Managing heterogeneous wireless sensor networks

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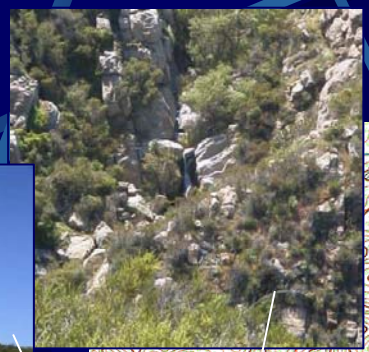
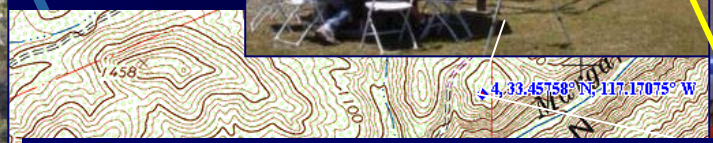
Our Research

- Scheduling and routing policies in HPWREN
- Problems:
  - Different types of traffic present (hi and low BW sensors, www, etc)
  - Different traffic priorities (e.g. RP fire sensing vs. weather station in La Jolla)
  - Various link qualities
  - Congestion, Reliability, Device lifetime
- Benefit:
  - Improved QoS, longer lifetime
  - Ability to tradeoff priorities vs. bandwidth availability
  - Balanced routing

- Team of two faculty and three students
  - Faculty: Tajana Simunic Rosing and Tara Javidi
  - Students:
    - Jaewook Shim (PhD)
      - Scheduling policy design, theoretical bounds on scheduling
    - Donghwan Jeon (PhD)
      - Lab setup and testing of scheduling and routing
      - QoS focused routing policies for sensor network
    - Daeseob Lim (MS)
      - simulation of scheduling and routing policies

Initial Project Test bed: Santa Margarita Ecological Reserve





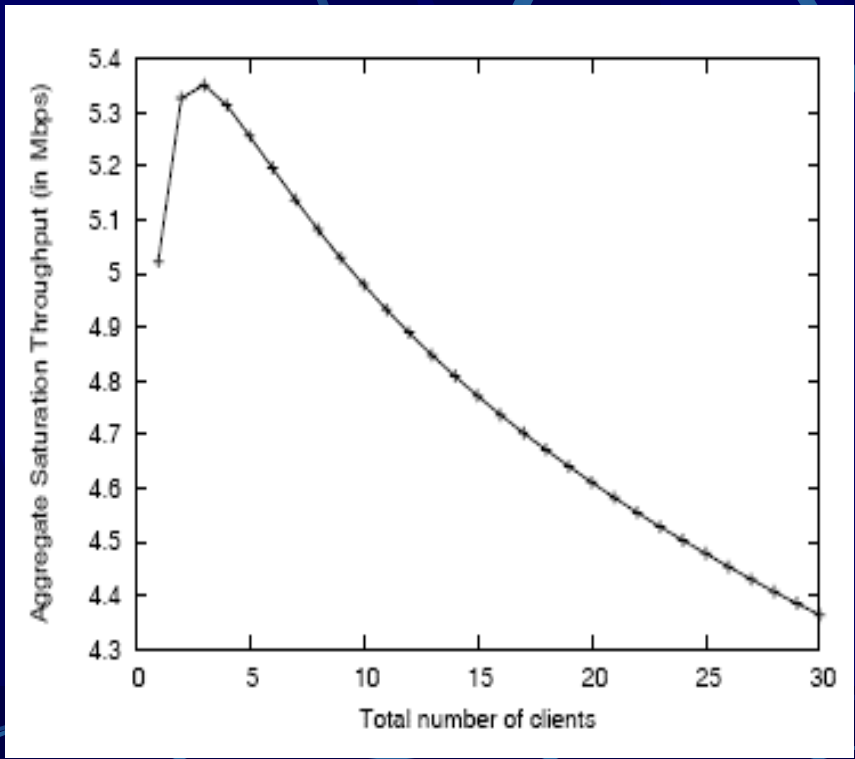
75 Sensor nodes connected via WLAN

Project status

- Summer focus (7/05-9/05) - scheduling for QoS
  - Analyzed and characterized traffic in SMER
  - Developed a simulator capable of implementing various scheduling policies
  - Currently:
    - Evaluating policies via simulation
    - Developing theoretical bounds on QoS improvements possible with scheduling
    - Designing a test bed with 20 sensor node cluster heads (XScale 27x DVKs) and 20 “backbone” nodes to be used for testing scheduling and routing policies
    - Writing a paper with initial results

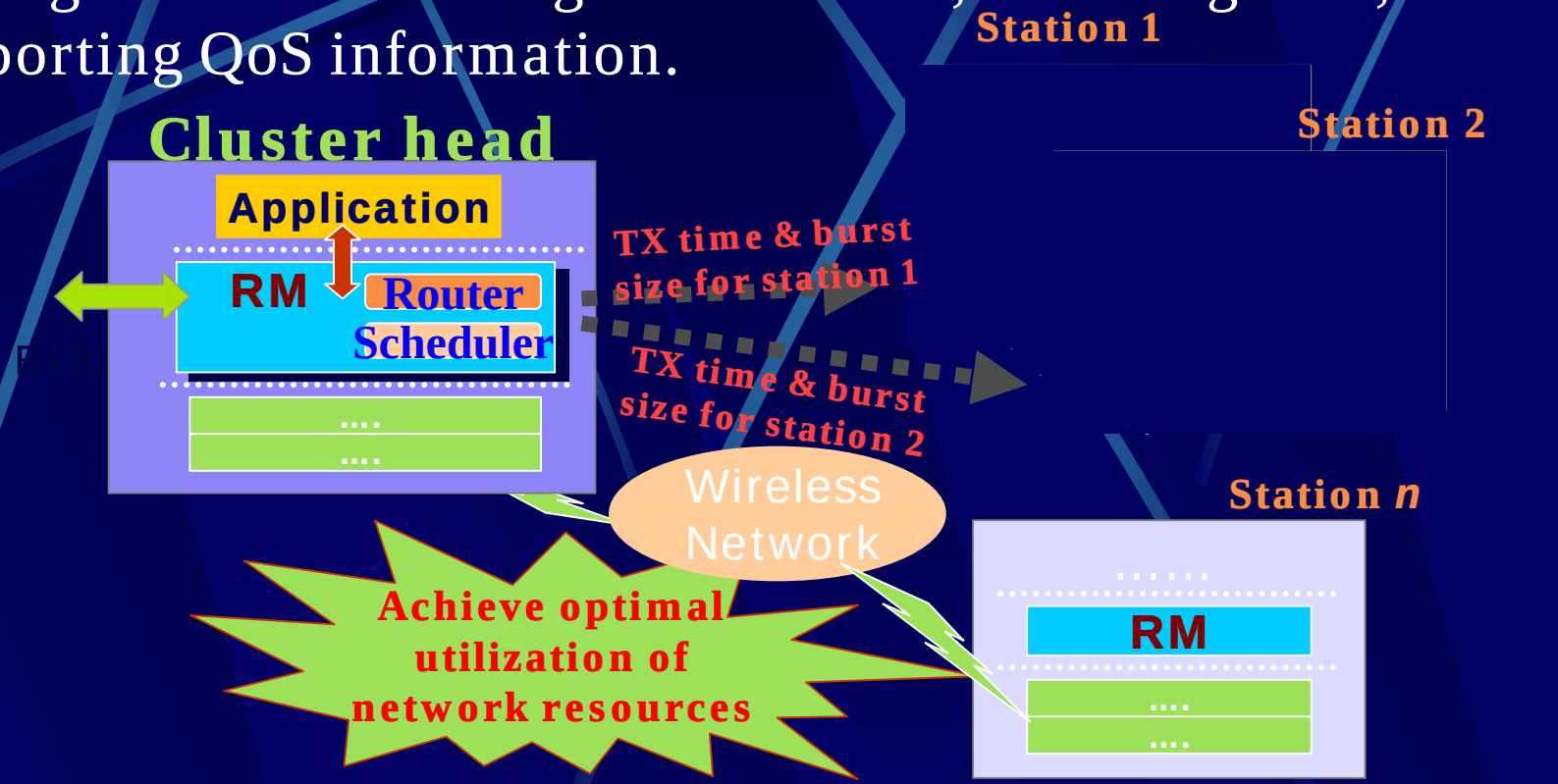
Why schedule?

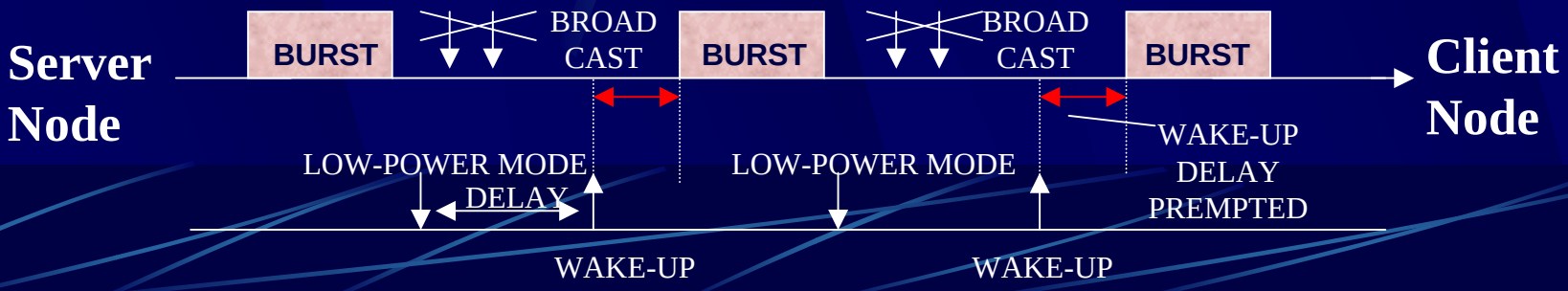
- For more than 3 concurrent clients using WLAN, the throughput falls rapidly due to contention
  - QoS suffers
- Schedule max 3 clients at the same time
  - Better QoS, larger power savings



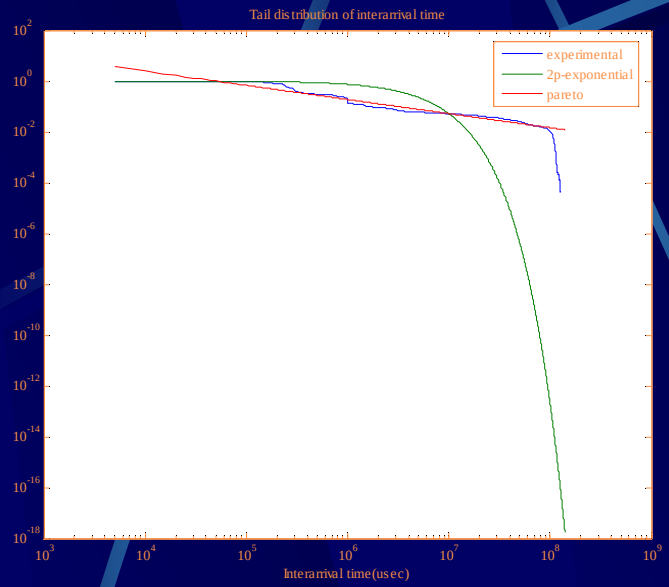
Resource Manager Model

- An agent for controlling wireless NIC, buffering data, and reporting QoS information.

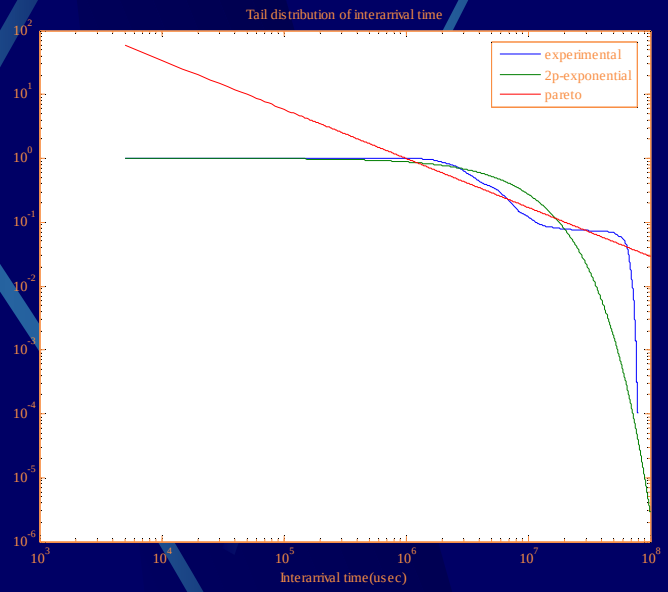


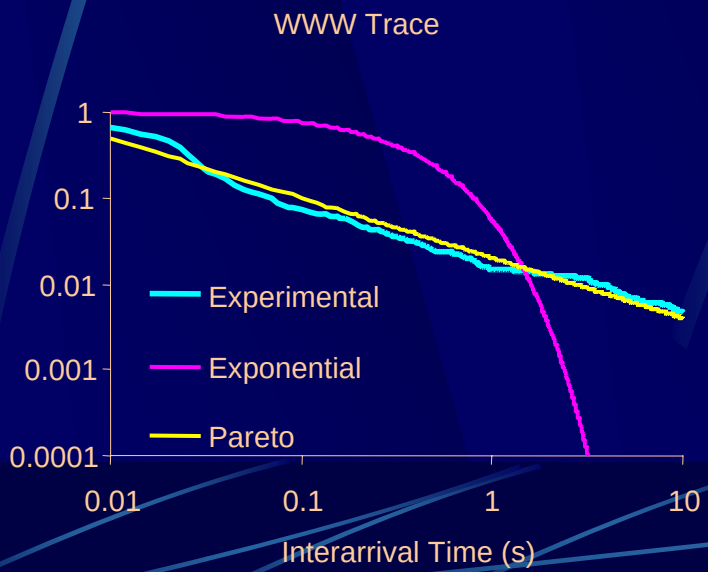


Traffic Characterization



Two different sensor nodes





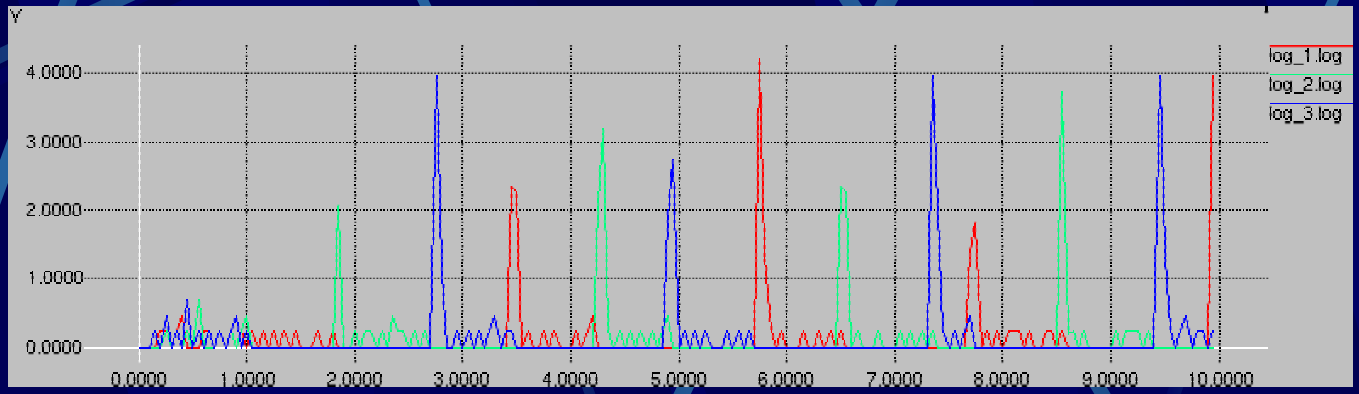
Distributions

$$2\,pExp = 1 - e^{-\lambda_e (t-\phi)}$$

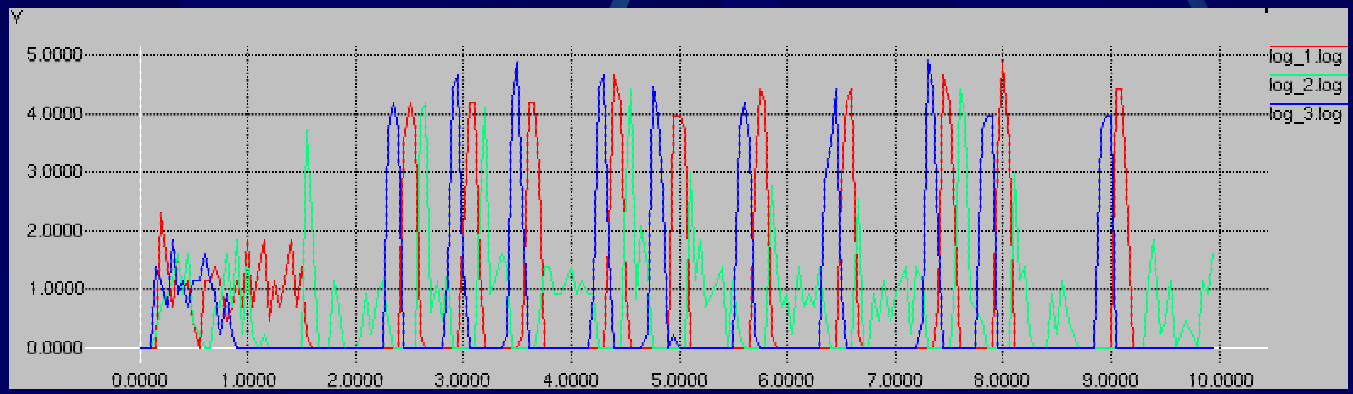
$$Pareto = 1 - b \cdot t^{-a}$$

Example : Round-Robin Scheduler

RR scheduling with **2-parameter exp model**



RR scheduling with **Pareto model**



Next Steps

- Scheduling:
  - Complete theoretical analysis
  - Compare scheduling algorithms via simulation
  - Implement on the test bed and evaluate with actual SMER traffic
  - Test in SMER
- Routing:
  - Expand simulator to include routing algorithms into RM
  - Compare various existing routing algorithms
  - Design an appropriate PBR for HPWREN