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MULTICAST ROUTING DIAGNOSTICS SYSTEM USING MACHINE LEARNING

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ABSTRACT

Techniques are described herein for using Machine Learning to detect anomalies that cannot be detected by programming or scripts. These anomalies must be discovered by prior issues that have been troubleshooted by classic network tools (e.g., debugs, show commands, packet capturing tools, etc.).

DETAILED DESCRIPTION

Multicast traffic relies on the forwarding state on routers to be forwarded correctly. Even when the forwarding state is present and correct on routers, the multicast traffic can be dropped or some degradation can occur. These issues are difficult to detect. The best way to track the correct forwarding of all multicast traffic is to track the state and the forwarding statistics at the same time on all nodes in the network. There are currently no mechanisms that achieve this.

Multicast is mostly used to deliver in-time video streams to the end-user. Existing solutions use scripting or programming to detect known or previously discovered issues that might occur with multicast routing in networks. As such, intermittent multicast traffic degradation and faulty topology states are often discovered very late. Accordingly, techniques described herein use Machine Learning to learn multicast state, topology, and forwarding statistics on routers.

The following examples are issues that can be detected using the techniques presented herein:

- incorrect state (incoming interface, outgoing interfaces, the multicast state itself, multicast entry and interface flags)
- tracking/learning the total number of multicast forwarding entries
- tracking/learning the type of entries (shared tree, source tree, BiDIR)
- tracking/learning the sources
- tracking/learning the used rendezvous points

- forwarding rate of traffic per multicast forwarding entry; this can be the rate of forwarding, stale forwarding statistics, change of type of forwarding counters (for example Reverse Path Forwarding (RPF) failures)

- tracking/learning the timers and their change (often too low or high)

- tracking/learning the complete tree of the multicast trees, if the Machine Learning gathers the information on all routers (directly or through a collector)

- any multicast state on routers, switches, servers, or other devices can be tracked by Machine Learning, including multicast state (control plane and hardware forwarding entries), multicast application state, and multicast client state

Figure 1 below illustrates an example output of the multicast state learning (entries, timers, flags, etc.). Anomalies are shown in blue.

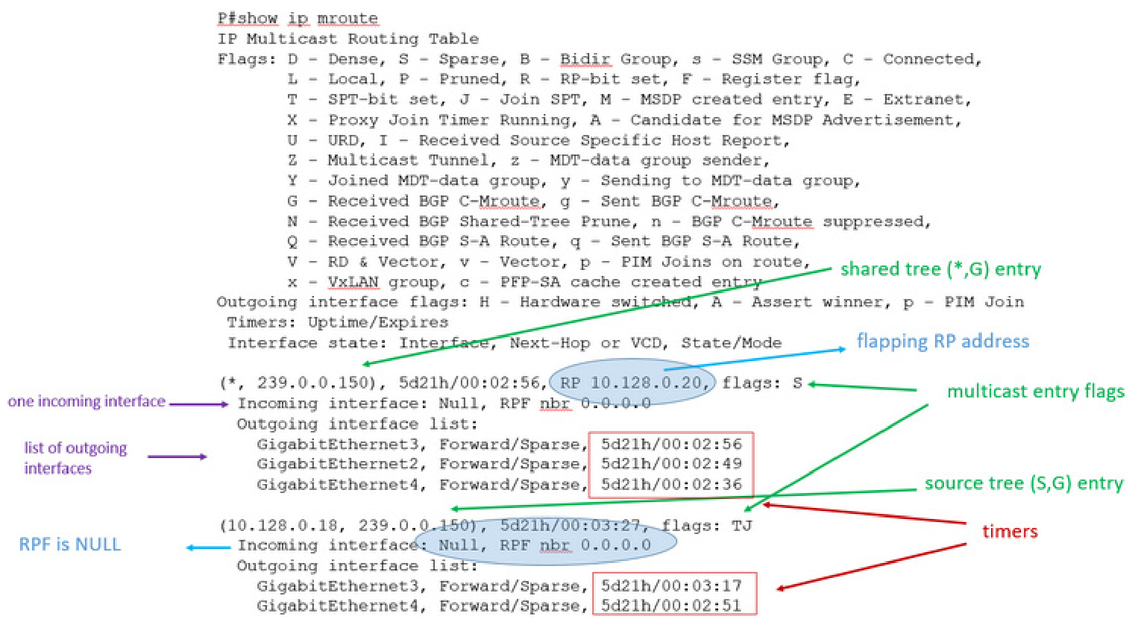
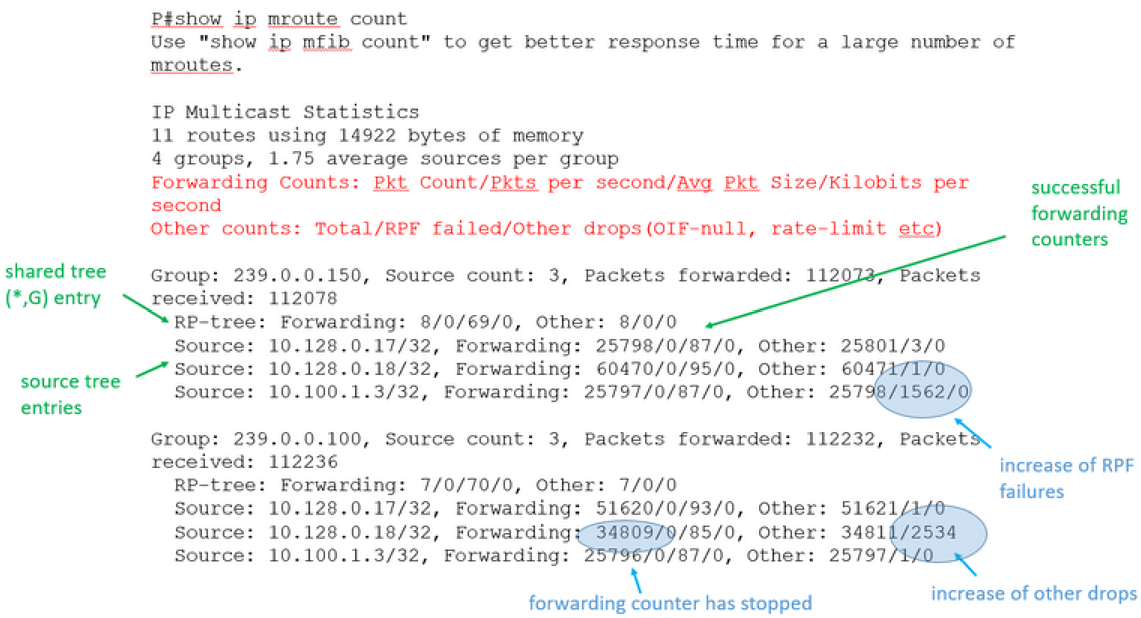


Figure 1

Figure 2 below illustrates an example output of multicast forwarding rates. Anomalies are shown in blue.



```
P#show ip mroute count
Use "show ip mfib count" to get better response time for a large number of
mroutes.

IP Multicast Statistics
11 routes using 14922 bytes of memory
4 groups, 1.75 average sources per group
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kilobits per
second
Other counts: Total/RPF failed/Other drops(OIF-null, rate-limit etc)

Group: 239.0.0.150, Source count: 3, Packets forwarded: 112073, Packets
received: 112078
  RP-tree: Forwarding: 8/0/69/0, Other: 8/0/0
  Source: 10.128.0.17/32, Forwarding: 25798/0/87/0, Other: 25801/3/0
  Source: 10.128.0.18/32, Forwarding: 60470/0/95/0, Other: 60471/1/0
  Source: 10.100.1.3/32, Forwarding: 25797/0/87/0, Other: 25798/1562/0

Group: 239.0.0.100, Source count: 3, Packets forwarded: 112232, Packets
received: 112236
  RP-tree: Forwarding: 7/0/70/0, Other: 7/0/0
  Source: 10.128.0.17/32, Forwarding: 51620/0/93/0, Other: 51621/1/0
  Source: 10.128.0.18/32, Forwarding: 34809/0/85/0, Other: 34811/2534
  Source: 10.100.1.3/32, Forwarding: 25796/0/87/0, Other: 25797/1/0
```


Figure 2

Figure 3 below illustrates usage of Machine Learning for multicast on routers.

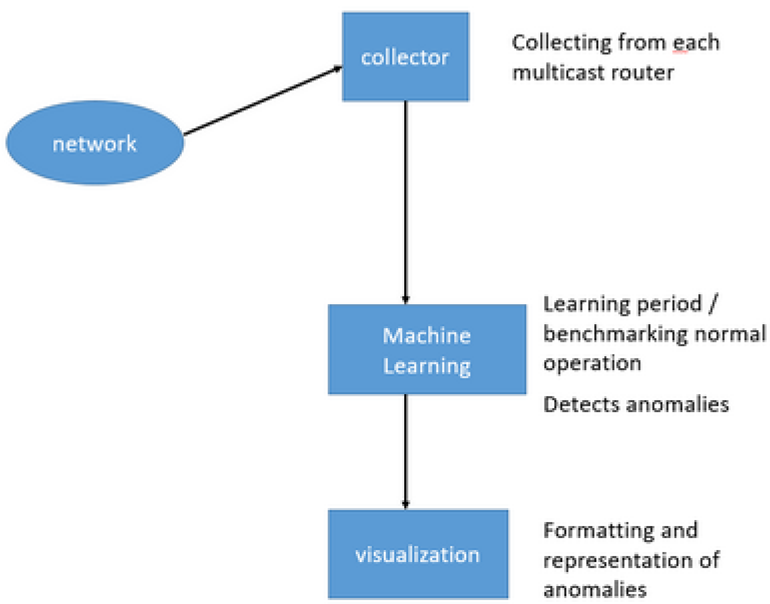


Figure 3

Techniques described herein provide real time feedback on multicast state and forwarding traffic rates. Issues may be detected that today are only possible to detect through superficial testing or complex and lengthy troubleshooting techniques. Faster warnings may be provided for issues that are compared to the learned benchmark information in the network. No complex input to tracking devices is required because

Machine Learning is used. Moreover, no rules need to be written to define the normal operation or need to be maintained for specific devices / networks for all the multicast traffic state and forwarding rates on all the routers (no scripting or programming is required). Machine Learning learns the multicast flows and their rates and benchmarks it.

In summary, techniques are described herein for using Machine Learning to detect anomalies that cannot be detected by programming or scripts. These anomalies must be discovered by prior issues that have been troubleshooted by classic network tools (e.g., debugs, show commands, packet capturing tools, etc.).