

# Selection of Paths in HDR

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## Abstract

In this report we consider the problem of Path Selection in HDR, a Hysteresis Driven Routing Protocol for EnHANTS - networks with Energy Harvesting units. HDR requires selection of two non-necessarily disjoint paths for each source. The paths are alternately used by the source to transmit data. Path selection in HDR leads to the problem of 2-splittable flow in graphs, that has been previously treated in the literature. In this report we model our problem as a 2-splittable flow problem, show that in general it is NP-Hard and provide algorithms for Fair Path Selection under the assumption of a uniform network.

## 1 Introduction and Model

Consider a wireless network, where one or more *sources* transmit data to a single collection point, referred to as the *sink*. The network consists of energy harvesting nodes, referred to as *relaying nodes*. Since we are interested in transmission limited by the harvested energy, the wireless links are assumed to have unlimited data transmission capacities.

The Harvesting Rates of the relaying nodes are possibly time varying and unknown. They limit the packet transmission rate from the sources to the sink. As we are interested in selecting routes that allow maximum transmission over the network, the sources and the sink should not limit data transmission. Thus, we assume energy-unlimited sources and sink. In addition, the sink is assumed to be land based and to possess a powerful transmitter, used in order to transmit control messages that are heard directly by all sources and by all relaying nodes. Moreover, the sink is assumed to have a processor that is able to run the routing algorithm and to send commands for its implementation. The considered network is referred to in [MGS<sup>+</sup>15] as EnHANTs (Energy Harvesting Networked Tags).

Given the limited amount of energy at the relaying nodes, classical routing algorithms, like AODV [PR99] and DSR [JMB01] and their later versions, are not applicable. Much simpler algorithms need to be developed. In HDR [Seg15], [ELSY17], [LS] it has been proposed to employ for each source two fixed *Routing Paths* to the sink and to split traffic between the two. HDR employs alternately the two paths, that are preferably, but not necessarily, disjoint. Nodes that

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