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# Personal Unattended Ground Sensors

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# Introduction



## Personal Unattended Ground Sensors (UGS)

- What are they?
- How would they be used?
- What operational constraints exist?



# What are they



- **Sensors for individual soldiers and small units**
  - Carried by soldiers
  - Emplaced by soldiers
  - Report to soldiers (first)
- **Primary capability - detect personnel and provide imagery for confirmation**
  - Non-imaging sensor
  - Imaging Sensor
- **Other potential capabilities**
  - Vehicle detection
  - Gunshot detection and localization
  - Chem/Bio detection



# Potential Missions



- **Clearing operations**
- **Small unit force protection**
- **Short term site monitoring**



# Clearing Operations



- **Urban and Complex (Tunnels and Caves) Terrain**
- **Mission: Clear areas of enemy combatants**
- **Sensors monitor**
  - ingress points to areas that are being cleared to detect infiltration
  - cleared areas to detect stay-behinds
- **Sensors placed during clearing operation**
- **Alerts monitored in real time by either**
  - clearing team(s), or
  - overwatch team



# Small Unit Force Protection



- **All Terrains (Urban, Open, Jungle)**
- **Mission: Unit staying in position for extended period (hours to days)**
- **Sensors monitor perimeter of position or selected axis of approach near a small unit to detect approaching personnel**
- **Sensors monitored in real time**



# Short term site monitoring



- **Sensors are left behind to monitor areas to detect activity**
  - Buildings that have been cleared
  - Ingress / egress routes
  - Chokepoints or other points of interest
- **Supports autonomous mode of operation**
  - In-field storage of alerts and images
  - Capable of summarizing past activity for quick upload
- **Supports standoff query of sensor field**
  - Soldiers can get activity summary before they enter area
    - Early warning of recent activity to spot ambushes



## Short Term Site Monitoring (cont)



- **Supports standoff query of sensor field (cont)**
  - Support connectivity to other Army assets
    - Other soldiers
    - Manned and unmanned vehicles (Air and Ground - UAVs, UGVs)
    - Standardized radio/network connection (e.g., Joint Tactical Radio System (JTRS) and Soldier Radio Waveform (SRW))
  - Additional component – Gateway node
    - Can provide storage and processing requirements
    - Incorporates standardized radio
    - Shouldn't be required for other missions
- **Supports Soldiers re-entering area**
  - Still provide real-time sensor monitoring



# Operational Constraints



Personal UGS system's design and performance must take into consideration operational constraints:

- Soldier constraints
- Mission constraints
- Logistical constraints
- Security constraints
- Other constraints



# Soldier Constraints



- **Carrying capacity**

- Soldiers already carry heavy loads
- Minimizing size and weight is a **key** requirement
  - Highly integrated electronics
  - Reduce radio size and weight by using low-power, multi-hop communications



- **Time**

- Soldiers have limited time to spare to monitor and control sensors
- Simplify use of system
  - Simple, quick to comprehend displays – Situational Awareness at a glance
  - Minimal levels of menu nesting



# Mission Constraints



- **Emplacement time**

- Many missions (e.g., clearing operations) require soldiers to maintain high, sustained operational tempo
- Soldier must be able to emplace sensors quickly
  - Eliminate configuration needed when emplacing sensors
    - self-configuring sensors (e.g., autogain, selecting modalities) and network (i.e., ad-hoc)
    - wide field-of-view on imaging sensor to eliminate pointing time
    - any required configuration should be doable before mission
  - Minimize types of sensors
    - reduce time needed to select sensor type and method of emplacement
    - one sensor type with multi-modalities better than several sensor types with single modality
    - may still need separate imaging and non-imaging sensors because of cost and emplacement differences



# Mission Constraints (cont)



- **Emplacement time (cont)**

- Provide network connectivity info in real time
  - Indication to soldier when sensor must be placed to maintain network connection
  - Eliminates backtracking to fill in network gaps

- Network must support quick setup time

- **Message transmission time**

- Need to minimize for real-time monitoring

- Alert transmission time ~ 1 sec

- Image transmission time ~ < 10 sec

- **Operating Life**

- Sensors will need to be able to operate for 2-3 days



# Logistical Constraints



- **Disposability**

- Mission needs or safety considerations may prevent recovery of sensors
- Sensors must be inexpensive enough to
  - Allow soldiers to leave them behind without having to account for them
  - Allow large quantities to be purchased to equip soldiers and support attrition
  - Exact cost threshold not yet determined, but somewhere around \$10 for non-imaging sensor, \$100 for imaging sensor
  - Low-cost is a **key** requirement

- **Re-usability**

- Sensors should be retrievable for re-use
  - reduces soldier burden – doesn't have to carry as many sensors
  - reduces logistic burden – don't have to resupply as many sensors



# Security Constraints



- **Secure**

- Enemy should not be able to tap into our network
  - Encrypted communications and authentication
- Enemy should not be able to utilize our sensors
  - Can't be used as sensor system
  - Can't be adapted to use as triggers for Improvised Explosive Devices

- **Stealthy**

- Comms traffic should be hard to detect
  - Low-power, multi-hop radios help



# Other Constraints



- **Sensors**

- localization can't rely on GPS

- GPS reception not available in all locations (inside buildings, tunnels, and caves)
    - GPS component and antenna cost and size may be prohibitive

- must operate down to full dark light levels

- tunnels and caves
    - Imaging sensors need illuminators (thermal infra-red still too high cost to be used)
    - Illuminators should be covert to naked eye (near infra-red)

- **Network**

- incremental growth – sensors can be added one at a time
  - multiple, mobile “data sink” nodes (nodes connected to soldier's display)



# Summary



## Personal Unattended Ground Sensors

- can support multiple small unit missions
- have unique capabilities and constraints compared to other Unattended Ground Sensors
- will have their design driven by requirements for extremely low cost and small size & weight