2-Phase Beaconing: All-in-one Beaconing and Traffic Monitoring Protocol

Master's Thesis Project
ETH Zürich

Student:
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Project Duration: 6 months

Project Description

The current SCION control plane works well but may not be the optimal solution to the problem of discovering the network, discovering paths that adhere to all participants' policies and getting current traffic information, all while being scalable and minimizing CPU cost.

This thesis will build on the existing control plane and explore some variations that may result in:

- reduced CPU load by reducing signature verification load,
- reduced overall complexity of the control plane by merging three solutions (beaconing, IREC, live traffic info) into two (2-phase beaconing, IREC),
- and more up-to-date link state information by frequently disseminating link states.

The main idea is to replace the traditional beaconing with a 2-phase mechanism that disseminates link state information to all participants, and then, based on the aggregated complete view of the relevant network region (a region is either an ISD or the sum of all core ASes), reaches out to create desired path segments. IREC serves as a fallback if no path can be found easily.

In this thesis you will explore and analyze the proposed modifications, analyze details and edge cases, and come up with a more detailed design for 2-phase beaconing (or modifications thereof). The design should then be implemented and evaluated in a simulator in order to validate or dismiss the claimed advantages.

Tasks

Below are the tasks that the student is required to accomplish in the scope of this project. Based on the findings that the student makes and the issues he encounters during his work on the project, the goals of the project can later be changed and the tasks can be revised.

- Provide a detailed architecture for the proposed control plane adaptations. This should include discussions of variations of the proposal.

- Implement the changes such that they can be simulated, for example in NS-3 or in our production code base. This can be built on an existing implementation available in the NetSec group.
- Run the simulation and investigate different edge cases, such as
    - areas with very restrictive routing policies
    - transit vs non-transit policies
    - routing around large scale network outages
    - recovering from large scale network outages
- Evaluate and discuss the results of the simulations
- Compare the results of the simulation with the current state-of-the-art control plane.

Optional Tasks

- Propose and evaluate traffic engineering strategies, extensions and possibilities
- Run the same simulation on the current control plane implementation
- Investigate link groups and how they can interact or be implemented with 2-phase beaconing

Technologies

SCION, C++ or Golang

Organization

The student will hold weekly meetings with the thesis advisor(s). During each weekly meeting, the student will be expected to briefly describe the work completed during the week. The student should promptly discuss any complications that arise (e.g. difficulty in understanding concepts or in creating tools) such that the advisor can assist the student in identifying alternative project directions. The advisor will assist the student toward completing any agreed upon milestones, as well as laying out the following week's goals.

Grading Scheme

Grade	**Description**
6.00	Design and implementation, as well as thesis are candidates for submission to an academic conference or workshop.
5.50	Thesis quality significantly exceeds expectations.
5.00	Thesis meets expectations.
4.50	Thesis partially meets expectations and has minor deficits.
4.00	Thesis meets minimum quality requirements; but has major deficits and is clearly below expectations