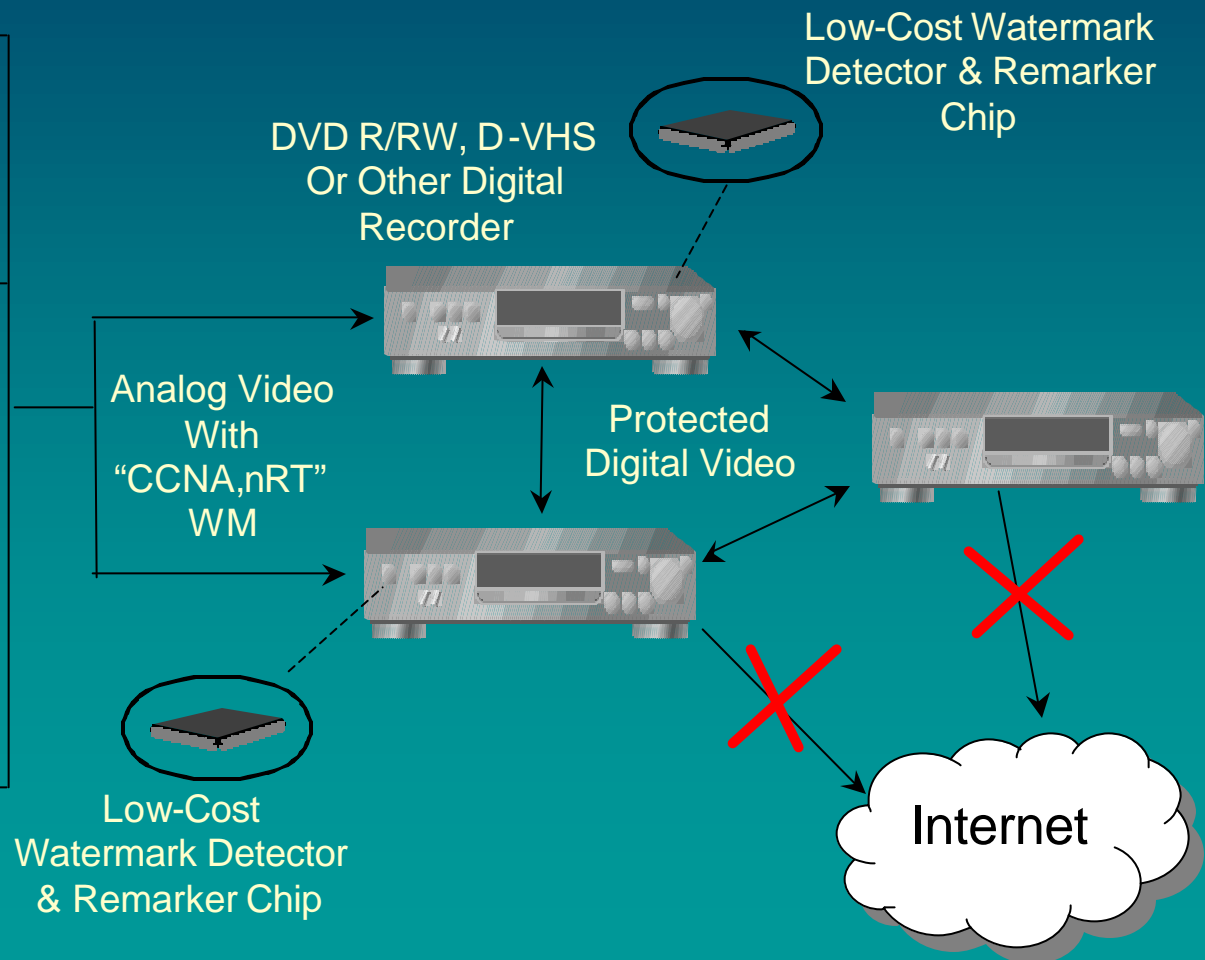
“Copy Control Not Asserted, no Re-Transmission”

- **Redistribution protection is triggered when WM detected**

Program Source



Consumer's Home



Elements of License & Specification Rights Holders

Available Now to Rights Holders

- Professional equipment: **embedding & verification**
 - **Real-time** video encoding
 - Serial **digital video** input and output (270 Mbps)
 - 525 and 625 operation
 - 1 rack unit chassis (19" x 1.73" x 12")
 - PC control via Ethernet
 - Broadcast monitoring variant of professional equipment installed at many locations worldwide
- Licenses & Pricing

Features of VWM Watermark Technology

Low Cost to End Product / Hardware Manufacturers

- Costs **acceptable** to major manufacturers of consumer devices
- Gate count, memory and MIPS :
 - **Small fraction** of that required for **existing functions**
 - **25K – 45K Gates + 72 KB RAM**
 - Depends on function: **baseband / MPEG** and **detect / remark**
 - **DSP & PC benchmarks available**
 - Requires identification of many assumptions
 - Allows for optimization
- **Technical Support Costs to End Product Manufacturers**
 - **No unexpected support costs**
 - **Mathematically modeled false positive probabilities**
 - **Extensive testing to validate models on 3 separate occasions by independent test organizations**
 - **Watermark prevents consumer action only when appropriate**
- **Significant **intellectual property** position**
 - **Designed to minimize need for 3rd party IP, e.g. MPEG-LA**

Extensively tested by multiple companies for cost effective implementation

Features of VWM Watermark Technology (2)

Robust

- **Conversion** to analog and back to digital
- **Horizontal and vertical image shifts**
- **Standards conversions**
 - NTSC to PAL and vice versa
- **Multiple VHS generations**
- **Filtering**
- **Scaling** of the video
 - Independently and arbitrarily in both horizontal and vertical directions
- **Color correction**
- **MPEG-2 compression** at wide range of bit rates and low resolutions
 - Three serial encode/decode cycles
- **Cropping**
- **Combinations of the above**

Extensively tested by multiple companies for robust and reliable implementation

Features of VWM Watermark Technology (3)

Payload Capability

- Detector able to detect 28 bits
- Easily able to support 5 usage states described by MPA

Perceptibility

- From independent test organizations performing double blind tests:

“None of the viewers considered the watermark even mildly annoying”

“The MPEG artifacts overwhelmed watermarking”

Features of VWM Watermark Technology (4)

Possible PC Locations

- **In-the-DVD** recordable **drive**
 - Technology robust against
 - random reads
 - multiple applications accessing drive
- **Video Capture Card**
- **Secure software**

Generational Copy Control

- **“Copy One Generation”** watermark triggers adding secondary watermark to video in remark module
- **Secondary watermark defines “No More Copies”**
- **Remarking modules available:**
 - C and VHDL
 - MPEG and baseband versions

Comparison of Video WM to Other Technologies for ARDG Purposes

Signaling Systems

- **CGMS-A**
 - More **limited payload** and usage state information
 - **Cheapest to circumvent**
 - **Much less robust**
- **Analog Protection System**
 - More limited payload and usage state information
 - **Cheaper to circumvent**
 - **Less robust in many environments**
 - Provides **additional protection** against VHS copying

Audio Watermark

- **Unable to independently provide protection to video**

Conclusion

- ✍ **Video watermarking addresses primary concerns of ARDG**
- ✍ **Single technology works in digital and analog domains**
- ✍ **Core technology has ancillary benefits for rights holders and consumers**
- ✍ **Available today for protecting high value video content**
- ✍ **Extensively tested and proven**
- ✍ **Supported by leading consumer electronics manufacturers**