

Privacy Vulnerabilities on Distributed Hash Tables

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Abstract Distributed Hash Tables (DHT) are overlay networks that enable distributed nodes to store and request data in a peer-to-peer (P2P) network. Data storage and data lookups are resolved collectively through a collaborative routing protocol in a deterministic way. The collaborative nature of DHTs results on resilient, scalable and decentralized networks where nodes are not required to maintain a complete view of the network while, simultaneously, not relying on central authorities. These properties make DHTs an important building block for the decentralized web and P2P systems. However, the decentralized nature of DHTs introduces privacy vulnerabilities due to the metadata leaked during the routing and lookup protocols. In na ve DHT implementations, it is trivial for any adversary to gather information about which nodes are requesting what data and which nodes are providing what data, without being detected and with relative low resources. Nowadays, the decentralized web ecosystem is relying heavily on DHTs as networks such as IPFS and Dat are steadily reaching mainstream adoption. Thus, it is important to address privacy preserving vulnerabilities of DHTs. Failing to deliver on user privacy will render decentralized systems unattractive as a viable alternative to centralized systems. In this paper we enumerate the privacy vulnerabilities of the most common DHT protocols and show how those vulnerabilities affect current applications that rely on distributed hash tables.

Introduction

Threat model

First, we define privacy and the adversary model considered throughout the paper. In summary, we define the adversary as being local, passive and internal. We consider  privacy of communication between peers and the metadata leaks that an adversary can gather and correlate to derive critical information about the application-level user. The metadata leaked by peers is due to to expected network activity as defined by the DHT protocol in place.

Previous work

(Memon et al. 2009) presents *Montra*, a monitoring system to capture traffic in a DHT networks with relatively few resources in a Kademlia DHT (Maymounkov and Mazi res 2002), while making sure the monitoring does not bias the network traffic. The monitoring is performed by DHT nodes called Minimal Visible Monitors (MVM). MVM nodes do not route requests or store content. Instead, MVM nodes are placed in multiple resource locations in order to capture lookup requests and thus link lookup originator with requested content ID. The underlying reason that makes it possible to accurately monitor the request traffic is because the Kademlia protocol (and generally all DHT protocols) replicate content to multiple nodes. Thus, the MVM nodes will eventually receive and log lookup requests for content that maps with their peer ID. *Montra* shows how trivial it is to leverage the collaborative nature of DHTs to

effectively monitor network requests and link peer identities with requested content. This can be accomplished with minimal network impact and requires relatively few computational resources. The authors show that their monitoring system can accurately capture around 90% the query traffic in a network with around 32000 peers using a relatively cheap computer (Intel Core 2 Duo with 1 GB RAM). A monitoring system such as *Montra* can be used to record and correlate user behavior over time based on the lookup requests issued by their nodes.

(Mittal and Borisov 2008) has shown several that

So while (Memon et al. 2009), [ref], [ref], show that vanilla DHT protocols leak metadata that can be correlated to , (Mittal and Borisov 2008), [ref], [ref], show how hard it is to achieve lookup and storing privacy in DHTs.

Syverson, Somesh Jha, and Xiaolan Zhang. Alexandria, Virginia, USA: ACM Press; ACM Press. <https://doi.org/10.1145/1455770.1455805>.

Privacy vulnerabilities of DHTs

Conclusion

References

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