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# JAVeLEN – An ultra-low energy ad hoc wireless network <sup>☆</sup>

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## Abstract

Wireless networks are often very lightly used. Some wireless networks, most notably sensor networks, are also energy-constrained – that is, the period of time during which the network is operational depends on battery lifetime. We have designed and simulated a novel design for a mobile ad hoc network with a low offered load (of approximately 1% average loading) that uses dramatically less (often 300 times or 99.7% less) power than industry standard protocols and yet achieves higher delivery reliability, handles substantially greater node densities, supports mobility, and has the ability to perform well even under high offered loads. Several innovations were required to achieve this efficiency, most notably the design of a dual-radio transceiver and careful redesign of the protocol stack (physical, media access, routing and transport protocols) to make effective use of the power of the radio transceivers.

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## 1. Introduction

Ad hoc networking protocols utilize radio frequency (RF) devices to find neighboring nodes, determine paths, and ultimately forward packets over multiple RF hops from a source to a destination – all without the use of a fixed infrastructure. Ad hoc protocols are therefore of most value in places where wireless communications is required,

because infrastructure is not available, cannot be trusted, or is too expensive for the particular applications. These particular situations also often imply scenarios where nodes will be required to operate on limited energy sources for extended periods of time. Sensor systems are the obvious applications where energy must clearly be minimized. Other systems include networks for robot teams, emergency personnel, or soldiers' radios, where minimizing energy is important because the nodes may be separated from power sources for long periods of time.

This paper describes a system called JAVeLEN – *Joint Architecture Vision for Low Energy Networking*. JAVeLEN is an ad hoc network that is extremely energy efficient, particularly when stationary or under low offered loads, and yet also supports

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