Ongoing Work in the Development of the VoxNet Platform

Lewis Girod
MIT/CSAIL

VoxNet Project (NSF IDBR)
Dan Blumstein (Lead PI)
Ying Lin, Sam Madden, Charles Taylor, Kung Yao (PI)
Travis Collier, Andreas Ali, Mike Allen, Ryan Newton,
and many others

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VoxNet Platform

Key Features:

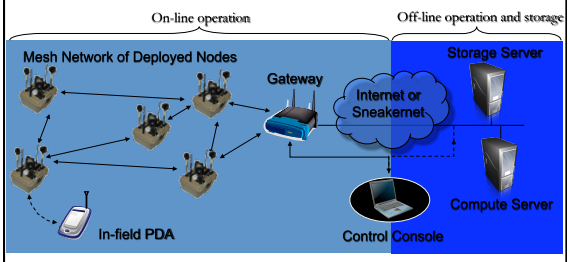
Rapid deployment
- Small / light
- Self-contained

Self calibration
- Absolute location
- Precise relative location
- Precise orientation

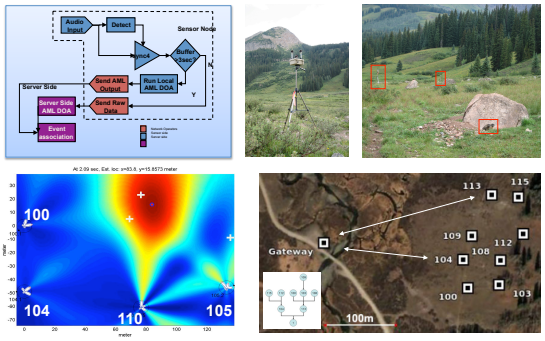
Query in the field
- Unknown environment
- Discoveries on the fly
- All data vs. events vs. what just happened

Travis Collier, Lewis Girod, Mike Allen

VoxNet architecture

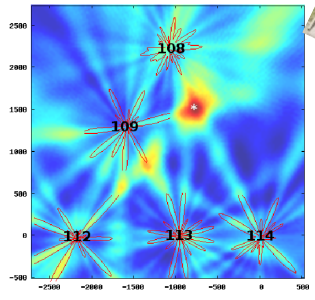


Distributed Acoustic Source Localization



Sensys 2006, IPSN 2007, CIDR 2007, IPSN 2008

IPSN Demo

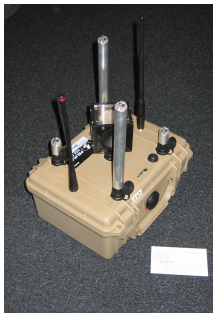


- Outdoor demo, behind Media Lab
- System deployed and auto-calibrated
- Human in field blows dog whistle
- System detects whiste, localizes source in real time

VoxNet V2 Node

Hardware:
2x PXA255
64MB RAM
8GB Flash
802.11B
Mica2 supervisor
Li+ battery
Charge controller

Sensors:
4x48KHz audio
3-axis accel
GPS
Internal temp



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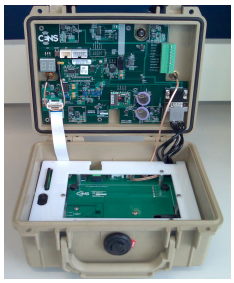
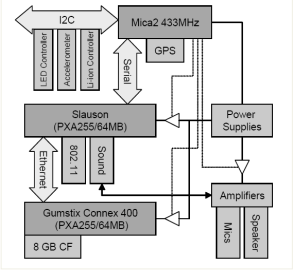
VoxNet V2 Hardware Architecture





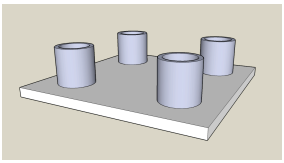
V2 Limitations

- Power consumption (7.5 W)
- Size and weight
- Cost and manufacturability
- Radio range / power consumption
- Self localization range
  - Sync? Sensitivity? Emitter strength?
- Time synchronization dependencies
  - Radio, Codec, Network topology
- Mechanical properties of array (wiggly)

VoxNet V3 Design Plan (IDBR)

- Smaller package, more mechanically secure
- COTS mainboard (Gumstix)
- Single custom peripheral board
  - USB, GPS, sampling
  - Reduced power draw, solar panel option
- Decouple sync from radio / codec design
  - Support variety of radio, sampling technologies
  - GPS timing option
- New emitter / mic preamp design

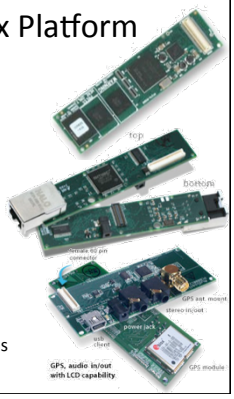
Mechanical



- Microphone barrels
  - Fitted using tube fittings
  - Preamp inside barrel
  - Gore-tex sleeve
- Microphone connectors
  - Separate from main PCB
  - Easier to change array design
- Small size Pelican case
- Stiffener body supports array
- New emitter design?
- External data port

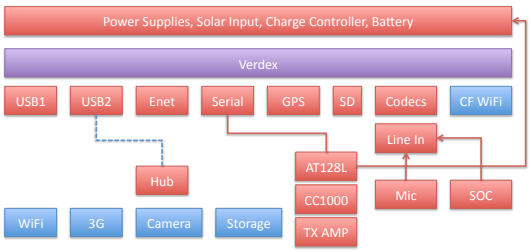
Based on Gumstix Platform

- Gumstix Verdex XL6P
  - 600MHz ARM, 128MB
  - 2 USB ports, 3 serial
  - $169
- Expansion boards
  - Ethernet, WiFi, SD
  - GPS, Sound, USB
  - Open source design
    - Cut and paste into new designs



Custom Peripheral Board

- USB, GPS, sampling
- Reduced power draw, solar panel option

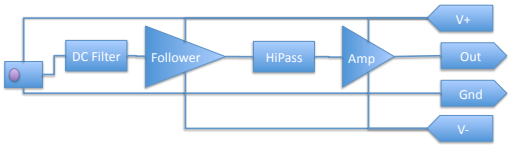


New Radio Options

- Via USB
  - 3G
  - High power Wifi
- Via CF
  - Low power Marvell WiFi CF module
- Via RS-232
  - Satellite, Freewave, etc
- Built-in 433MHz CC1000 + RF power amp
  - Time sync and low power standby

New Sampling Interface

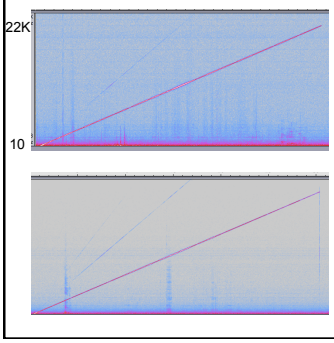
- Old sampling interface was major power draw
- 4 to 8 channels; Design not yet settled:
  - Multiple COTS codecs? DSP+ADC? FPGA+ADC?
- Mic Preamp integrated into mic barrels
  - High pass filter to reduce wind noise



Testing strategy

- Measure microphone sensitivity
  - Compared to what?
  - Impact of channel
- Directional vs. Omni
- Sectored mics with attenuators (ICA analysis?)
- Best approach may be an application-based test strategy

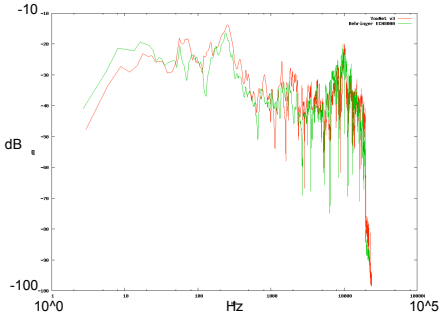
Sweep test



New Mic Preamp, Line-in at 20% gain

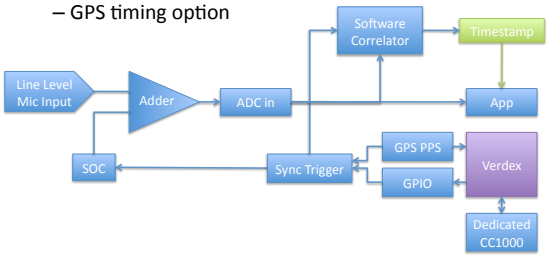
Behringer ECM8000, Rolls phantom power, Mic input, max gain

VoxNet3 Preamp vs. Behringer ECM8000
10Hz–22KHz Spectrum Plot



New Time Sync Strategy

- Decouple sync from radio / codec design
  - Support variety of radio, sampling technologies
  - GPS timing option



New Emitter Design

- Tune center frequency for emitter / environment
  - Test this today / tomorrow ?
- Enclosure design
  - Resonant cavity?

Summary: VoxNet V3 Design Plan

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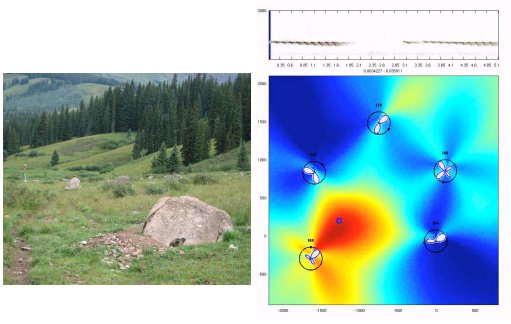
AML In Action



Behringer ECM8000 vs New Preamp 10-300 Hz Spectrum Plot