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Measurements, Analysis & Modeling of Private Trackers





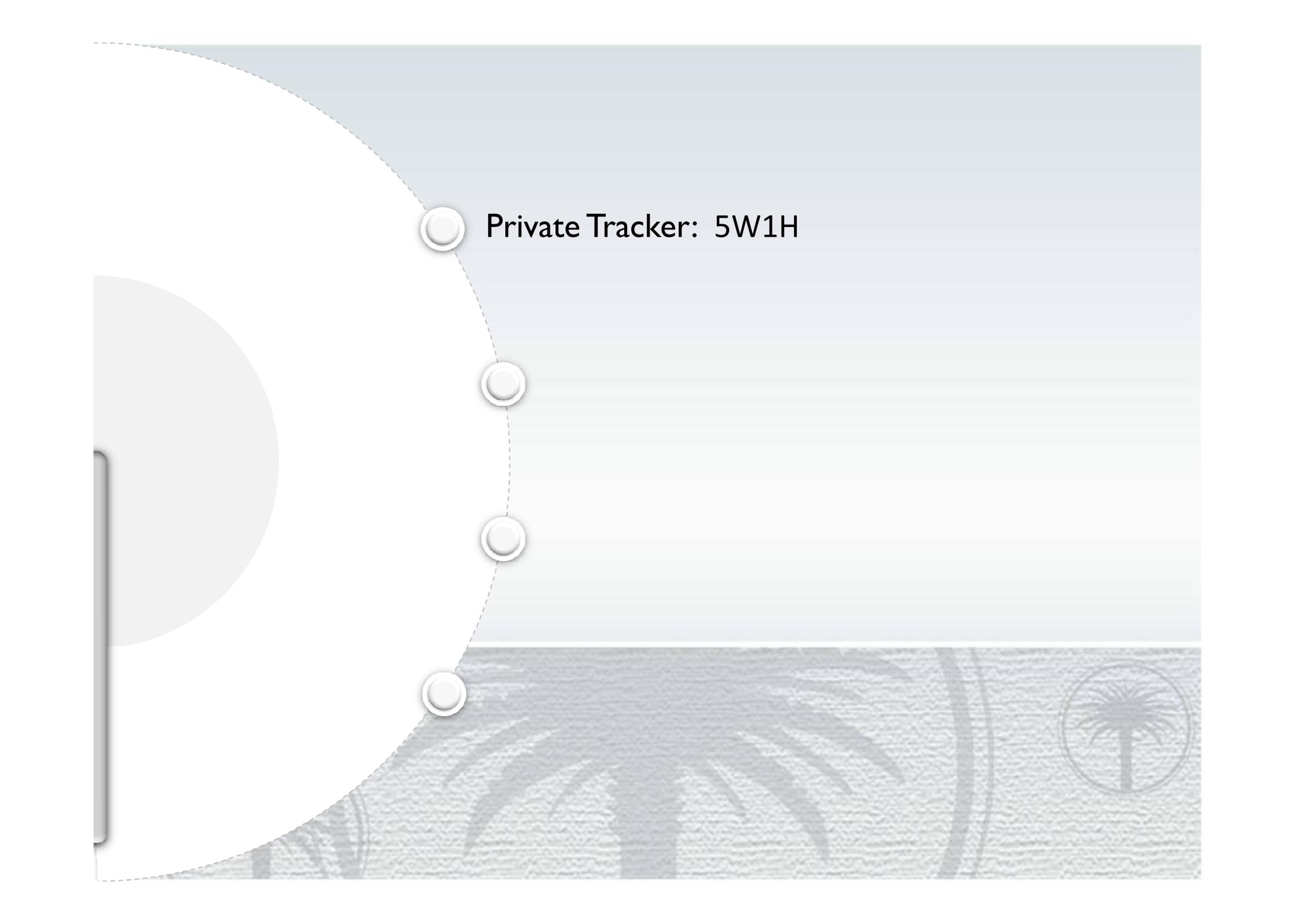
Private Tracker: 5W1H

Overview

Measurement

Analysis





Private Tracker: 5W1H

Private Tracker: 5W1H

WHAT

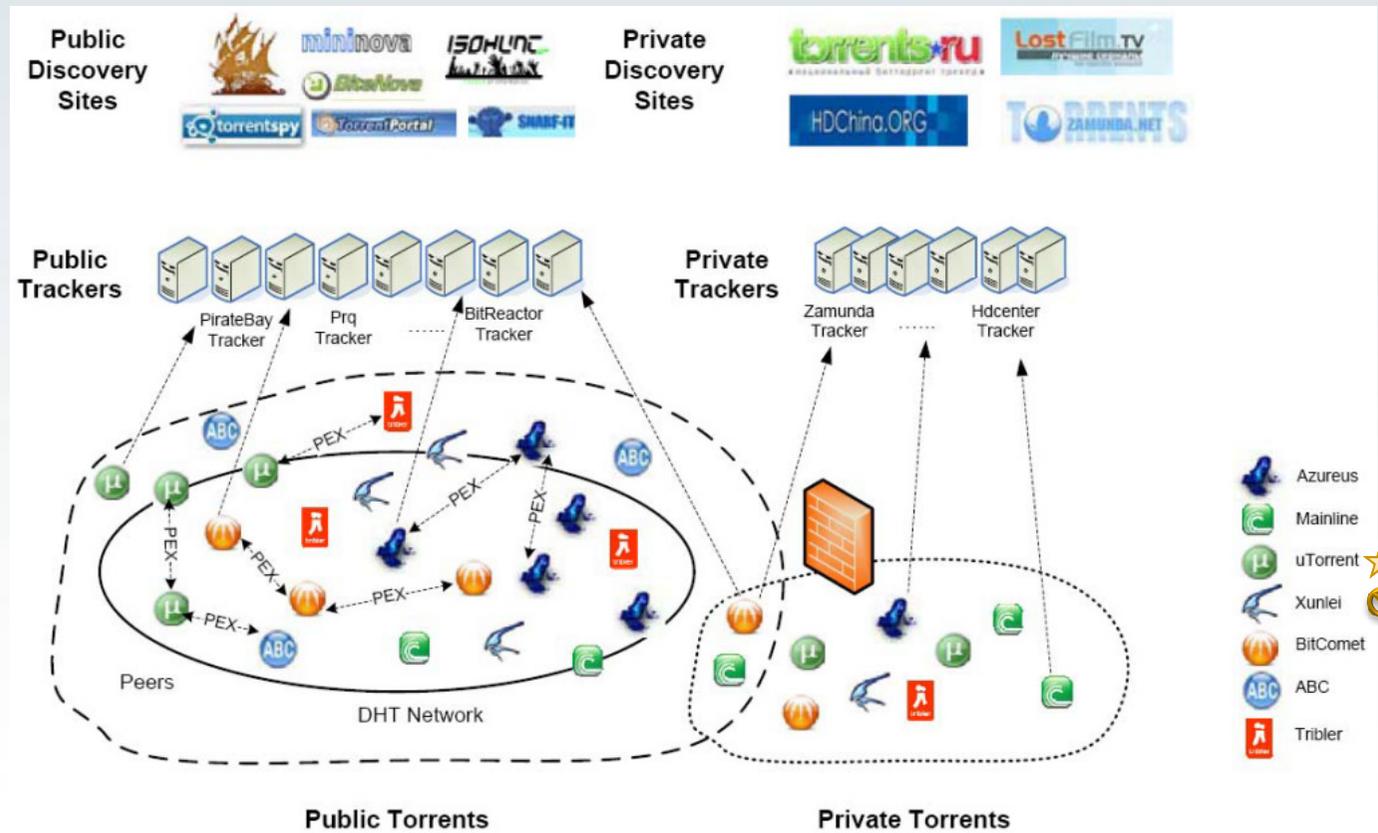
WHO

WHERE

WHEN

WHY

HOW



Private Tracker: 5W1H

WHAT

WHO

WHERE

WHEN

WHY

HOW

Country	Percentage of users	Country	Percentage of users
Russia	30.7%	Bulgaria	3.8%
USA	17.4%	Greece	2.9%
India	8.3%	UK	2.6%
Ukraine	4.9%	Turkey	2.3%
Japan	4.1%	Romania	2.2%

Private Tracker: 5W1H

WHAT

WHO

WHERE

WHEN

WHY

HOW



Country	# of sites	Country	# of sites
USA	194	Malaysia	15
Netherlands	107	Luxembourg	14
Germany	83	Ukraine	10
Sweden	58	Thailand	9
France	50	Bulgaria	8
Canada	46	Denmark	8
Hungary	44	China	8
Romania	36	Czech Republic	7
UK	36	Slovenia	7
Russia	16	Others	117

Private Tracker: 5W1H

WHAT

WHO

WHERE

WHEN

WHY

HOW



From: Google Insight for Search

Private Tracker: 5W1H

WHAT

WHO

WHERE

WHEN

WHY

HOW

Users & Torrents Scale

- Everyone vs. Registered Users

Incentive Mechanism

- Tit-for-Tat vs. Share Ratio Enhancement

Traffic Counting

- N/A vs. Ratio (Upload/Download)

Download Performance

- Uncertainty vs. Fast

Private Tracker: 5W1H

WHAT

WHO

WHERE

WHEN

WHY

HOW

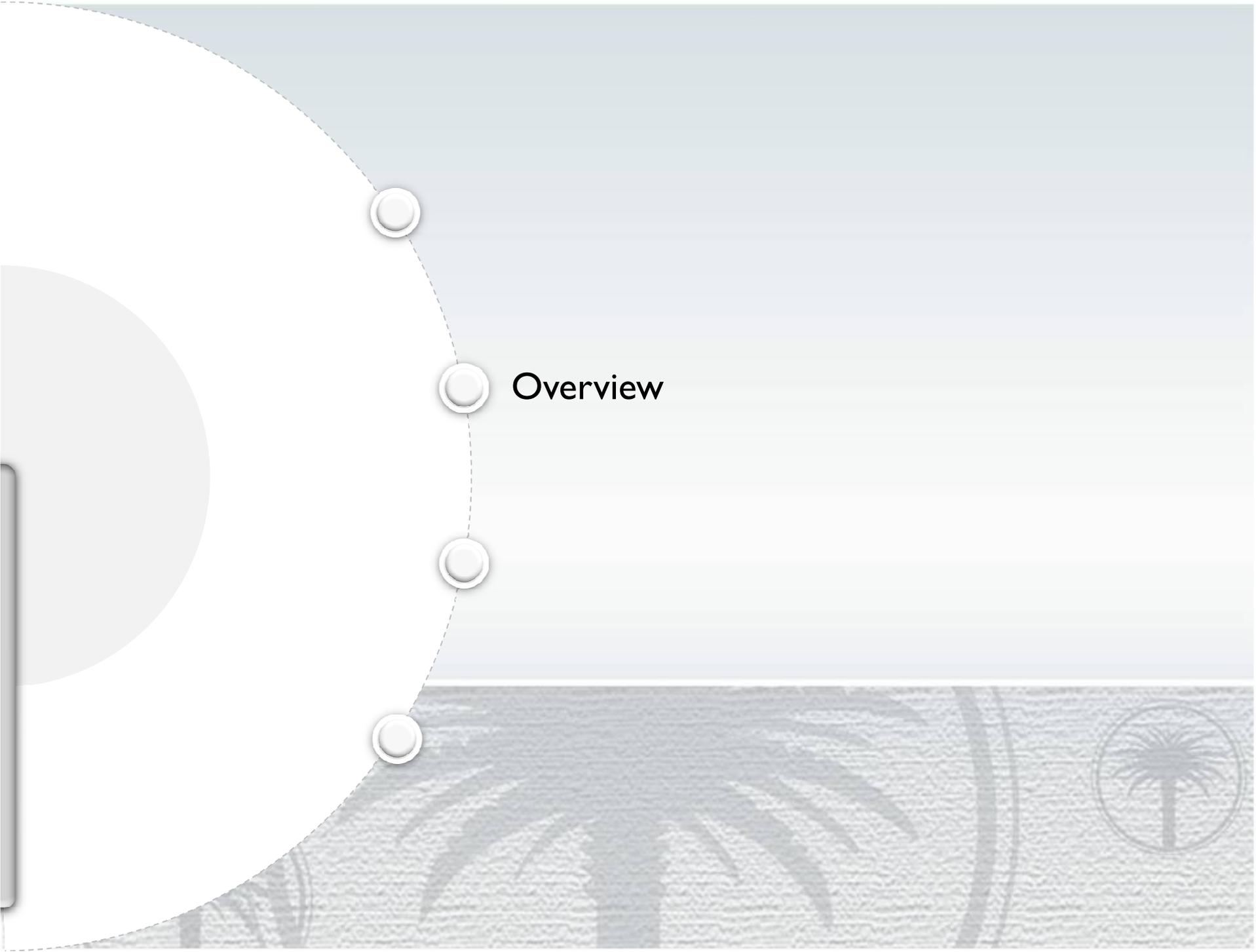
User Viscosity

Torrents Evolution

13 private & 2 public tracker
Over 4 months
31 datasets, 2.5 million torrents

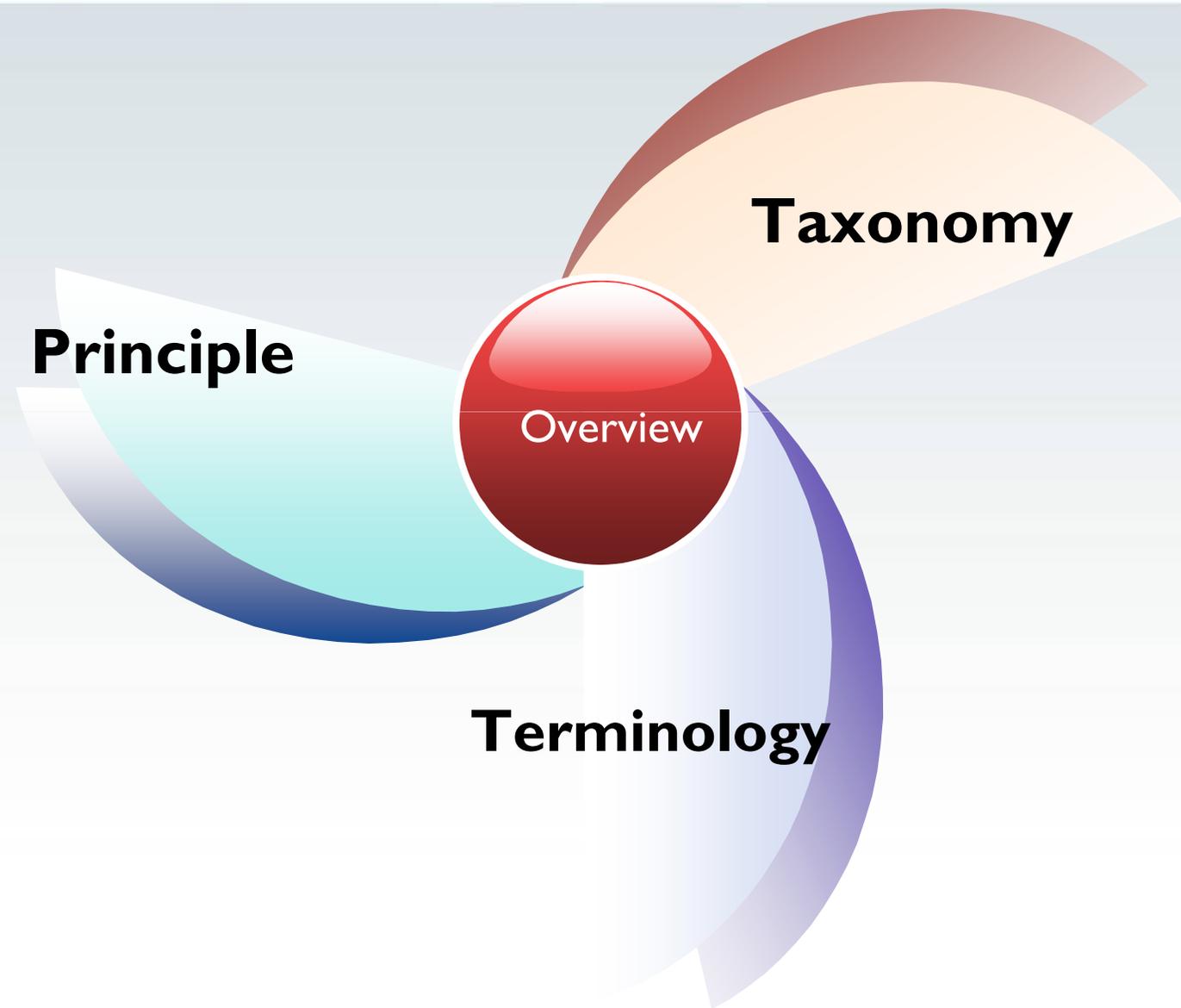
User Behaviors

Content Distribution

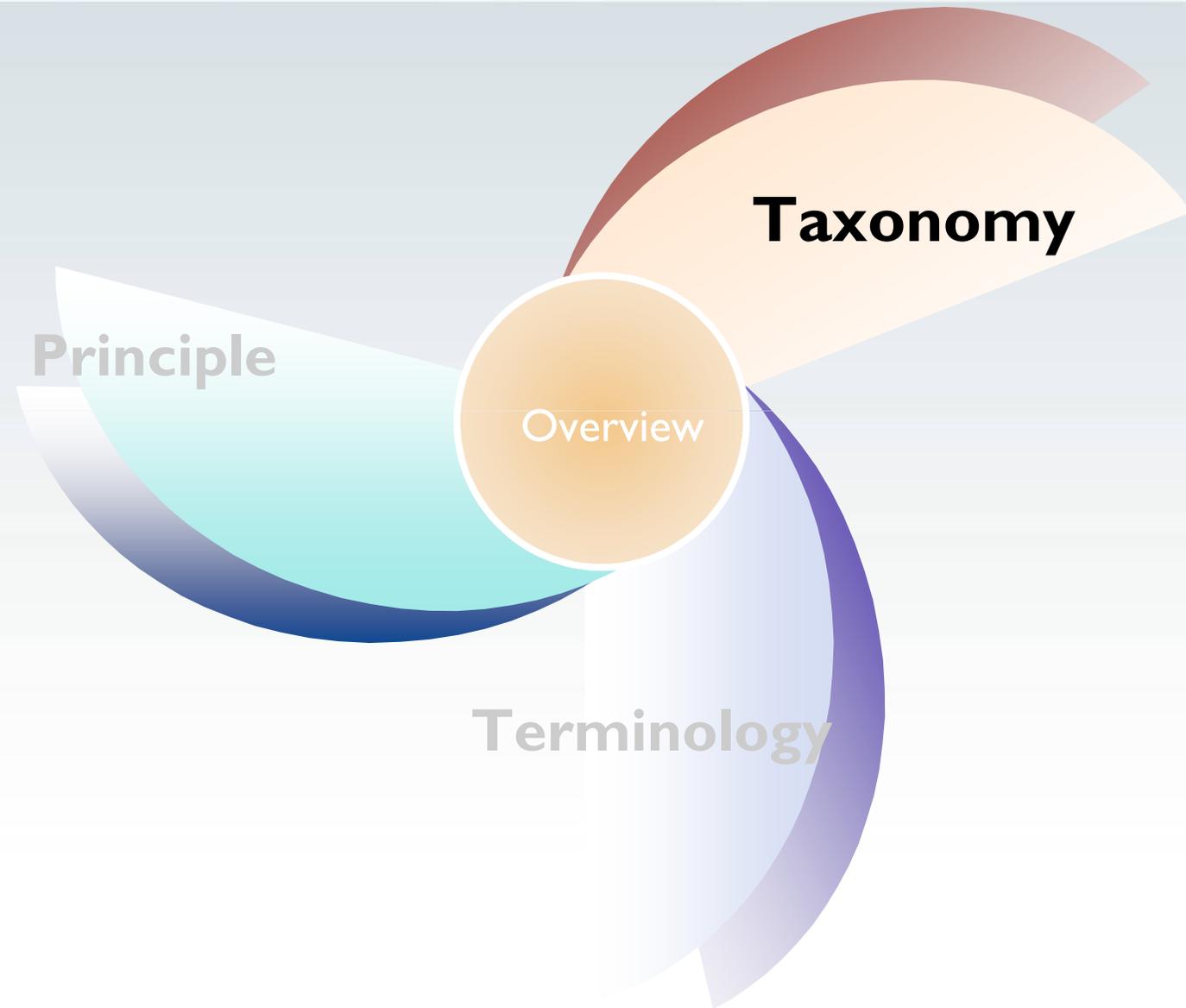


Overview

Overview



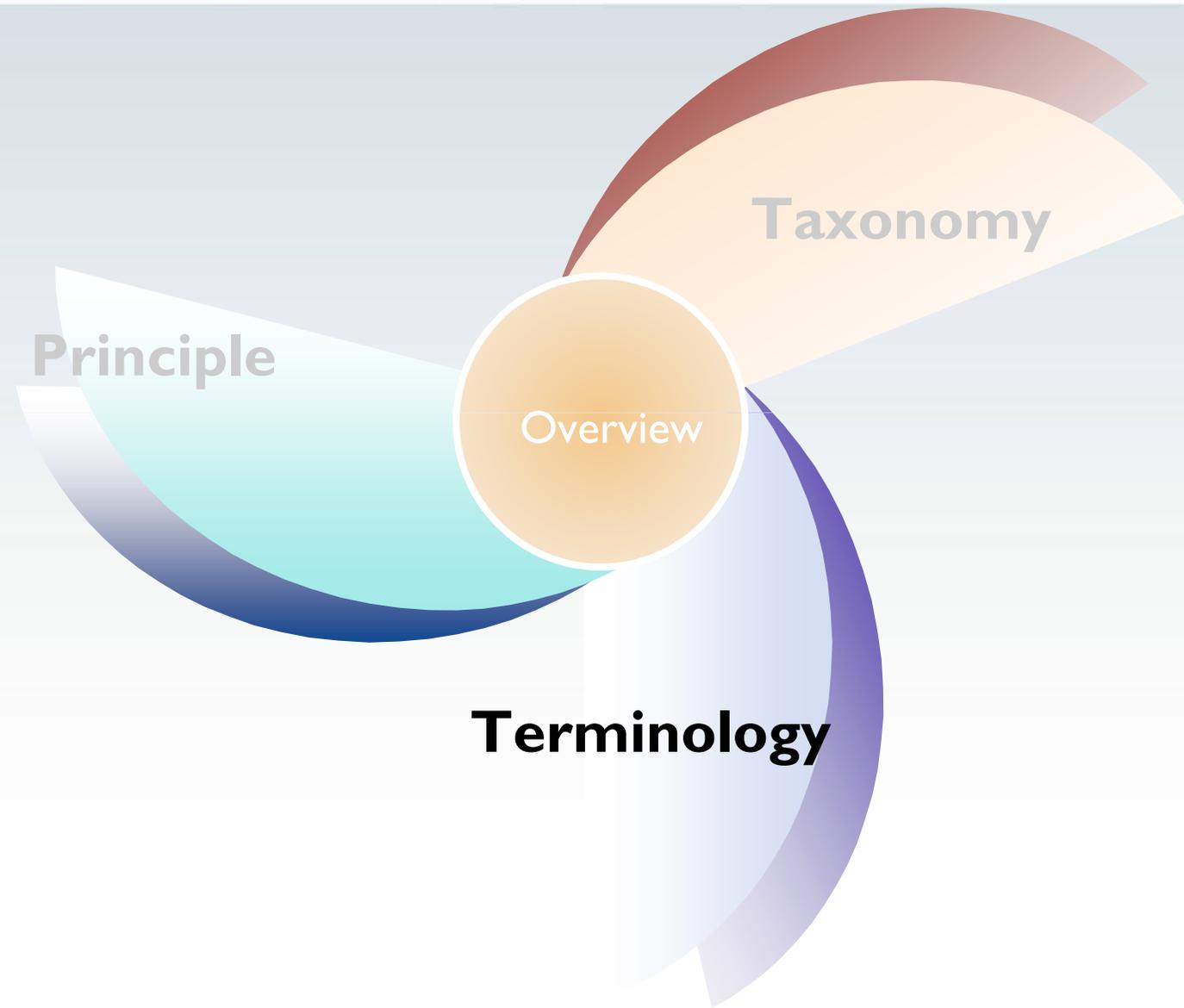
Taxonomy



Taxonomy

Private Trackers		
<i>Role</i>	<i>Operation Process</i>	<i>Related Terms</i>
Tracker User	Registration	Invitation Code
	Sharing (Seeding & Leeching)	Share Ratio, Passkey, Slot, Snatched, Freeleech, HnR, Point System
	Contribution	User Class
Tracker Owner	Building & Publishing	Codebase, Seedbox
	Ranking Improving	Scene Release, Pre/Pre'd, Pre-time

Terminology



Terminology

1

Registration

Invitation Code

- Typical registration way.
- Members meet specific requirements are eligible.
- Invite friends to join private tracker by sending invitation code.

2

Sharing Contents

Share Ratio

- $T_{upload} / T_{download}$

Passkey

- Unique identity assigned to each registered user by private trackers.
- Hexadecimal string.
- Appended to the announce URL in the .torrent file

HnR

- The behavior that a peer stops uploading as soon as it completes downloading.
- HnR is highly prohibited.

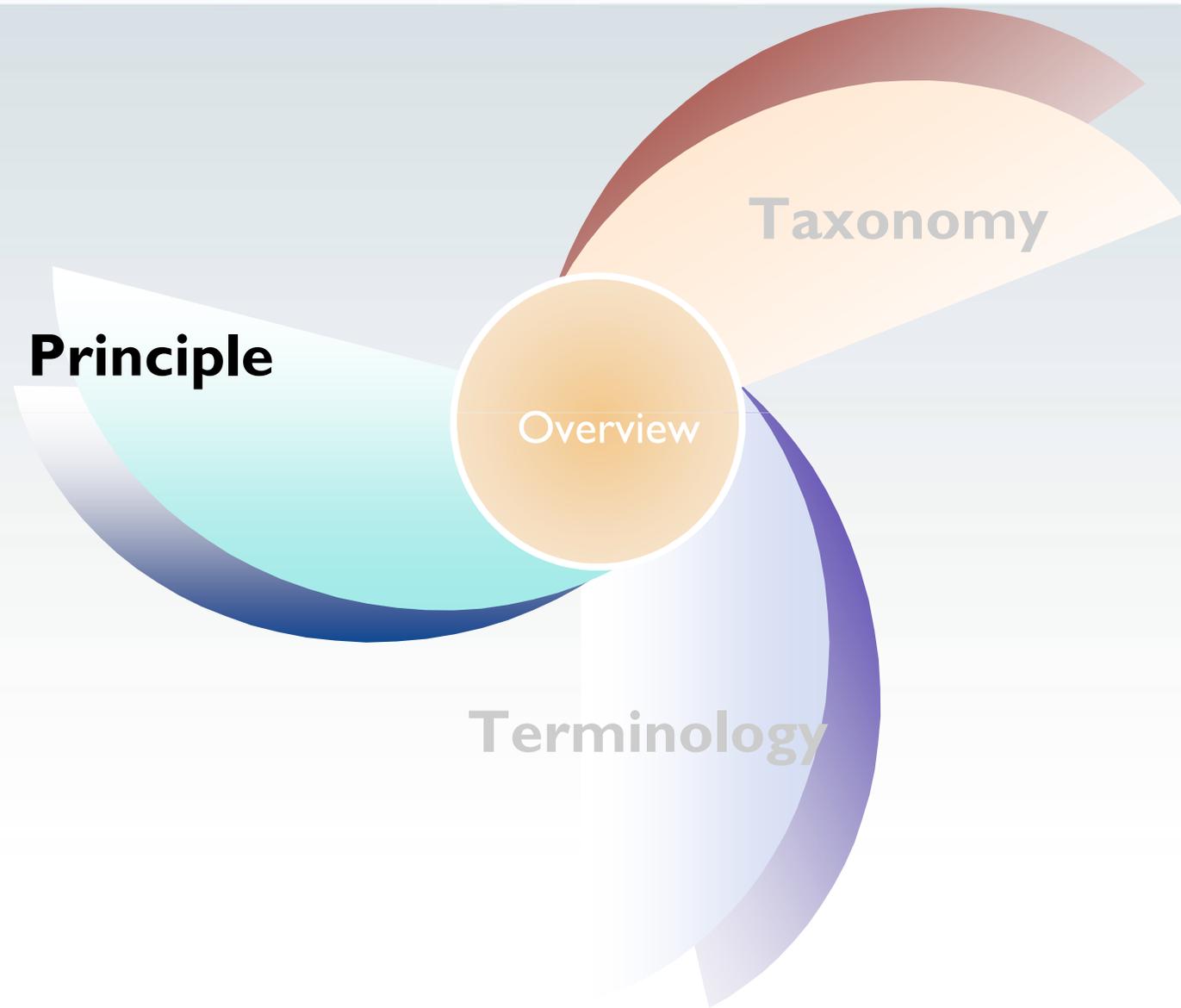
3

Contribution

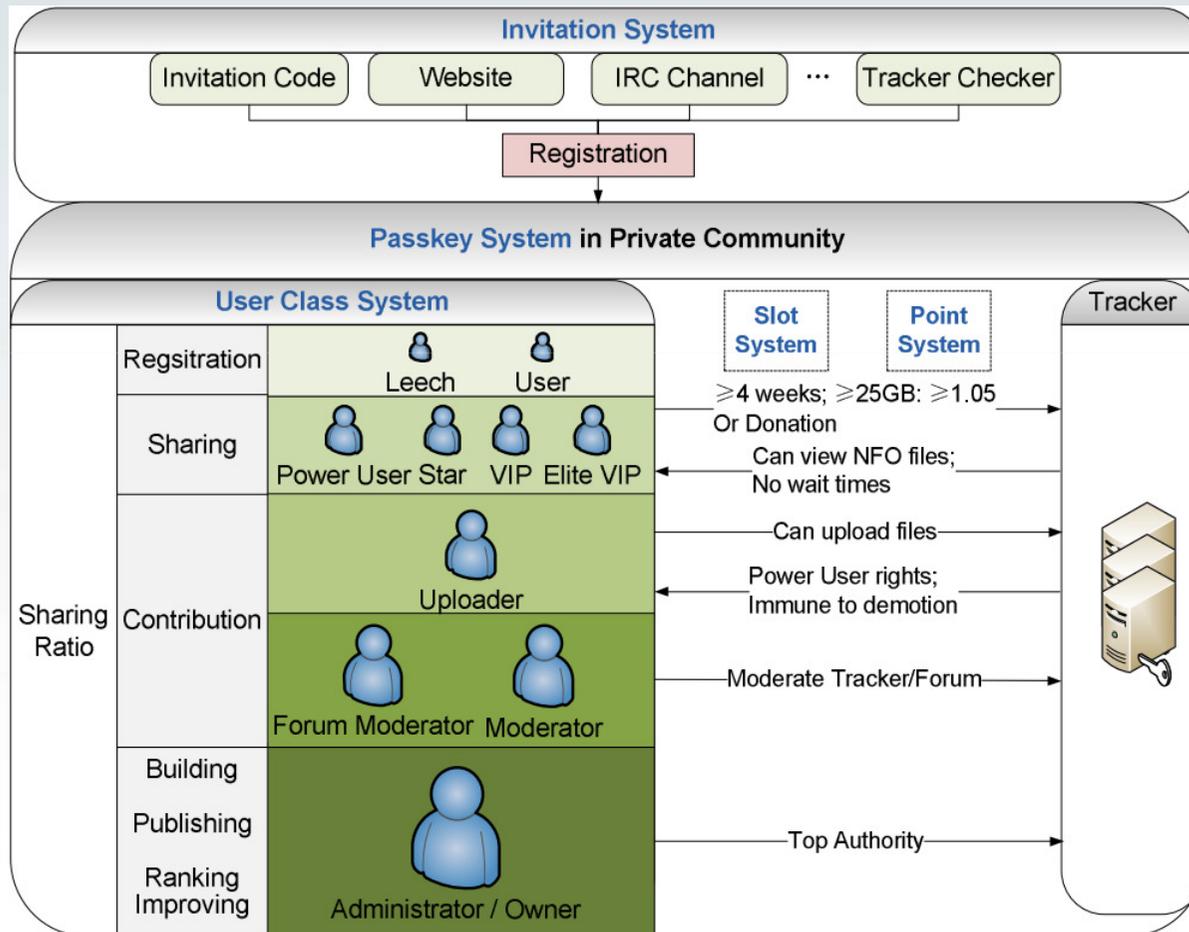
User Class

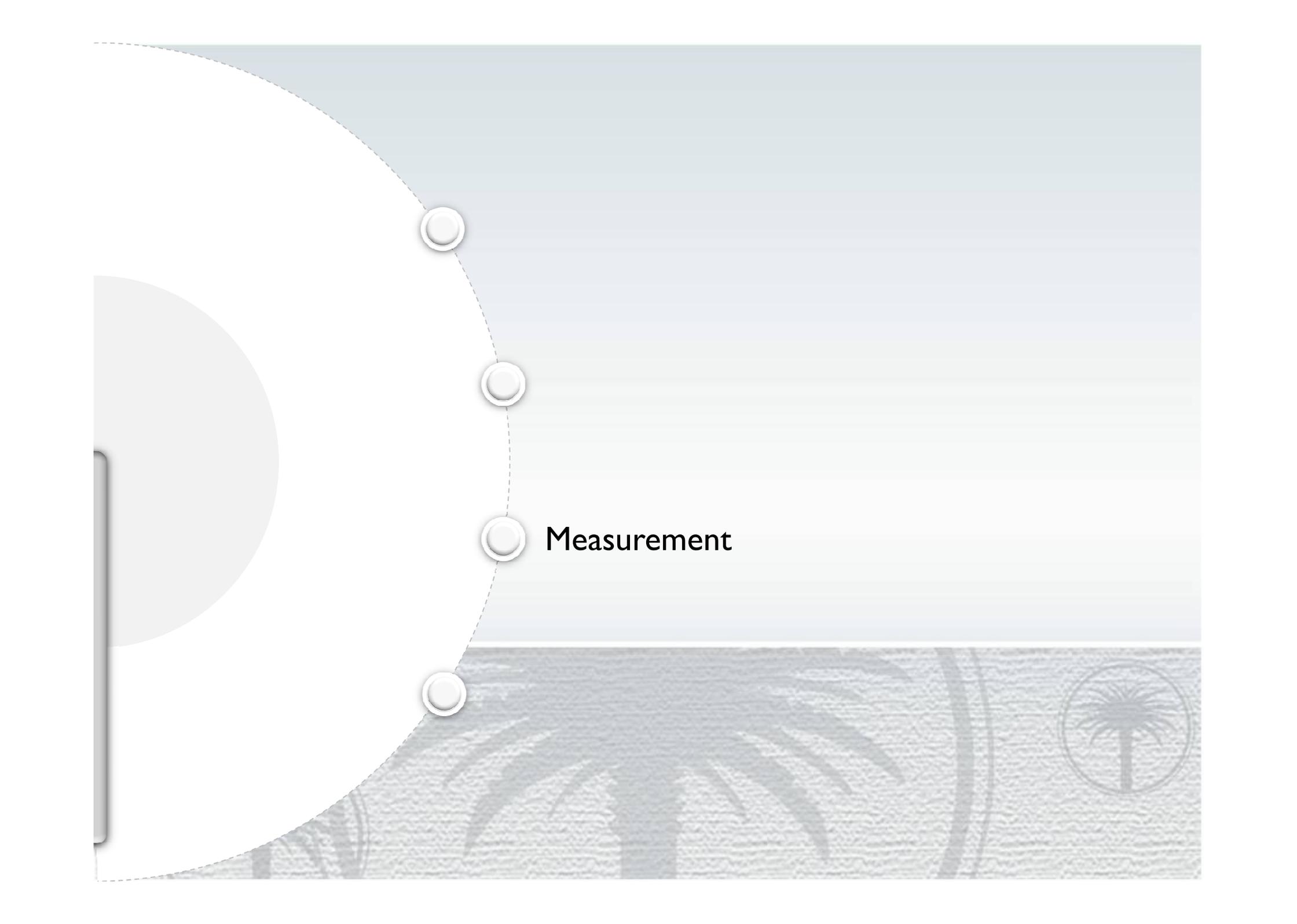
- Ranking system to categorize users based on contribution to community.

Principle



Principle

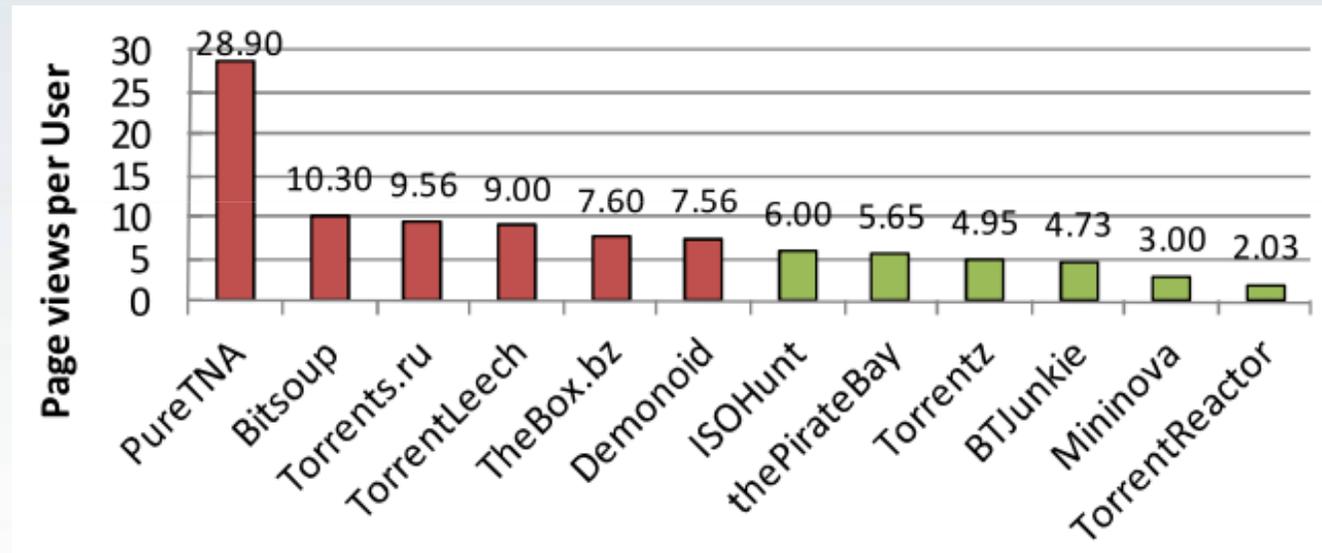




Measurement

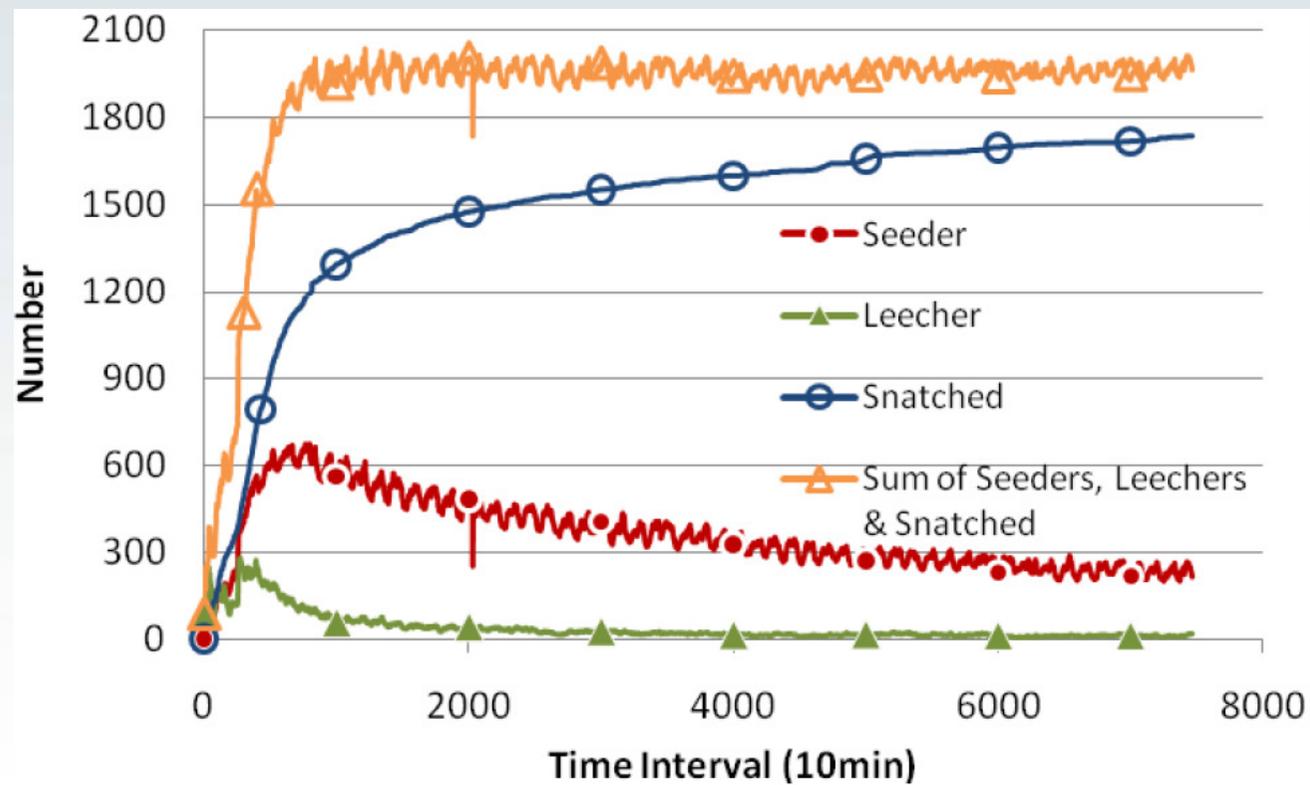
Measurement

- User Viscosity



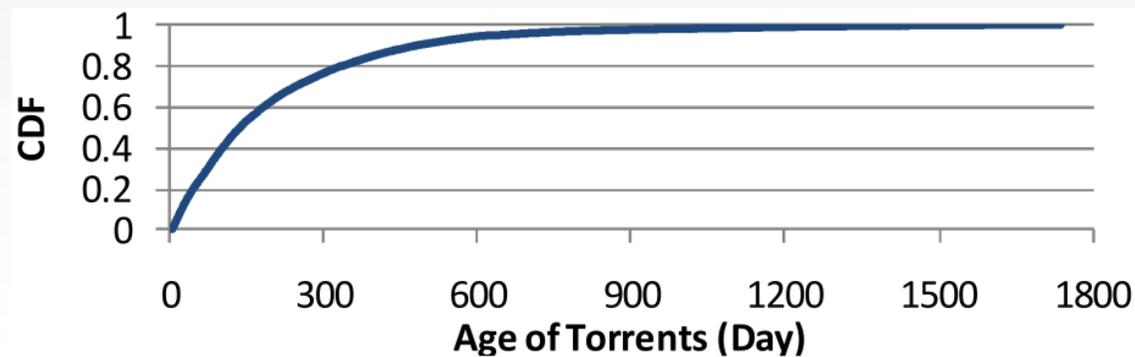
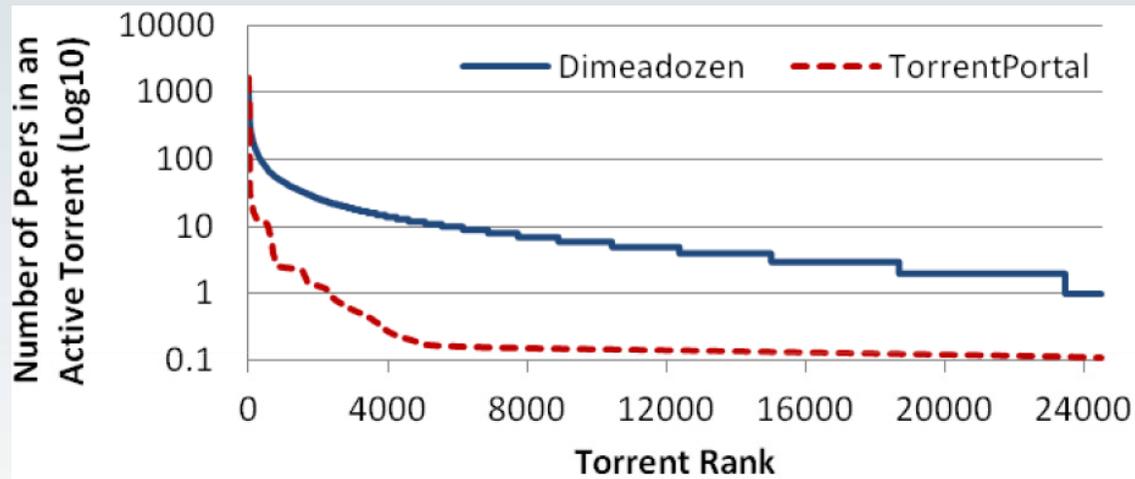
Measurement

- Torrents Evolution



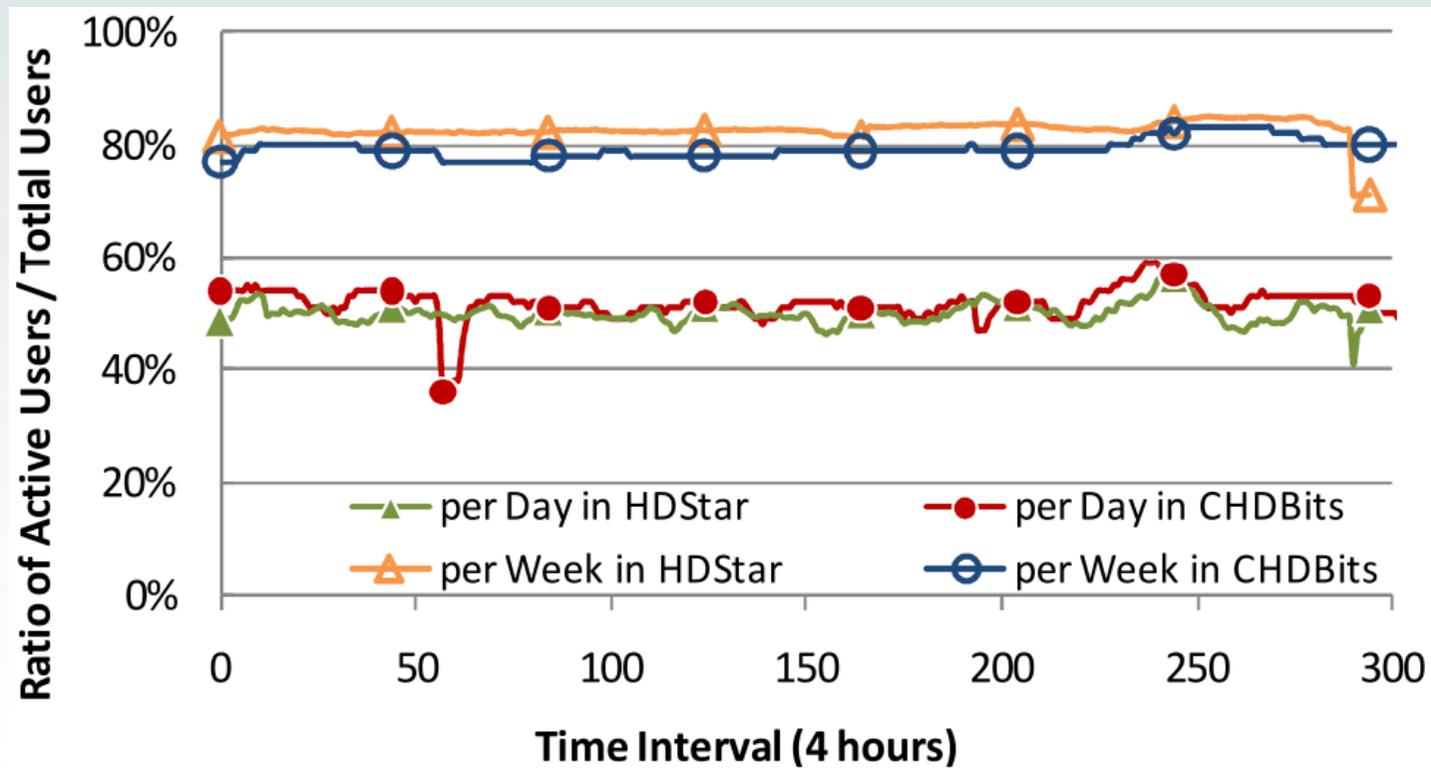
Measurement

- Torrents Evolution (cont.)



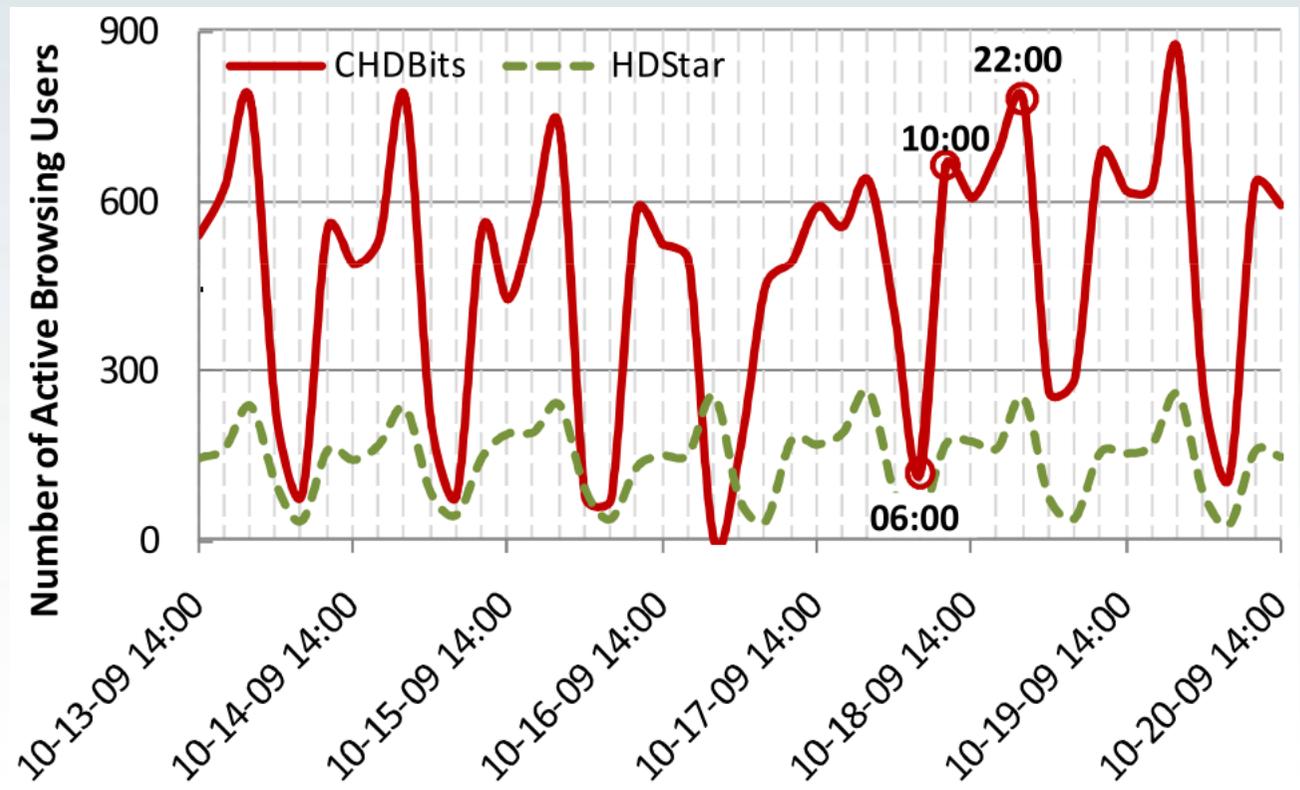
Measurement

- User Behaviors – Activity of Users



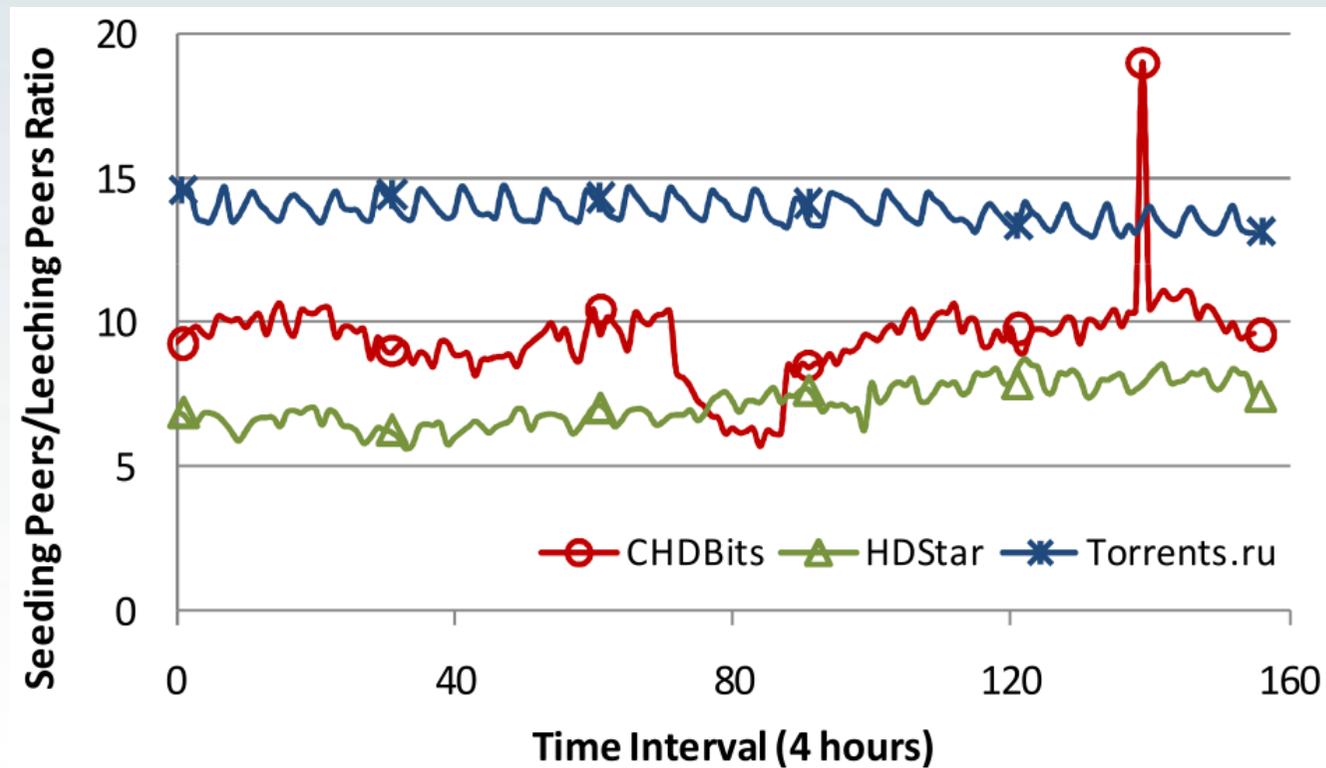
Measurement

- User Behaviors – Activity of Users (cont.)



Measurement

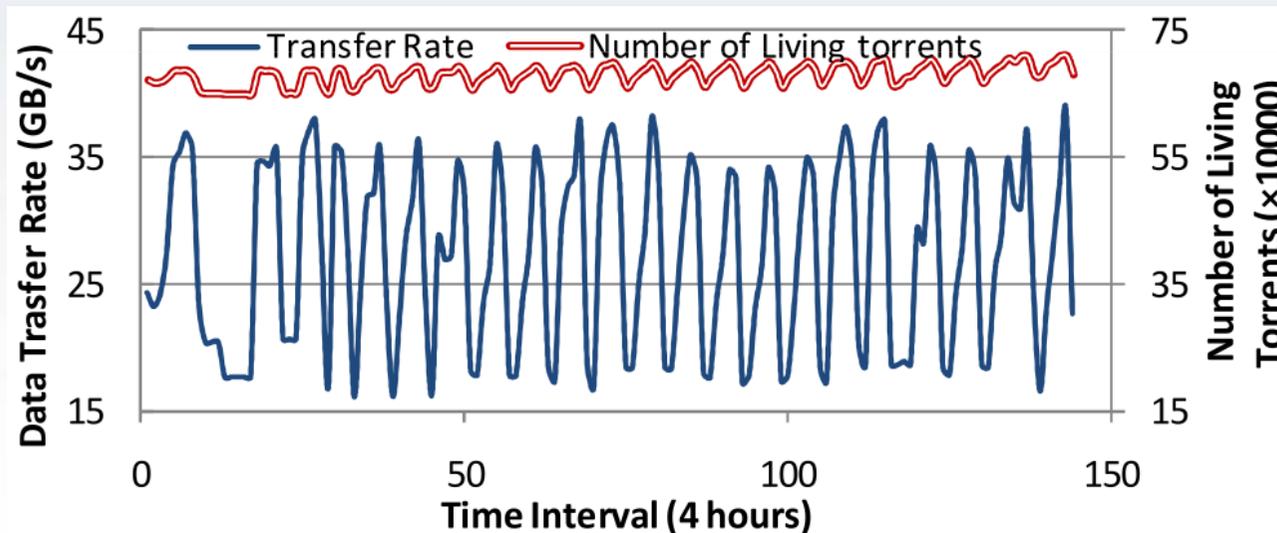
- User Behaviors – Activity of Peers



Measurement

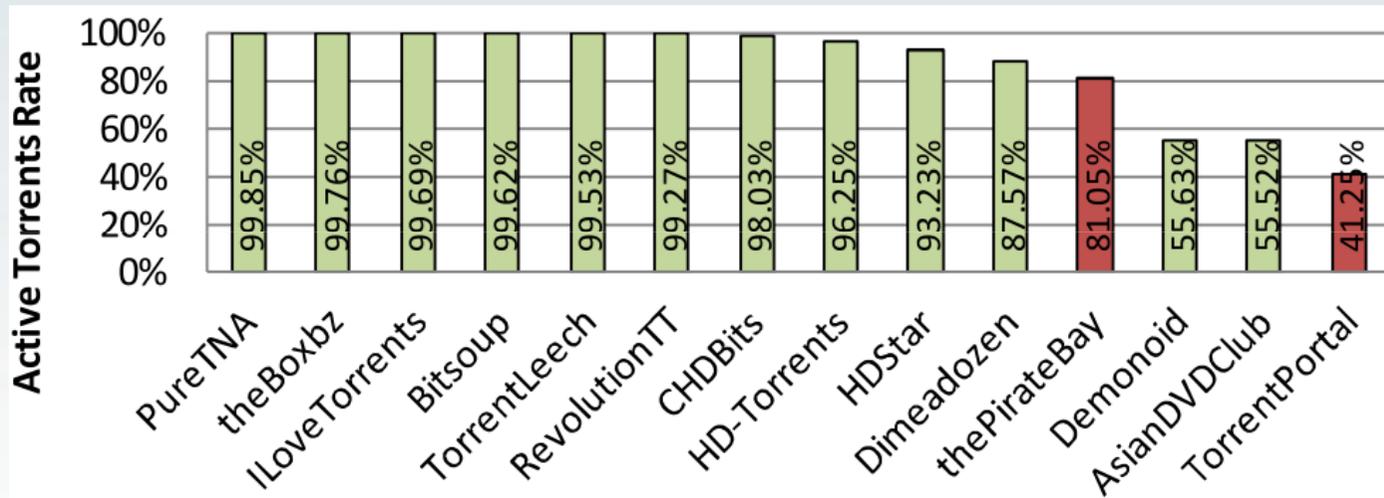
- User Behaviors – Data Transfer Traffic

e.g. Torrents.ru alone has more than 1000TB of content and generates more than 46GB/s of Internet traffic.



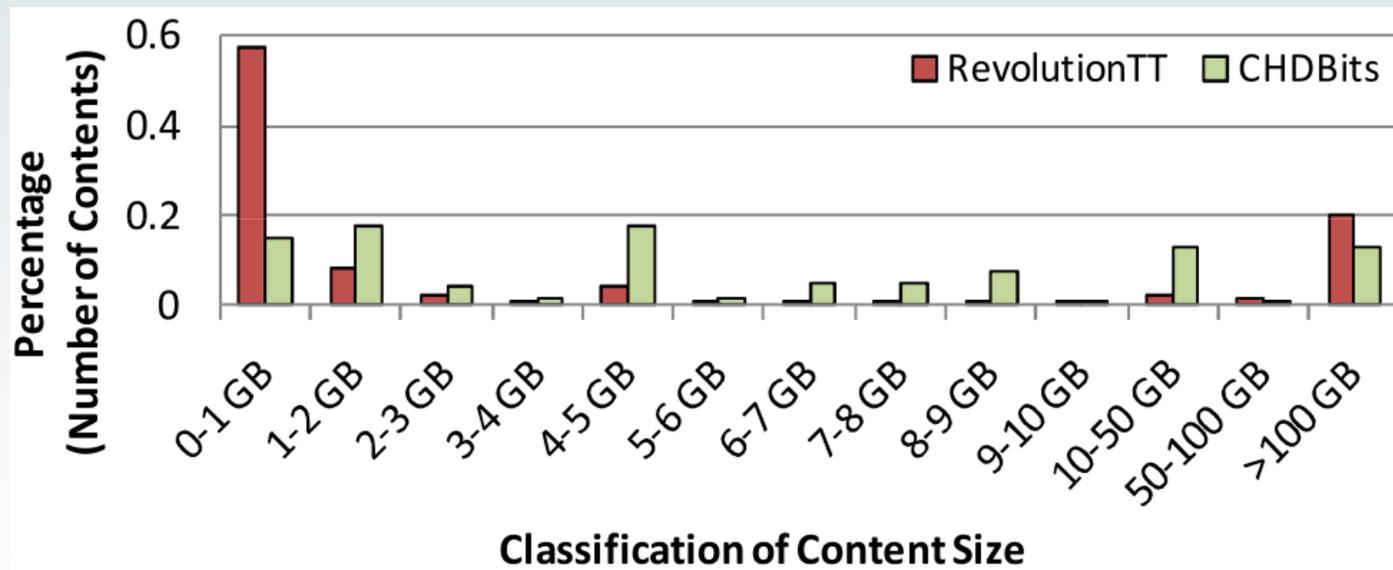
Measurement

- User Behaviors – Active Torrents



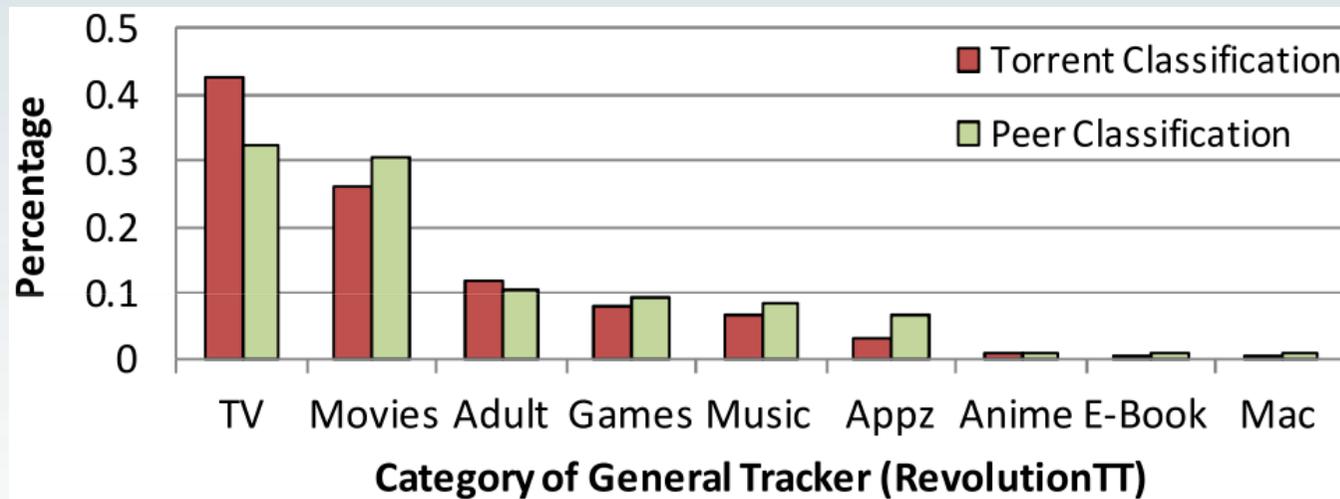
Measurement

- Content Distribution – Content Size



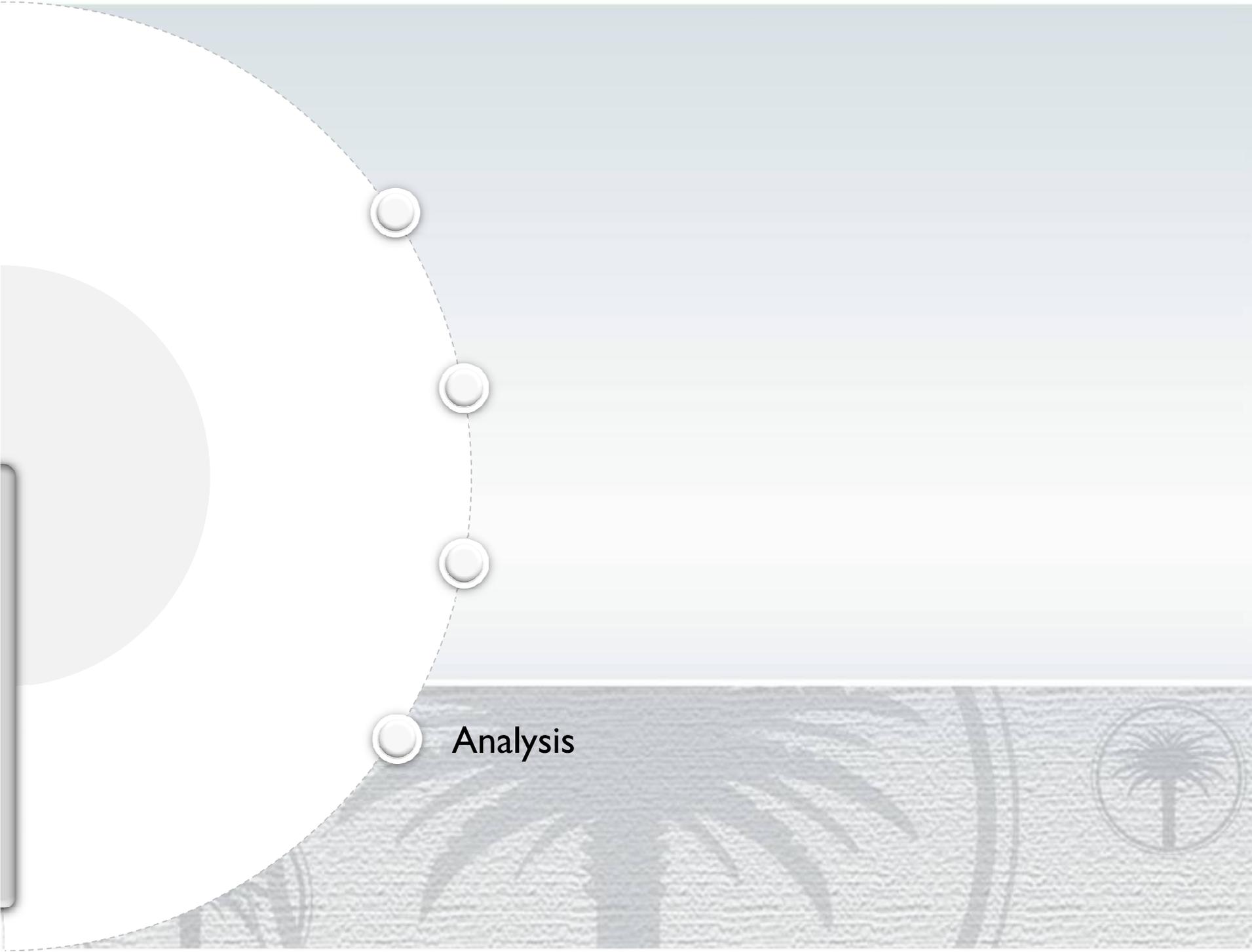
Measurement

- Content Distribution – Category



TOP 5 CATEGORIES IN DIMEADOZEN

Category	Rock	Alternate	Jazz	Singer or Songwriter	Progressive Rock
Percentage	27.03%	7.17%	7.63%	5.15%	6.92%



Analysis

Analysis

- Analysis of SRE Mechanism based on Game Theory
 - **Upload Level**
 $UL = \{(ul_1, ul_2, \dots, ul_p) \mid p \in N\}$, lowest \rightarrow highest
 - **Download Level**
 $DL = \{(dl_1, dl_2, \dots, dl_q) \mid q \in N\}$, lowest \rightarrow highest
 - **Strategy Space for a peer**
 $S_k = \{(ul_i, dl_j) \mid i, j, k \in N, 1 \leq i \leq p, 1 \leq j \leq q\}$
 - **Strategy Space for P2P System**
 $S = \{(S_1, S_2, \dots, S_n) \mid n \in N\}$
 - **Utility for P2P System**
 $u = \{(u_1, u_2, \dots, u_n) \mid n \in N\}$

Analysis

- Analysis of SRE Mechanism based on Game Theory

Weak Nash Equilibrium

UTILITY FUNCTION

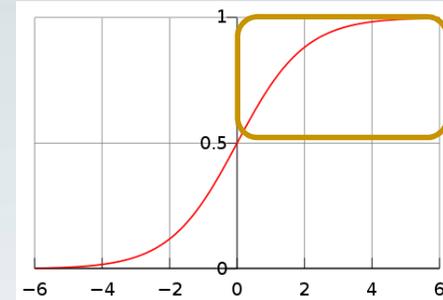
	Peer j (u_{high})	Peer j (u_{low})
Peer i (u_{high})	<u>(u_{high}, u_{high})</u>	$(u_{low}, u_{intermediate})$
Peer i (u_{low})	$(u_{intermediate}, u_{low})$	<u>(u_{low}, u_{low})</u>

Strict Nash Equilibrium

Analysis

- Modeling of SRE Mechanism: S-Curve

$$\ln(r) = b_0 - \frac{b_1}{d}, \quad r \geq 0, d > 0, r, d \in R$$



$$b_0 = 0.179$$

$$b_1 = 4.326$$

$$b_0 = 0.023$$

$$b_1 = 11.81$$

	Downloaded Data	Share Ratio (no less than)
RevolutionTT	3.0GB	0.3
	6.0GB	0.50
	10.0GB	0.80
	>10.0GB	>0.8
CHDBits	10GB	0.3
	50GB	0.4
	100GB	0.5
	200GB	0.6
	400GB	0.7
	>400GB	0.95

Analysis

- Improvement of SRE Mechanism

Period of time away from the last seeding

Share Ratio

- *Activity of user in terms of seeding time Ω*
- *The number of seeding torrents Ψ*

$$Ratio_{final} = r - P(t_l) + \sum_{i=1}^n \Omega(t_s) \times \Psi(n_i),$$

$$r, t_l, t_s, n_i \geq 0, r, t_l, t_s \in R, n_i \in Z$$

Conclusion

1

Private Trackers

- Overview
- Taxonomy

2

Measurement

- User Viscosity
- Torrents
- User Behaviors
- Contents

3

Analysis

- Effectiveness
- Modeling
- Improvement