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Operations, Administration and Maintenance (OAM) features for RAW
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Abstract

The wireless medium presents significant specific challenges to achieve properties similar to those of wired deterministic networks. At the same time, a number of use cases cannot be solved with wires and justify the extra effort of going wireless. This document presents some of these use-cases.

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1. Introduction

RAW (Reliable and Available Wireless) is an effort to provide deterministic behavior over a network that includes a wireless physical layer. Enabling the wireless communication reliable and available is even more challenging than it is with wires, due to the numerous causes of loss in transmission that add up to the congestion losses and the delays caused by overbooked shared resources. To provide quality of service along a multihop path that is composed of wired and wireless hops, additional methods needs to be considered to leverage the potential lossy wireless communication.

Traceability belongs to Operations, Administration, and Maintenance (OAM) which is the toolset for fault detection and isolation, and for performance measurement. More can be found on OAM Tools in .

The main purpose of this document is to details the requirements of the OAM features recommended to construct a predictable communication infrastructure on top of a collection of wireless networks. In particular, we expect to provide packet loss evaluation, self-testing and automated adaptation to enable trade-offs between resilience and energy consumption.

This document describes the benefits, problems, and trade-offs for using OAM in wireless networks to provide availability and predictability.

In this document, the term OAM will be used according to its definition specified in [RFC6291]. We expect to implement an OAM framework in RAW networks to maintain a real-time view of the network infrastructure, and its ability to respect the Service Level Agreements (delay, reliability) assigned to each data flow.

1.1. Terminology

- OAM entity: a data flow to be controled;

- OAM end-devices: the source or destination of a data flow;

- defect: a temporary change in the network characteristics (e.g. link quality degradation because of temporary external interference, a mobile obstacle)

- fault: a definite change which may affect the network performance, e.g. a node runs out of energy,

2. OAM to provision appropriately the resources

RAW networks expect to make the communications predictable on top of a wireless network infrastructure. Most critical applications will define a Service Level Agreeemnt to respect for the data flows it generates. Thus, the wireless networks have to be dimensionned to respect these SLAs.

To respect strict guarantees, RAW relies on a PCE which has to schedule the transmissions in the different wireless networks. Thus, resources have to be provisionned to handle any defect. OAM represents the core of the overprovisonning process, and maintains the network operational by updating the schedule dynmically.

Fault-tolerance also assumes that multiple path have to be provisionned so that an end-to-end circuit keeps on existing whatever the conditions. OAM is in charge of controling the recplication/ process

To be energy-efficient, reserving some dedicated out-of-band resources for OAM seems ireealistic, and only in-band solutions are considered here.

3. Operation

4. Administration

To take proper decisions, the network has to expose a collection of metrics

- Packet losses: the time-window average and maximum values of the number of packet losses has to be measured. Many critical applications stop to work if a few consecutive packets are dropped;

- Received Signal Strength Indicator (RSSI) is a very common metric in wireless to denote the link quality. The radio chipset is in charge of translating a received signal strngth into a normalized quality indicator;

- Delay: the time elapsed between a packet generation / enqueuing and its reception by the destination;

These metrics should be collected:

- per virtual circuit to measure the end-to-end performance for a given flow. Each of the paths has to be isolated in multipath strategies;

- per radio channel to measure e.g. the level of external interfence, and to be able to apply counter-measures (e.g. blacklisting)

- per device to detect misbehaving node, when it relays the packets of several flows.

4.1. Energy efficiency requirements

RAW targets also low-power wireless networks, where energy represents a key constraint. Thus, we have to cake care of the energy and bandwidth consumption. The following techniques aim to reduce the cost of such maintenance:

piggybacking: some control information has inserted in the data packets if they don't fragment the packet (i.e. the MTU is not exceeded). Information Elements represent a standardized way to handle such information;

flags/fields: we have to set-up flags in the packets to monitor to be able to monitor them accurately. A sequence number field may help to detect packet losses. Similarly, path inference tools such as [ipath] insert additionnal information in the headers to identify the path followed by a packet a posteriori.

5. Maintenance

6. Informative References

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[RFC6291] Andersson, L., van Helvoort, H., Bonica, R., Romascanu, D., and S. Mansfield, "Guidelines for the Use of the "OAM" Acronym in the IETF", BCP 161, RFC 6291, DOI 10.17487/RFC6291, June 2011, <https://www.rfc-editor.org/info/rfc6291>.

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