In-Band Telemetry Optimization Problem Formulation

Fernando Spaniol
Luciana Salete Buriol
Jonatas Marques
Luciano Gaspary Paschoal

May 2018

1 Overall

$$\mathbf{min} \sum_{k \in K} \sum_{u \in V} Y_{ku}$$

$$\mathbf{s.t} \sum_{k \in K} X_{ak} = 1 \qquad \forall a \in A$$

$$X_{af} \leq F_{af} \qquad \forall a \in f, \forall finF$$

$$X_{ak} \geq Y_{ku} \qquad \forall k \in K, \forall a = (u, v) \in A$$

$$Y_{ku} - X_{ak} \geq -C_{vk} \qquad \forall k \in K, \forall a = (u, v) \in A$$

$$(-Y_{ku} + X_{ak}) * Q \geq C_{kv} \qquad \forall k \in K, \forall a = (u, v) \in A$$

$$C_{ku} \in \mathcal{Z}^{+}$$

$$X_{ak} \in \{0, 1\}$$

$$Y_{ku} \in \{0, 1\}$$

2 Constant and Variable Definition

2.1 Constants

D = Amount of items available in each router of the network.
F = Set of flows present in a network.
K = Possible routes for a given truck.
A = Set of links (or archs) in a given network.
V = Sets of routers in a network.
Q = Variable that defines the max amount any given flow can carry.

2.2 Variables

C_{ku} = Variable that represents the charge of flow k after passing node u.
X_{ak} = Variable that controls whether a link a is in route k.
Y_{ku} = Variable that defines whether route k dispatches on node u.

3 Objective

We want to minimize the subgroups where the item fetching is done in a network environment. To do so, we want to minimize the values in Y.

$$\textbf{min} \sum_{k \in K} \sum_{u \in V} Y_{ku}$$

4 Restrictions

Make sure that all nodes are covered.

$$\sum_{k \in K} X_{ak} = 1 \qquad \forall a \in A$$

Make sure that a route only covers an arch if the flow with the same index passes by it.

$$X_{af} \leq F_{af} \qquad \forall a \in f, \forall f in F$$

Make sure that a group only dispatches if it collects in that arch.

$$X_{ak} \geq Y_{ku} \qquad \forall k \in K, \forall a = (u, v) \in A$$

The next two restrictions make sure of the following:

- If X_{ak} equals 1 and C_{kv} equals 0, it means that the content was dispatched, therefore Y_{ku} equals 1.

- If X_{ak} equals 1 and C_{kv} is more than 0, it means that the content was not dispatched, therefore Y_{ku} equals 0.

- If X_{ak} equals 0, then C_{ku} has to be 0 and Y_{ku} also has to be 0.

$$Y_{ku} - X_{ak} \geq -C_{vk} \qquad \forall k \in K, \forall a = (u, v) \in A$$

$$(-Y_{ku} + X_{ak}) * Q \geq C_{kv} \qquad \forall k \in K, \forall a = (u, v) \in A$$