

Wissenschaftliche Bewertung von DRM-Systemen

Scientific evaluation of DRM systems

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- ⌘ Adversary model
- ⌘ Strength of existing systems
- ⌘ Tendencies
- ⌘ DRM technologies
- ⌘ Summary

What is the scope of the attacker?

⌘ More general: What are the security demands?

- ⊗ confidentiality of content
- ⊗ integrity of content
- ⊗ availability of content

⌘ Confidentiality:

- ⊗ protection against piracy
 - ⊕ copy one content
 - ⊕ copy every content in a certain time frame
 - ⊕ break the entire system (copy every message at every time)

⌘ Integrity:

- ⊗ authorized access to content
- ⊗ protection of ownership of content

⌘ Availability:

- ⊗ prevention of denial of service attacks

Adversary model

⌘ Security depends on the supposed strength of the attacker.

⌘ Resources

- ⊗ Money
- ⊗ Time
- ⊗ Knowledge

The existence of specialized tools shifts the "knowledge" to anybody

⌘ insider or outsider

- ⊗ concerning organizational aspects
(secrecy of master encryption keys)
- ⊗ concerning design secrets
(e.g. of protection functionality in hard- and software)

⌘ Who wants to attack a system?

- ⊗ Hobbyist (naïve attacker, no financial efforts)
- ⊗ Serious attacker (intelligent, probably no financial efforts)
- ⊗ Professional attacker (intelligent, financial motivation)

Strength of existing systems

⌘ Very limited protection

- ⊗ Most systems
 - ⊕ protect against hobbyists
- ⊗ DRM systems realized in software
 - ⊕ no or nearly no protection against serious attacks
- ⊗ DRM systems realized in hardware
 - ⊕ weak protection against serious attacks

⌘ In the best case:

- ⊗ Technical components of DRM systems consist of special adapted and well-known IT security functions

⌘ Worst case:

- ⊗ Content contains proprietary DRM signals or functions without any special protection

- ⌘ Pirates try to “reverse engineer” DRM systems
 - ⊗ make them useable on other platforms (Linux, ...)
 - ⊗ make them independent of a certain hardware and software seller

- ⌘ Pirates in the Internet shift their “activities” to services
 - ⊗ peer-to-peer services
 - ⊗ anonymous communication services

- ⌘ Pirates may use Trojan Horses to get content illegally
 - ⊗ This is a very subtle and serious thread!

- ⌘ Attackers make their knowledge public as automated tools
 - ⊗ Hobbyists can now do professional attacks

DRM Technologies

⌘ Basic IT security technologies

- ⊗ Encryption

- ⊗ Tamper resistant hardware devices

⌘ Special designed DRM technologies

- ⊗ Fingerprinting

- ⊗ Watermarking

*content
detection*

⌘ Naïve security mechanisms

- ⊗ Regional coding of content

- ⊗ Filter mechanisms

- ⊗ Incompatible formats and media

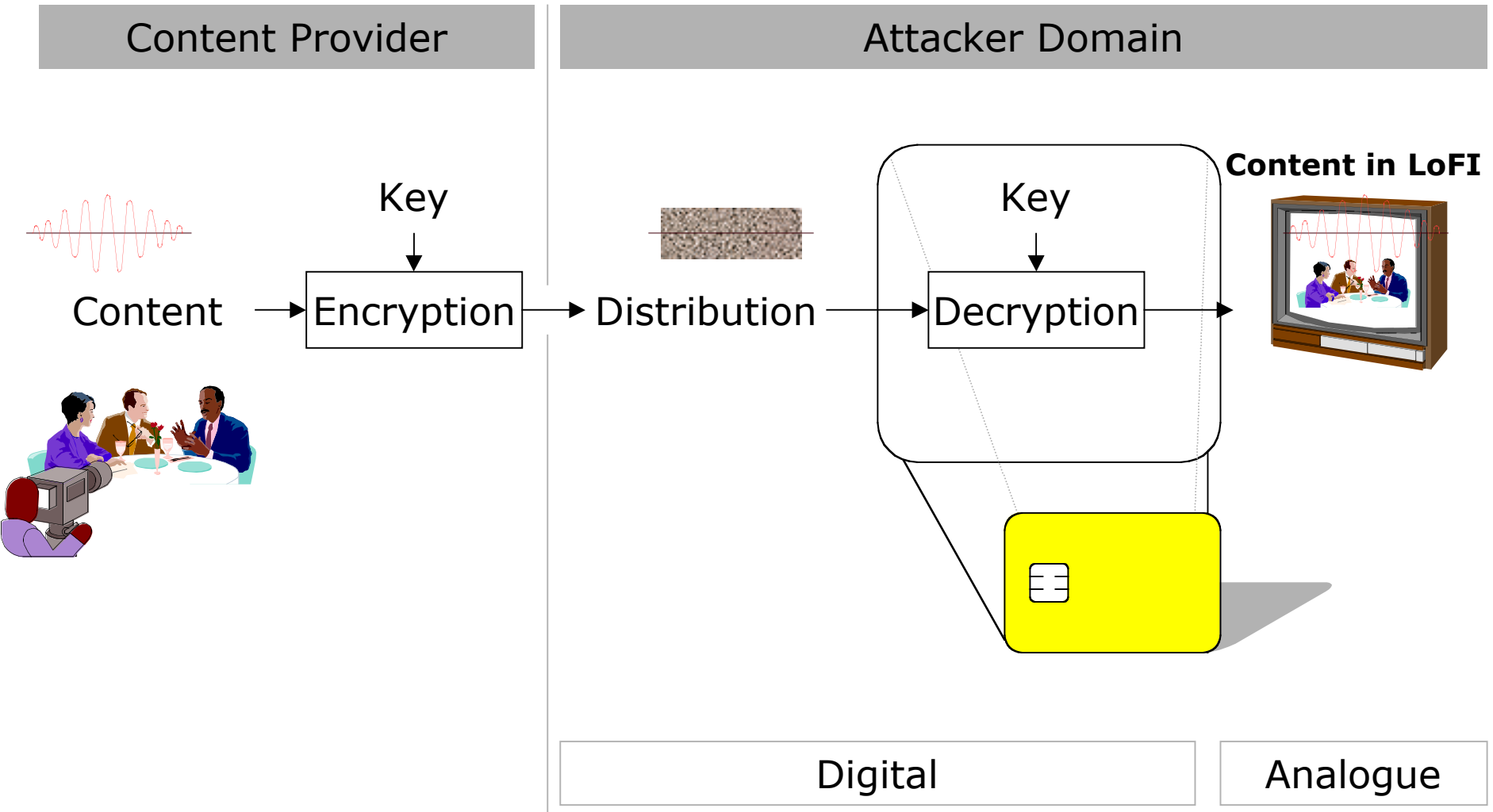
- ⊗ DRM codes without any protections against removing

- ⊗ ...

*copy
protection*

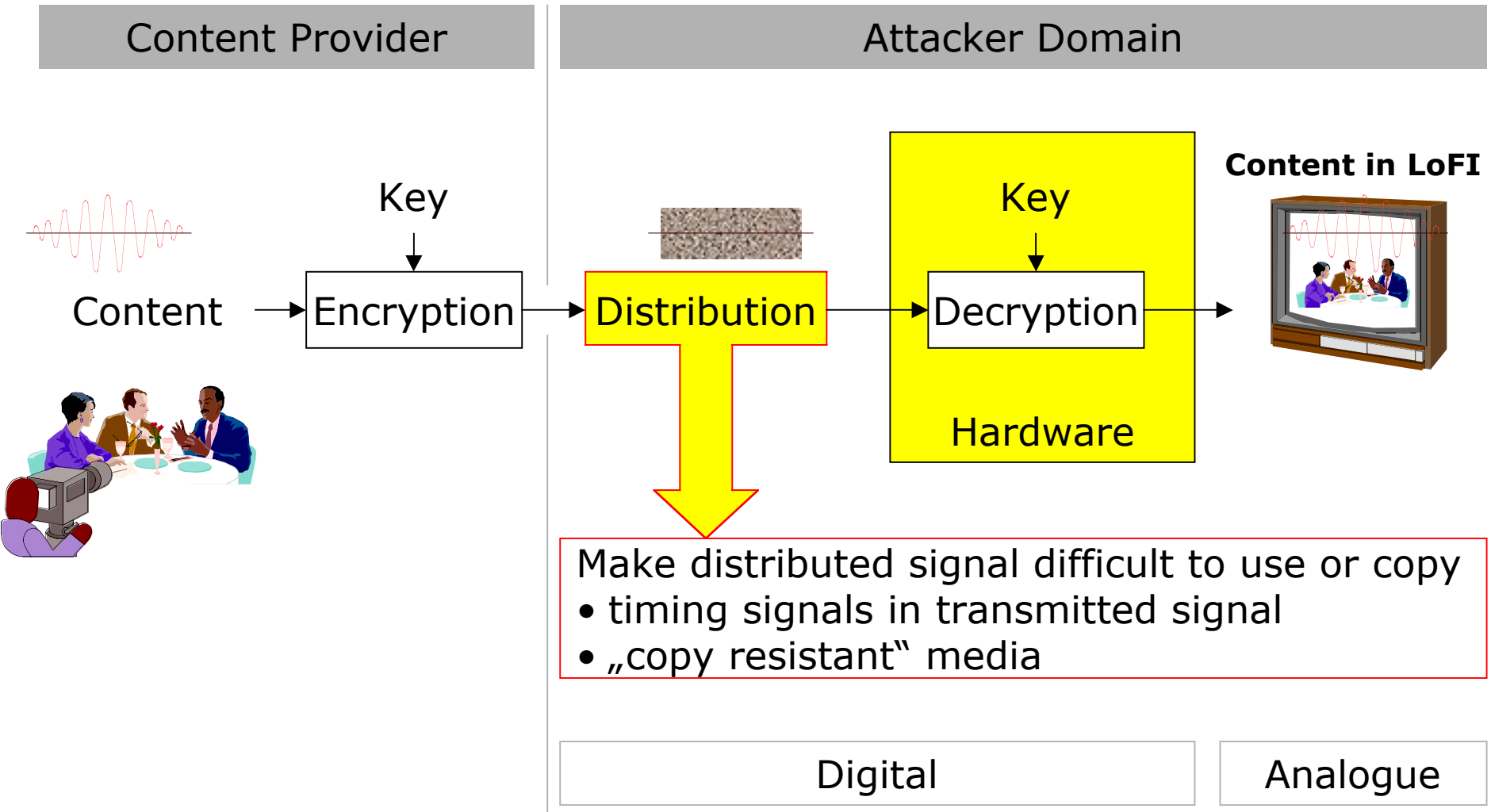
Design Options for Copy Protection

⌘ Protect pay-services from unauthorized access

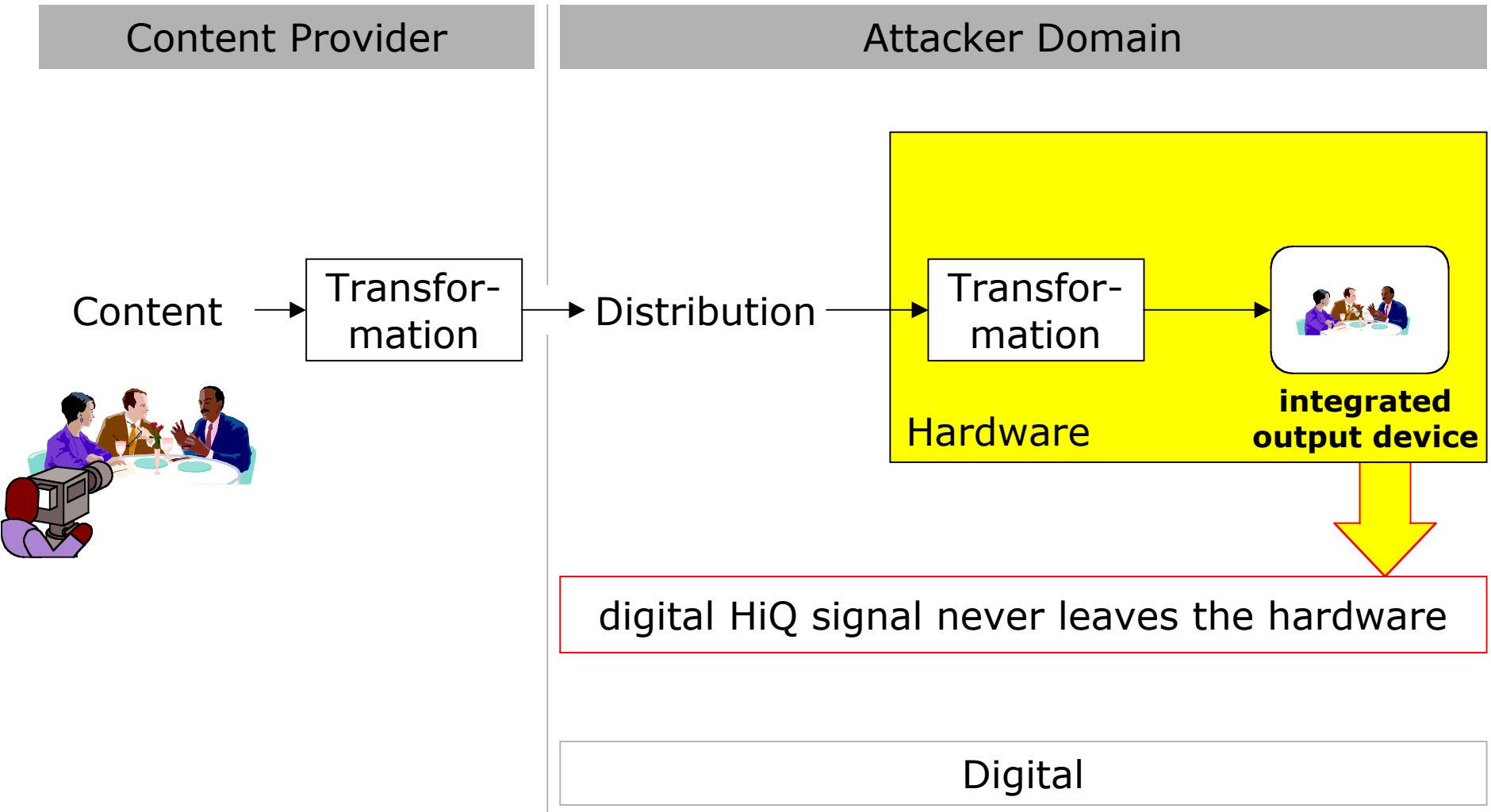


Design Options for Copy Protection

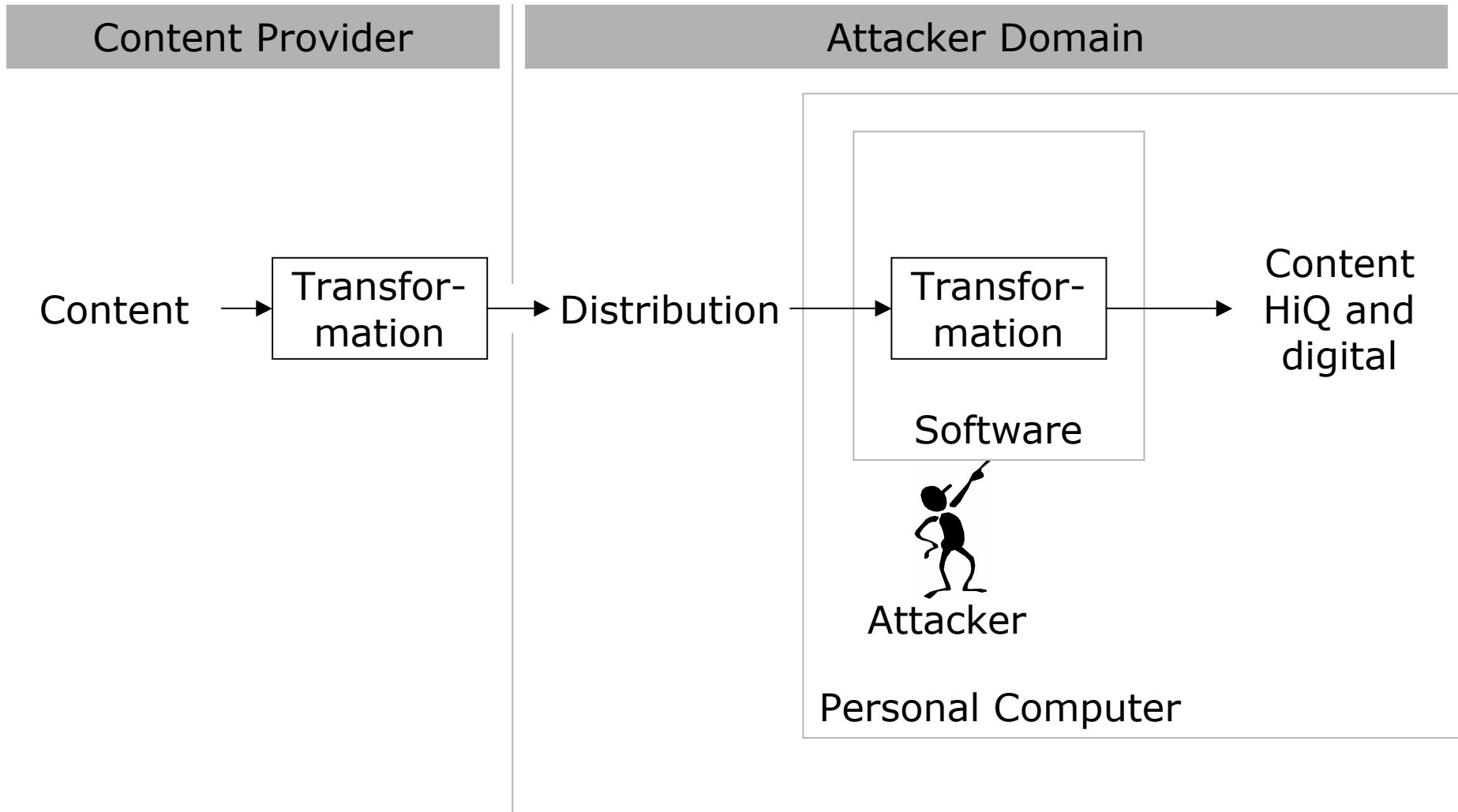
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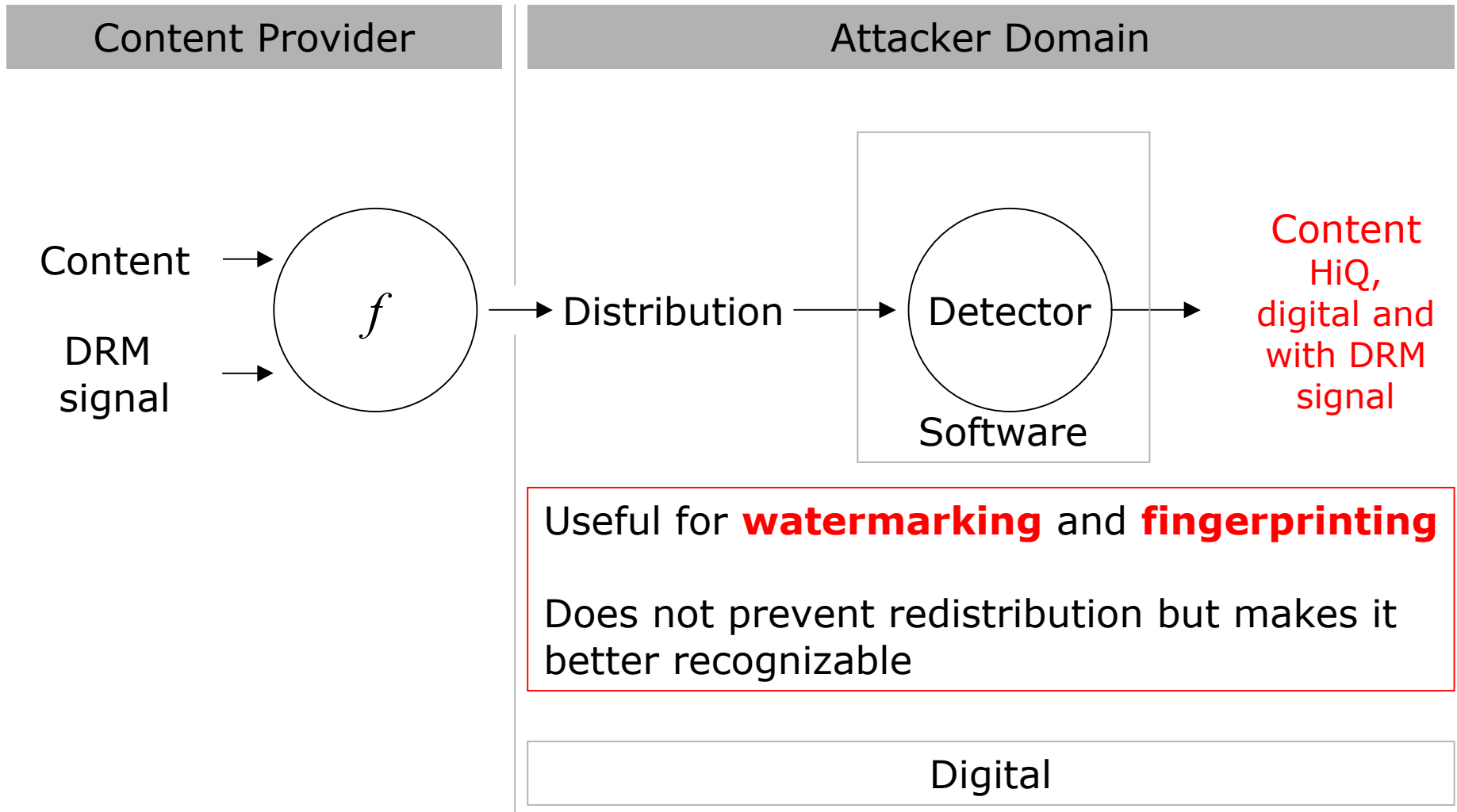
Design Options for Copy Protection



Never! Too dangerous!



What is possible in software?



What is possible in software?

Content Provider

Attacker Domain

Attention!

Scope is changing!

Not: Protection against illegal copying

But: **Detection** of copies

Content

DRM
signal

Content
HiQ,
digital and
with DRM
signal

printing

Does not prevent redistribution but makes it better recognizable

Digital

⌘ Basic IT security technologies

- ⊗ Encryption
- ⊗ Tamper resistant hardware devices

⌘ Special designed DRM technologies

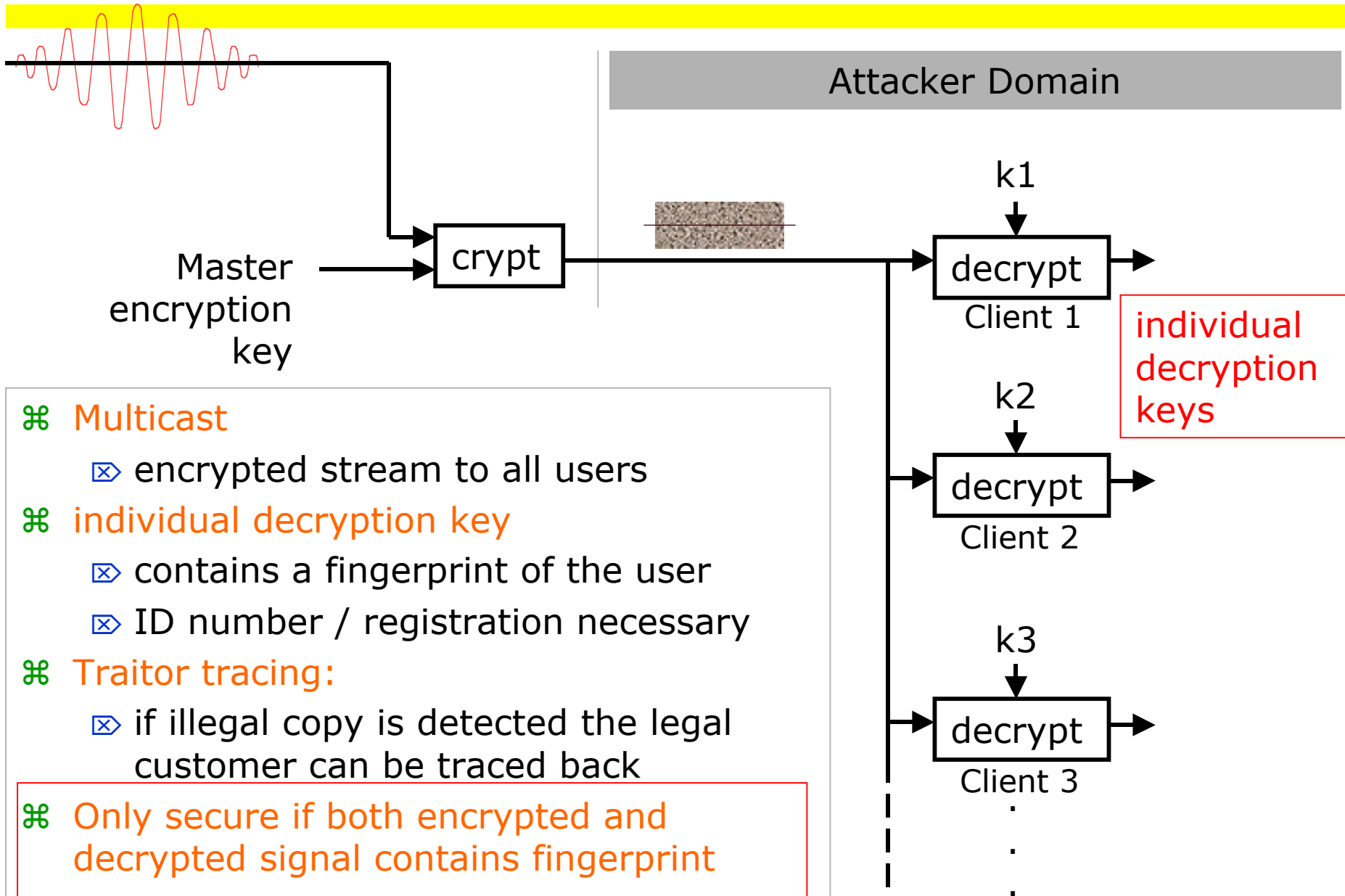
- ⊗ Fingerprinting
- ⊗ Watermarking

*content
detection*

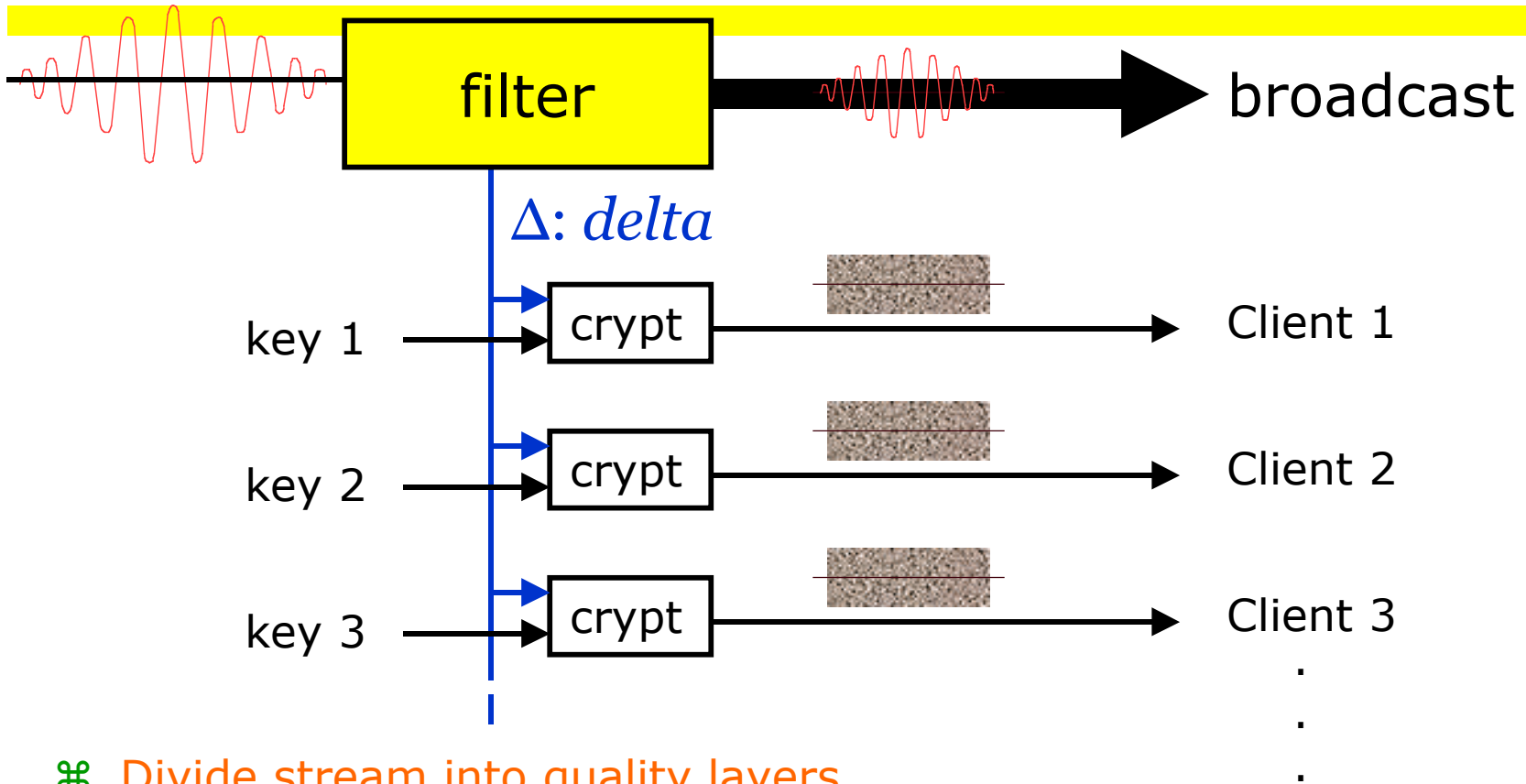
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- ⊗ Filter mechanisms
- ⊗ Incompatible formats and media
- ⊗ DRM codes without any protections against removing
- ⊗ ...

Broadcast encryption



> LoFi Broadcast, HiFi Encryption



⌘ Divide stream into quality layers

- ⊠ Everybody gets the low quality layer
- ⊠ Paying customers get encrypted layers

⌘ MP3:

- ⊠ division of mp3 stream into quality layers

⌘ costs are linear in the number of users

⌘ Basic IT security technologies

- ⊗ Encryption
- ⊗ Tamper resistant hardware devices

⌘ Special designed DRM technologies

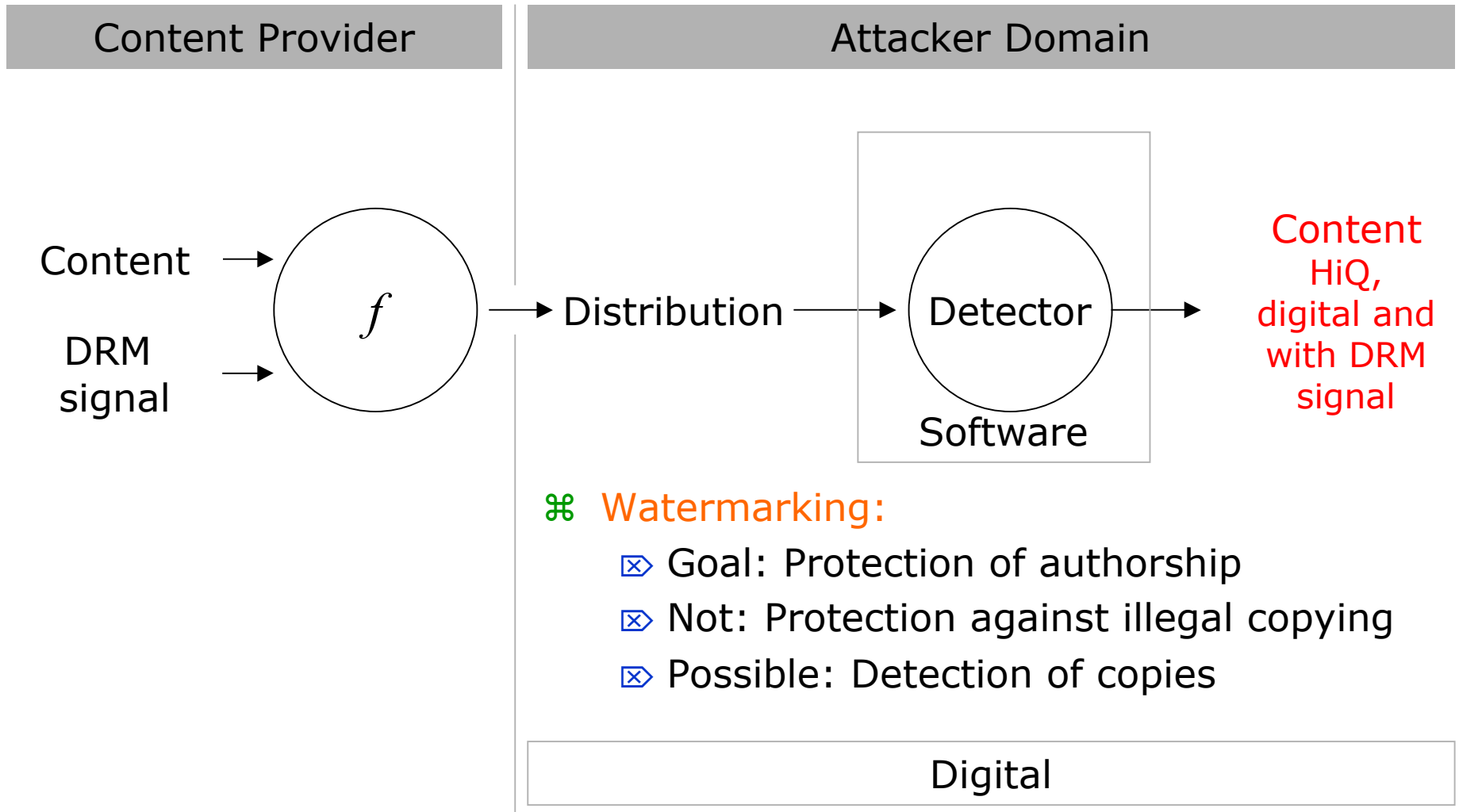
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*content
detection*

⌘ Naïve security mechanisms

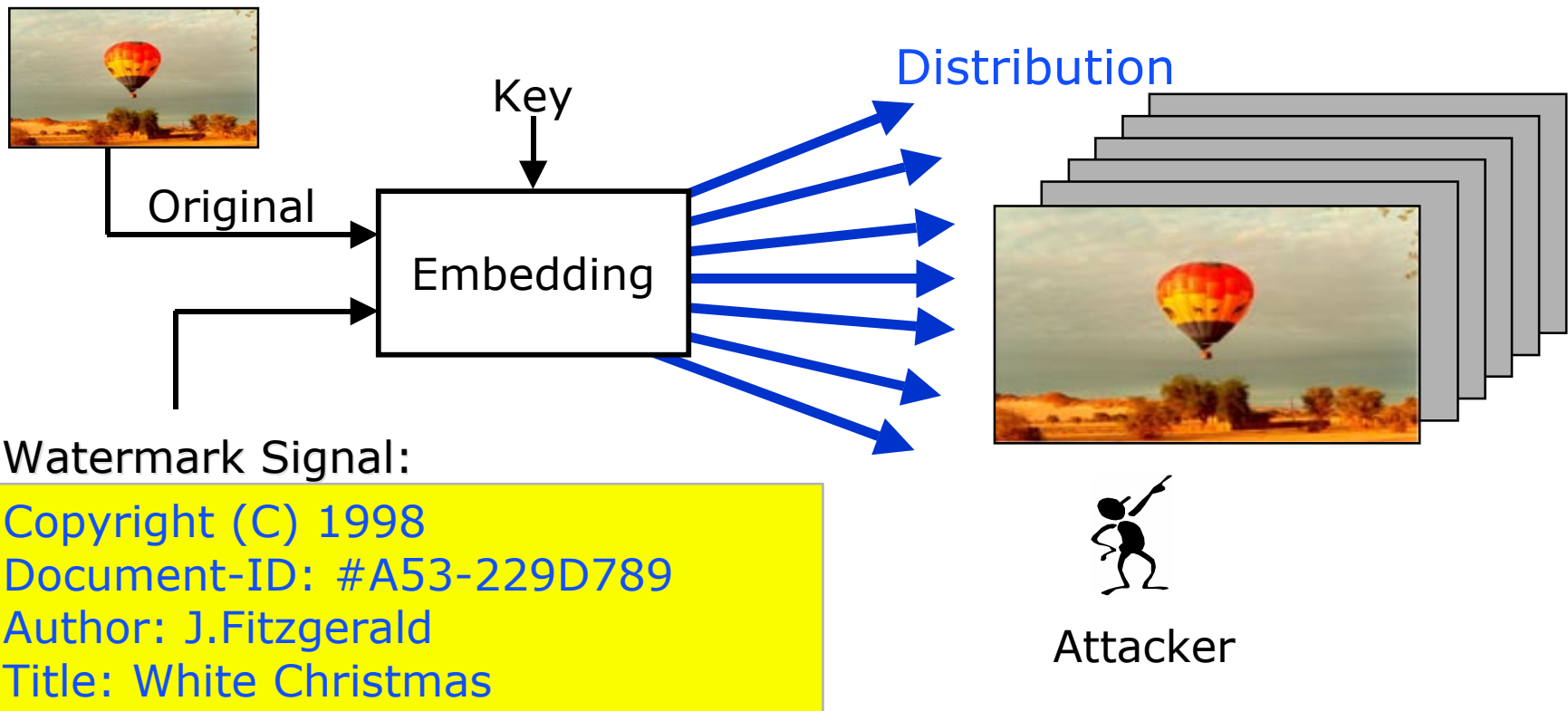
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Watermarking



Watermarking

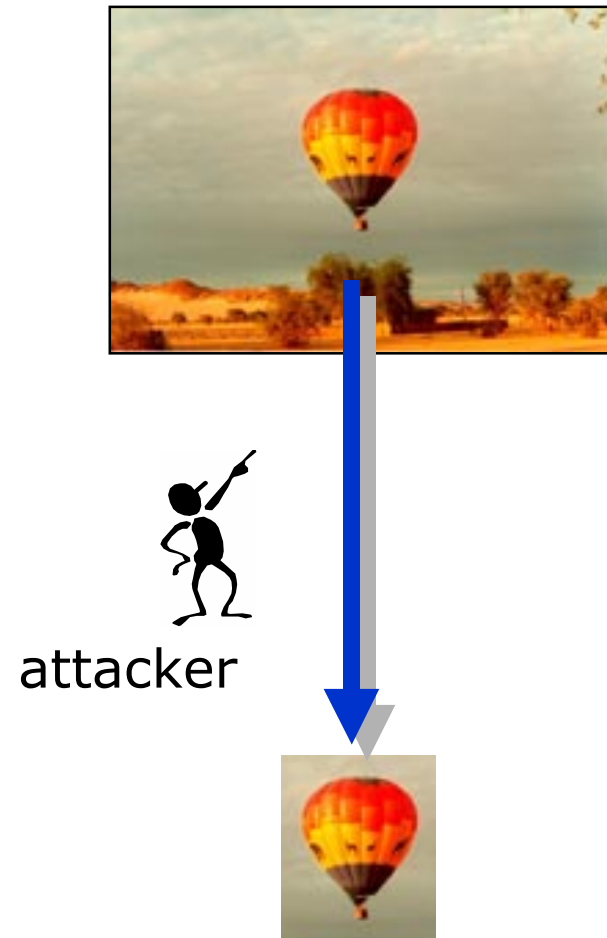
- ⌘ Scope: Protect authorship of digital content
- ⌘ correlation necessary
- ⌘ few 100 bit
- ⌘ strong changes



> Watermarking

- ⌘ Digital-Analogue-Conversion
- ⌘ Analogue-Digital-Conversion
- ⌘ Re-Sampling
- ⌘ Re-Quantization
- ⌘ Compression
- ⌘ Dithering
- ⌘ Rotation
- ⌘ Translation
- ⌘ Cropping
- ⌘ Scaling

- ⌘ Collusion Attacks



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Document-ID: #A53-229D789
Author: J.Fitzgerald
Title: White Christmas

> Security of watermarking systems

⌘ Theory

- ⊗ robustness
- ⊗ non-interference
- ⊗ detectability

⌘ Praxis: (attacks by M. Kuhn, F. Petitcolas, 1997)

⊗ StirMark

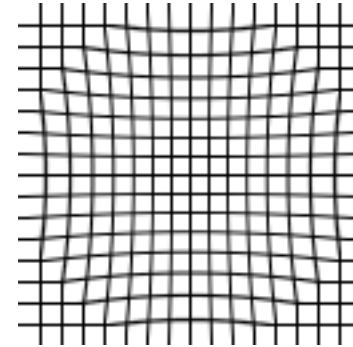
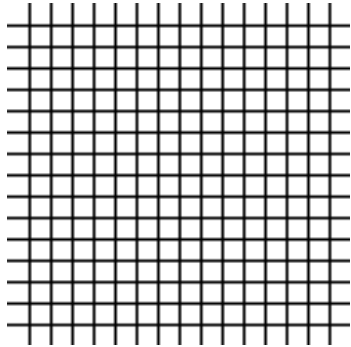
- ⊗ Software
- ⊗ removes watermarks
- ⊗ watermark is no longer detectable
- ⊗ <http://www.cl.cam.ac.uk/~fapp2/watermarking/stirmark/>

⊗ Mosaic Attack

- ⊗ divides web images into a mosaic of tabular cells
- ⊗ browser reconstructs the view of the image

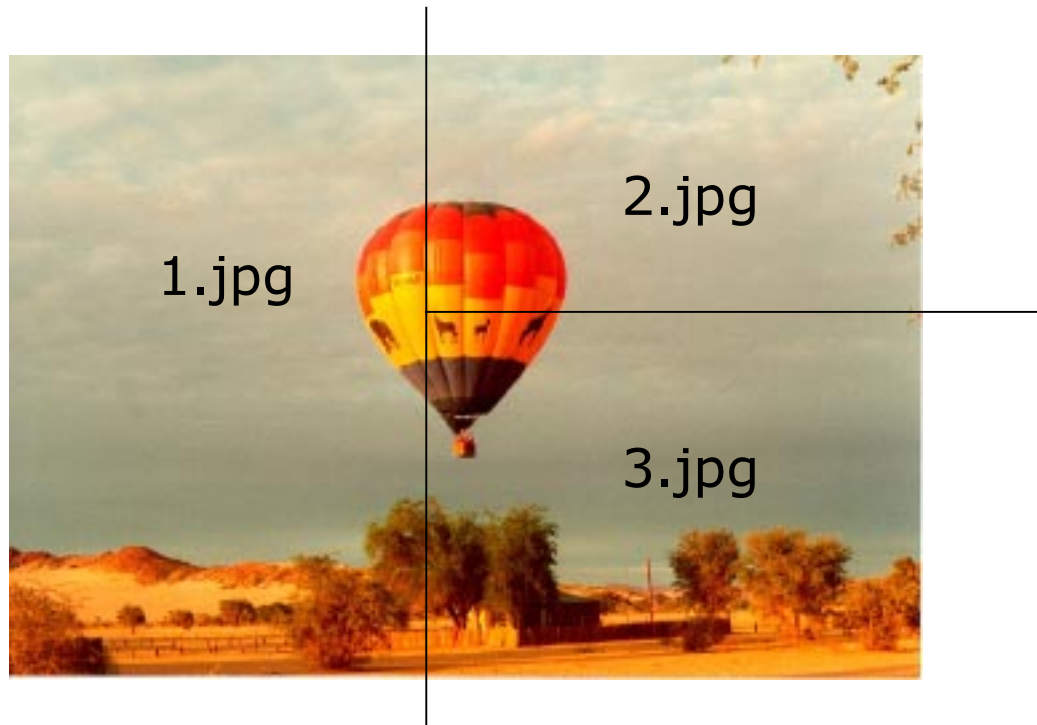
Stirmark Attack

- ⌘ non-linear transformation of a picture
- ⌘ synchronization gets lost
- ⌘ no anchor for detector to find the position of embedded signal



Mosaic Attack

- ⌘ divides web images into a mosaic of tabular cells
- ⌘ uses html statements
- ⌘ browser reconstructs the view of the image
- ⌘ protects from very simple web robots that look for illegally distributed material



⌘ Basic IT security technologies

- ⊗ Encryption
- ⊗ Tamper resistant hardware devices

⌘ Special designed DRM technologies

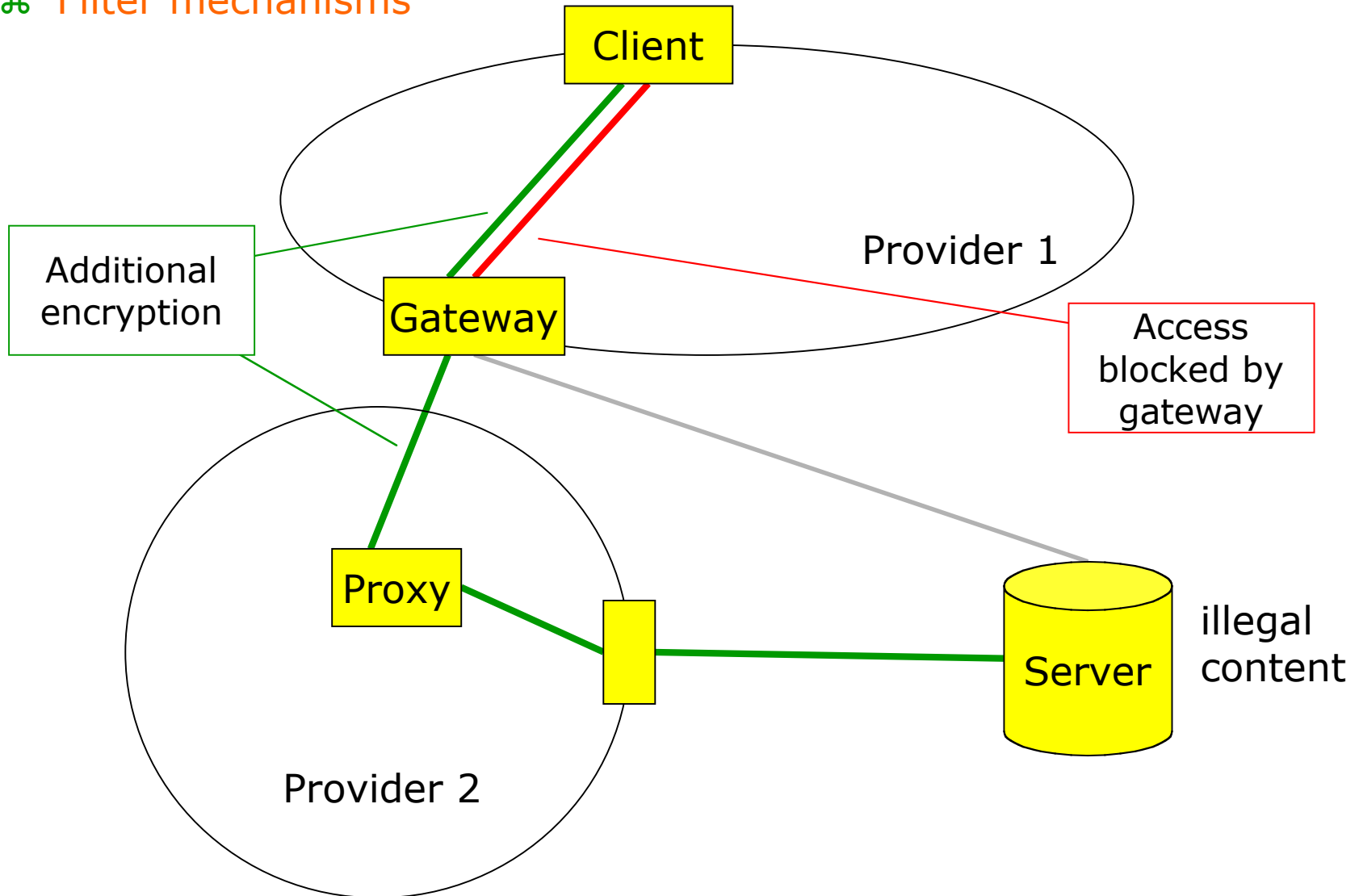
- ⊗ Fingerprinting
- ⊗ Watermarking

⌘ Naïve security mechanisms

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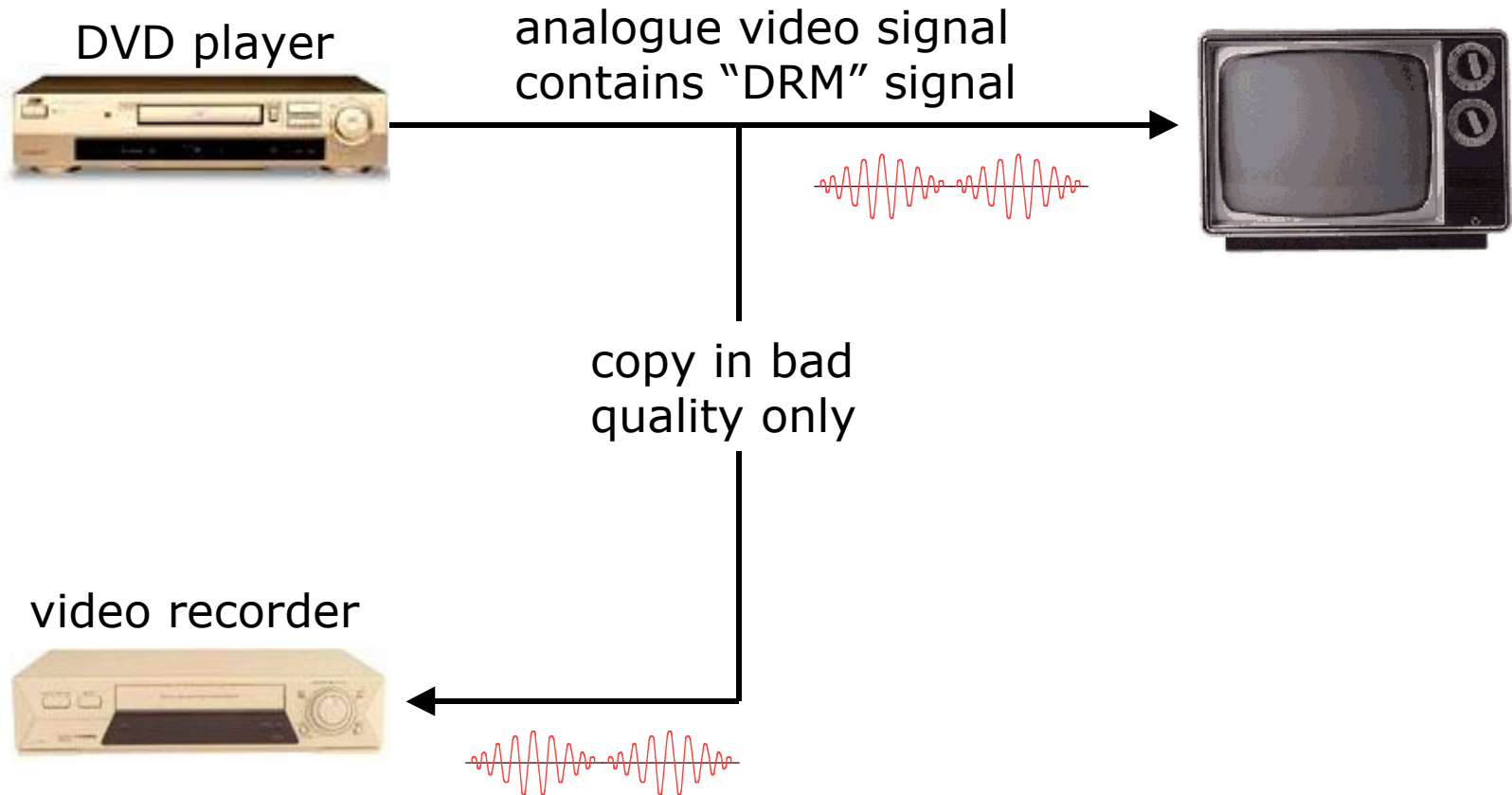
Naïve security mechanisms – examples

⌘ Filter mechanisms



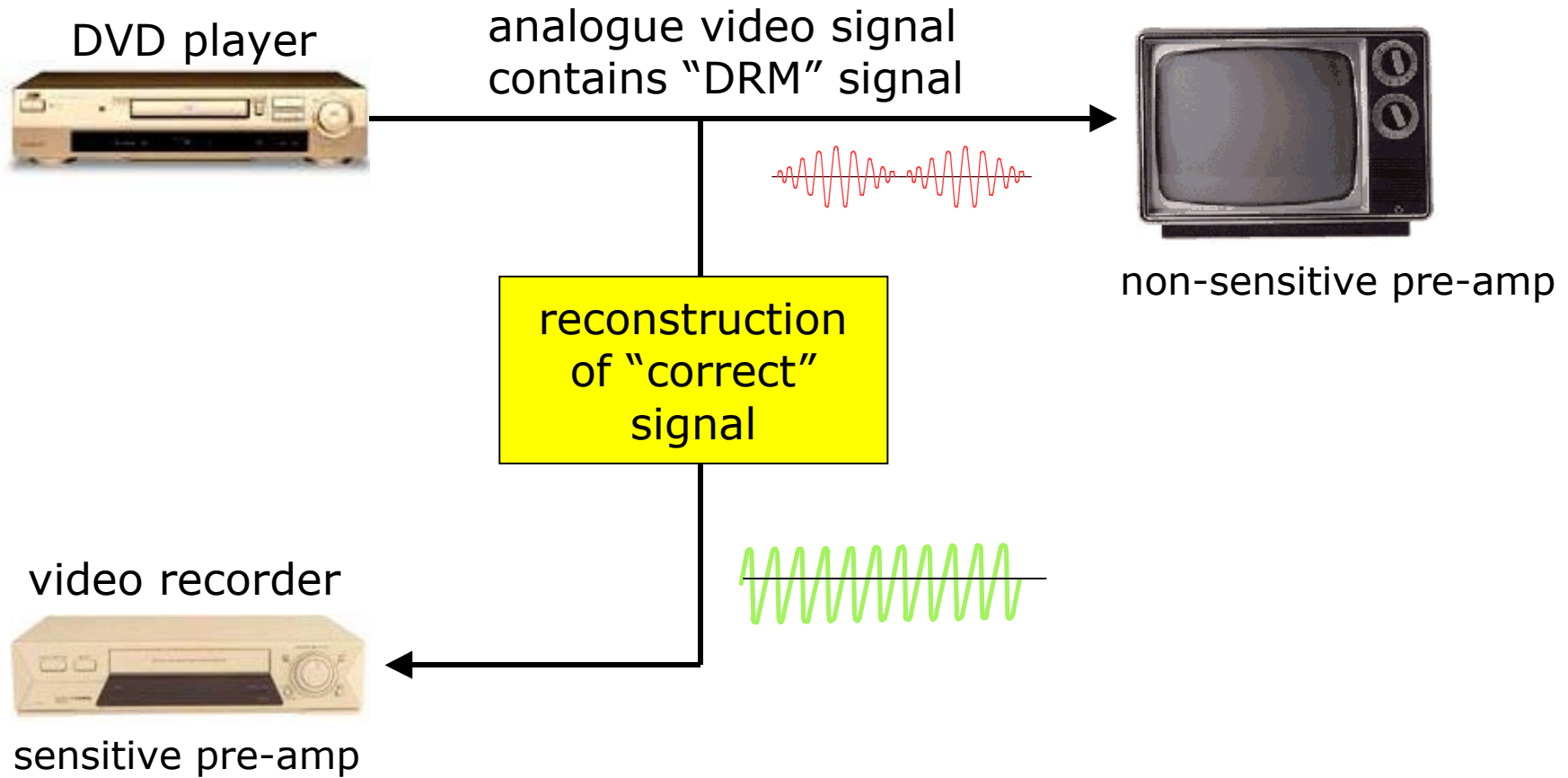
Naïve security mechanisms – examples

⌘ copy protection in videos recorders



Naïve security mechanisms – examples

⌘ copy protection in videos recorders



Naïve security mechanisms – examples

⌘ DRM codes without any protections against removing

digital audio player



digital audio



digital recorder



MD, CD-R (Audio), DAT

Original: copy
bit unset



010010101110101110101010011100110010

Copy: content
with copy bit set



010011101111101111101011011101110011

Naïve security mechanisms – examples

⌘ DRM codes without any protections against removing

digital audio player



digital audio

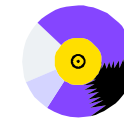
digital recorder



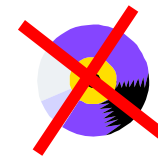
MD, CD-R (Audio), DAT



010010101110101110101010011100110010



010011101111101111101011011101110011



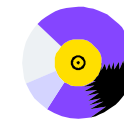
Reset copy bit to make copies



010011101111

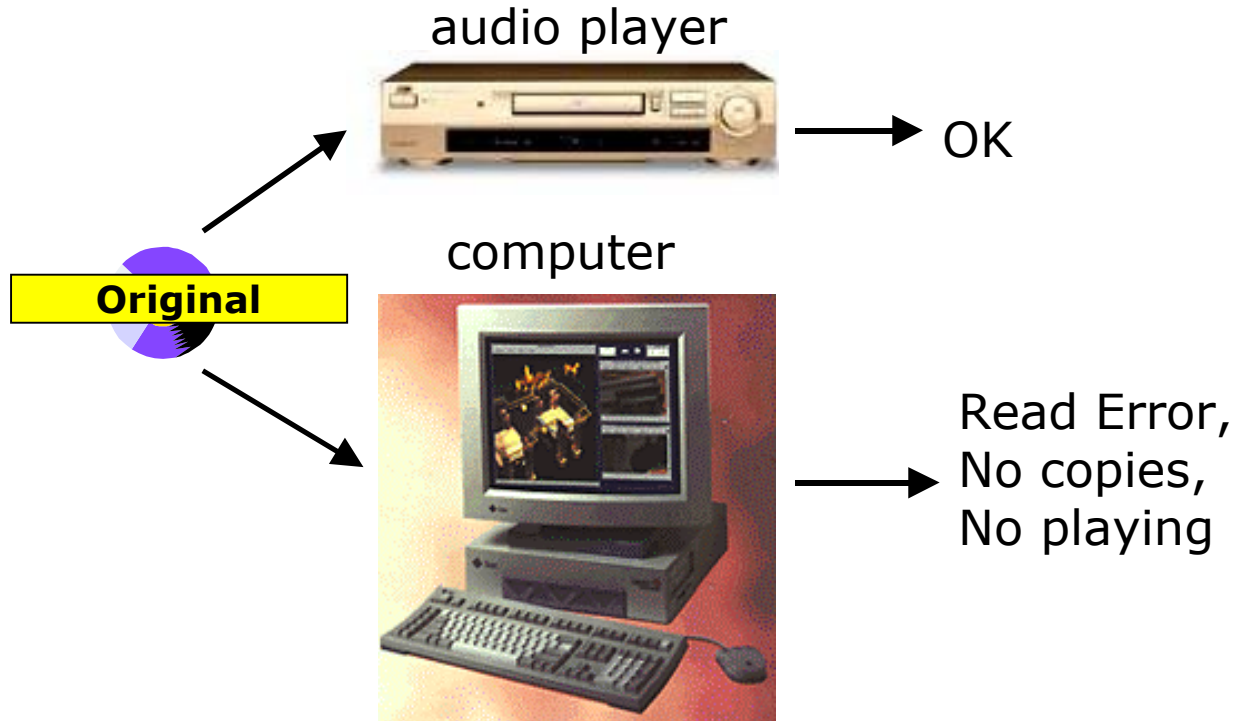


010010101110



Naïve security mechanisms – examples

⌘ incompatible formats and media

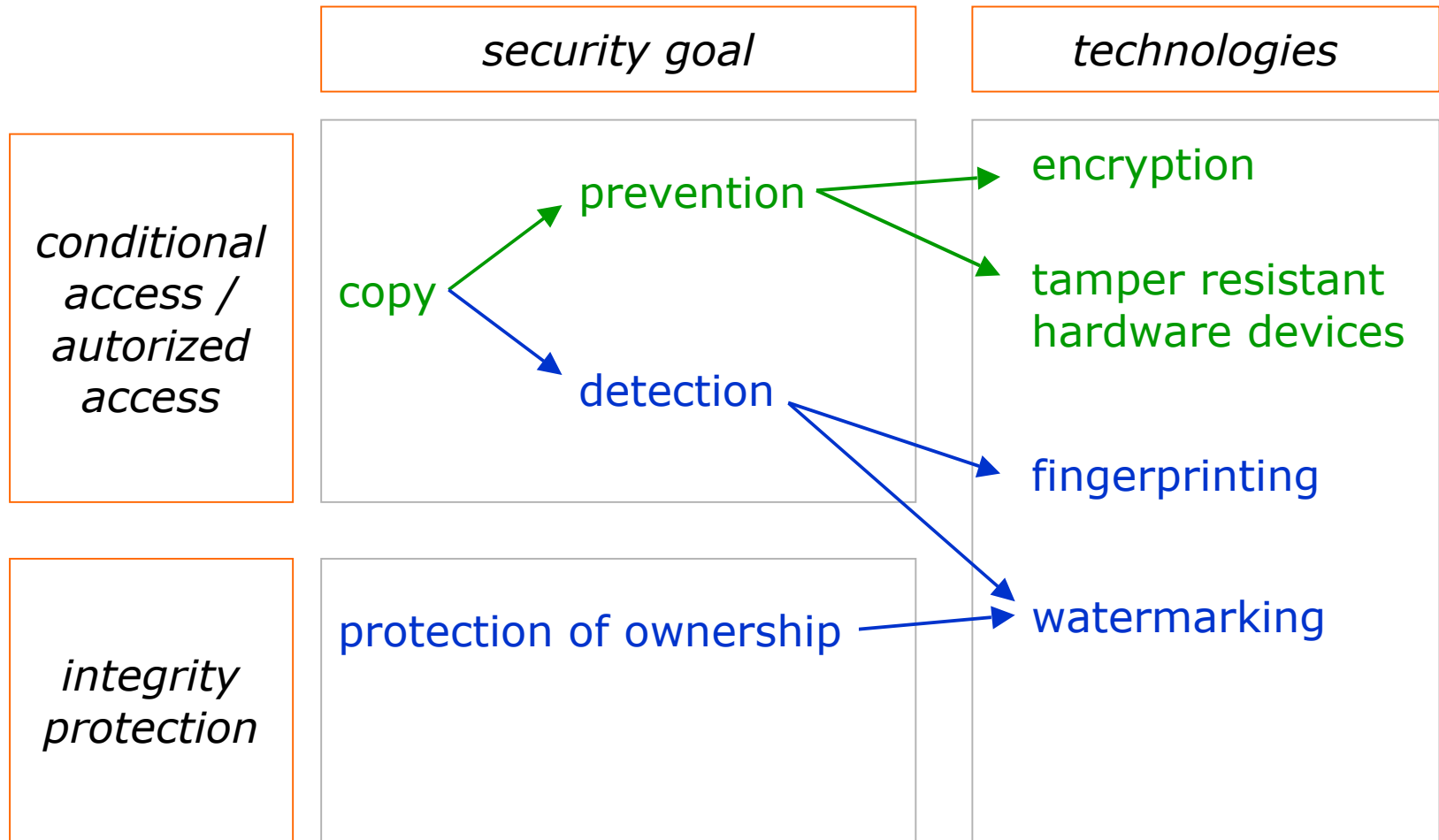


Naïve security mechanisms – examples

⌘ incompatible formats and media



Basic security goals and corresponding technologies



Secure DRM systems

⌘ Secure DRM systems connect a DRM signal with the content to protect in a way that the content signal is useless without the DRM signal.

⌘ Options:

- ⊗ DRM signal is part of the content signal (e.g. in watermarking systems)
- ⊗ DRM signal is necessary to access/decrypt the encrypted content signal

⌘ Important point:

- ⊗ Detection of DRM signal cannot be bypassed
- ⊗ Hardware or software **encapsulation**

⌘ Software

- ⊗ not recommendable

⌘ Hardware

- ⊗ breaking is a matter of time and money