Vignesh Renganathan Raja, Chung-Horng Lung, Abhishek Pandey, Guo-ming Wei, Anand Srinivasan, 2016. A subtree-based approach to failure detection and protection for multicast in SDN. *Frontiers of Information Technology & Electronic Engineering*, **17**(7):682-700. http://dx.doi.org/10.1631/FITEE.1601135

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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)

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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.

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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.

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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

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Major results

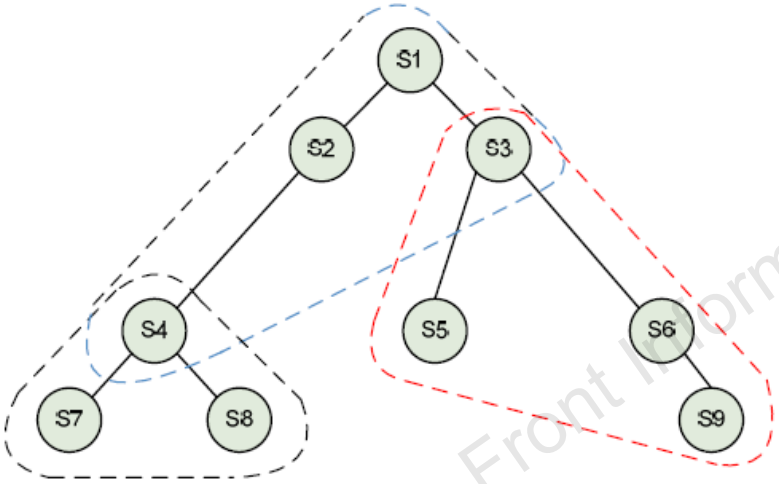


Fig. 4 A sub-divided tree of OpenFlow switches

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

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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.

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