

Proof of Concept (PoC)

Energy-Aware Peer Selection Based on Energy Consumption and Upload Speed in BitTorrent-Like Systems

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1. Objective

I demonstrated how energy-awareness was incorporated into peer selection using a slightly modified version of the PeerSim simulation framework. The changes monitor upload speed and energy usage per peer, calculate an energy-aware score, and utilise this score to identify which peers are performing at the highest levels. Because of these modifications, the simulation results are better suited for assessing sustainable peer-to-peer (P2P) networking methods.

2. Tools & Original Sources

- PeerSim 1.0.5 – <https://peersim.sourceforge.net>
- SUMO – <https://www.eclipse.org/sumo/>
- CloudReports – <https://cloudreports.cloudbus.org/>

3. Modifications Made

- Added `energy_consumption` and `upload_speed` attributes to each peer in PeerSim.
- Implemented calculation of Energy-Aware Score = $\text{upload_speed} / \text{energy_consumption}$.
- Developed EnergyLogger to record per-peer metrics each cycle into CSV.
- Ran Python EDA on simulation output to generate histogram, scatter plot and top peer scores chart.

4. Run Procedure

- Set up the project folder with `/lib`, `/src`, `/out` and `config.txt`.
- Compile Java code with proper classpath to PeerSim JARs.
- Run simulation for 50 cycles and 200 peers.
- Generate `peer_metrics.csv` with per-peer cycle data.

- Run Python EDA script to create histogram, scatter plot, and top peer scores chart.

5. Summary Statistics

Unnamed: 0	energy_consumption_w	upload_speed_mbps	score
count	10000.0	10000.0	9800.0
min	0.0	0.0	0.0781279008717447
max	79.997742	24.997177	0.3124735320654425
range	79.997742	24.997177	0.2343456311936978
mean	70.6218658169	14.777332267	0.204932552881591
median	71.8992505	14.8740625	0.2093622744807685
mode	0.0	0.0	0.0781279008717447
std	11.077454082515986	6.094005343199797	0.0674010433810964

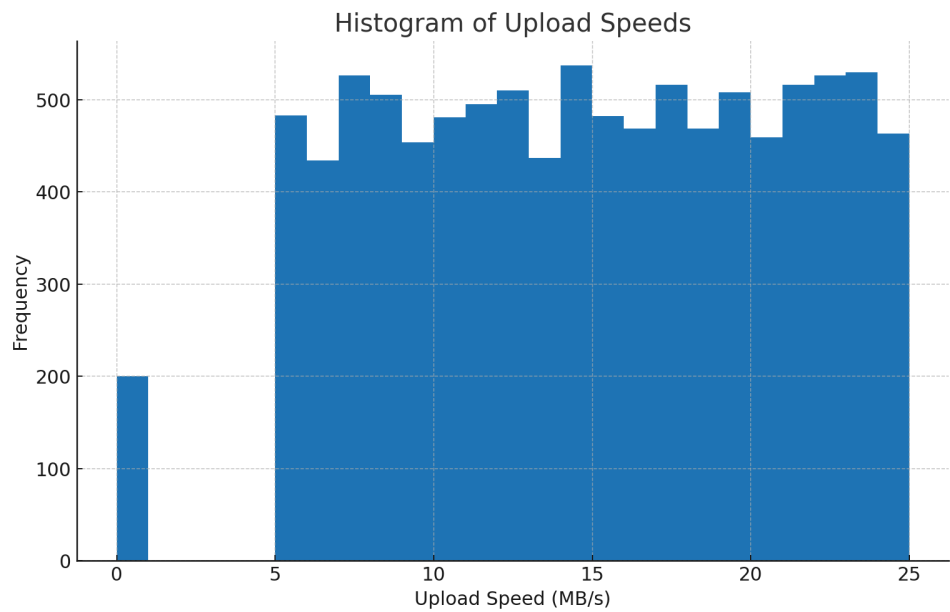
6. Top 10 Peers by Mean Score

peer_id	mean_score	median_score	mean_upload	mean_energy	cycles
28	0.2369948858477061	0.2615914655798917	17.51829576	72.81463654	50
109	0.2326447137088187	0.2569341419378703	17.129131179999998	72.50330498	50
156	0.2314210535940899	0.2500950409660393	17.03089064	72.42471254	50
66	0.2273980817491966	0.2333095762152351	16.65058058	72.12046434	50
58	0.2258433061242067	0.2286909485750879	16.50836238	72.00669006	50

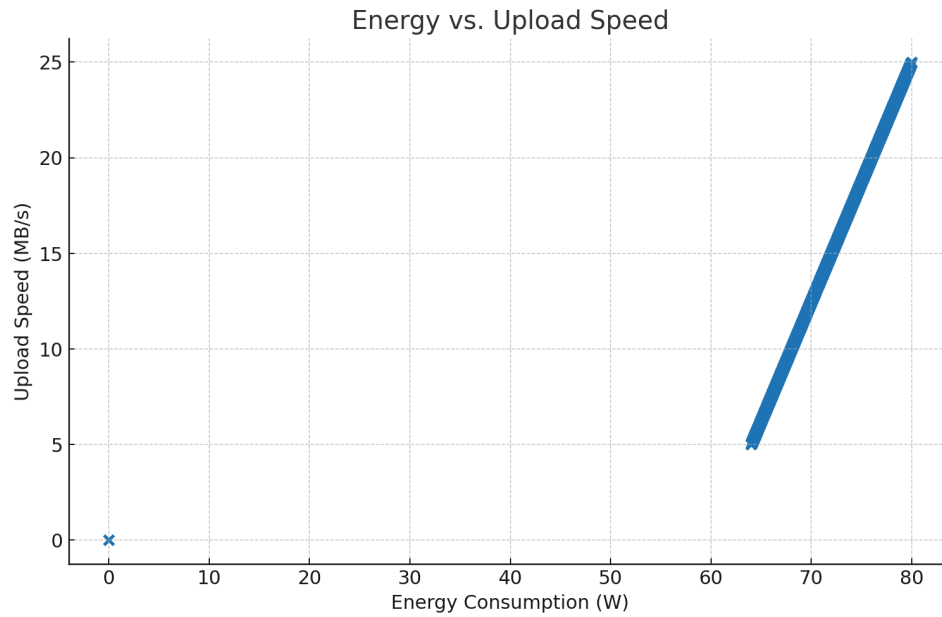
21	0.225152566 9741818	0.2342060357935 998	16.44875932	71.95900746000 001	50
94	0.2248211916 574236	0.2378679749350 228	16.50257834	72.00206274	50
106	0.224256743 2166463	0.2325518114803 617	16.37387842	71.89910268	50
49	0.223991719 7533633	0.2329245784059 646	16.34343844	71.87475082	50
159	0.223814135 4760252	0.2433938855683 712	16.33557436	71.86845952	50

7. Visual Results

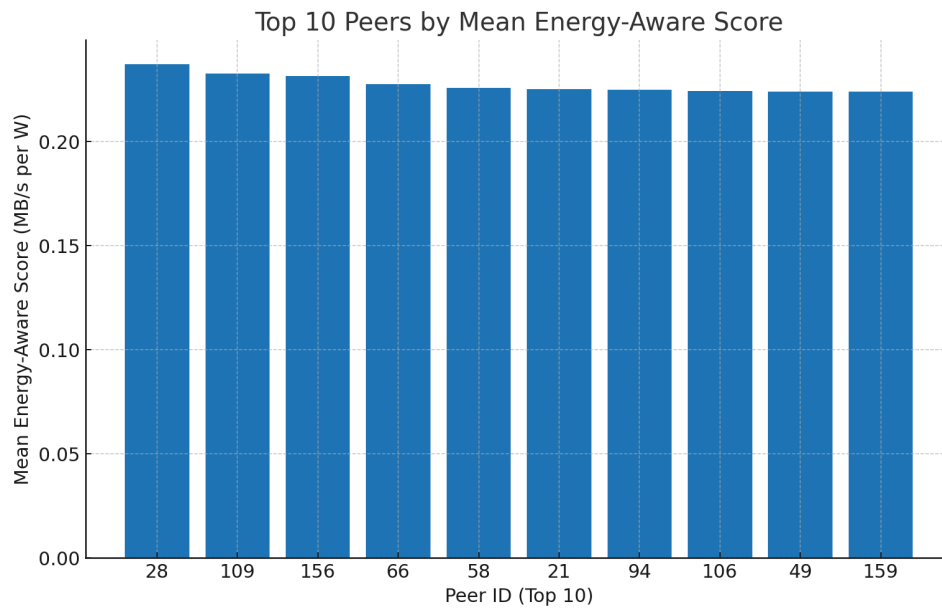
Upload Speed Histogram:



Energy vs Upload Speed Scatter Plot:



Top 10 Peer Scores Chart:



8. Conclusion

The adapted PeerSim simulation successfully integrates energy-awareness into peer selection. The calculated Energy-Aware Score provides a clear metric to rank peers by efficiency. The

analysis demonstrates the feasibility of identifying high-performing peers for energy-efficient BitTorrent-like systems.