

### **Nuovo DRM Paradiso**

Towards a verified, fair DRM protocol

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## **Digital Rights Management**

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#### ■ Goal:

- restrict access to content (movies, music, ...)
- access granted only when complying with license

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  - trusted devices
  - trusted content providers



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- Method:
  - enforce link by bundling license with encrypted content
- **■** Environment:
  - trusted devices
  - trusted content providers
- Intruder:
  - untrusted device owners
  - untrusted network

## **Enabling C2C exchange**



■ bottleneck in provider-to-client exchanges: bandwidth

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- solution: enable client-to-client exchanges...

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- solution: enable client-to-client exchanges...
- ... whilst preserving DRM

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Adapt intruder model:

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#### Adapt intruder model:

■ complete, lasting protection unrealistic...

## **Enabling C2C exchange**

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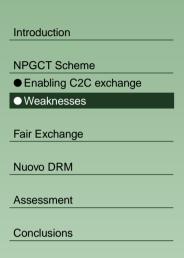
Conclusions

- bottleneck in provider-to-client exchanges: bandwidth
- solution: enable client-to-client exchanges...
- ... whilst preserving DRM

#### Adapt intruder model:

- complete, lasting protection unrealistic...
- thus: migitation procedures:
  - detection
  - revocation list

### Weaknesses



1. P2C: no link between content request and received rights attack: insert rights

### Weaknesses

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- 1. P2C: no link between content request and received rights attack: insert rights
- 2. C2C: No link between delivery of content and payment attack: abort before paying

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#### Fair Exchange

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"Either both parties terminate successfully, or none does"

■ Not possible without TTP ⇒ overhead!

### Optimistic fair exchange:

- only use TTP if fairness violated otherwise
- protocols:
  - optimistic exchange (no TTP)
  - finish succesfully (using TTP)
  - abort all commitments (using TTP)

### Fair exchange in DRM

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- DRM assumption: trusted devices, untrusted device *owners* ⇒ devices may be halted, but otherwise comply
- exchange in DRM: content for money
  - abort before either exchanged
    - ⇒ no problem
  - abort after both exchanged
    - ⇒ succesful termination
  - abort after one, before other
    - $\Rightarrow$  not fair...

## **Achieving FE in DRM**

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How to introduce fair exchange? (Tip: first address the question: who can be TTP?)

Hints:

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■ will anyone give you money if you didn't receive it?

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- can anyone provide content if you didn't receive it?

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#### Solution:

■ provider = TTP

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- can anyone provide content if you didn't receive it?

- provider = TTP
- first exchange money, then content

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- provider = TTP
- first exchange money, then content
- no abort protocol necessary!

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How to introduce fair exchange? (Tip: first address the question: who can be TTP?)

#### Hints:

- will anyone give you money if you didn't receive it?
- can anyone provide content if you didn't receive it?

- provider = TTP
- first exchange money, then content
- no abort protocol necessary!
- relies on compliance of devices

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Motivation:

Goals of Nuovo:

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#### Motivation:

- address weaknesses
- increase assurance of security

#### Goals of Nuovo:

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#### Motivation:

- address weaknesses
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#### Goals of Nuovo:

- effectiveness
- secrecy
- resist content masquerading
- fairness

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Provider — client exchange

P: provider; C: client; M: content; R: rights

- 1.  $owner(C) \rightarrow C : P, h(M), R$
- 2.  $C \rightarrow P : C, n_C$
- 3.  $P \rightarrow C : \{n_P, n_C, C\}_{sk(P)}$
- 4.  $C \to P := \{n_C, n_P, h(M), R, P\}_{sk(C)}$
- 5.  $P \to C: \{M\}_K, \{K\}_{pk(C)}, \{R, n_C\}_{SK(P)}$
- concrete protocol
- first weakness addressed (validity of R)

### **C2C** protocols

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Client — client optimistic exchange: similar to P2C for clients C, D

Client — client, recovery:

$$5^r$$
.  $D: resolves(D)$ 

$$6^r$$
.  $D \to P$ :  $D, n'_D$ 

$$7^r$$
.  $P \to D$ :  $\{n_P, n'_D, D\}_{sk(P)}$ 

$$8^r$$
.  $D \to P$ :  $\{n'_D, n_P, \langle n_D, n_C, h(M), R', C \rangle, P\}_{sk(D)}$ 

$$9^r$$
.  $P \to D$ :  $\{M\}_K$ ,  $\{K\}_{pk(D)}$ ,  $\{R', n'_D\}_{SK(P)}$ 

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Modelling in  $\mu$ CRL:

- Nuovo DRM
- communication model
- intruder model Dolev-Yao, with restrictions

Analysed scenario's:

- 1. no intruder, synchronous communication (effectiveness)
- 2. intruder, asynchronous communication (secrecy, masquerading, fairness)

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- $\sqrt{\text{effectiveness}}$
- secrecy
- resisting content masquerading
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- $\sqrt{\text{effectiveness}}$
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- Identified weaknesses in NPGCT
- Designed improvement: Nuovo DRM Paradiso
- Formally verified design goals
- Provide a reworked revocation method

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Thank you for your attention!