

TVR
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**Using ALTO for exposing Time-Variant Routing information
draft-contreras-tvr-alto-exposure-00**

Abstract

Network operations can require time-based, scheduled changes in nodes, links, adjacencies, etc. All those changes can alter the connectivity in the network in a predictable manner, which is known as Time-Variant Routing (TVR). Existing IETF solutions like ALTO can assist on the exposure of such predicted changes to both internal and external applications then anticipating the occurrence of routing changes. This document describes how ALTO helps in that purpose.

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[1.](#) Introduction

There can be operational situations where changes in the network, such as modifications in either nodes, links or adjacencies, can introduce variations on the routing of that network. Use cases representative of such operational situations are documented in [[I-D.birrane-tvr-use-cases](#)]. Those predictable changes can be scheduled from a higher-level system (e.g., OSS) or from a Network Controller.

Since the expected changes can be predicted beforehand, then it is possible to anticipate the impacts of that changes in the routing of the network, for instance by means of algorithms embedded in the Network Controller allowing to recalculate the resulting routing metrics, or through experimental observations e.g. in network digital twins [[I-D.irtf-nmrg-network-digital-twin-arch](#)].

Being feasible then to automatize the changes and to pre-calculate the impacts that those changes can introduce into the routing of the network, it is possible to expose such changes in advance in a way that applications (both internal and external) can become aware of those routing variations along time.

Current IETF solutions like ALTO [RFC7285] have been conceived for exposing topological information with associated metrics. In consequence, ALTO can be perceived as a suitable piece for allowing to expose the impacts due to changes in the routing of a network. Figure 1 sketches a potential architecture facilitating the exposure of changes introduced by TVR operation. There can be multiple variants of such architecture.

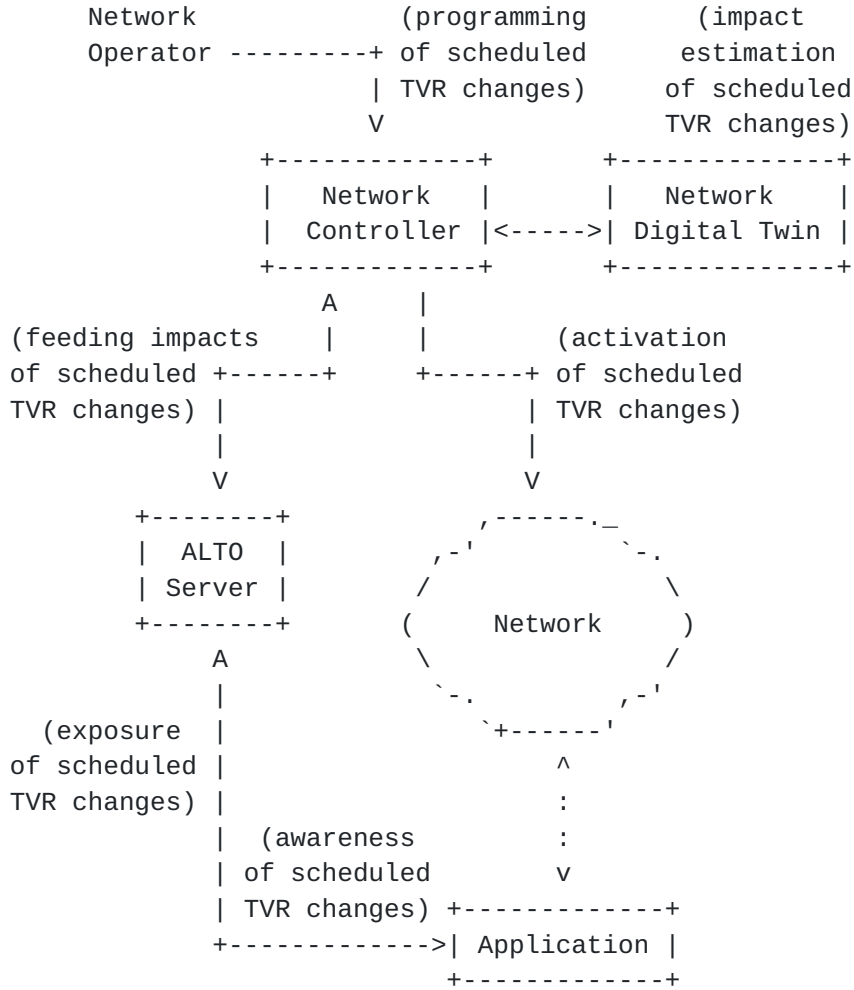


Figure 1. Potential architecture using ALTO for TVR

2. Capabilities of ALTO for exposing information

2.1. ALTO exposed information

ALTO [[RFC7285](#)] provides topological-related information in the form of both network and cost maps. The network map basically summarizes the IP address ranges aggregated in each Provider-defined Identifier (PID). Such IP addresses define either customers or service functions attached to each network node. The cost map details the topological relationship among PIDs in terms of a certain metric. The basic metric provided is the routing cost among PIDs, but other metrics can be also provided such as performance-related metrics [[I-D.ietf-alto-performance-metrics](#)].

Because of the possibility of incorporating additional metrics and a variety of topological information, ALTO can be considered as a generic IETF network exposure function [[I-D.contreras-alto-ietf-nef](#)].

2.2. Mechanism for anticipating routing changes in ALTO

For the purpose of exposing future changes on the reachability between PIDs in the network, ALTO defines in [[RFC8896](#)] a calendared cost map (named ALTO cost calendar) which allows to signal future changes on the cost metric. Thus, for a metric related to routing, the cost calendar can expose scheduled modifications in the connectivity between PIDs in a natural manner.

The ALTO cost calendar presents the information (i.e., metrics between PIDs) in the form of JSON arrays, where each listed value corresponds to a certain time interval. The ALTO cost calendar also includes attributes to describe the time scope of the calendar. The calendar provided by ALTO has the following attributes defined in [[RFC8896](#)]:

- * "Calendar-start-time", which indicates the date at which the first value of the calendar applies.
- * "Time-interval-size", that defines the duration of an ALTO Calendar time interval in a unit of seconds.
- * "Number-of-intervals", that indicates the number of values of the cost calendar array.
- * "Repeated", which is an optional attribute that indicates how many iterations of the calendar value array have the same values.

3. Interaction with routing protocols augmented to support TVR advertisements

The architecture in Figure 1 assumes the intervention of a Network Controller in order to schedule and activate the changes in the network in a predictable manner. However, it could be the case that existing routing protocols become augmented in order to natively support the advertisement of network changes along the time, as suggested in [[I-D.taylor-tvr-prb-stmt](#)]. If that is the case, ALTO can participate of the network routing information by listening to IGP's and/or peering with BGP speakers, as described in [[RFC7971](#)].

4. Discussion

Several topics require further discussion with regards the usage of ALTO for TVR.

- * ALTO enables a way of exposing Time-Variant Routing information to applications. It is necessary to assess if the exposed information reflects the set of actions that can be scheduled in TVR according to [[I-D.taylor-tvr-prb-stmt](#)].
- * ALTO cost calendar defines a number of time-related attributes. It is necessary to analyze if such attributes are sufficient for expressing the time variance nature of the routing changes in TVR.
- * The expectation in [[I-D.taylor-tvr-prb-stmt](#)] is to extend existing routing protocols to convey TVR information. It is necessary to define how ALTO can participate of the routing information processing and analyzing the new TVR-related information included in the routing protocols.
- * The data model (or models) that could be defined in TVR could be leveraged by ALTO, so that can be aligned in terms of the time-variant routing information to be exposed to applications. It is needed an analysis of potential improvements to calendared routing-related information in ALTO cost calendar.

These topics can motivate further work in TVR and/or ALTO WGs.

5. Security and operational considerations

Same security and operational considerations as described in [[RFC8896](#)] apply also in this document.

6. Informative References

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