

Bit Torrent Summary

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Context

- **History:** User upload speeds rise (dial-up → e.g. DSL): Client Server → P2P.
- **Model:** Publisher upload rate P ; N clients with upload rate C ; hope to get upload rate of $P + f \cdot N \cdot C$ instead of just P . Faster for all.
- **P2P History:** Napster (centralized) → Kazaa (distributed) → DHTs → BitTorrent
- **Challenges:** Freeloaders, incentives; churn, illegal content shutdown, firewalls, flash crowds.

Bit Torrent Terminology

- **File** → broken into pieces → subpieces
- **Seeders** (upload only) and leechers (still downloading but willing to upload some)
- **Tracker**: tracks all nodes in a swarm
- **Neighbors**: the random subset of all current nodes, a node connects to
- **Torrent**: file name, swarm (set of nodes)

Timeline

- Arranges for a seeder (s) and tracker
- Nodes find tracker from say Google
- Nodes contact tracker to get a random subset of other nodes to be neighbors
- Nodes request blocks from seeder and leecher neighbors till done, then continue uploading

Request Protocol: Main Ideas

- **Rarest First**: 20-40 neighbors: who to ask? Ask for pieces that fewest neighbors have.
- **Tit-for-tat**: 5 concurrent uploads to nodes that have highest download rate
- **Optimistic unchoking**: Every 30 seconds, upload to N regardless of N's download rate
- **Pipelining**: Make 5 concurrent subpiece requests on separate connections to saturate uplink
- **Priority**: Always finish piece before other pieces

Rarest First Motivations

- **Limited Seed Bandwidth**: System gains if peers get unique seed blocks and others from peers.
- **Seed failure**: increases probability that all blocks are transferred to swarm before this
- **Churn**: leaves common blocks till later so more likely despite churn
- **Local pairwise decision**: would it be more globally optimal for seed to send unique blocks it has never sent?

Tit for Tat Motivation

- Tit for tat found to be surprisingly effective in iterated prisoners dilemma.
- **Example:** Both Cooperate (3,3), One Defects (5, 0), Both defect (1,1)
- **Example run:** 2 Tit-for-Tat, 2 Defectors, 6 games. Tit for tat: 28, Defectors: 26. Why?
- Assume benevolence but learn
- **Problems:** Local, assumes symmetric and immediate payoff, needs altruism in seeder.
- **Bit Thief etc:** Software to cheat

Robust Incentives Summary

Beyond Tit for Tat

- Huge populations with churn:
- Asymmetric payoff
- Wishes to handle whitewashing: scamming followed by a new identity.
- Uses a simple model of asymmetry (7,-1) else (0,0), and round-based simulation Claims to apply to more general form of PD.

Story Line

- **Ch 1: Normalized generosity:** Beyond Tit for Tat: service provided to consumed. Normalize peers generosity to mine → 3 times more generous
- **Conclusion:** Normalized generosity works with private history works badly beyond some size.
- **Reason:** Random peers, less likely to get repeats, no history → lead to mass defections

Story Line

- **Ch 2: Server Selection:** Choose to interact with people you have provided service to.
- **Conclusion:** Better than with only private history but not so great with high turnover
- **Reason:** More turnover → less likely for people we have served to stay around

Story Line

- **Ch 3: Shared History:** Keep global history of everyone's service and consumption
- **Conclusion:** Works well with turnover of even 10% but is vulnerable to collusion.
- **Reason:** A group of colluders could pretend they get great service from each other.

Story Line

- **Ch 4: Max Flow Algorithm:** Weigh player B's opinion on C based on my trust of B. Sort of like Page-Rank but Max Flow not Eigen Value.
- **Conclusion:** $O(V^3)$ generally, approximate $O(V)$
- **Further issues:** Moles and other liars

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- **Ch 5: Dealing with Strangers, Traitors:** Need to deal with strangers and whitewashers
- **Conclusion:** Check recent history for strangers to give service; use only limited global history to deal with traitors

Questions

- Why do you think BitTorrent succeeded.
- What ideas did it add to the conversation?
- Do you think Tit-for-Tat really is the reason that there is little freeloading.
- Better mechanisms: few peers finish rather than forcing people to hang around.
- Robustness versus incentives: Azareus client
- BitTorrent paper poorly evaluated. Is that needed for a successful system. Consider TCP
- What is its future

Questions

- What do you think of the simulation framework?
How convincing is it?
- What ideas did it add to the conversation?
- What is the relation between Page Rank and Max Flow for reputation.
- Isn't the mole problem more than the authors state?
- Are rationality and game theoretic notions really the crux of the matter?