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English scientific summary

The goal of UPIN is to develop and evaluate a scalable distributed system that enables users to cryptographically verify and easily control the paths through which their data travels through an inter-domain network like the Internet, both in terms of router-to-router hops as well as in terms of router attributes (e.g., their location, operator, security level, and manufacturer). UPIN will thus provide the solution to a very relevant and current problem, namely that it is becoming increasingly opaque for users on the Internet who processes their data (e.g., in terms of service providers their data passes through as well as what jurisdictions apply) and that they have no control over how it is being routed. This is a risk for people's privacy (e.g., a malicious network compromising a user's data) as well as for their safety (e.g., an untrusted network disrupting a remote surgery).

The UPIN project is novel in three ways:

1. UPIN gives users the ability to control and verify the path that their data takes through the network all the way to the destination endpoint, both in terms of hops and attributes of routers traversed. UPIN accomplishes this by adding and improving remote attestation techniques for on-path routers to existing path verification mechanisms, and by adopting and further developing in-packet path selection directives for control.
2. We develop and simulate data and control plane protocols and router extensions to include the UPIN system in inter-domain networking systems such as IP (e.g., using BGP and segment routing) and emerging systems such as SCION and RINA.
3. We evaluate the scalability and performance of the UPIN system using a multi-site testbed of open programmable P4 routers, which is necessary because UPIN requires novel packet processing functions in the data plane. We validate the system using the earlier motivating examples as use cases.

The impact we target is:

● Increased trust from users (individuals and organizations) in network services because they are able to verify how their data travels through the network to the destination endpoint and because the UPIN APIs enable novel applications that use these network functions.
● More empowered users because they are able to control how their data travels through inter-domain networks, which increases self-determination, both at the level of individual users as well as at the societal level.

English public summary

Most users of the Internet do not know how their traffic flows through the network to its final destination and cannot verify or control its path. The UPIN project's result will be a system that gives Internet users the control and insight they do not have but urgently need.

Dutch public summary

De meeste internetgebruikers weten niet hoe hun verkeer zich door een netwerk verplaatst naar zijn uiteindelijke bestemming en ze kunnen dat pad niet verifiëren noch controleren. UPIN ontwikkelt een systeem dat gebruikers de controle en het inzicht geeft dat nu ontbreekt maar hard nodig is