

# Towards an Economic Analysis of Trusted Systems

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# Content Providers and the Internet: A Love-Hate Relationship

♥ Computers and digital documents drastically lower the costs of content **creation** and **reproduction**.

♥ Internet drastically lowers the cost of content **distribution**.

♥ Vast amounts of content can be delivered to vast numbers of consumers at very low cost to providers.  
⇒

# Love-Hate Relationship, cont.

- ⊗ Once content is transferred from provider's computer to consumer's, provider loses control over it.
  - ⊗ Low-cost reproduction and distribution can be done by anyone, not just content "owners."
- ⇒ Low costs and high volume don't necessarily lead to high profits.

Content providers' ideal world is one of (almost) pre-Internet-era prices and Internet-era costs.

# Trusted Platforms

Informal defn.: Networked computers that can **prove** to each other that they are running only **authorized** software. Proofs are achieved by **hardware-supported, cryptographic** protocols.

Examples: TCG, Microsoft's NGSCB

Could enable **remote control** of data after it's been transferred to another machine.

## Applications

- **Copyright enforcement / content businesses**

Privacy protection

? Security-policy enforcement generally

?

# Multidisciplinary Study

Technology: How to design, build, and mass-produce trusted platforms cost-effectively?

Policy: Is remote control of data socially desirable and ethically sound?

This talk: Economics

- Would trusted platforms be widely adopted?
- Are there economically better, technologically feasible alternatives?

# A Two-Sided Market

Trusted platforms must be adopted by

- Content providers
- Content consumers

Each market has externalities.

- Provider cares about how many consumers are using a particular platform.
- Consumer cares about how many providers are producing for a particular platform.

The study of such markets is relatively recent.

# Model

Section 2 of paper contains basic trusted-platform market model.

Derives parameterized expressions for

- content providers' revenue
- platform vendor's revenue
- consumers' net utility

No conclusions yet, just open questions

# Open Research Questions

## Platform-market structure and governance:

- One platform
  - Proprietary technology, one vendor
  - Industry-consortium technical standard, multiple vendors
  - Academic technical standard, multiple vendors
- Multiple competing platforms

## Multihoming:

- Does platform competition increase efficiency?
- Incentives for interconnectivity and interoperability?



# Open Research Questions, cont.

## Timing and uncertainty:

- Dependence on distribution of consumers' valuations
- Will high-value content providers be early adopters?  
Will this determine the structure of the platform market?

## Information asymmetry:

- Will platform vendors reveal security vulnerabilities?
- See related work by Schechter and Smith.

# Alternative to Trusted Platforms

Consumer can use the content in three ways.

- Authorized use only (utility  $u_a$ )
- Flexible private use (utility  $u_p$ )
- Uncontrollable network use (utility  $u_n$ )

$$0 < u_a < u_p < u_n < \infty$$

Future utility is discounted with factor  $\delta \in (0, 1)$ .

# Alternative to Trusted Platforms, cont.

Monitoring infrastructure:

Stochastically observe network use.

Unauthorized action can be detected with probability  $q$ .

Once caught, the user is forced to adopt a trusted platform (*i.e.*, is denied even flexible private use).

# Pricing Constraints

Participation constraint:

$$u_p - r_p \geq u_a - r_a$$

( $r_a$  price for authorized use ;  $r_p$  price for flexible private use)

Incentive constraint:

$$(u_p - r_p) + \frac{\delta}{1-\delta} (u_p - r_p) \geq (u_n - r_p) + \delta (qV_a + (1 - q) V_p)$$

$$\left( V_a = \frac{1}{1-\delta} (u_a - r_a) ; V_p = \frac{1}{1-\delta} (u_p - r_p) \right)$$

# Potential Advantage of Monitoring

The price difference

$$r_p - r_a = \frac{(u_p - u_n)(1 - \delta) + \delta q(u_p - u_a)}{\delta q}$$

will be positive if

$$(u_p - u_n)(1 - \delta) + \delta q(u_p - u_a) > 0.$$

This is achieved when either  $\delta$  or  $q$  is sufficiently high.

# Conclusion

If the detection probability  $q$  is high enough, the content provider is better off allowing flexible private use and monitoring (imperfectly) for public abuse.

Model was developed before iTunes was released but may partially explain iTunes' success.

Policy question:

Will users prefer monitoring to copy prevention?

Technical question: How to make  $q$  high enough?