

# The Future of the Internet: Peer-to-peer (P2P) overlay-based networking

*NS\_PCOM7E January 2023 A*

Group 2: Nisa, Nomusa, Prannoy, Xue Ling

---

# The Future of the Internet

## Introduction

- Internet: an integral part of our lives
  - Digital communication, work, interaction
- Technology, information & knowledge sharing
  - Peer-to-peer (P2P)

# Peer-to-peer (P2P) overlay-based networking

## Definition

- Decentralised network architecture: mesh-like
- Direct communication between computers (as both client & server)
- P2P overlay-based networking protocols
  - BitTorrent
  - TOR
  - Freenet
  - KAD

# Peer-to-peer (P2P) overlay-based networking

## Advantages

- Decentralisation: Highly distributed networks
    - Functional without any central servers
    - High fault-tolerance
  - Lower (running) costs
    - Less need for expensive infrastructure
  - High scalability potential
    - Ideal architecture for the future of the Internet
  - Privacy: Anonymous
-

---

# BitTorrent

---

# Peer-to-peer (P2P) overlay-based networking

BitTorrent

- Popular file distribution system
  - Divide large files into smaller pieces
  - Each peer downloads & uploads pieces to other peers
- Sharing information stored in a distributed host system
  - Redistribute load
- Saves cost
  - Data saved on different host machines - exchange data

---

---

# TOR

---

# Peer-to-peer (P2P) overlay-based networking

TOR

- Specialised web browser
- Onion routing
  - Route traffic through multiple nodes in TOR network
  - Session key generated in each hop gets deleted
  - Difficult to trace traffic source
- Anonymous
  - More data privacy than standard web browser (i.e. Chrome)
  - Chrome browser: Network goes through ISP servers



---

# Freenet

---

# Peer-to-peer (P2P) overlay-based networking

Freenet

- Privacy & availability
- Share & communicate anonymously: publish, replicate, retrieve data
- Location-independent
  - High availability
  - Scales with number of users
  - Distribute data across network: difficult to censor/block content

---

---

**KAD**

---

# Peer-to-peer (P2P) overlay-based networking

KAD

- eMule file-sharing app
- Distributed Hash Table (DHT):  
index files & network locations
  - Quick & easy to find consistent format
  - Peers locate & download files from other peers
  - Distributed nature: Grow/shrink system without significant operational impact

---

---

# Limitations of Other Technologies & Conclusion

---

# Limitations of Content Centric Networking (CCN) and/or NDN or COAST

Why It May Not Be the Best  
Solution for the Future of the  
Internet

- Some advantages over traditional IP network
  - Scalability challenges: Significant infrastructure & app changes
  - Limited support for real-time apps
  - Security & privacy concerns
  - P2P Overlay may be better suited for the future of the Internet
-

# Limitations of MobilityFirst Architecture

Why It May Not Be the Best  
Solution for the Future of the  
Internet

- High implementation cost
  - Limited compatibility with existing networks
  - Complexity
    - Specialised skills & knowledge
  - Still in research phase
  - Not suitable for all use cases
-

# Limitations of Adoption of IPv6 and Associated Security Measures

Why It May Not Be the Best  
Solution for the Future of the  
Internet

- Some advantages: improved address space & security
  - Limits & challenges
    - Compatibility issues with older devices, systems
  - IPv6
    - Costly & time-consuming
    - Requires significant infrastructure upgrades
    - Risk of fragmentation & incompatibility if IPv6 adoption is not universal
  - Combination of different approaches & solutions
    - DNSSEC, HTTP/3, IPsec
-



# Peer-to-peer (P2P) overlay-based networking

## Conclusion

- Promising technology: device and user growth
  - Protect privacy: Anonymous platform
  - Cost saving: spread across users
  - Improved security: data not concentrated in central servers  
= no single point of failure
    - Difficult for attackers to target and steal data
  - Security concern: No central entity management
-

---

# References

Clarke, I., Sandberg, O., Wiley, B. and Hong, T.W., 2001, March. Freenet: A distributed anonymous information storage and retrieval system. In Designing privacy enhancing technologies: international workshop on design issues in anonymity and unobservability Berkeley, CA, USA, July 25–26, 2000 Proceedings (pp. 46-66). Berlin, Heidelberg: Springer Berlin Heidelberg.

Cohen, B., 2003, June. Incentives build robustness in BitTorrent. In Workshop on Economics of Peer-to-Peer systems (Vol. 6, pp. 68-72).

Dingledine, R., Mathewson, N. and Syverson, P., 2004. Tor: The second-generation onion router. Naval Research Lab Washington DC.

---

---

# References

Fuchs, C., 2007. Internet and society: Social theory in the information age. Routledge.

Lua, E.K., Crowcroft, J., Pias, M., Sharma, R. and Lim, S., 2005. A survey and comparison of peer-to-peer overlay network schemes. IEEE Communications Surveys & Tutorials, 7(2), pp.72-93.

Raychaudhuri, D., Seskar, I., Ganu, S., Kolenkiewicz, M., & Venkataramani, A. (2012). MobilityFirst: a mobility-centric and trustworthy internet architecture. Proceedings of the ACM SIGCOMM workshop on Future human-centric multimedia networking, 1-6.

---

---

# References

Steiner, M., En-Najjary, T. and Biersack, E.W., 2007. Exploiting KAD: possible uses and misuses. ACM SIGCOMM Computer Communication Review, 37(5), pp.65-70.

Stoica, I., Morris, R., Karger, D., Kaashoek, M. F., & Balakrishnan, H. (2001). Chord: A scalable peer-to-peer lookup service for internet applications. ACM SIGCOMM Computer Communication Review, 31(4), 149-160.

Wang, Y., Zhang, D., & Xu, C. Z. (2012). A comparative study of content-centric networking and traditional IP networking. IEEE Communications Magazine, 50(7), 106-113.

---

---

# References

Yang, S.J. and Chen, I.Y., 2008. A social network-based system for supporting interactive collaboration in knowledge sharing over peer-to-peer network. *International Journal of Human-Computer Studies*, 66(1), pp.36-50.

Yang, Y., Liu, J., & Zhang, J. (2015). A survey of peer-to-peer overlay network architectures. *IEEE Communications Surveys & Tutorials*, 17(1), 69-93.

Zhang, J., Hu, J., & Wang, X. (2012). Peer-to-peer overlay-based network and its applications. *Journal of Computer Science and Technology*, 27(5), 923-937.

---