Great Ideas In Traditional Communication

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IP is Dead, Long Live IP for Wireless Sensor Networks

Jonathan W. Hui, David E. Culler

SenSys'08

Motivation

Issue - WSNs architecture relied on application-specific networking protocols, making it hard to compose.

Factors auguring well -

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Factors auguring well -

- WSN network architectures substantially matured
- Standard links emerged
- IP evolved

Why wasn't IP standard (IPv4) suitable? / WSN requirements

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- Layered architecture - resource constraints
- Small address space - may not be able to support consistently growing no. of devices/ Limits addition of devices with unique identity (Do sensor nodes need unique identity?)
- Auto address configuration mechanism - not reliable for unattended devices

Hypothesis

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An IPv6 based network architecture can be adapted for standardizing WSN communication

What made IPv6 based architecture adaptable for WSN?

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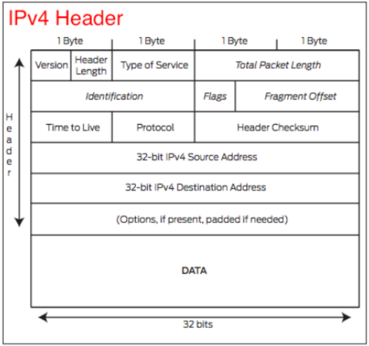
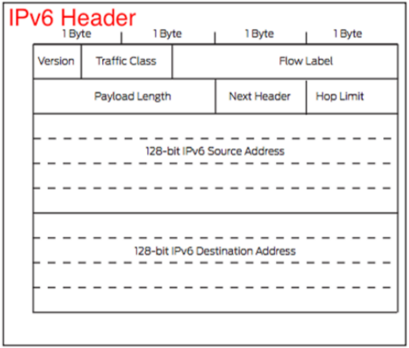
- Large address space - supports more devices
- Adaptation layer in 6LoWPAN - short(compact) addresses
- Subnet generalization - helpful for routing within WSN
- Routing framework - aligns resource constraints and workloads





Evaluation - Results

Deployment	Year	RP (m)	DC	Latency (s)	DRR
GDI [43]	2003	20	2.2%	0.54-1.085	28%
Redwoods [48]	2004	5	1.3%	300	49%
FireWxNet [23]	2005	15	6.7%	900	40%
WiSe [44]	2006	30	1.6%	60	33%
Dozer [7]	2007	2	1.67%	15	98.8%
SensorScope [4]	2008	2	1.11%	120	95%
IPv6	2008	1	0.65%	0.125	99.98%

Table 2: Performance of prior WSN deployments. *Report period (RP) is the time delay between data transmissions. Duty cycle (DC) is the fraction of time the radio spent in the active state. Worst-case per-hop latency is determined by the radio's wake period. The data reception rate (DRR) is the fraction of data received at the collection point.*

Discussion ☺

Discussion ☺

’One Thing’ - IPv6 based network architecture for WSN

Efficient Network Flooding and Time Synchronization with Glossy

Fedrico Ferrari, Marco Zimmerling, Lothar Thiele, Olga Saukh

IPSN'11

Motivation

Issue - Reliability and latency in WSN communication at a lower energy cost

Hypothesis

Constructive interference through simultaneous transmissions of the same packet can improve the flooding efficiency and it also enables network-wide time synchronization

Deployment

- Identified the constraints for constructive interfering of packets through MATLAB simulations
- Run a theoretical analysis
- Validated in controlled setup, testbeds

Evaluation - Results

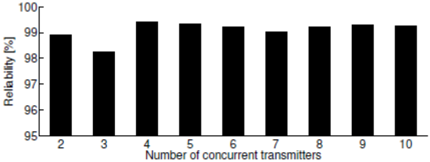


Figure 12: Reliability depending on number of concurrent transmitters, including capture effects, for $N = 1$. *Reliability is fairly constant and always above 98 %, thus showing no significant dependency on the number of concurrent transmitters.*

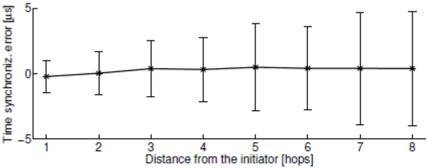
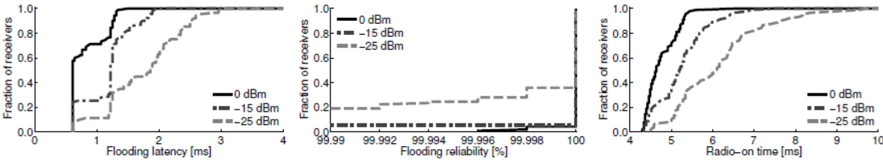


Figure 13: Accuracy of time synchronization in Glossy. *The absolute error on the reference time computed by a receiver is below 0.4 µs, even at receivers that are 8 hops apart from the initiator.*

Evaluation - Results



(a) Flooding latency. (b) Flooding reliability. (c) Radio on-time.

Figure 14: cdf of Glossy performance on Twist with three different transmit powers, for $N = 3$.

Motivation

Issue - Reliability and latency in WSN communication at a lower energy cost

Works that inspired their line of thought -

8. RELATED WORK

Using Glossy, nodes transmit the same packet concurrently. This idea stems from work on cooperative communication schemes [28]. However, requirements such as precise time synchronization among multiple transmitters have long been considered too demanding for an implementation on real sensor nodes [30].

Flury and Wattenhofer demonstrate the feasibility of signaling a binary value to all nodes with an unmodulated wave [13]. Constructive interference provides the opportunity to extend this to real data packets. Dutta *et al.* propose Backcast as an acknowledged anycast service [11]. Backcast exploits constructive interference of short acknowledgment packets automatically generated by the radio hardware. It does not require synchronization among the nodes, but the application has very limited control over the content of the

Discussion ☺

The One thing -

Discussion ☺

The One thing -

Efficient Network Flooding for WSN

WSN Efficient Network Flooding

Leverage constructive interference for efficient network flooding with implicit time synchronization