Linking the Unlinkable: Design, Analysis, and Implementation of Network Flow Fingerprints for Fine-grained Traffic Analysis

UMASS AMHERST

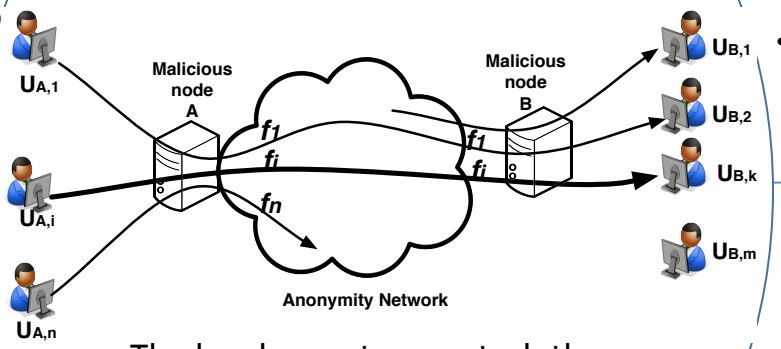
Challenge:

- Linking network flows is extremely important to security and privacy on the Internet, as it can help in tracing back to cybercriminals.
- However, linking network flows in real-world is significantly challenging due to 1) the large volumes of Internet traffic, and 2) the use of encryption and other content obfuscation mechanisms.

Solution:

- We investigate a new approach for scalable flow linking, called "flow fingerprinting"
- In this approach, one embeds invisible tags into network flows by modifying their patterns, such as packet timings. Such invisible tags facilitate the linking of network flows

An example scenario of using flow fingerprinting to link network flows



The border routers perturb the timing patterns of ingress flows by strategically delaying packets. Such artificial traffic pattern is used to link flows

Scientific Impact:

- This project takes the first steps in designing and implementing flow fingerprints.
- We will use the detection and estimation theory to derive optimal fingerprinting mechanisms.
- We will establish a theoretical model for the design and evaluation of future flow fingerprinting mechanisms.

Broader Impact:

- The outcomes of the project can be use to identify and stop cybercriminals in real-world
- Computer science education (e.g., by integrating discussions into classes) is a key part of this project
- Involving women and students from underrepresented minorities in the project is another key component

PI: Amir Houmansadr (University of Massachusetts Amherst)

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