Dozer

Ultra-Low Power Data Gathering in Sensor Networks

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Environmental Monitoring

- Continuous data gathering
- Unattended operation
- Low data rates
- Battery powered
- ~~Network latency~~
- ~~Dynamic bandwidth demands~~

Energy conservation is crucial to prolong network lifetime

Energy-Efficient Protocol Design

- Communication subsystem is the main energy consumer
  - Power down radio as much as possible

TinyNode	Power Consumption
uC sleep, radio off	0.015 mW
Radio idle, RX, TX	30 – 40 mW

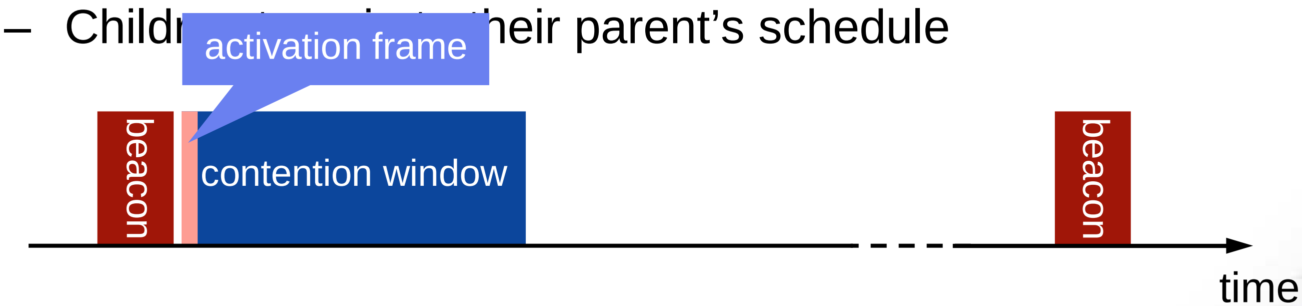
- Issue is tackled at various layers
  - MAC
  - Topology control / clustering
  - Routing

➡ Orchestration of the whole network stack to achieve duty cycles of ~1‰

Dozer System

- Tree based routing towards data sink
  - No energy wastage due to multiple paths
  - Current strategy: SPT
- TDMA based link scheduling
  - Each node has two independent schedules
  - No global time synchronization

- The parent initiates each TDMA round with a beacon
  - Enables integration of disconnected nodes
  - Childr [illegible] heir parent's schedule

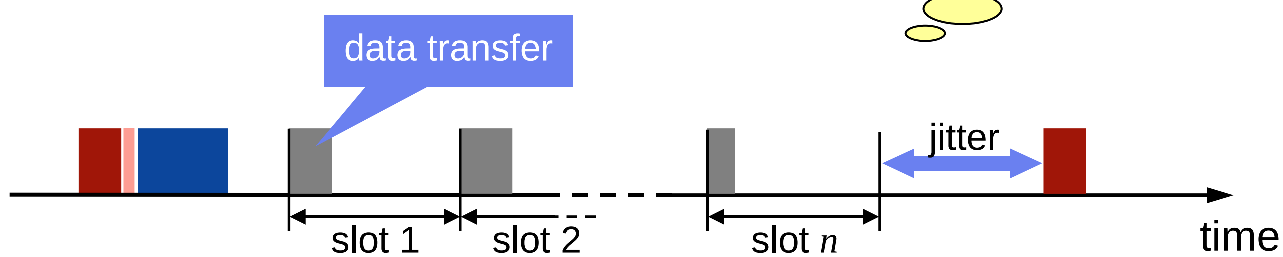


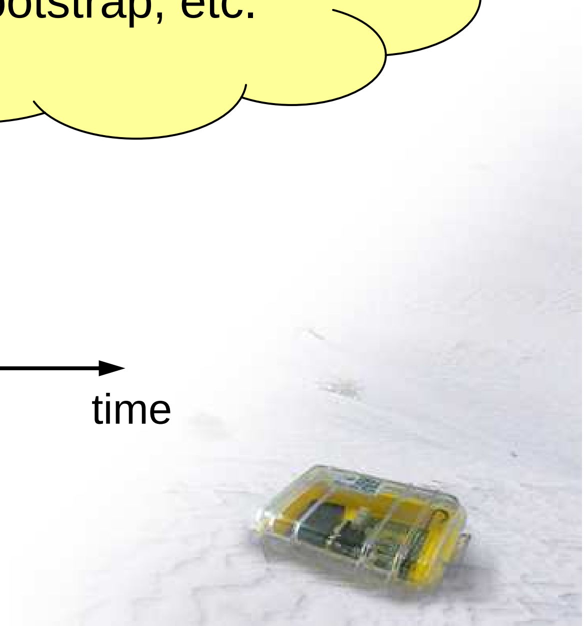
Dozer System

- Parent decides on its children data upload times
  - Each interval is divided into upload slots of equal length
  - Upon connecting each child gets its own slot
  - Data transmissions are always ack'ed

- No traditional MAC layer
  - Transmissions happen at exactly predete
  - Collisions are explicitly accepted
  - Random jitter resolves schedule collisions

Clock drift, queuing, bootstrap, etc.

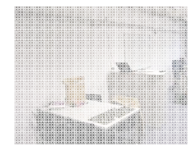




Evaluation

- Platform
  - TinyNode
    - MSP 430
    - Semtech XE1205
  - TinyOS 1.x

- Testbed
  - 40 Nodes
  - Indoor deployment
  - > 1 month uptime
  - 30 sec beacon interval
  - 2 min data sampling interval

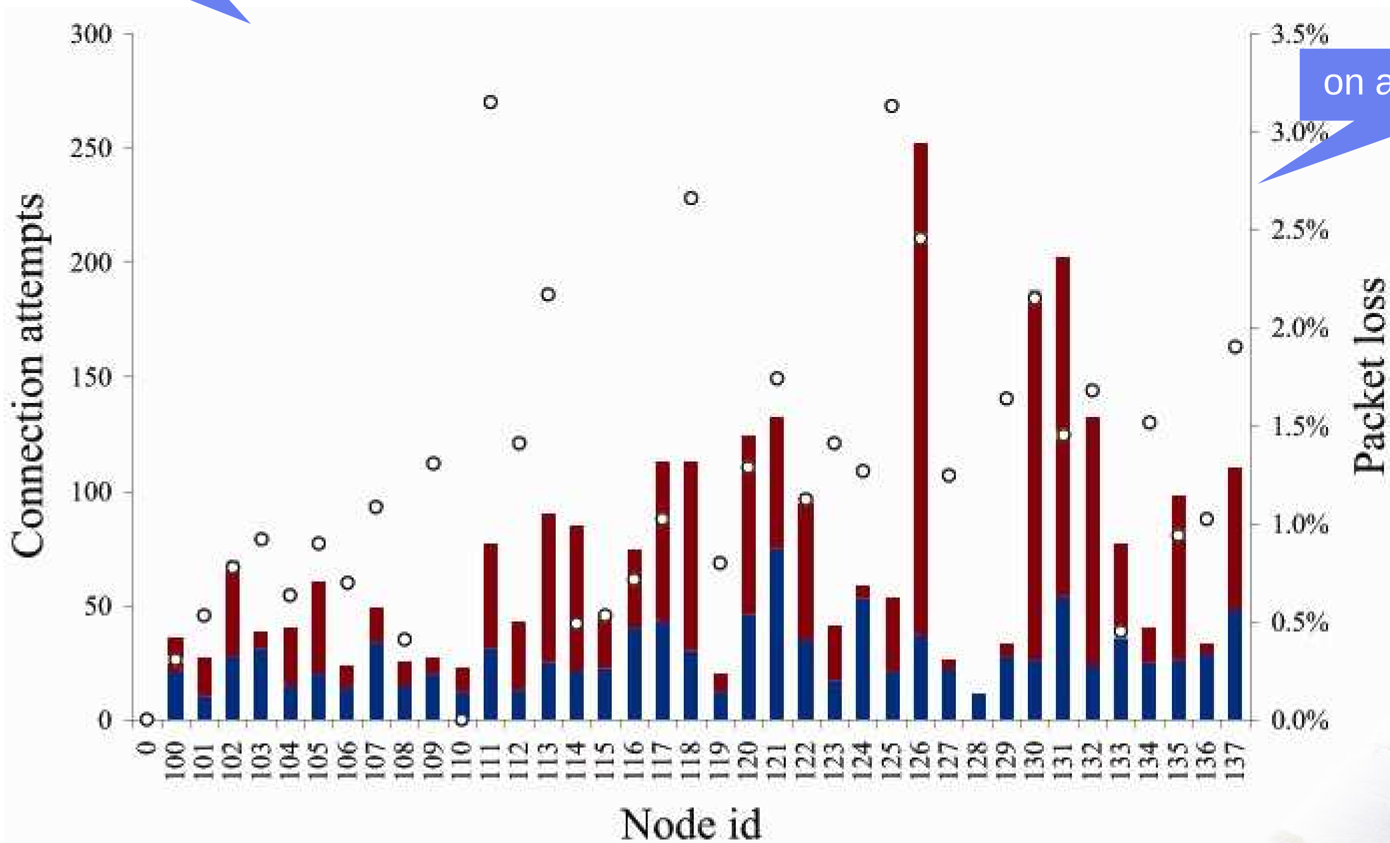


Dozer in Action

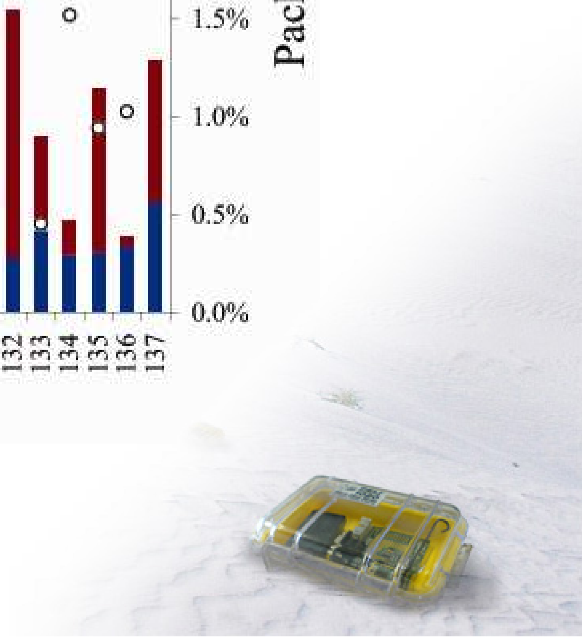
Pascal von Rickenbach, ETH Zurich @ IPSN 2007

Tree Maintenance

1 week of operation

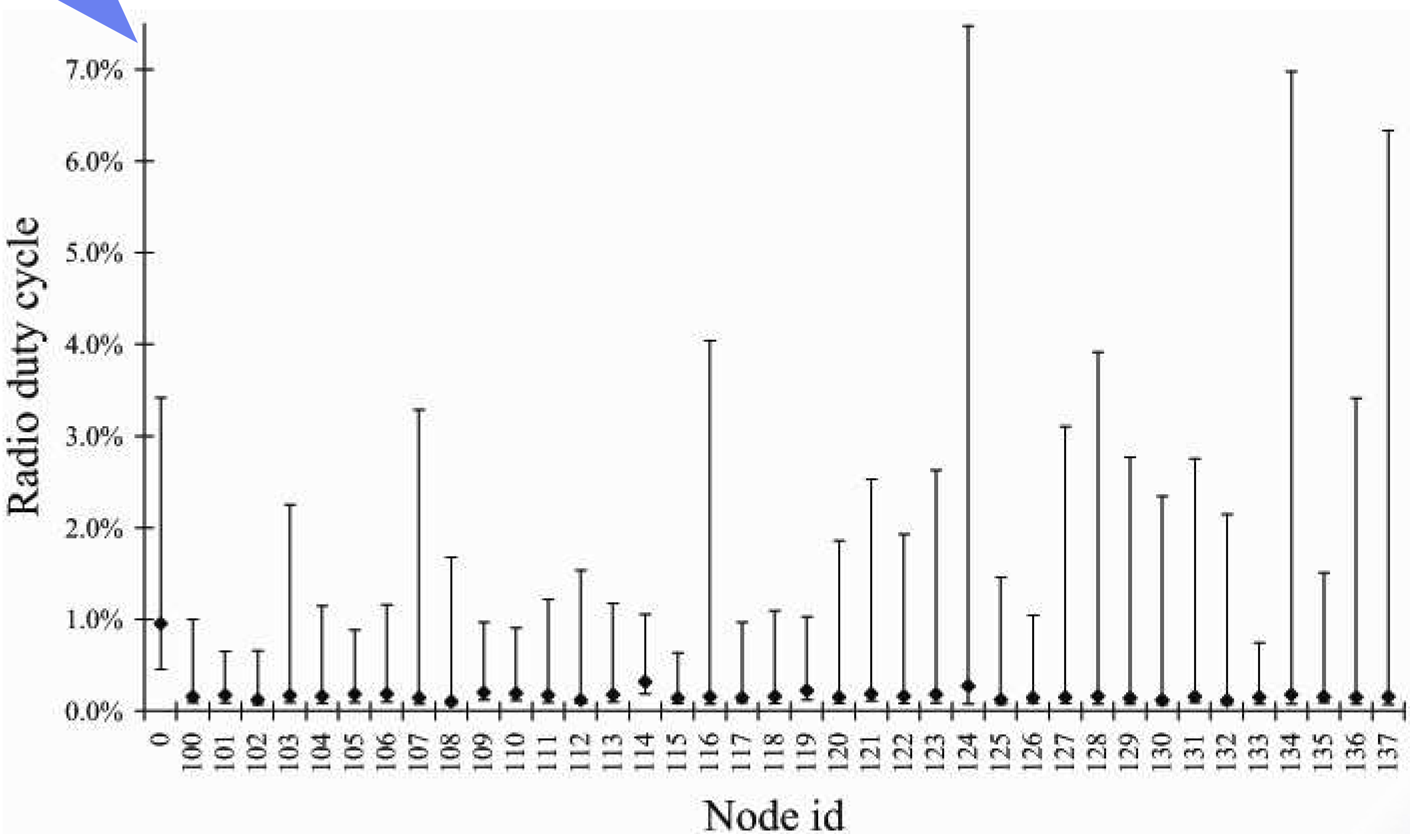


on average 1.2%

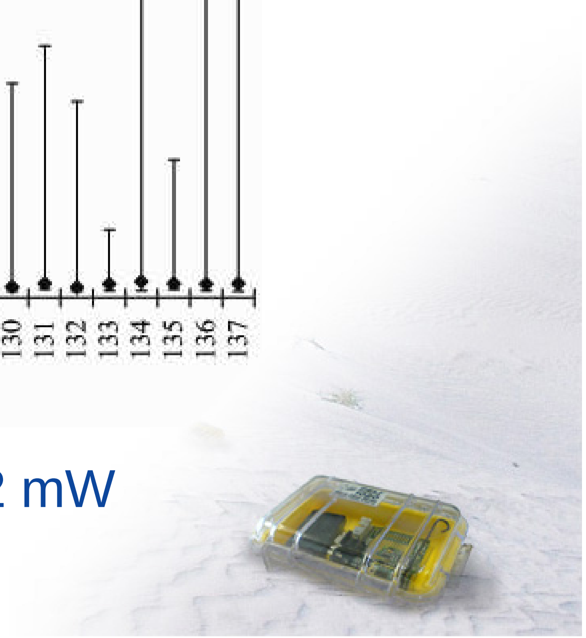


Energy Consumption

on average 1.67‰



➡ Mean energy consumption of 0.082 mW



Conclusions & Future Work

- Conclusions
  - Dozer achieves duty cycles in the magnitude of 1‰.
  - Abandoning collision avoidance was the right thing to do.

- Future work
  - Incorporate clock drift compensation.
  - Optimize delivery latency of sampled sensor data.
  - Make use of multiple frequencies to further reduce collisions.

Questions?
Comments?

Distributed
Computing
Group