INTELLECTUAL PROPERTY AND PUBLIC POLICY:
II. A better route to Tech standards
Technological standards are

- ubiquitous (e.g. wireless networks, complex global supply chains): compatibility/interoperability/network externalities;
- shaped by standard-setting organizations (SSOs).
Two main functions of standard setting organizations (SSOs)

(1) *Discovery and certification*

IP owners seek certification with standard setting organizations (like academics with journals, or issuers of bonds/stocks with investment banks, analysts and rating agencies).

Lots of entry in certification market*. Wide range from fully independent SSOs to largely captured special interest groups (SIGs)

*Even ignoring de facto standards and de jure government ones (HDTV in US).

Trade-off when choosing a certification venue: Tougher certifier

- lowers probability of positive opinion
- has higher credibility vis-à-vis users.
(2) Steering toward a particular technology ("essentialization") and price regulation (corollary of steering function)

Current (FRAND*) approach:
  - loose ex-ante price commitments;
  - ex-post assessment of meaning of the implicit commitment faces informational problems.

Standardization process is under tremendous stress: many disputes around the world—such as those involving Apple, Google, Microsoft, and Samsung—concern commitments made during the standardization process.

* Fair, reasonable and non-discriminatory.
II. PRICE REGULATION FUNCTION

FRAND. *Informational difficulties*: are royalties "reasonable"?

1. *Difficulties familiar from antitrust treatment of patent pools*:
   - hard to know whether patents are complements or substitutes/how essential they are
   - furthermore
     - pattern of C/S depends on licensing prices
     - pattern of C/S changes over time.
2. In context of *standard setting*:

- Informational problems are compounded by ex-post nature of assessment: would be surprising if judges did much better than antitrust authorities for patent pools.
- Independent licensing is rather useless ex post (patents often have become standard-essential patents)!
- Essentialization often leads to \(1/n\) (patent counting) rule

[non-participation in SS process is an hidden cost of absence of ex-ante price commitments; also potential bias in innovation strategies, toward unambitious innovations.]
Support in favor of ex-ante view

Position that what's fair and reasonable should reflect an ex-ante view.

- Judge Posner in Apple vs. Motorola
  "The proper method of computing a FRAND royalty starts with what the cost to the licensee would have been of obtaining, just before the patented invention was declared essential to compliance with the industry standard."

- Judge Robart in Microsoft vs. Motorola.

- Policymakers:
  - DOJ: Business Review letters (VITA, IEEE)
  - Marjoraras 2005

- Law and economics literature: e.g., Swanson-Baumol, Lemley-Shapiro.

How do we implement ex-ante view?
Research has two goals

(A) Explore an alternative/complement to FRAND that is not as information-intensive.

(B) Build on a conceptual framework that

- admits whole range from perfect substitutes to perfect complements
- allows us to study consequences of ex-post and ex-ante price setting.
Example:
Two possible technologies \{1\} and \{2\} each covered by one patent (different patent holders). Perfect substitutes:

\[ V(\{1\}) = V(\{2\}) = V(\{1,2\}) = V. \]

User preferences \( V(S) - P(S) - \theta \).

Let \( D(P) \equiv \Pr(\theta \leq V - P) \) denote the demand curve.

Competitive prices: \( p_1 = p_2 = 0 \).

Standard setting:

- If SSO chooses \{1\}, then ex-post owner of patent 1 is monopoly charges \( P^m = \operatorname{arg\,max} PD(P) \).
- If SSO chooses \{1,2\}, then both patents are essential. Cournot pricing yields total price \( \hat{P} > P^m \) pool forms and charges \( P^m \).

[Actually, SS0 strictly prefers \{1,2\} if not perfect substitutes.]
Price commitment proposal

• Require that patent holders commit to a maximum price (price cap) $\bar{p}_i$ before standard is chosen (as SSO VISA has required since 2006)

  $\Rightarrow$ SSO chooses $\min \{ \bar{p}_i \}$

  (if $\min \{ \bar{p}_i \} < P^m$. If $\min \{ \bar{p}_i \} \geq P^m$, then each IP can undercut to $P^m - \varepsilon$ and get full monopoly profit for herself).

Bertrand competition again $\Rightarrow \bar{p}_1 = \bar{p}_2 = 0!$

• Problem: “forum shopping”: By selecting an SSO without price commitments, each makes $\pi^m / 2$ don’t want to go to SSO that requires price commitments!

How general is this?
MORE GENERAL FRAMEWORK

- Framework modifies the “\( V(S) - P(S) - \theta \)” model in two ways:

  1. **Distinction between functionalities and patents**
     
     [Distinction becomes relevant under a standard.]

  2. **Putty-clay technology**
     
     Technology fully malleable before standard is set and rigid afterwards.

- Functionalities \( i \in \{1, \ldots, n\} \). \( S \) is a subset of functionalities.

  Value to users: \( V(S) \) is not necessarily increasing in the number of functionalities (implementation costs of bulky standards).

  Efficient combination: \( S^* = \arg \max_S V(S) \)
• **Users/implementers**
  
  o Heterogeneous w.r.t. their (opportunity) cost $\theta$ of implementing technology. Gains from $S$ iff:
    
    $$V(S) \geq \theta + P(S)$$
    
    ($P(S) =$ total user cost of acquiring licenses)
  
  o Distribution $F(\theta)$.

  [Density $f(\theta)$. Monotone hazard rate $= f/F$ decreasing.]
Distinguish between
- functionalities
- patents reading on these functionalities.

Standard defines *functionalities*.

*Patents reading on functionality* $i$

Best implementation of $i$ can command markup $m_i \geq 0$

$[m_i = 0$ if public domain/open source$]$

$m_i$ measures within-functionality substitution opportunities.
COMPETITIVE BENCHMARK: PUTTY ENVIRONMENT

IP owners set prices $p_i \leq m_i$.
Price of bundle $S$:

$$P(S) = \Sigma_{i \in S} p_i$$

**Definition (competitive equilibrium).** A competitive equilibrium is a set of prices $\{p_i\}_{i=1,\ldots,n}$ and the users' choice of a consumption basket $\mathcal{T}$ such that:

(a) users maximize their utility over the consumption basket:

$$V(\mathcal{T}) - P(\mathcal{T}) = \max_{S} \{V(S) - P(S)\}$$
(b) IP holders maximize their profit given the possibility of within- and across-functionality substitution and the concern that some users do not purchase the technology: for all $i,$

$$p_i = \min \{m_i, e_i, \hat{p}_i\}, \quad (1)$$

where

$$e_i \equiv V(\mathcal{T}) - P(\mathcal{T} \setminus \{i\}) - \max_{\{S | i \notin S\}} \{V(S) - P(S)\}, \quad (2)$$

and

$$\hat{p}_i \equiv \arg \max_{\{p_i\}} \{p_i D(p_i + P(\mathcal{T} \setminus \{i\}) - V(\mathcal{T}))\}. \quad (3)$$
Some results on competitive prices

- A competitive equilibrium involves efficient design: $\mathcal{T} = S^*$.
- A competitive equilibrium exists.
- Two unconstrained competitive prices must be equal: If $p_i = \hat{p}_i$ and $p_j = \hat{p}_j$, then $p_i = p_j$.
- Uniqueness?
  - yes if decreasing incremental contributions.
  - yes more generally if essentiality parameters $e_i(S)$ uniquely defined for all $S$ (by contrast think of perfect complements...)
  - later on (standard), all functionalities will be ex-post essential, and so equilibrium will be unique.
Multiple marginalizations and pool formation

What if $P_c(S^*) > P_m(S^*)$ where

$$P_m(S^*) = \arg \max \{ P D(P - V(S^*)) \}?$$

Result generalizes that in Lerner-Tirole (2004):

- **Anti-competitive pool** $P_c(S^*) < P_m(S^*)$
  
  Independent licensing $\Rightarrow$ there exists an equilibrium leading to prices $P_c(S^*)$. Unique if $e_i$ unique and/or unbundling.

- **Pro-competitive pool** $P_c(S^*) > P_m(S^*)$

  Pool at price $P_m(S^*)$ stable to independent licensing (unique outcome if unique competitive equilibrium or "consistent selection").
COMPETITIVE BENCHMARK

- Monotonicity-in-bargaining assumption: \( i \)'s share of pool dividends weakly increasing in \( i \)'s no-pool profit and weakly decreasing in others' no-pool profits.

- Competitive benchmark: users pay

\[
P^c(S^*) = \min \{ P^c(S^*), P^m(S^*) \}
\]

for technology \( S^* \).
NO PRICE COMMITMENT PRIOR TO STANDARD SETTING

- **Timing:**
  - Unilateral or collective price commitments?
  - Standard setting
    - by users
    - by IP holders
  - Pool formation?
  - Non-cooperative pricing of individual licences (whether pool has been formed or not)

- Pessimistic view of FRAND. But even if FRAND constrains ex post market power, effects will still be at play, just not as extreme.
Once standard $S$ has been chosen:

**Modified value function**

\[
\hat{V}(T) = \begin{cases} 
  = V(T) & \text{if } T = S \\
  \leq V(S) & \text{if } S \subseteq T \\
  = 0 & \text{otherwise.}
\end{cases}
\]

**Pricing**

either \( p_i^* = m_i \)

\( (1') \)

or \( p_i^* = \arg \max_{p_i} \left\{ p_i D(\sum_{j \in S, j \neq i} p_j^* + p_i - V(S)) \right\} \)

\( (3') \)

Ex-post prices are unique: \( p_i^* = \min \{ m_i, \hat{p} \} \text{ for } i \in S \)
Post-standard pool formation
  - Individual licensing useless
    (no competition among functionalities any more)
  - But pools always beneficial.
1. *Design selected by users* (users choose $S$, prices are set ex post). Two inefficiencies:

- *Monopoly pricing*
- *Essentiality-competition bias*: Another hidden cost of lack of price commitment.

Asymmetric case: $S \neq S^*$, biased toward low-essentiality but low-$m_i$ functionalities.
2. Design selected by IP owners

Underinclusiveness:

Maximize *average* (per patent) profit (like in a labor-managed firm). Assume functionalities are ranked in importance. Then

\[
\bar{k} \equiv \max \left\{ k \mid k = \arg \max_{\tilde{k}} \max_{P} \left\{ \frac{PD(P - V(S_{\tilde{k}}))}{\tilde{k}} \right\} \right\}
\]

Then \( \bar{k} \leq k^* \).

Furthermore an increase in demand (in \( \gamma \), where value is \( V(S) + \gamma \)) induces more under-inclusiveness.
3) **Price discussions within standard setting: reverse holdup**

- Hazard = expropriation of IP owners (buyer cartelization).
  Even balanced SSO (equal weight on user surplus and IP profit) insists on $P=0$ (maximizes ex-post diffusion).

**Proposition: (reverse holdup)** $\alpha =$ weight on profit

Suppose that $\alpha \leq 1$. Then, under SSO bargaining power,
(i) the SSO imposes $P(S)=0$ for all $S$ ;
(ii) the SSO chooses the efficient standard ($S = S^*$).

- SSO that is strongly biased toward IP owners lacks credibility in other dimensions (certification).
Approach: Following a value discovery phase, enter a recess so as to allow price commitments

1. *Price commitments*: Holders of relevant patents non-cooperatively commit to price caps $\bar{p}_i$ on royalties, were the corresponding functionalities later incorporated into the standard.

2. *Standard morphing*: The SSO empowers the users, who choose $S$. It is prohibited, as it currently is, from discussing prices: it only selects the standard.

3. *Ex-post pool formation*: The owners of patents that read on the selected standard can, if they wish so, form a pool (allowing independent licensing) and set a price for the bundle.
4. *Independent licenses*: The patent owners select prices \( p_i = p_{i|L} \leq \bar{p}_i \) for individual licenses.

5. *User selection*: Individual users choose whether to adopt the technology, and if so acquire either individual licenses or the bundle from the pool (if relevant).
Relation between competitive benchmark and outcome of structured price commitment process is a priori non-trivial:

Price cap may serve to

- affect technology design
  - induce SSO to drop rival functionalities
  - get one's patent included in the standard
- alter others' ex-post prices
- achieve a better bargaining position in pool formation negotiations.
At stage 2, a user-friendly SSO chooses $S$ so as to solve

$$\max_{S} \{ V(S) - \min \{ P(S), P^m(S) \} \},$$

where $P(S) =$ ex-post equilibrium total price given commitments $\{ \bar{p}_i \}$. 
Proposition (structured price commitments).

Under structured price commitments,

(i) if \( P_c(S^*) < P_m(S^*) \), an equilibrium of the structured-price-commitment game involves commitments to the competitive prices \( \overline{p}_i = p_i^c \) for all \( i \) and the choice of efficient standard \( S^* \) (and then no pool is formed). And so the competitive outcome \( (S^*, P_c(S^*)) \) prevails. Furthermore, the competitive equilibrium is the only equilibrium if the \( \{e_i\} \) are uniquely defined for all \( S \).

(ii) if \( P_c(S^*) \geq P_m(S^*) \), the competitive benchmark \( (S^*, P_m(S^*)) \) is achieved, although the price commitments then in general differ from \( \left\{ p_i^c \right\} \).

It is an equilibrium for IP owners in \( S^* \) to commit to ex-post prices \( \overline{p}_i = p_i^* \).
Will price commitments emerge spontaneously in the market place?

Forum shopping among, say, user-oriented SSOs. Some (like VITA) demand price commitments; others do not.

Proposition (market non-emergence of price commitments).

When the competitive price is smaller than the monopoly price, (i) in the symmetric case patent holders prefer the absence of price commitment and so choose to have their technology certified by an SSO that does not require price commitments; (ii) in the asymmetric case and with $n = 2$ and $m_i = \infty$, the owner of the less important patent prefers the absence of price commitment; the owner of the most important patent prefers to avoid a price commitment if and only if

$$p_1^c D \left( p_1^c + p_2^c - V(S^*) \right) \leq \frac{P_m(S^*)}{2} D \left( P_m(S^*) - V(S^*) \right)$$

holds.
Discussion

- Dispensing with FRAND?
  - no need for FRAND in this framework
  - in practice, some mistakes (parties' & SSO's failure to identify important patent). FRAND, even if weak, puts some constraint on ex-post pricing.

- Price commitments and FRAND as complements rather than substitutes.
Improving FRAND

Lemley-Shapiro (2013)
- final offer arbitration* with any willing licensee to determine the royalty rate.

* Each party submits its final offer to the arbitrator, who then must pick one of those two offers.

Kühn-Scott Morton-Shelanski (2013)
- faster and less costly processes to determining FRAND rates,
- process to seeking injunction,
- cash price (issue of comparability- cross-licensing, bundling, etc),
- “smallest salable unit”: recovery of damages not based on sales/profits of the entire product. Rather incremental value of the infringing features over the next best non-infringing alternative.

Recent IEEE rule change.
Price commitments are a promising approach for dealing with SEPs.

Alleys for future research

- **Theory**
  - multidimensional ("Ramsey") price commitments. Different classes of users;
  - dynamic evolution of standards;
  - coordinated effects.

- **Empirics**
III. CERTIFICATION FUNCTION

*Modeling:* “as simple as $a \ b \ c$”

Focus on *overall* value proposition, not on substitutability/complementarity pattern. “One” technology sponsor trying to maximize expected profit.

Users are homogenous, have utility:

\[ U = a + b + c \]

- known attractiveness shifter
- unknown quality parameter
- concessions (e.g. minus price)

Distribution $F(b)$ with density $f(b)$ (monotone hazard rate: $f/(1-F)$ increasing).

No one knows $b$ ex ante (extension: sponsor has signal about $b$).
Certifier (SSO) has utility

\[ U + \alpha \pi \]

\( \alpha = \) sponsor-orientation parameter
Free entry into certification: all \( \alpha \geq 0 \) are available; can commit to a reporting strategy.

Timing:

- Technology sponsor chooses
  - \( \alpha \) (+ reporting strategy)
  - \( c \)
- Certifier learns \( b \) and reports to users
- Users decide whether to adopt
Mechanism design approach: A priori complex, but characterization simple: Wlog, can focus on following reporting strategy:

\[
\begin{cases}
\text{“adopt” if } b \geq b^* \\
\text{“don’t adopt” if } b < b^*
\end{cases}
\]

(1) **Maximal complacency.** Cutoff $b^*$ satisfies:

\[
a + M^+\left(b^*\right) + c = 0
\]

where $M^+\left(b^*\right) \equiv E\left(b \mid b \geq b^*\right)$

Note that $a + b^* + c < 0$ (pooling is key).

(2) Delegation: $c^*$ also maximizes \(\left\{c + \alpha \pi(c)\right\}\)

\[\rightarrow\text{ can defer the choice of concession to the selected SSO.}\]
**Welfare:** suppose social planner has preferences $U + w \pi$. Then there exists a cutoff $a_0$ such that:

- If $a \leq a_0$, then laissez-faire is optimal: concern is adoption.
- If $a > a_0$, $\alpha^*$ too large (but regulating *only* $\alpha$ or $c$ reduces welfare: destroys coherence).
**Testable implication**

More attractive ($\alpha$ increases) →
- fewer concessions ($c^*$ decreases)
- less user-friendly SSO ($\alpha^*$ increases)

**Empirics:** Chiao et al (2007). 59 SSOs

- Sponsor orientation ($\alpha$)
  - nature of organization (SIG,...)
  - membership (individuals or just corporations?)
  - voting rules (consensus?)
  - age of organization (older ones more user friendly).
- Concessions ($c$)
  - FRAND vs. royalty free
  - disclosure requirements
  - dispute resolution.
Findings:

- $\alpha$ and $c$ indeed negatively correlated
- mature technological subfield (proxy for attractiveness) $\rightarrow$ high (sponsor friendly)
- more (competition among) SSOs in a given technology subfield $\rightarrow$ tighter relationship between user friendliness and concessions*.

* Imperfect competition: SSO compete to attract IP owners. For example, user-friendly SSO may want to limit concessions so as not to scare IP owners.
• Many open topics for research on standard setting:
  o “non-discriminatory” feature
  o dynamic standards
  o interaction certification-functionality selection
  ...

• Many open issues on intellectual property more generally.
• Empirical work.
• Conceptual frameworks help rethink policy.

Please join us in this endeavor!
THANK YOU VERY MUCH