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Know when to listen: SDN-based protocols for directed IoT networks

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Know when to listen: SDN-based protocols for directed IoT networks^{☆,☆☆}Renan Cerqueira Afonso Alves^{a,1,*}, Cintia Borges Margi^a, Fernando A. Kuipers^b^a *Universidade de São Paulo – São Paulo, Brazil*
^b *Delft University of Technology – Delft, The Netherlands***Abstract**

Low-power wireless networks are an integral part of the Internet of Things, composed of resource-constrained devices harvesting ambient information. The appearance of unidirectional links is characteristic of low power wireless networking due to physical effects, device heterogeneity and manufacturing imperfections. Despite the prevalence of unidirectional links, most routing and radio duty cycling protocols designed for these networks do not account for such links. We provide unidirectional-link-capable protocols and study the impact of using such links on network performance indicators, such as the data delivery ratio, delay and energy consumption. Our protocols are flexible and flooding-free, leveraging centralized knowledge provided by the Software-Defined Networking paradigm. Our experiments reveal that, while unidirectional links must be detected, using them for routing enhances network performance only if the unidirectional links are long.

Keywords: Radio Duty Cycling, Software-Defined Networking, Unidirectional Links, Wireless Sensor Networks

1. Introduction

The Internet of Things (IoT) is a term used to describe the trend of inter-connecting everyday objects and sensors via the internet [3]. It spans sub-

topics such as agriculture automation, smart cities, and eHealth.

Low-power wireless networks are expected to play a key role in realizing the IoT, since devices operating on batteries or harvesting energy require efficient wireless communication to save on scarce energy resources.

Homogeneous low-power wireless networks are prone to the existence of unidirectional links, which occur spontaneously due to non-isotropic antennas, multipath fading, and variations during the radio/antenna manufacturing process [30]. The occurrence of unidirectional links is even higher in heterogeneous networks, due to inherent differ-

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