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A subtree-based approach to failure detection and protection for multicast in SDN

Key words: Software-defined networks (SDNs), OpenFlow, Multicast tree, Protection, POX controller, Mininet, Multiprotocol label switching (MPLS)

Corresponding author: Chung-Horng Lung

E-mail: chlung@sce.carleton.ca

 ORCID: <http://orcid.org/0000-0002-5662-490X>

Introduction

- Multicasting has become popular due to video and multimedia applications. There are high quality-of-service (QoS) requirements for multicasting.
- Network protection and restoration is critical for multicast applications.
- Software-defined networking (SDN) is a fast evolving paradigm and has gained tremendous attention.
- This paper investigates a subtree-based approach to network failure detection and protection for multicast in SDN.
 - The goal is to efficiently protect a large multicast tree and to meet the QoS requirements.

Features of our approach

- Use of a proactive subtree-based protection scheme.
 - A 'subtree' refers only to a tree whose root has more than one direct child.
- A multicast tree is divided into multiple subtrees.
- Protection of a multicast tree becomes protection of each of the subtrees:
 - Minimizes the failure detection time and is easier to provide backup paths within a subtree
 - If a failure occurs, the changes are made only to the subtree, not the entire tree.
- Make use of the OpenFlow protocol to support failure detection and identification of the corresponding subtree for protection.

Method

- Divide a multicast tree into subtrees
- Failure detection
 - Monitored by the Discovery component in the SDN POX Controller
- Failure localization
 - Identify where the failure exactly occurs
- Failure protection
 - Identify the kind of protection (link or node protection) needed
 - Send flow table modifications to switches responsible for initiating protection

Major results

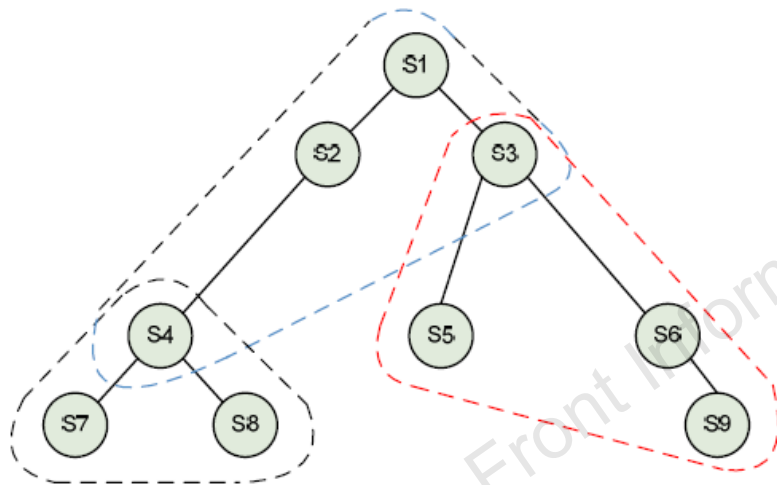


Fig. 4 A sub-divided tree of OpenFlow switches

Table 2 Average failure recovery time

| Link | Average failure recovery time (ms) | Standard deviation (ms) |
|-------|------------------------------------|-------------------------|
| S1-S2 | 0.20 | 0.154 |
| S1-S3 | 0.14 | 0.057 |
| S2-S4 | 0.44 | 0.245 |
| S3-S5 | 0.48 | 0.254 |
| S3-S6 | 0.14 | 0.058 |
| S4-S7 | 0.32 | 0.222 |
| S4-S8 | 0.15 | 0.037 |
| S6-S9 | 0.31 | 0.230 |

Conclusions

- Multicast applications are popular and have high QoS requirements.
- Proposed a subtree-based approach to support network failure detection and protection for multicast trees in SDN.
- Failure detection can be done more efficiently and failure identification and recovery can be started earlier to improve QoS.