# Siphon:Overload Traffic Management using Multi-Radio Virtual Sinks in Sensor Networks

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# Outline

- Introduction
- Siphon design
- Simulation evaluation
- Conclusion and Discussion

# Introduction

- The existing experimental mote networks of any size can only operate under fairly light workloads
- These applications commonly experience periods of persistent congestion and high packet loss.
- The bottleneck is sink.

# Introduction

- Funneling effect:
  - Since events generated under varying workloads move quickly toward sink points. This leads to increased transit traffic intensity, congestion, and packet loss so that reducing application fidelity measured at sink.
  - As a result, the sensors nearest the sink will use energy at the fastest rate.

# Introduction

- Since most congestion control schemes [2][6][7]been proposed typically assume that all nodes are equal,they don't adequately address the funneling effect.
- The paper proposes a method that randomly or selectively distributes some multi-radio virtual sinks(VSs) to siphon off events.

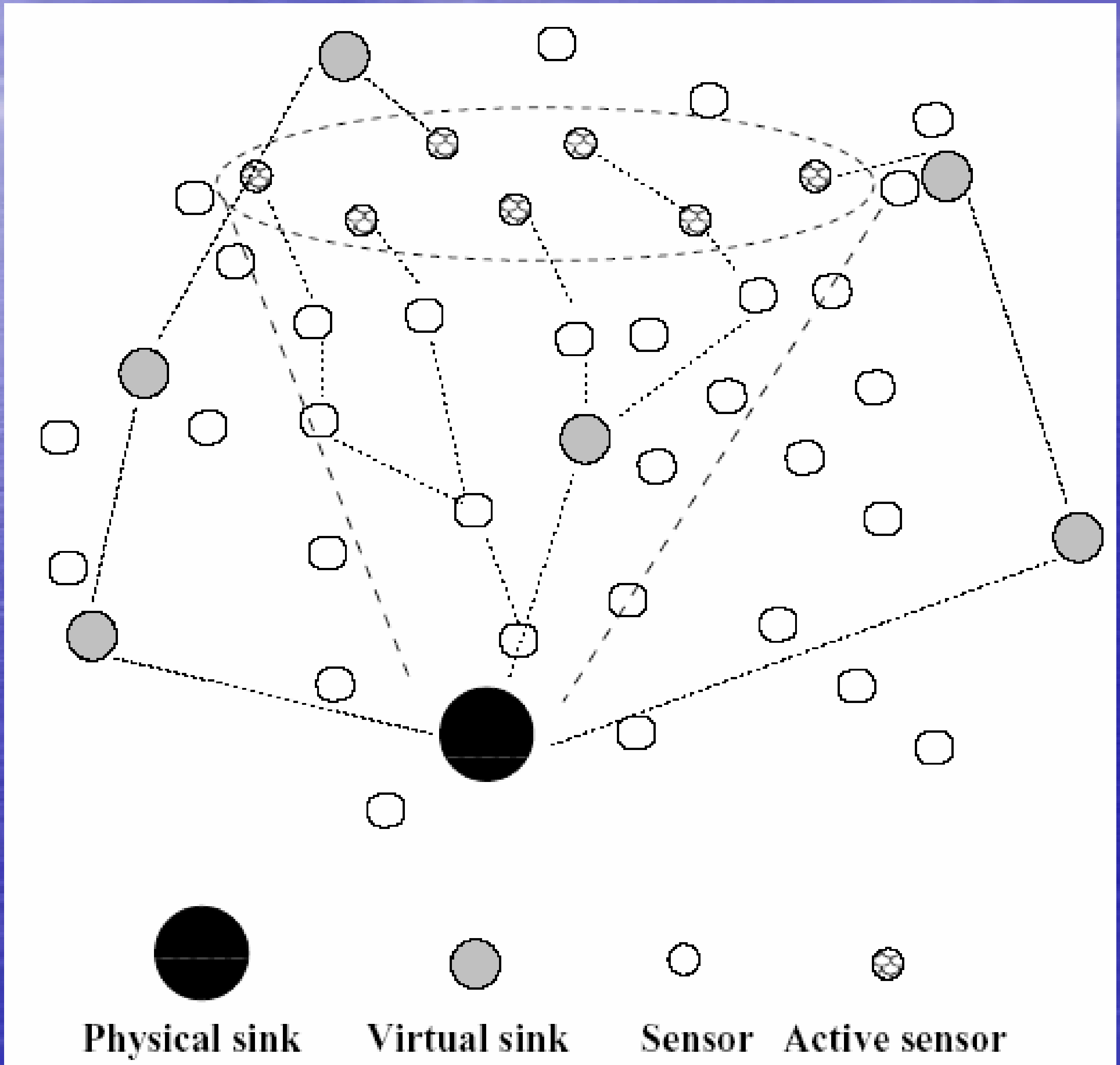
# Siphon

- Virtual Sinks are equipped with a secondary long-range radio inferface(e.g.IEEE802.11, or WiMAX in the future) that can dynamically form a secondary ad hoc network rooted at physical sink.
- They take selected traffic off the original WSN before the onset of congestion and move it the physical sink using the secondary radio network.

# Siphon design

- The detailed design of Siphon algorithm
  - Virtual sink discovery and visibility scope control
  - Congestion detection
  - Traffic redirection

# Siphon design-overview



# Virtual sink discovery and visibility scope control

- Since there is no guarantee that a VS is adjacent to a congested region,a method for  nodes to discovery a VS nearby is necessary.
- A signature byte is embedded in the periodic broadcasted control packets originated by physical sink. The byte contains a VS-TTL value.

# Virtual sink discovery and visibility scope control

- Detail steps:
  - Physical sink broadcasts the signature byte with VS-TTL = $\iota$ .
  - For VS nodes ,if a signature byte is received ,then identify the forwarder as next Siphon hop. And rebroadcast the byte after setting VS-TTL = $\iota$ by the two radio interfaces.
  - For common nodes, they record the VS ID and VS-TTL into a VS list and rebroadcast the packet after decrease VS-TTL.

# Congestion detection

- It indicates the proper time a sensor should attempt to utilize any VSs it has discovered.
- Two techniques:
  - **Node-initiated**: when local channel load approaches or exceeds a theoretical upper bound or the buffer grows beyond a high mark. The packets generated by the nodes will set the redirection bit.
  - **Post-facto**: When physical sink measured application fidelity degrades below a certain threshold , physical sink propagate the signal by its secondary radio interface.

# Traffic redirection

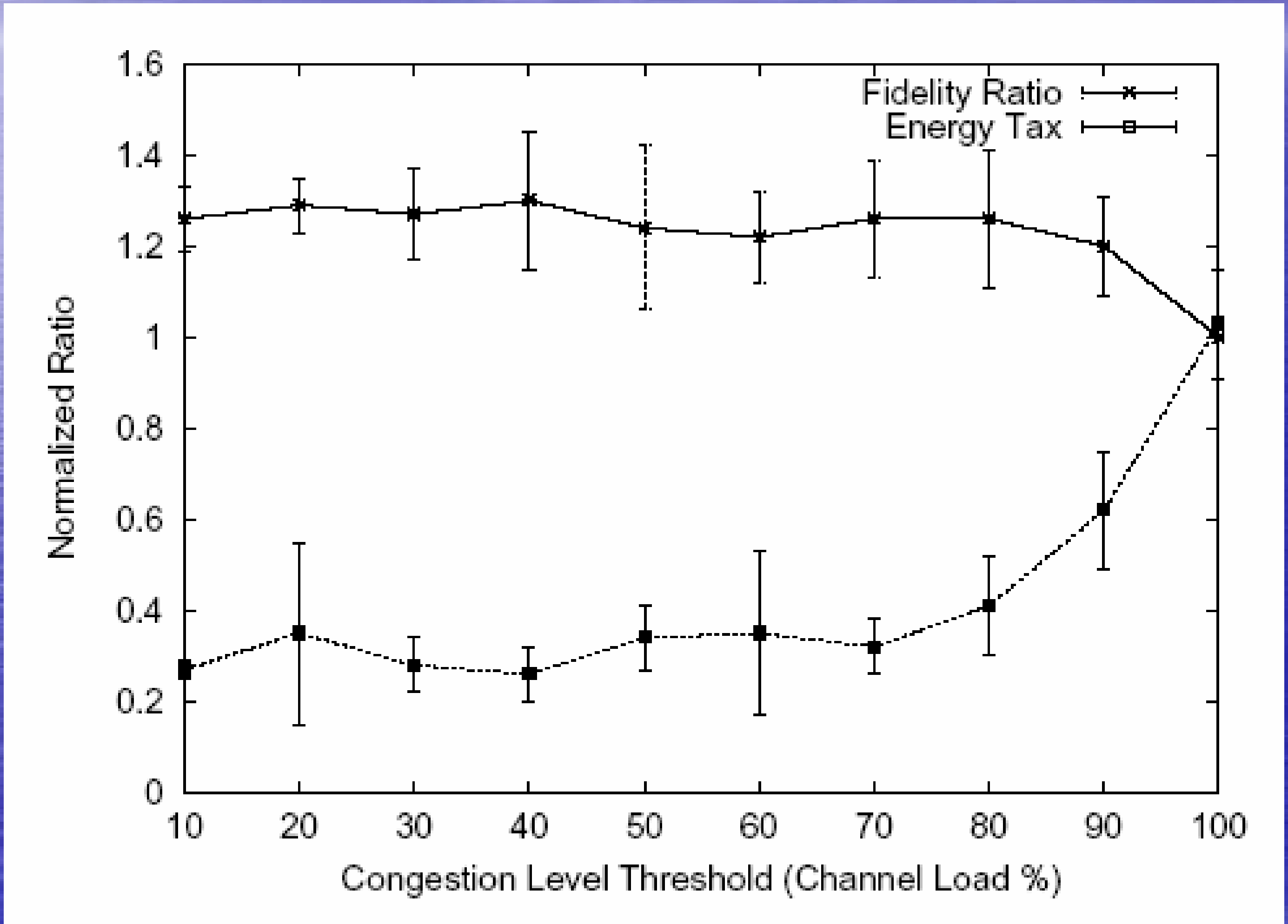
- That is enabled by the use of one *redirection bit* in the network layer header.
- Two approaches:
  - On-demand :the bit is set only when congestion is detected
  - Always-on :the bit is always set
- When a redirected packet is received, the node checks the list and forward to nearest VS.

# Simulation evaluation

- Performance metrics:
  - **Energy Tax** = (Tot. pkts dropped in the network1)/(Tot. pkts rcvd at the physical sink)
  - **Energy Tax Savings** = ((Avg E.Tax w/o Siphon) - (Avg E.Tax w/ Siphon))/(Avg E.Tax w/o Siphon).
  - **Fidelity Ratio** = (Pkts rcvd at the physical sink w/Siphon)/(Pkts rcvd at the physical sink w/o Siphon)
  - **Residual Energy** = (Remaining energy)/(Initial energy).

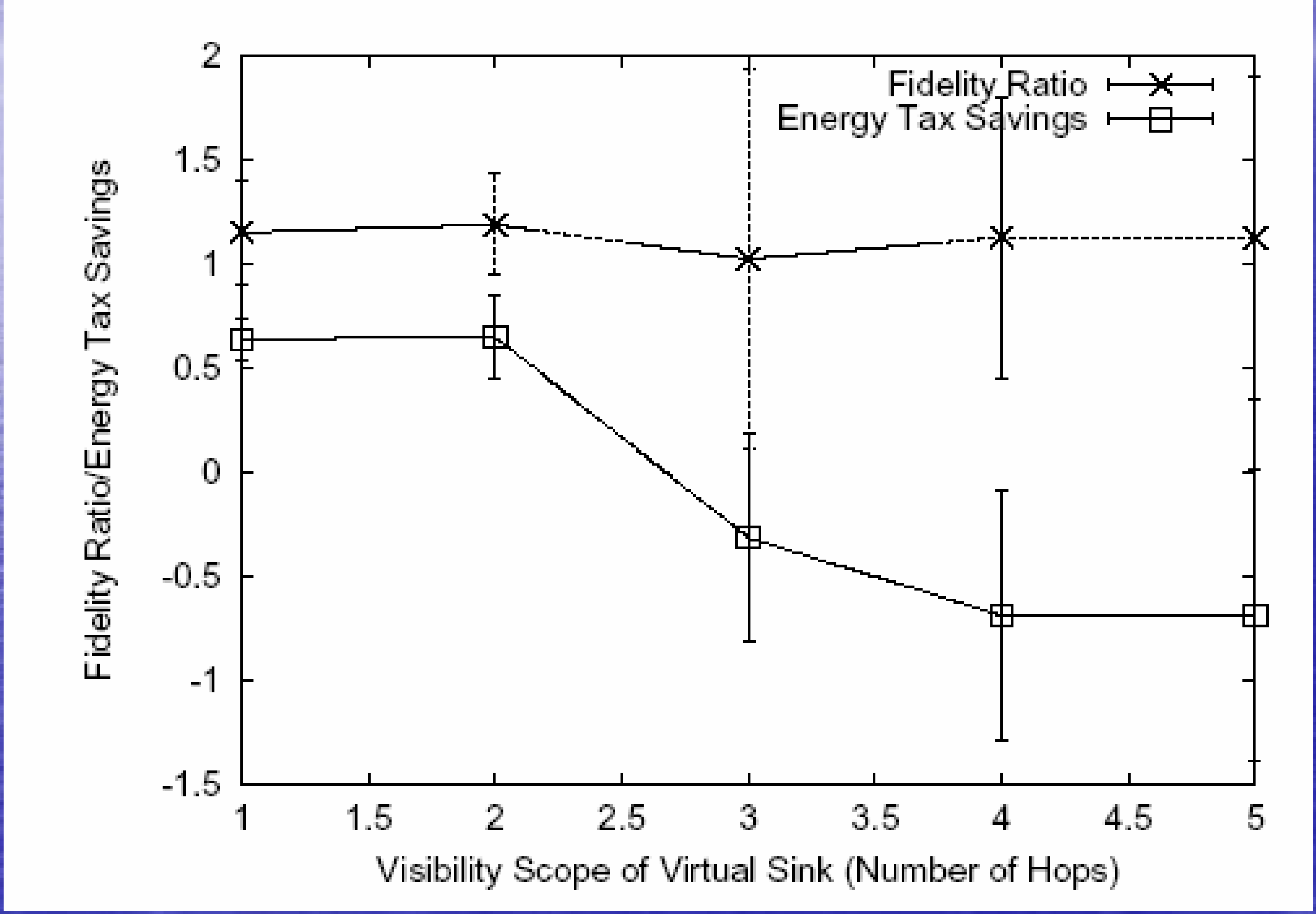
# Simulation evaluation

## -early congestion detection



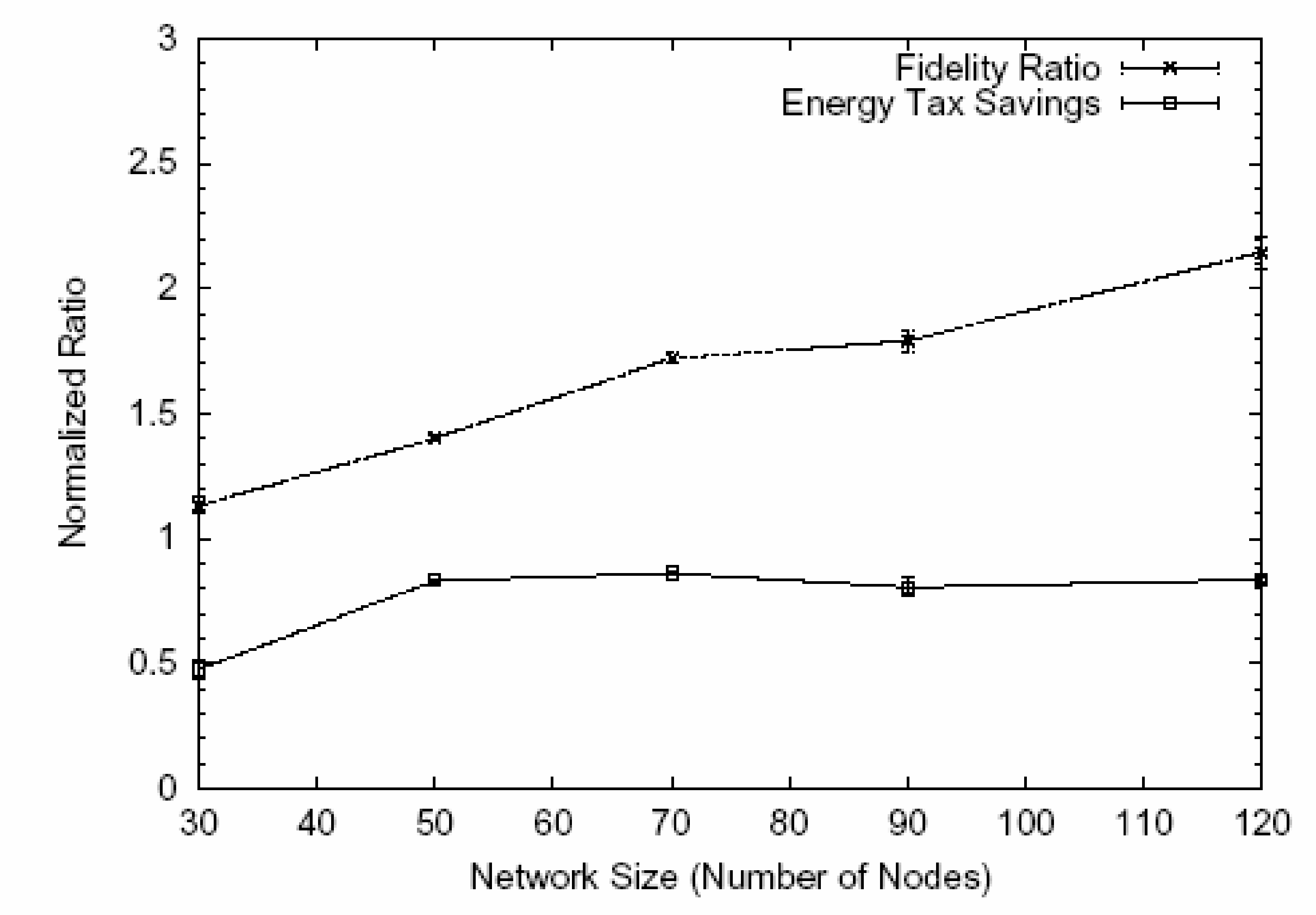
# Simulation evaluation

-virtual sink's visibility scope impact



# Simulation evaluation

-scalability



# Conclusion and Discussion

- The paper proposes a solution of growing need for improved congestion control, load balancing and overload traffic management by using a secondary radio network to siphon off overload traffic.
- Since WSN has many physical constraints, combination with other tools to achieve application requirement seems an alternative trend.