

Ad-blocking Games: Monetizing Online Content Under the Threat of Ad Avoidance

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Online Advertising

- ▶ \$ 31.74 billion in the US in 2011



- ▶ Nuisance for many users
 - ▶ Annoying distractions
 - ▶ Increasing page load time
 - ▶ Privacy and security implications
- ▶ Ad avoidance!
 - ▶ E.g., Adblock Firefox browser add-on
 - ▶ Revenue loss for content providers and ad networks

Monetizing Online Content

- ▶ Content providers (CPs) adapting as well
 - ▶ NYTimes introduced a paywall in 2011
- ▶ CPs need the means to decide their best strategy
 - ▶ How to monetize online content?

Monetizing Online Content Under the Threat of Ad Avoidance

- ▶ Study the interplay between
 - ▶ Users' attempts to avoid commercial messages
 - ▶ Content providers' design of countermeasures

Ad Avoidance Technologies

- ▶ Client side solutions typically as Web browser add-ons
- ▶ Prevent loading or hide elements classified as ads based on lists of *filter rules*
 - ▶ Subscribe to community-generated or manually create lists
 - ▶ Selectively allow elements, pages or websites (*whitelisting*)
- ▶ Server side solutions (e.g., Privoxy)

CP's Countermeasures to AB

1. Inform users on adverse effect of AB
2. Prevent users with AB from accessing the content
3. Offer users to pay subscription fees for ad-free content
4. Tie a website's functionality to the download of ads
5. Make it harder to distinguish ad elements from content

- ▶ Firstly, CPs have to detect users with AB
 - ▶ Detection JavaScript code available online

Game-theoretic Models

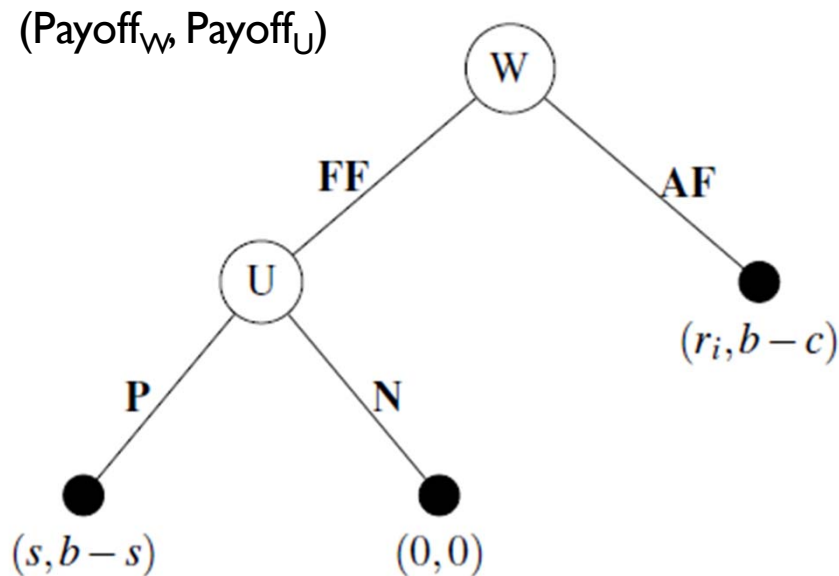
- ▶ Interactions between a user (U) and a website (W):

	AB	AB Detection & Countermeasures
Model 1	✗	✗
Model 2	✓	✗
Model 3	✓	✓

- ▶ Website analyzes users individually
 - ▶ Sequential game between a website and a user
- ▶ Users' strategies:
 - ▶ Block (B) vs. Abstain (A)
 - ▶ Pay (P) vs. Do not pay (NP) fee-financed content
- ▶ Websites' strategies:
 - ▶ Ad-financed (AF) vs. Fee-financed (FF)
 - ▶ Investment (DI) vs. No Investment (NI) in AB detection & Countermeasures
- ▶ Impression-based ad revenue model

Traditional Case: No AB & No Detection

- ▶ Extensive form game with complete information



- ▶ b – user's benefit of accessing the content
- ▶ c – cost of viewing ads
- ▶ s – subscription fee
- ▶ r_i – impression-based ad revenue

- ▶ Subgame Perfect Nash Equilibria (SPNE)

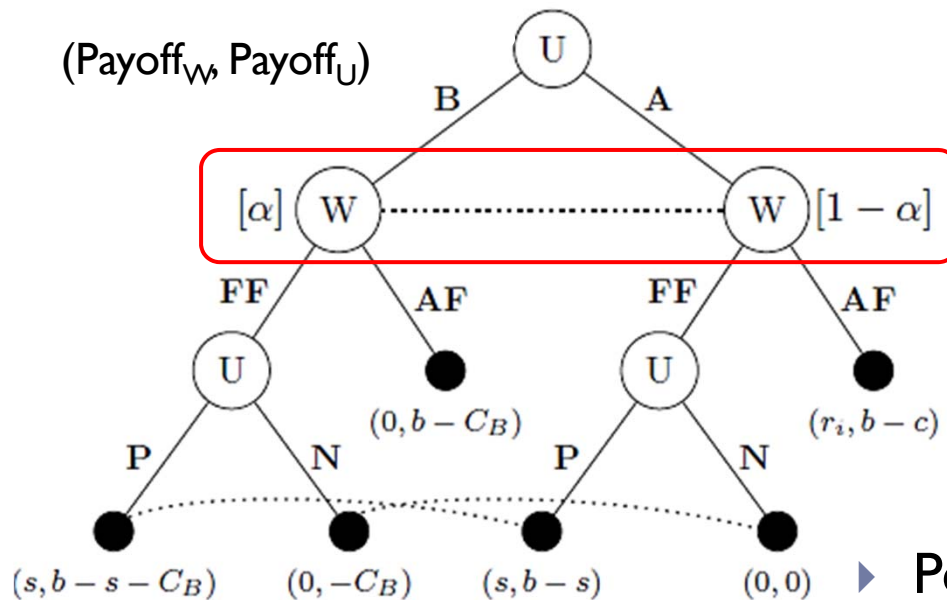
W: Ad-financed (AF) vs. Fee-financed (FF)

U: Pay (P) vs. Do not pay (NP) fee

$b > s$	
$s > r_i$	(FF, P)
$s < r_i$	(AF, P)
$b < s$	
	(AF, N)

Threat of Ad Avoidance & No Detection

- ▶ Extensive form game with *imperfect* information



- ▶ C_B – cost of AB
- ▶ α - W's belief that U has AB

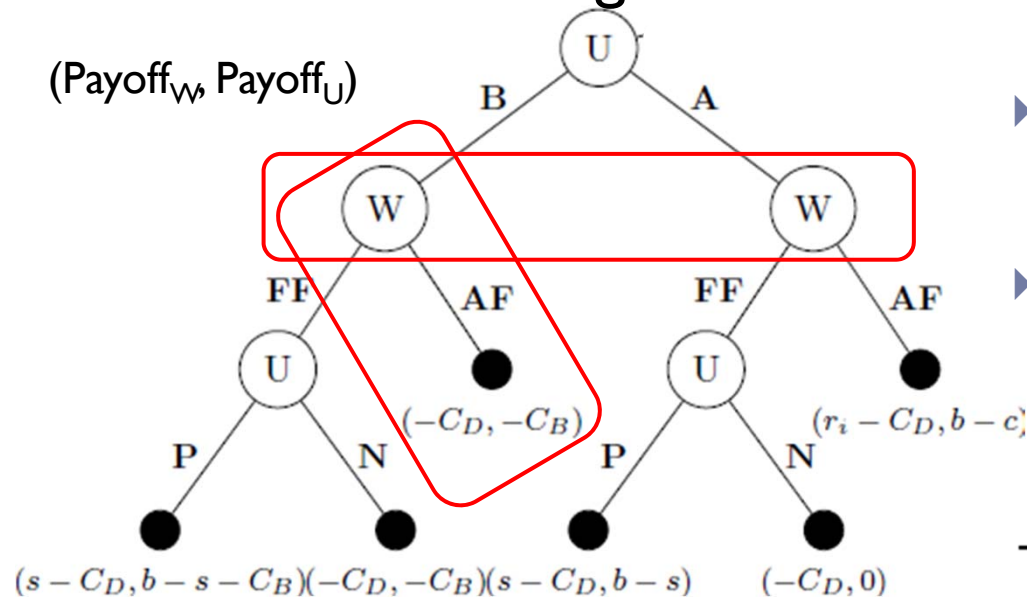
▶ Perfect Bayesian Nash Equilibria (PBNE)

U: Block (B) vs. Abstain (A)

	$C_B < c$	$C_B > c$
$s > r_i$	(A P, FF; $\alpha = 0$)	(A P, FF; $\alpha = 0$)
$b > s$	$s < r_i$ (A P, FF; α) $\alpha > \frac{r_i - s}{r_i}$	(A P, FF; α) $\alpha > \frac{r_i - s}{r_i}$
	(B P, AF; α) $\alpha < \frac{r_i - s}{r_i}$	(A P, AF; $\alpha = 0$)
$b < s$	(B N, AF; $\alpha = 1$)	(A N, AF; $\alpha = 0$)

CPs Invest in AB Detection & Countermeasures

- ▶ Extensive form game with complete information



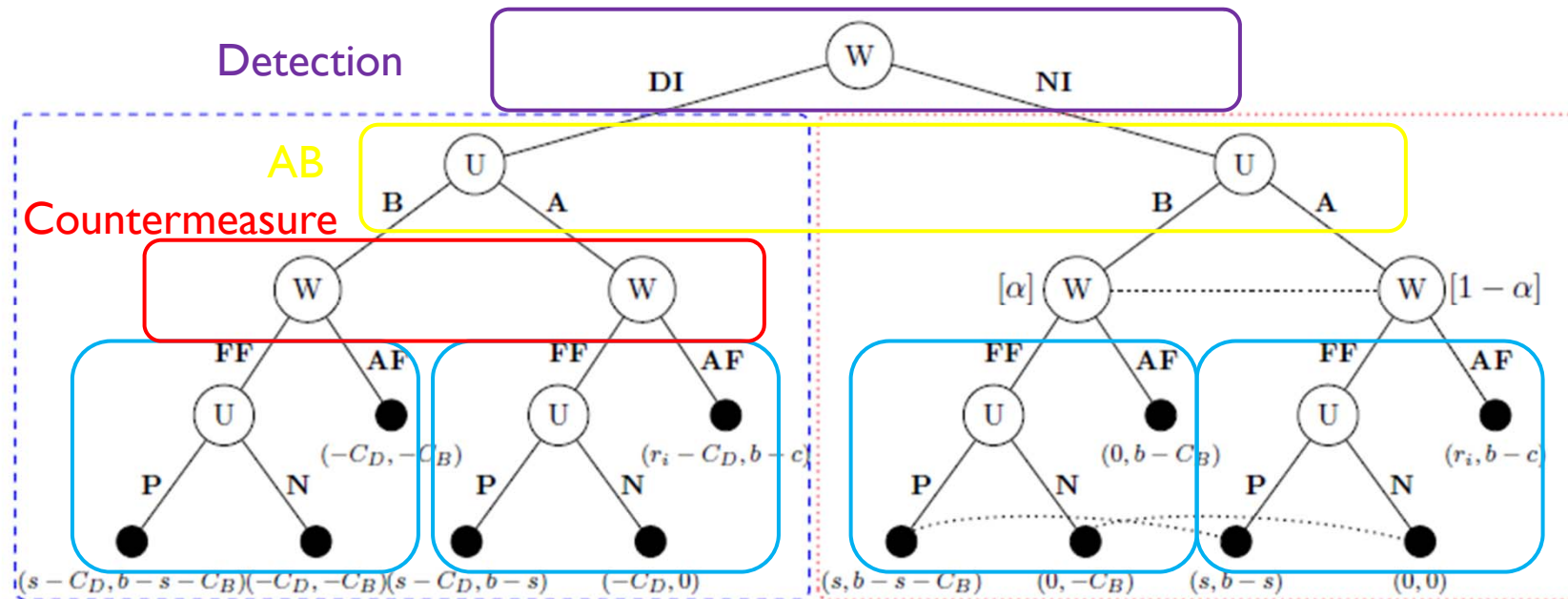
- ▶ C_D – cost of detection of AB

- ▶ If U uses AB -> no content

SPNE:

$C_B < c - s$ $C_B > c - s$	
$s > r_i$	(A P, FF)
$b > s$	$s < r_i$ (B P, FF) (A P, AF)
$C_B < c - b$ $C_B > c - b$	
$b < s$	(B N, FF) (A N, AF)
	(B N, AF)

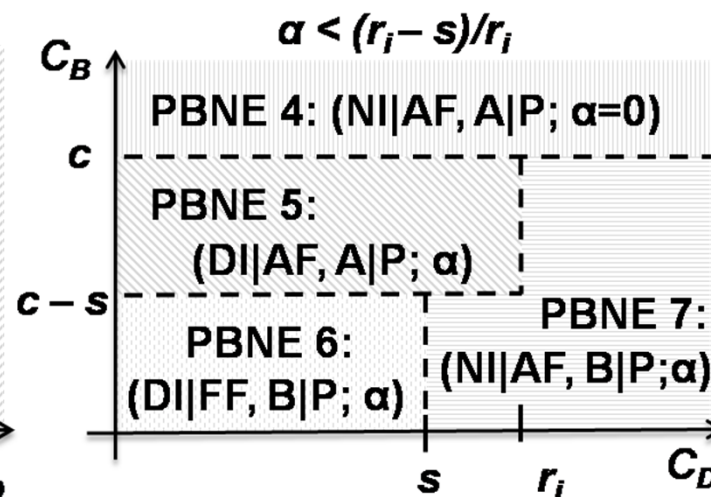
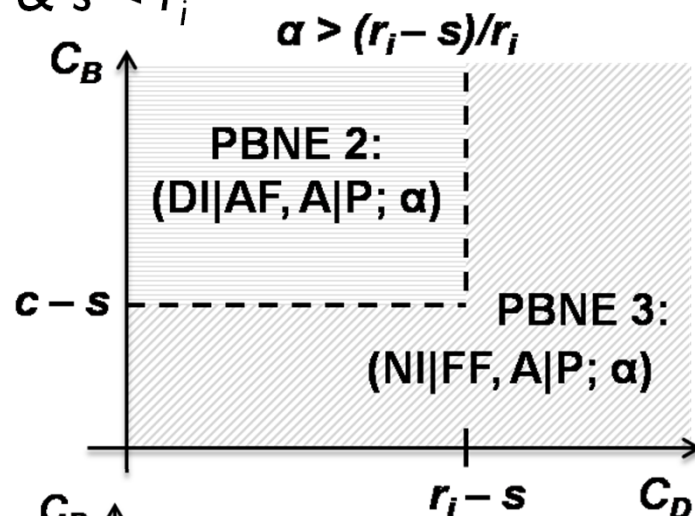
Ad Avoidance & Detection vs. No Detection



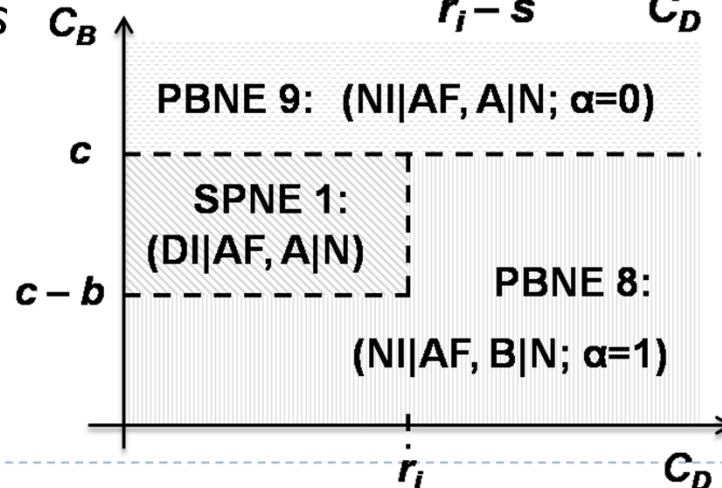
Game-theoretic Results: Framework for CPs

► Case 1: $b > s$ & $s > r_i$ PBNE 1: (NI|FF, A|P; $\alpha=0$)

► Case 2: $b > s$ & $s < r_i$



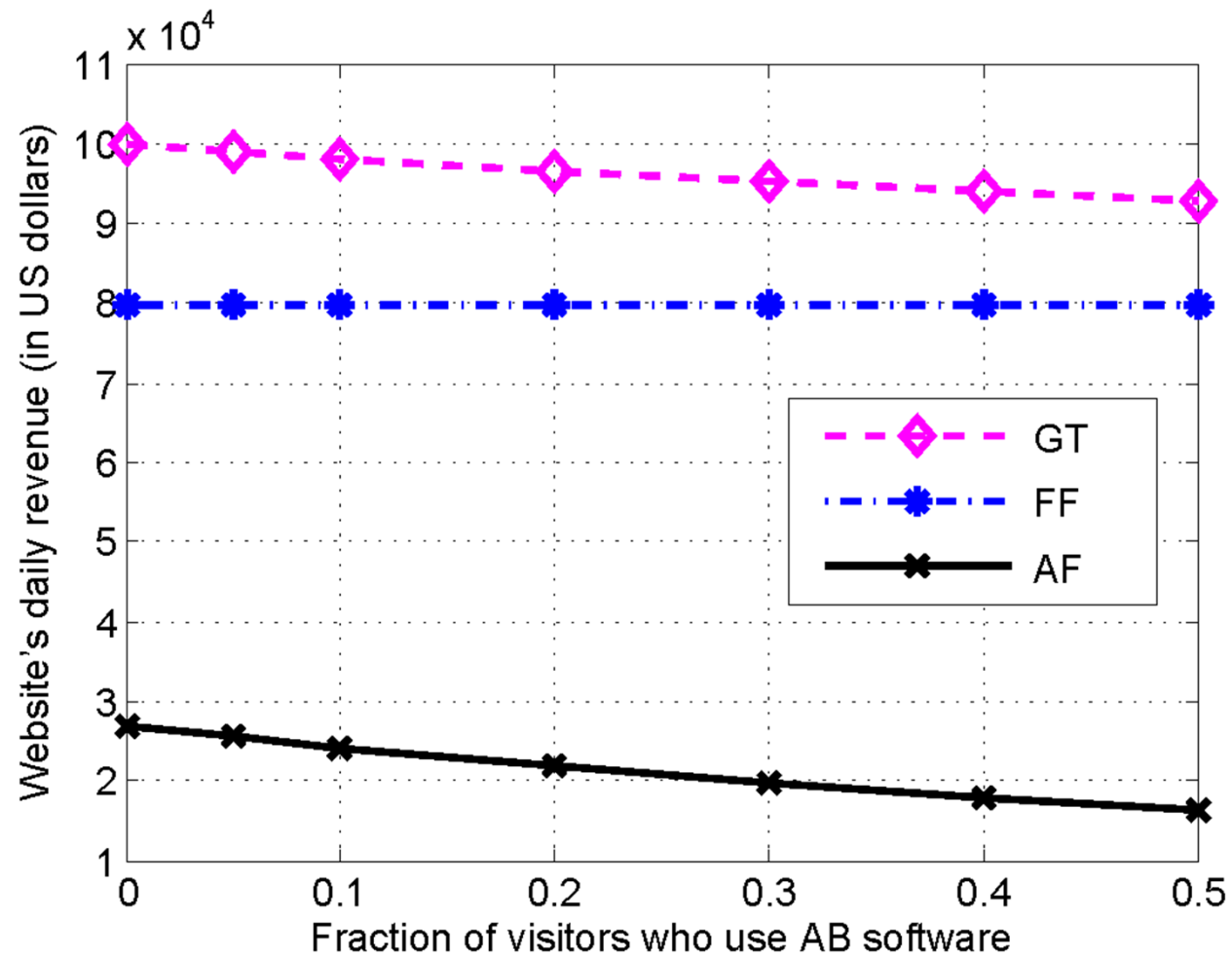
► Case 3: $b < s$



Simulation Approach

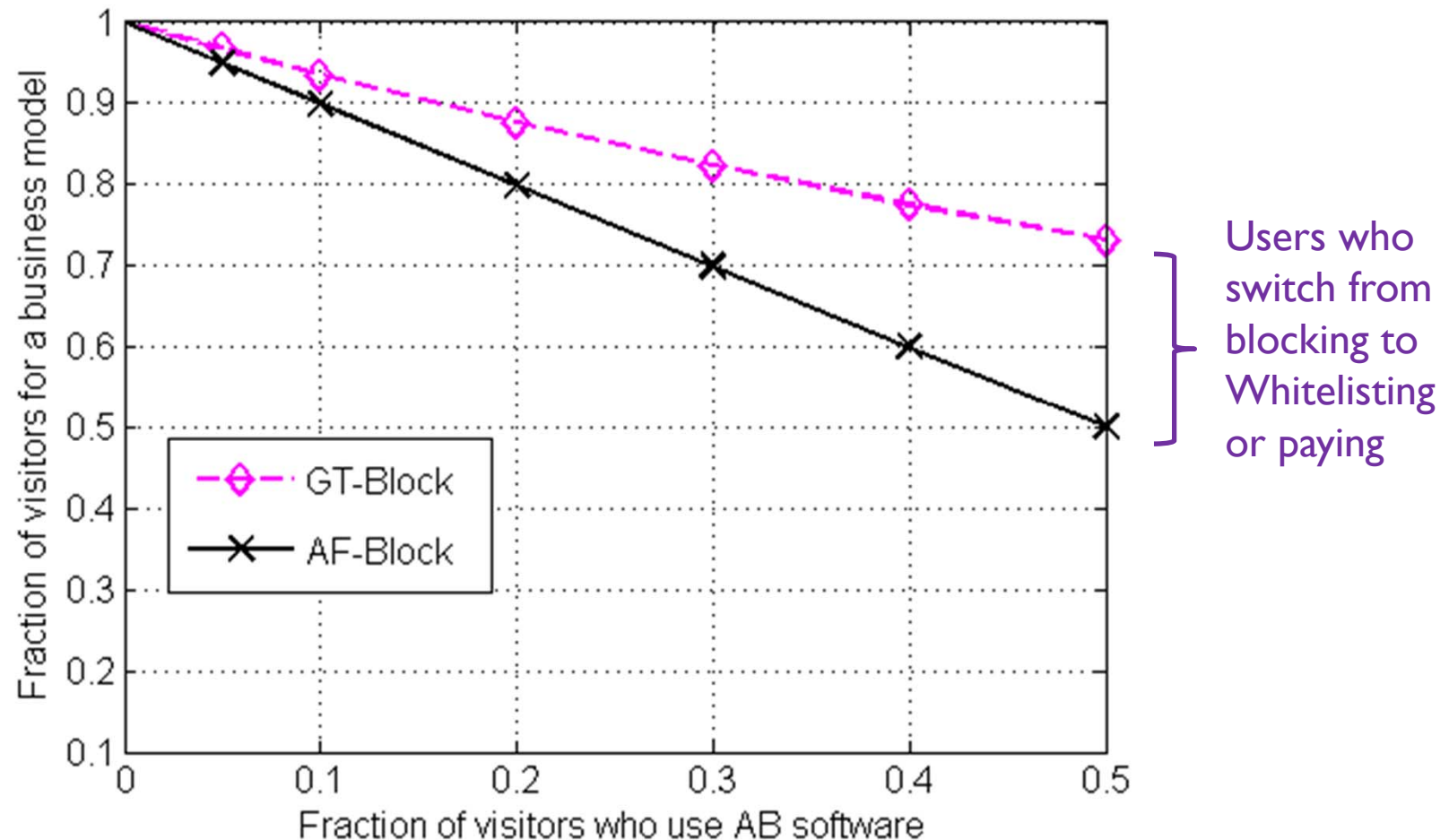
- ▶ Financial Times (FT)
- ▶ 1 million pageviews per day
- ▶ Micropayment s per pageview
 - ▶ Based on \$4.99 per week & # of pageviews per visitor per day
- ▶ Impression-based ad revenue (r_i) (β distribution)
 - ▶ Based on CPM between \$1 and several tens of \$
- ▶ Benefit (b) of accessing the content
 - ▶ s.t. 25% of FT visitors opt for fee-financed content
- ▶ Cost (c) of viewing ads (bimodal distribution)
- ▶ Negligible costs of blocking ads (C_B) & detecting AB (C_D)

Simulation Results



- ▶ GT approach increases the revenue

Simulation Results



- ▶ GT approach allows VWS to monetize from a larger number of visitors

Conclusions & Future Work

- ▶ Developed a framework usable by CPs to ponder their options to mitigate consequences of ad avoidance
- ▶ Strategically applying game-theoretic approach and individually analyzing each user maximizes CPs' profit
 - ▶ Adoption of AB detection technologies and countermeasures discourages use of AB in certain cases
- ▶ Understanding users' aversion to ads and valuation of the content is essential for making an informed decision
 - ▶ Requires more user profiling -> privacy implications
- ▶ Extend the model
 - ▶ Include multiple interactions between a website and a user
 - ▶ Uncertainty about users' valuation of the content and ad aversion
 - ▶ Competition among websites with the similar content