Performance Metrics for First Responder Locating/Tracking Technologies

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Locating and Tracking Performance Metrics

Overview

• **Introduction**
  – Locating versus tracking
  – Locating who, why, and and under what conditions
  – How well do we need to track

• **Performance Standards**
  – Metrics
  – Testing protocols

• **Summary**
Locating versus Tracking -

- Locating
  - Current Location

- Tracking
  - Current location, movement, & history
Locating – Who & Why?

- **Who is being located?**
  - Fire fighters & law enforcement officers
  - Building occupants, victims, suspects

- **Why locate?**
  - **Need to rescue**
    - fire fighters, officers, victims, etc.
  - **Guide rescue operations**
    - **Self extraction** –
      » fire fighter has locator w/ floorplan
    - **Rapid Intervention Teams**
      » Fire fighter has tag / beacon / ID
      » Search team has locator
Tracking – Who & Why?

- **Who is being tracked?**
  - Fire fighters & law enforcement officers
  - Building occupants, victims, suspects

- **Why track?**
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    - fire fighters, officers, victims, etc.
  - **Guide rescue operations**
    - **Self extraction** –
      » fire fighter has tracker w/ floorplan
    - **Rapid Intervention Teams**
      » Fire fighter has tag / beacon / ID
      » Search team has tracker
  - **Tactical Decisions**
    » Incident commander
    » Fire suppression – hose teams
    » Smoke ventilation – vent windows & roof
    » Staging additional resources
Locating & Tracking - where or what building type?

- **Type I or Fire-Resistive (NFPA)**
  - High rise office, shopping centers, or residential units
  - Reinforced concrete, structural steel (protected)

- **Type II or Noncombustible**
  - Office buildings, warehouses, auto repair shops
  - Metal frame with metal walls, metal frame with masonry walls, masonry walls with metal roof

- **Type III or Ordinary**
  - Office buildings, retail stores, mixed occupancy, apartment buildings
  - Noncombustible bearing walls and combustible roofs
  - Most buildings are of this type

- **Type IV or Heavy Timber**
  - Exterior noncombustible or limited combustible, masonry
  - Interior structural members, walls, columns, floors and roofs are large timbers
  - Common in the New England area

- **Type V or Wood Frame**
  - Single family dwelling, restaurants, retail stores
  - Log, post & beam, balloon, platform, and plank & beam
  - Structural members are wood and exterior walls are combustible
Under what conditions?

<table>
<thead>
<tr>
<th>Thermal Class</th>
<th>Maximum Time (min)</th>
<th>Maximum Temperature</th>
<th>Maximum Flux (kW/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>25</td>
<td>100 C / 212 F</td>
<td>1</td>
</tr>
<tr>
<td>II</td>
<td>15</td>
<td>160 C / 320 F</td>
<td>2</td>
</tr>
<tr>
<td>III</td>
<td>5</td>
<td>260 C / 500 F</td>
<td>10</td>
</tr>
<tr>
<td>IV</td>
<td>&lt;1</td>
<td>&gt;260 C / 500 F</td>
<td>&gt;10</td>
</tr>
</tbody>
</table>
## Location & Tracking – Resolution

### Residential Scenario

<table>
<thead>
<tr>
<th>Resolution meters</th>
<th>Location</th>
<th>Escape</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X-Y Direction</td>
<td>Z Direction</td>
</tr>
<tr>
<td>100</td>
<td>City Block +/-</td>
<td>10 floors +/-</td>
</tr>
<tr>
<td>10</td>
<td>Front or rear of house</td>
<td>3 floors +/-</td>
</tr>
<tr>
<td>1</td>
<td>Room</td>
<td>Floor +/-</td>
</tr>
<tr>
<td>0.1</td>
<td>Location in Room</td>
<td>Correct Floor</td>
</tr>
</tbody>
</table>
## Location & Tracking - Resolution

### Industrial Scenario -

<table>
<thead>
<tr>
<th>Resolution (meters)</th>
<th>Location</th>
<th>Escape</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X-Y Direction</td>
<td>Z Direction</td>
</tr>
<tr>
<td>100</td>
<td>Building +/-</td>
<td>10 floors +/-</td>
</tr>
<tr>
<td>10</td>
<td>Section of Bldg</td>
<td>3 floors +/-</td>
</tr>
<tr>
<td>1</td>
<td>Room</td>
<td>Floor +/-</td>
</tr>
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</table>
Location and Tracking – Performance Standards

- **Required Performance**
  - **Rescue and Tactical**
    - Range or penetration through structure
      - Incident command or RIT
    - 3D Resolution
    - Different building types
    - High temperature and wet environment
    - Distance between nodes/units
    - How many nodes can be tracked simultaneously
    - Require fire fighter to enter data?
    - With or without fire fighter input
    - Other data critical
Location and Tracking – Performance Standards

• Required Performance cont’d

  – Operational requirements
    • Weight
    • Survive high temperature
    • Battery / Power requirement
    • Does not interfere with other equipment, such as radios
    • Integrate with other electronic equipment
    • Operate with gloves on
    • Intrinsically safe
Location and Tracking – Performance Standards

- Once the performance requirements are established –
  - What yardstick or metrics does one use to evaluate required performance?
    - Establish measurement techniques
      - Signal quality
    - Develop representative test scenarios
      - Building Materials
      - Thermal environments
    - Performance metrics passed to Standards Development Organizations
      - NFPA, ASTM, NIJ
  - How does one verify the performance?
    - Standard testing protocols
    - Technology neutral and unbiased
    - Testing methods passed to Standards Development Organizations
      - NFPA, ASTM, NIJ
Location and Tracking Performance Standards

- Roles of NIST
  - Fundamental Science
    - Measurement or metrology (working with DHS)
    - Signal penetration (working with DHS)
    - Sensor design
    - Combustion Science
  - Building performance
  - Fire Environment
  - Performance Standards and Testing Protocols
    - Signal quality (working with DHS)
    - Sensor interfaces/performance (working with DHS)
    - Thermal exposure testing (working with DHS)
    - Network design (working with DHS)

- Develop new technology where expertise exists
Performance Standards Summary

• **Technology must meet the performance needs**
  – First responders
    • Rescue
    • tactical
  – Public / building occupants

• **Technology must operate**
  – Different building types
  – Different thermal conditions

• **Develop Standards & testing protocols**
  – Insure technology consistently performs as needed
  – Technology neutral and unbiased standards/protocols
Performance Standards Future Work

• **Assist in development of new technology**
  – Technical expertise
  – Internal research funds
  – Grants

• **Evaluate current systems**
  – Laboratory-scale tests
  – Full-scale fire exposure tests
  – Collaborate with Fire Service

• **Standards & testing protocols**
  – Representative building types
  – Representative exposure conditions
Locating and Tracking Performance Standards

• Thank you ....
• Questions?

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Why Invest in Locating/Tracking Technology?

- **Firefighter Fatalities** – 117 in 2004 (USFA)
- **Total Injuries** – 80,800 in 2004 (NFPA)
  - Fireground – 37,976 injuries

- Magnitude of U.S. Annual Losses ~ $128 billion total cost

- Tracking fire fighters allow
  - Better tactical decisions
    - Faster suppression
    - Decreased property losses
Under what conditions?