

# Comparative Evaluation of Unlicensed Spectrum Policy

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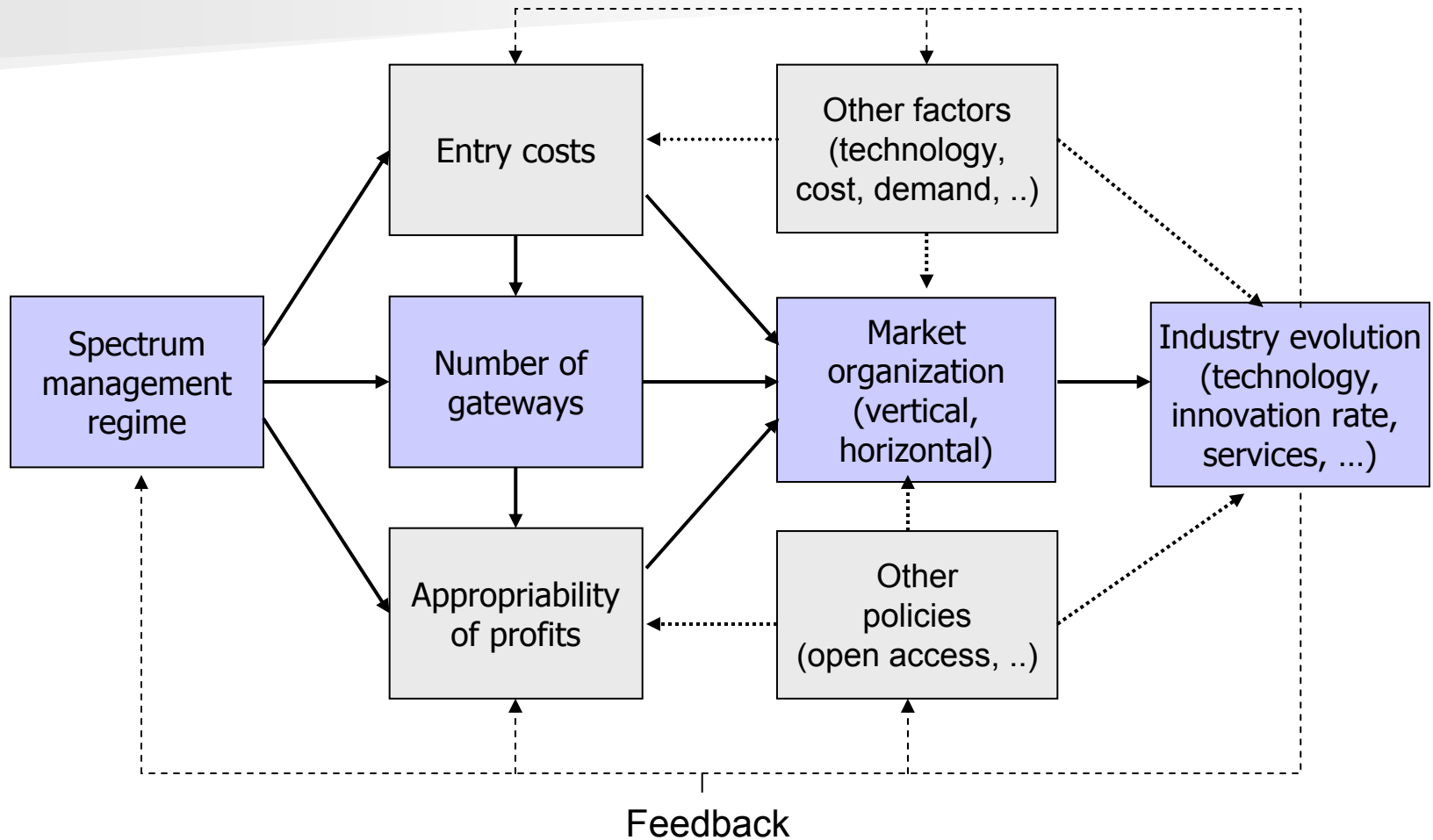
# Framework

- Efficiency implications
  - Given technology (“static efficiency”)
    - Technical efficiency (throughput, bit/joule, ...)
    - Productive efficiency (least cost combination)  
Allocative efficiency (consumer valuations)
  - Changing technology (“dynamic efficiency”)
    - Implications for investment decisions
    - Implications for innovation decisions
  - Transaction costs
- Stakeholder effects

# Elementary features

	Exclusive rights			Quasi-exclusive	Non-exclusive
	Licensing	Flexible Licensing	Ownership	Commons	Open access
Allocation	Government planning	Government planning	Endogenous (owners), government	Endogenous (users), government	Endogenous, government
Assignment	Administrative process	Auction	Auction, market transactions	External: auctions ..., internal: users	Endogenous
Dynamic adjustment	Government planning	Government planning, licensees	Market transactions	Users	Endogenous

# Spectrum policy & industry evolution



# Spectrum policy regimes

	Licensing+	Ownership	Commons	U-NII Open access	Real time lease
Entry costs	Bid price (sunk) plus indirect	Bid price (sunk), market price	Dependent on access rules	None	Dynamic oppor- tunity costs
Market structure	Govern- ment	Sunk costs & strategy	Self- regulation	Endo- genous	Endo- genous
Appropria- bility of innovation premium	High	High	Dependent on access rules	Low	High if futures markets evolve

# Spectrum policy regimes ...

	Licensing+	Ownership	Commons	UII open access	Real time lease
Static efficiency	Low	Moderate to high	High	Moderate to high	High
Dynamic efficiency	Low to Moderate	High for network innovations	High for application, equipment innovations	Low to high	High
Transaction costs	Under ideal conditions low	Could be high	Could be very high	High	Could be high

MS ... market structure

# Evaluation of unlicensed

- Alternative coordination mechanisms and protocols will have different efficiency and stakeholder effects
- Methodological options
  - Case studies and empirical approaches
  - Analytical solutions
  - Simulation and computational approaches
  - Experiments and test-bed approaches

# Spectrum policy regimes ...

	Flexible Licensing	Ownership	Commons	Open access	Real time lease
Spectrum use (band, time, etc.)	G	G initially, O thereafter	G, M, U	M, U	G, M, U
Standards, protocol	L, M, G	O, M, G	M, U	M	M
Services	G, L	O	U	M, U	M, U

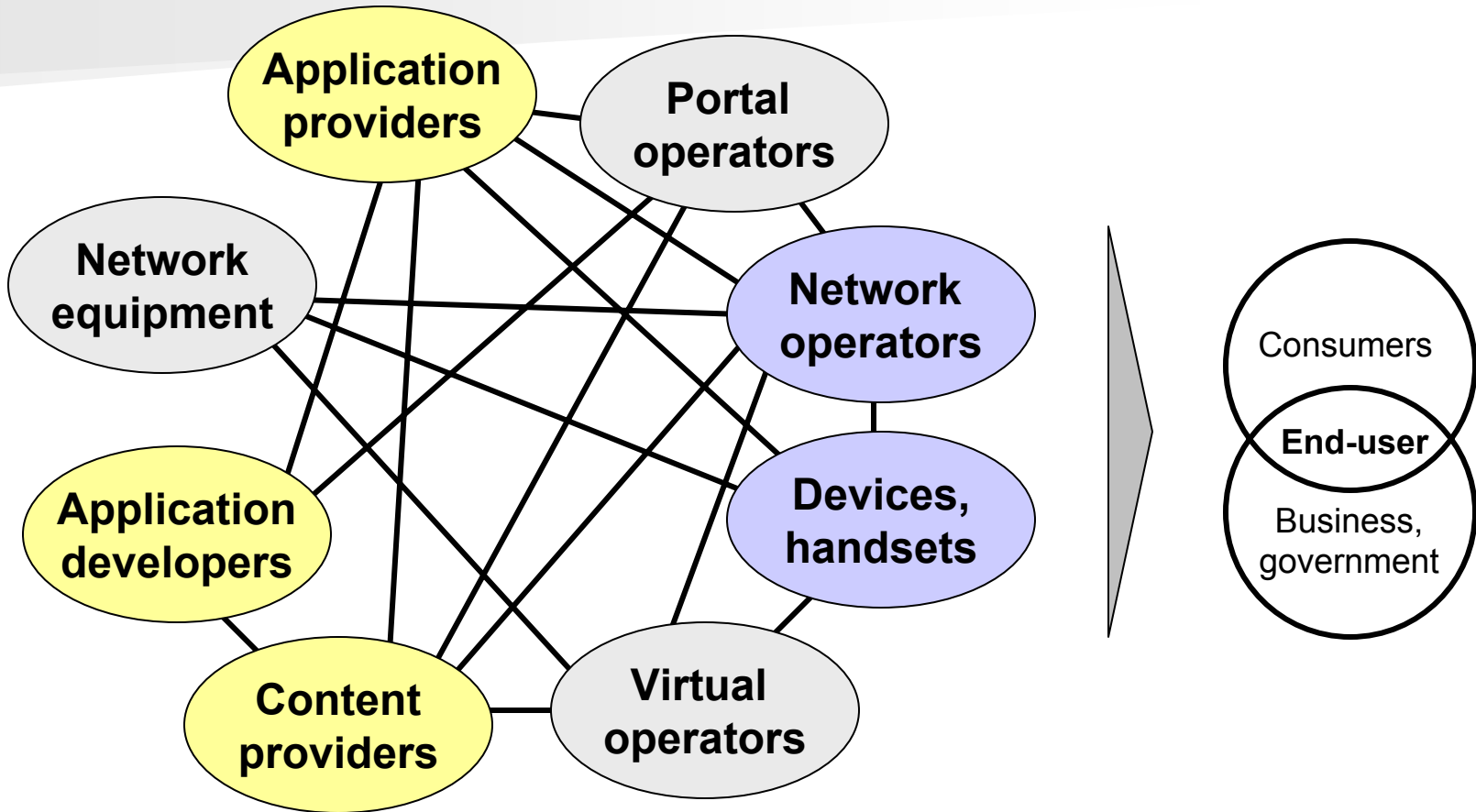
G ... government; L ... licensee; M ... equipment manufacturers; O ... owners; U ... end-users

# Stakeholder analysis

	Licensing	Licensing+	Ownership	Commons
Spectrum use (band, power, time)	G	G	G initially, O thereafter	G, M, U
Standards, protocols	L, M, G	L, M, G	O, M, G	M, U
Content format	G, L	G, L	O	U
Specific content	L (TV), users (cellular)	L (MMDS), users (PCS)	O, U	U

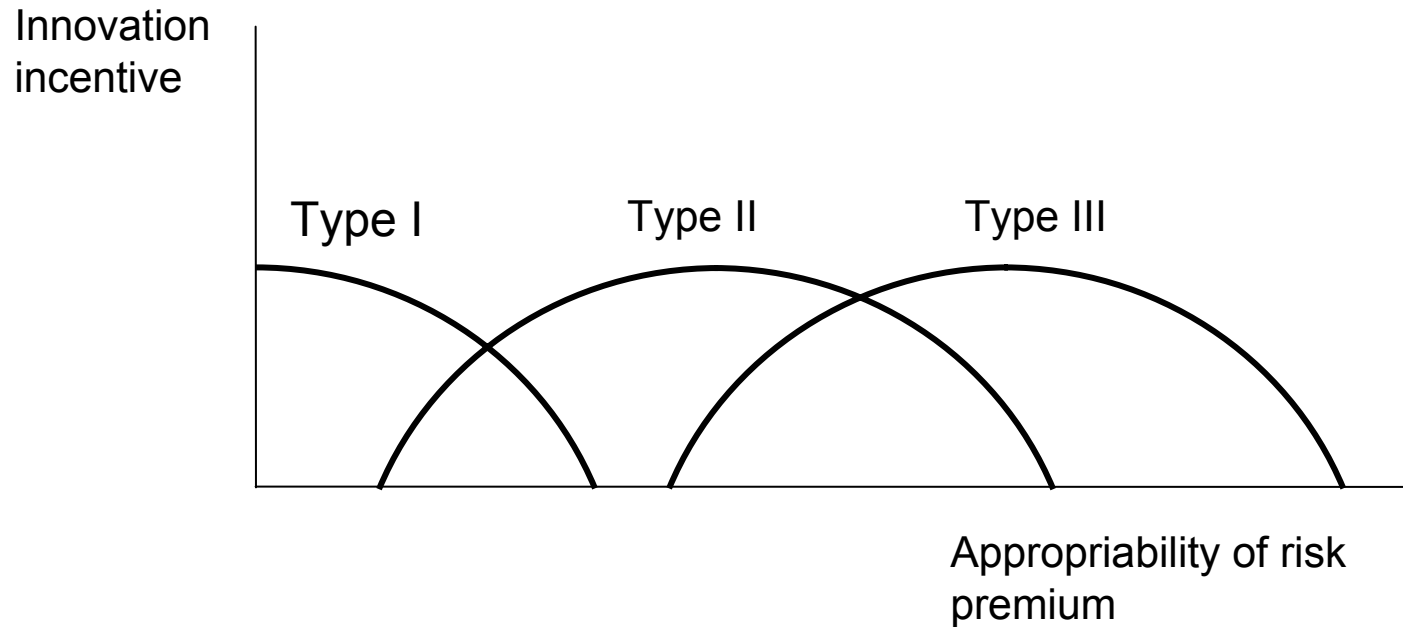
G ... government; L ... licensee; M ... equipment manufacturers; O ... owners; U ... end-users. Inspired by Benkler (1998)

# Innovation in the mobile internet

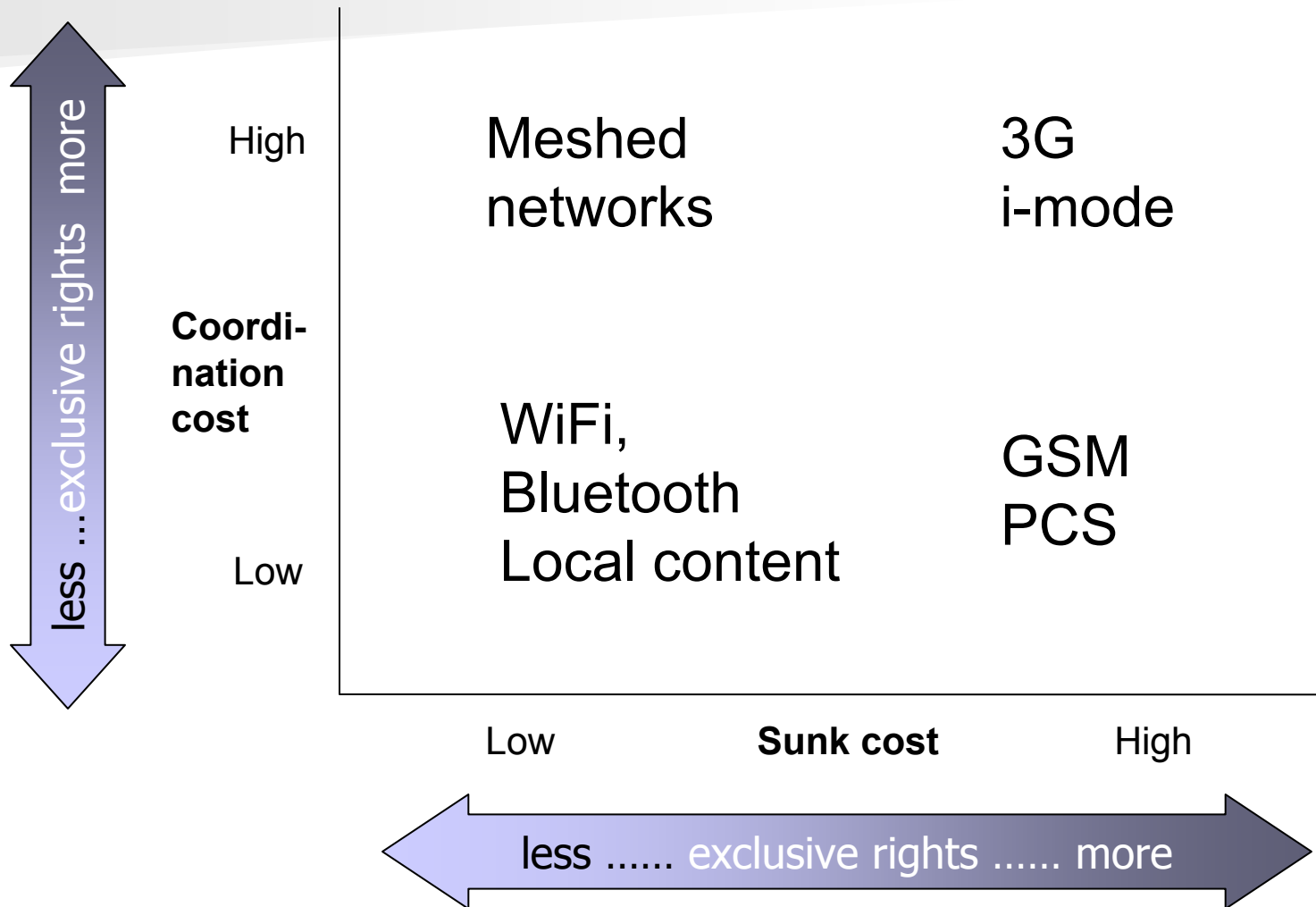


Adapted from European Information  
Technology Observatory (2002).

# Innovation incentive and appropriability



# Complementary combinations



# Policy conclusions

- Significant differences between models with regard to legal and economic rights
- Different types of innovation processes facilitated by different regimes
- Open access neither necessary nor sufficient for dynamic mobile industry
- Optimal spectrum policy should facilitate institutional learning through mixed model
- Open question: how to determine mix?