Adaptive Routing Notification for Load-balancing

draft-liu-rtgwg-adaptive-routing-notification

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Background

- **Adaptive Routing (AR) /Dynamic load balancing (DLB):** Dynamic routing decisions based on changes in network load status.

- **Local Adaptive Routing**
  - local congestion ---> decide the traffic to be rerouted ---> change the traffic path locally

- **Remote Adaptive Routing**
  - local congestion ---> decide the traffic to be rerouted ---> no other local path available
  - ---> AR notification (ARN) to upstream node(s)
  - ---> upstream node changes the traffic path

This document provides analyses on different ARN mechanisms, including the information carried in ARN and how they are delivered into the network.
Considerations for ARN

KEY points for changing traffic path remotely

- **Local node generating ARN**
  - Which node(s) should the ARN be sent to?
    - ===> the destination address of the ARN message

- **Remote AR node**
  - Which traffic’s forwarding table needs to be adjusted?
    - ===> traffic identifier (e.g., flow ID, 5-tuples) in ARN, uniquely identifies traffic forwarded along the same path
  - Which port in the forwarding table needs to be blocked?
    - ===> auxiliary info with ARN that helps locate the original outport on the AR node, directly carried or indirectly indicated
ARN Option 1

- ARN sent to the upstream along the (reverse) traffic forwarding path
- Upstream AR node treats the ARN receiving port as the original outport

**S6 traffic forwarding**
- receive traffic 1
- record the traffic identifier and the receiving port (port6-2) of traffic 1

**S6 congestion processing**
- congestion occurs
- traffic 1 needs to be rerouted
- look at the local record for the receiving port (port6-2) of traffic 1
  - ARN sent to S2 via port6-2

**S2 ARN processing**
- ARN received from port2-6
- if other path available, block port2-6 in the forwarding table of traffic 1
- if no other none-congested path, further send ARN via its own receiving port of traffic 1 (port2-4)

**Pros**
- No too much change for the routing and forwarding procedure

**Cons**
- Records maintained on the local device for every flow requiring AR (stateful)
ARN Option 2

- ARN sent directly to the nearest upstream node that is able to perform AR for this traffic
- Original outport on the upstream node of the traffic carried inside ARN

### S7 traffic forwarding
- more than one path(outport) available for traffic1
- choose one outport for traffic forwarding (port7-4)
- embed S7 ID and port7-4 ID in the packet

### S4 congestion processing
- more than one path(outport) available for traffic1
- choose one outport for traffic forwarding (port4-2)
- replace SW ID and port ID with S4 ID and port4-2 ID

### S2 traffic forwarding
- only one outport meets forwarding requirements
- forwarding traffic 1 directly

### S6 congestion processing
- congestion occurs
- send ARN directly to S4 with S4 ID and port4-2 ID included

### S4 ARN processing
- block port4-2 in the forwarding table for traffic 1

**Pros**
- no traffic receiving records locally

**Cons**
- need to modify packets of the traffic
ARN Tag

- ARN mechanisms require the devices to consume additional resources.
  - option 1 The nodes record the traffic identifier and receiving port of the traffic.
  - option 2 The nodes check whether there's more than one path for the packet and put the device identifier and outport identifier into the packet.

- ARN is not necessary for all traffic
  - Rerouting small flows has not much effect on alleviating congestion.
  - The path for some detection/telemetry messages may need to be maintained.

- ARN Tag
  - Only tagged packets are processed additionally after traffics are received.
  - ARNs are generated only for traffics to which tagged packets belong after congestion.
Summary

- The definition of AR varies in different contexts.
- In this draft, AR is regarded as a fast partial path adjustment mechanism, in response to instantaneous traffic imbalances caused by network events.
- Each ARN option has its own pros and cons, the common point is that it requires additional consumption of device resources.
- ARN Tag helps to reduce the processing burden on the device.
Next Steps

- Continue to work on analysis on ARN options, e.g, sending ARN by multicast.
- Welcome feedback and comments!
Thank You!
Backup Slides

original traffic forwarding path

ARN sending direction

congestion