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NOAA

ALERT-2 Working Meeting

October 24, 2007
Sacramento, CA

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ALERT-2 Working Meeting

Proposed Agenda

- ALERT-2 Phase I SBIR Project
  - Tim Salo
- ALERT-2 Requirements Specification
  - Tim Salo
- ALERT-2 Modem Productization Plans
- ALERT-2 Technologies Discussion
  - Tim Salo
- ALERT-2 Phase II SBIR Objectives
  - Tim Salo

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NOAA Phase I SBIR Project

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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
    - Implementation
- Phase I Duration:
  - July 16, 2007 – January 15, 2008

NOAA Phase I SBIR Project

- Phase I Deliverables
  - Online Tools (http://www.alert-2.com/)
    - ALERT-2 mail lists
    - ALERT-2 document repository
  - ALERT-2 Requirements Specification
    - Initial version distributed, available online
    - A few comments received, mostly minor
    - Soliciting comments via phone
    - Topic for today

NOAA Phase I SBIR Project

- Phase I Deliverables (cont)
  - Draft ALERT-2 Protocol Specification
    - Topic for today
- Phase II Plans
  - Intend to submit Phase II SBIR proposal
    - Implement ALERT-2 Protocols
    - Deploy in field trials
    - Topic for today

ALERT-2 Working Meeting
ALERT-2 Requirements

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ALERT-2 Requirements

- Draft version 0.1: August 25, 2007
  - Distributed in early September
  - Dozens of downloads
  - A few, minor comments
- Does this document represent a consensus of the ALERT community?
- Suggest a point-by-point review of Section 3

ALERT-2 Requirements

- 3.1 Equipment

  - Support bidirectional communication

  - Not *require* remote nodes to receive

ALERT-2 Requirements

- 3.2 Performance
  - Provide enhanced throughput
    - TBD messages per hour
    - Bluewater Design modem provides this
  - Ensure better channel utilization
    - TBD per cent utilization
    - Time slotted protocol would be nice (required)
  - Support larger networks
    - 1024 nodes

ALERT-2 Requirements

- 3.2 Performance (cont)
  - Support more sensors per node
    - Pretty much unlimited
  - Support more networks per channel
    - 15 networks per share a single RF channel
  - Ensure minimum latency
    - Report latency of less than TBD

ALERT-2 Requirements

- 3.3 Reliability
  - Reduce or eliminate packet loss due to congestion
    - Bluewater Design modem will help somewhat
    - Time-slotted MAC protocol probably required
  - Detect and discard packets that contain transmission errors.
    - Bluewater Design modem will provide this

ALERT-2 Requirements

- 3.3 Reliability (cont)
  - Minimize the number of packets that are lost as a result of congestion or transmission errors
    - Bluewater Design modem will help
    - Time-slotted MAC protocol may be required
    - Link-layer retransmission may be required

ALERT-2 Requirements

- 3.4 Naming and Addressing
  - Ensure that every ALERT-2 *node* is assigned a permanent, globally unique identifier
    - e.g., 48-bit IEEE MAC address
    - Use in databases (?)
  - Permit every ALERT-2 *node* to be configured with a text identifier
    - Software, other nodes should be able to read this
    - Use in databases (?)

ALERT-2 Requirements

- 3.4 Naming and Addressing (cont)
  - Use a short address for most purposes
    - e.g., 16-bit address to save bandwidth and energy
    - Address of node might change
      - e.g., don’t use in database

ALERT-2 Requirements

- 3.5 Application Services
  - Support multiple applications per node
    - e.g., network management application; stream guage application, ...
  - Permit a specific application to be addressed
  - Support multiple application protocols
    - Different applications may use different protocols

ALERT-2 Requirements

- 3.5 Application Services (cont)
  - Provide an unreliable datagram service
    - Hope single packet gets to destination
    - Equivalent to current ALERT protocol
  - Provide a reliable datagram service
    - Make sure single packet gets to destination
  - Provide a reliable transport service
    - Make sure lots of data get to destination

ALERT-2 Requirements

- 3.6 Application Protocols
  - Each application should have its own protocols specified
  - ...

ALERT-2 Requirements

- 3.7 Interoperability and Compatibility
  - Ensure interoperability between implementations and vendors
    - Products that conform to the ALERT-2 specification should be assured of interoperating with each other
  - Share an RF channel with the original ALERT protocol
    - Significant ALERT-2 functionality may not be available in mixed ALERT/ALERT-2 networks

ALERT-2 Requirements

- 3.7 Interoperability and Compatibility (cont)
  - Support existing transmitters and transceivers
    - Bluewater Design modem designed to do this

ALERT-2 Requirements

- 3.8 Extensibility
  - Permit new versions of the ALERT-2 protocol to be deployed incrementally
  - Permit new applications and new application protocols to be deployed without changes to the underlying ALERT-2 protocols
  - Permit application protocol to change without affecting other applications

ALERT-2 Requirements

- 3.9 Network Administration, Management
  - Support remote network management
  - Permit passive base stations
  - Support automatic base station fail-over
  - Minimize manual configuration
  - Configure routers and routing automatically.

ALERT-2 Requirements

- 3.10 Energy Conservation
  - Permit remote nodes to sleep
    - Important, but may be hard to do well
  - Operate with limited computational power and storage capacity in remote nodes

ALERT-2 Requirements

- 3.11 Security
  - Optionally ensure the integrity of data
  - Optionally prevent disclosure of data
  - Optionally ensure that the source of data is identified
  - Optionally ensure that data packets cannot be replayed
  - Optionally authenticate users or applications
  - Optionally authorize operations

ALERT-2 Requirements

- 3.12 Intellectual Property
  - Make protocol specifications freely available
  - Permit implementation without paying fees

ALERT-2 Working Meeting Technologies Discussion

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Technologies Discussion

- Detailed discussion about potential technologies may be useful
  - Select (self-selected) audience?
  - Move later in day?

Technologies Discussion

- Terminology
  - Node
    - Informally, something with an antenna
  - Smart Node (SN)
    - A node with few power constraints
    - e.g., base station
  - Dumb Node (DN)
    - A node with (severe) power constraints
    - e.g., remote station

Technologies Discussion

- Addressing
  - Assign 16-bit addresses to every *node*
  - Only one type of address
    - Use for MAC, link, network protocols
  - Configure addresses statically (manually)
  - Optionally, divide into:
    - Network (4 bits)
    - Address within network (12 bits)
  - Future: configure addresses automatically

Technologies Discussion

- Applications
  - Each node may contain many application
  - Each application has a standard address within the node
    - e.g., 8 bit application address
    - Analogous to Internet port numbers
      - Probably associated with network-layer protocol, not transport-layer protocol

Technologies Discussion

- Routing
  - Dumb nodes know how to get to a smart node
  - Smart nodes understand topology of network
  - Manually configured
  - Future: automatic, dynamic configuration of routing
    - i.e., a routing protocol

Technologies Discussion

- Protocol Layers
  - Physical Layer
  - Media Access Control Layer
  - Link Layer
  - Transport Layer
  - Application Layer

Technologies Discussion

- Physical Layer
  - Bluewater Design modem
  - ALERT-2 should probably work with other physical-layer protocols (modems)

Technologies Discussion

- Media Access Control (MAC) Protocol
  - Responsible for determining which station can transmit when
  - A time-slotted protocol could be a really big win
    - Eliminate congestion
    - Enhance utilization (versus 18% for Aloha)
  - Time slot of one second or less
    - Maximum latency of small number of minutes or less
  - Smart Node (e.g., base station) controls timing

Technologies Discussion

- Media Access Control (MAC) Protocol
  - Should support sleeping nodes
    - Smart node hold packets until dumb node wake up
  - Future: dynamic allocation of time slots
  - Future: mixed time-slotted, contention protocol
  - Lots of examples
    - e.g., IEEE 802.15.4 (used by ZigBee), 802.11 (Wi-Fi)
  - This is beyond the scope of my funding...

Technologies Discussion

- Link Layer Protocol
  - Responsible for transmission between nodes
  - Retransmitting lost packets can be highly beneficial
    - Should provide both reliable and unreliable link-layer service
  - Lots of examples to work from
    - HDLC/SDLC/ADCCP/...

Technologies Discussion

- Link Layer Protocol
  - Packet likely to include:
    - [Link] source address
    - [Link] destination address
    - Control
      - Sequence number / packet identifier
      - Acknowledgement
      - Etc.
  - Header probably transported in Bluewater Design header

Technologies Discussion

- Network Layer Protocol
  - Responsible for end-to-end delivery of packets
  - Handles forwarding through ~~repeaters~~ routers
  - Packet likely to include:
    - [Network] source address (16 bits)
    - Source port address (8 bits)
    - [Network] destination address (16 bits)
    - Destination port address (8 bits)
    - Control

Technologies Discussion

- Network Layer Protocol
  - Vaguely analogous to a stripped-down IP
  - Will assume that smart nodes know how to route, dumb nodes don't
  - Smart nodes will maintain routing tables
    - How complete?
  - Dynamic routing protocol is topic for further investigation...

Technologies Discussion

- Transport Layer Protocol
  - Responsible for end-to-end (application-to-application) delivery of data
  - Provide unreliable datagram service
    - Analogous to UDP
  - Provide reliable datagram service
    - Analogous to “reliable UDP”

Technologies Discussion

- Transport Layer Protocol
  - Provide reliable byte-stream service
    - Analogous to [stripped-down] TCP
      - Short end-to-end delays (small sequence number space)
      - Avoid packetization/fragmentation issues
      - Push congestion control to MAC layer
  - Packet format
    - Thinking about this

Technologies Discussion

- Application Layer Protocols
  - Every application can have its own protocols
    - Probably datagram and reliable byte-stream protocols are independent
  - Application protocols can evolve independently

  - I can *help* you design and specify these
    - I don't have the domain expertise

Technologies Discussion

- What am I missing?

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Phase II Plans

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Phase II Plans

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