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NOAA

ALERT-2 Working Meeting
NOAA Phase I SBIR Project

January 10, 2008
Longmont, CO

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NOAA Phase I SBIR Project

- Overall Objectives
  - Develop a next-generation suite of wireless communication protocols for automated flood warning systems
    - Freely available (open, non-proprietary) protocol specification
    - Field-proven implementation
- Phase I Duration:
  - July 16, 2007 – January 15, 2008

NOAA Phase I SBIR Project

- Phase I Deliverables
  - Project Web site
    - http://www.alert-2.com/
  - ALERT-2 Requirements Specification
    - Two versions distributed, available online
  - Draft ALERT-2 Protocol Specification
    - Initial version available online
  - Draft Phase II Plan

NOAA Phase I SBIR Project

- Phase II Plans
  - Intend to submit Phase II SBIR proposal
    - Implement ALERT-2 Protocols
    - Deploy in field trials

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ALERT-2 Requirements

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ALERT-2 Requirements

- Draft version 0.1: August 25, 2007
  - Dozens of downloads
- Draft version 0.2: December 30, 2007
  - Basic requirements haven't changed much
  - New background material added
  - More technical material moved to ALERT-2 Protocol Specification

ALERT-2 Requirements

- Requirements culled from
  - October 25, 2006 ALERT-2 session at SAAS
  - 2006 SAAS and 2007 NHWC conferences
  - Proceedings from other NHWC, SAAS, and AUG conferences
  - Yahoo! Floodsystems group
  - Personal conversations

ALERT-2 Requirements

- 3.1 Functionality
  - Provide real-time, best-effort datagram service
- 3.2 Performance
  - Enhanced throughput
  - Better channel utilization
  - Support larger networks
  - Support more sensors
  - Ensure minimum latency

ALERT-2 Requirements

- 3.3 Reliability
  - Reduce or eliminate packet loss due to collisions
  - Detect and discard corrupted packets
  - Minimize packets lost due to transmission errors, collisions, or congestion

ALERT-2 Requirements

- 3.4 Extensibility
  - Don’t limit sensors that can be supported
  - Simplify implementation of new functionality
  - Provide three types of service:
    - Best-effort datagram service
    - Reliable datagram service
    - Reliable packet stream service

ALERT-2 Requirements

- 3.5 Network Administration/Management
  - Reduce required labor
  - Enable remote network management
  - Permit passive base stations
  - Support automatic base station fail-over
  - Support multiple, independent networks per channel
  - Simplify deployment of new protocols, functionality

ALERT-2 Requirements

- 3.6 Interoperability and Compatibility
  - Support transmit-only nodes
  - Ensure interoperability between implementations and vendors
  - Share channel with original ALERT protocol
- 3.7 Transmission Media
  - Support Blue Water Design modem
  - Easily support other transmission media

ALERT-2 Requirements

- 3.8 Energy Conservation
  - Permit nodes to sleep
  - Operate with resource-constrained nodes
- 3.9 Security
  - Provide optional modern security features
    - Integrity, non-disclosure, source verification, replay prevention

ALERT-2 Requirements

- 3.10 Intellectual Property
  - Freely available protocol specification
  - Permit anyone to implement protocols without fees, licenses

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Protocol Specification

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Protocol Specification

- Terminology, Components, Concepts
  - Node
    - Remote Node
    - Router
    - Base Station
    - Reduce-Function Device
    - Full-Function Device

Protocol Specification

- Terminology, Components, Concepts
  - Network
  - Address
    - 16-bit integer assigned to *node*
  - Network Address
    - High-order bits of an address
    - Low-order bits are node within a network
    - Local administrators collectively agree on networks
    - Enables independently administered networks

Protocol Specification

- Terminology, Components, Concepts
  - Interface
  - Router
  - Routing
    - Driven by route table
    - More general approach to filter lists

Protocol Specification

- Terminology, Components, Concepts
  - Application
    - Software within a node
    - Separately addressable by ALERT-2 protocols
    - Can have its own protocols (datagram and reliable packet stream)
    - For example:
      - Sensor monitoring application
      - Network management application
      - File management application
      - ...

Protocol Specification

- Terminology, Components, Concepts
  - Port number
    - Addresses application within a node
  - Application services
    - Best-effort datagram service
    - Reliable datagram service
    - Reliable packet stream service

Protocol Specification

- Terminology, Components, Concepts
  - Protocol Layers
    - Physical-layer protocol
    - Media Access Control (MAC) protocol
    - Link protocol
    - Transport protocols
    - Application protocols

Protocol Specification

- Physical-Layer Protocol
  - Blue Water Design modem
  - Easily adaptable to other media (e.g., modems)

Protocol Specification

- Media Access Control (MAC) Protocol
  - Responsible for determining which station can transmit when
  - A time-slotted protocol *might* be a really big win
    - Control or eliminate collisions
    - Enhance utilization (versus 18% for ALOHA)
  - Will write paper for ALERT Users Group meeting

Protocol Specification

- Link Protocol
  - Responsible for transmission between nodes
  - Provides acknowledged and unacknowledged services
  - Permits various header fields to be not transmitted

Protocol Specification

- Link Protocol
  - Link Control Byte
    - Control/Data (2 bits)
    - Link-Layer Destination Address Elided
    - Network-Layer Source Address Elided
    - Network-Layer Destination Address Elided
    - Ports Elided
    - Reserved (2 bits)

Protocol Specification

- Link Protocol
  - Source Address (2 Bytes)
  - Destination Address (2 Bytes) (Optional)
  - Packet ID (1 Byte)
    - Supports link-level acknowledgements, retransmissions
    - Detects lost packets for unacknowledged packets
  - Data

Protocol Specification

- Network Layer Protocol
  - Responsible for end-to-end delivery of packets
  - Handles forwarding through routers

Protocol Specification

- Network Layer Protocol
  - Network Control Byte
    - Version (3 bits)
    - TTL (3 bits)
    - Transport Protocol ID (2 bits)
  - Source Address (2 Bytes) (Optional)
  - Destination Address (2 Bytes) (Optional)
  - Source Port (1 Byte) (Optional)
  - Destination Port (1 Byte) (Optional)

Protocol Specification

- Transport Protocols
  - Responsible for end-to-end (application-to-application) delivery of data
  - Three transport protocols
    - Best effort datagram
    - Reliable datagram
    - Reliable packet stream

Protocol Specification

- Transport Protocols
  - Best effort datagram transport protocol
    - No transport-layer header
    - Uses unacknowledged link-layer service
  - Reliable datagram transport protocol
    - One-byte header
      - Data/Ack (1 bit)
      - Packet ID (7 bits)

Protocol Specification

- Transport Protocols
  - Reliable packet stream transport protocol
  - Vaguely similar to TCP
  - Header:
    - Control Byte
      - Version (3 bits)
      - SYN/FIN/ACK (3 bits)
      - Spare (2 bits)
    - Packet ID

Protocol Specification

- Application Layer Protocols
  - Recommend Type/Length/Value (TLV) construct
  - Each value is sent as a tuple:
    - Type – type of value being transported
    - Length – length of value
    - Value – value being transported

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Phase II Plans

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Phase II Plans

- Intend to submit Phase II proposal
  - Due March 2008
  - If funded, start August 2008
- Likely contents
  - Implement ALERT-2 protocols
  - Deploy in field tests
  - Lots of other pieces...
- I will need your support

Phase II Plans

- Numerous open questions
  - What should I deliver?
    - Source code?
    - Complete hardware device? Which one?
      - I really want to focus on software
  - If I deliver a component (software) how will it be integrated into a system?
    - Who will do this?
    - Who will fund this?

Phase II Plans

- Numerous open questions
  - What software environment should I target?
  - What hardware environment should I target?
- If I deliver a hardware solution:
  - How does this fit with vendors' plans
  - How do I integrate with sensors for field trials?
  - Does the hardware include a modem?
  - Again, I want to focus on software, avoid hardware

Phase II Plans
Lots of Questions

- What is the status of the modem?
- What does the modem do?
- Who is responsible for delivering the modem hardware?
- For hardware support?
- For software support?

Phase II Plans

- Commercialization Plan
  - A Phase II proposal can't succeed without a good commercialization plan
  - I am open to suggestions
  - I need to discuss this with the vendors prior to Phase II proposal