X-MAC

A Short Preamble MAC Protocol for Duty-Cycled Wireless Sensor Networks

ABSTRACT

X-MAC, a low power MAC protocol for wireless sensor networks (WSNs), is developed for duty-cycled WSNs such as B-MAC. This protocol reduces the energy consumption by employing a shortened preamble which solves the problems of low power listening and retains its advantages. In the following, we will introduce how X-MAC approaches low-power communication, simplicity, a decoupling of transmitter if receive sleep schedules, low per-hop latency, flexible adaption to bursty and periodic sensor data sources.

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How can we get **better performance** and **energy saving** for wireless communication ?

Performance Comparison

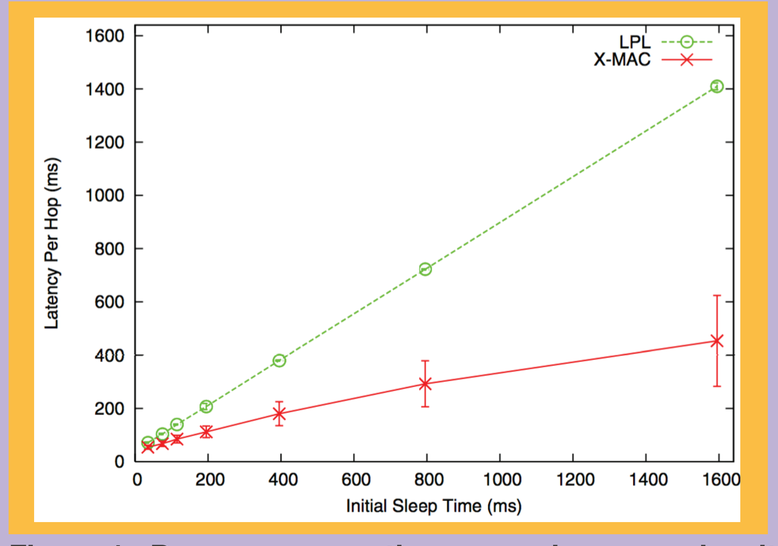


Figure 1 : Power consumption per node versus density

Topology and protocol : One receiving node, one to nine transmitting nodes. Each node sends a packet once every 9 seconds to the receiving node and all nodes have a sleep period and preamble length of 500ms. An oscilloscope has been attached to one of the transmitting nodes to measure mean current draw in mA.
Results : Energy consumption of the LPL protocol increases with network density, whereas for X-MAC it remains relatively constant.

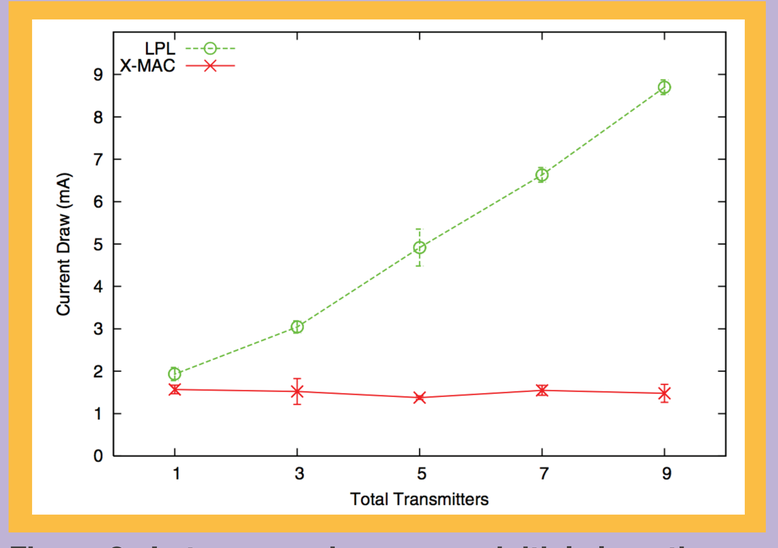
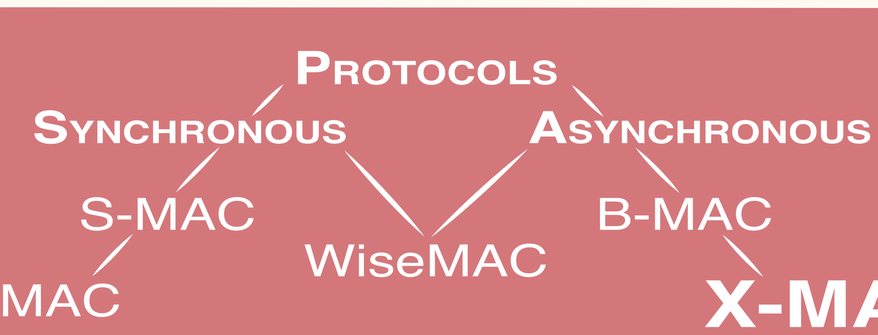


Figure 2 : Latency per hop versus initial sleep time

Topology and protocol : Chain of eight nodes. Packets are generated at one end such as there is only one packet at the same time on the chain. Traversal time is measured using the system clock of the computer connected to all the nodes.
Results : As determined analitically, the latency is about 50% that of LPL. This is because the receiver, on average, wakes up half-way through the preamble.

Related Works



S-MAC	Adaptive listening and reduce latency	Wastes energy by staying awake at the end of data transmission
T-MAC	Improves S-MAC by using one fifth of the energy used by S-MAC	Reduces throughput and increas latency
B-MAC	Surpasses existing protocols in terms of throughput, latency, and energy consumption	Suffers from the overhearing problem and long preamble dominates the energy usage
WiseMAC	Solves many problemes associated with low power communication	No adaptation with traffic patterns

How it works ?

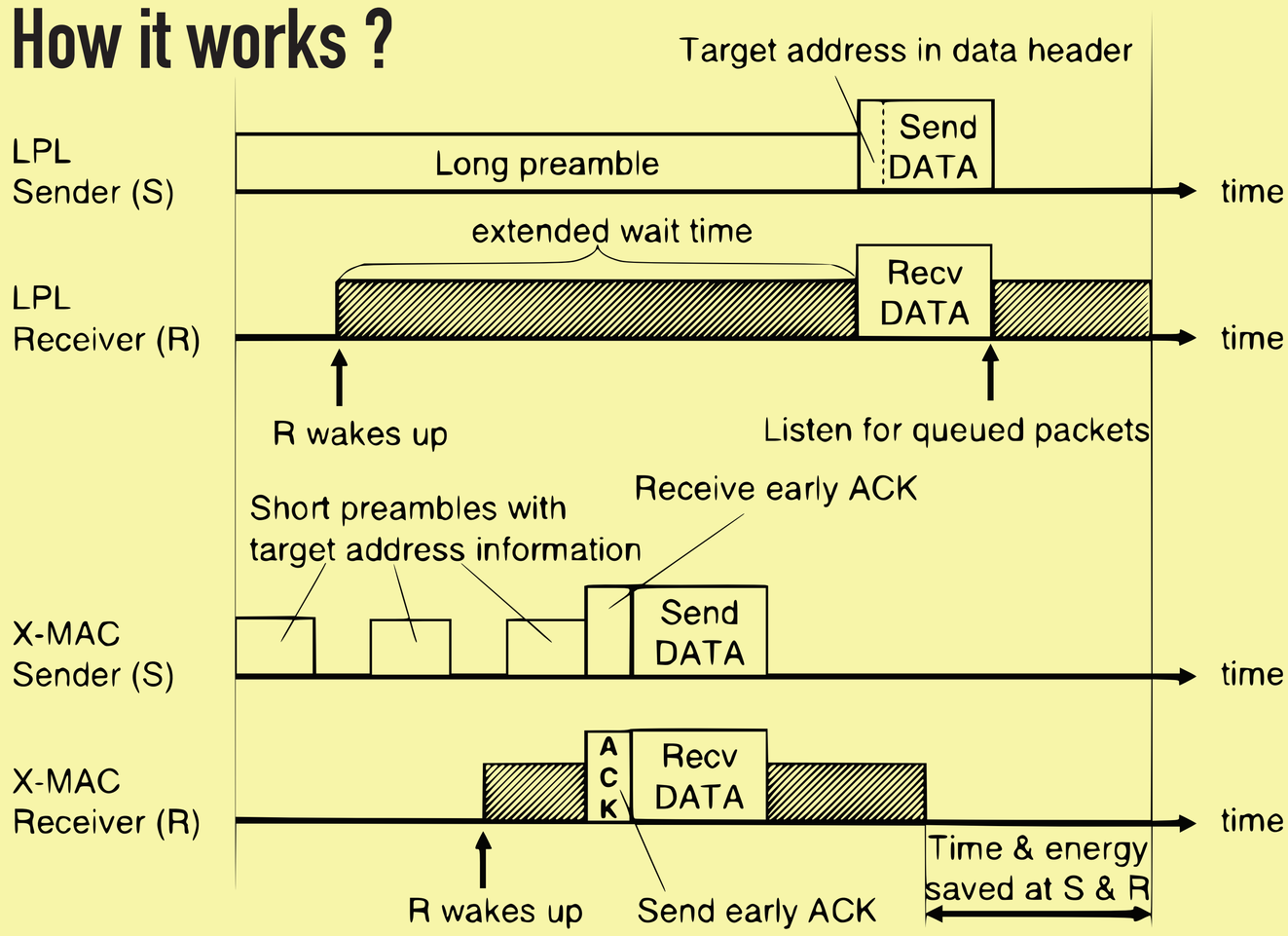


Figure 3 : Comparison of the timelines between LPL's extended preamble and X-MAC's short preamble approach.

Unequalled Performance !

Thanks to its system of strobed preamble packets and the small pauses between those packets, X-MAC succeed in sparing a lot of energy during the connection for both the transmitter and the receiver. Moreover, this MAC protocol allows less latency, since every receiver can go back to sleep if the short strobed preamble doesn't match instead of waiting the whole preamble.

X-MAC is also adaptable to actual sensor motion which are more and more popular and contains a lightweight algorithm to have optimal sleep and listen periods.

This low power MAC protocol appears as the best candidate for the wireless sensor network as a good solution for nowadays search for performance and efficiency.

Further Information

www.insa-lyon.fr/xmac