Integrated Modeling and Simulation of an Urban Operation Scenario

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Highlights

- **Goal:** Modeling the communications and coordinated operation of military/rescue groups in urban areas
- **Units:** ground sensor network, UAVs, rescue units(vehicles)
- **Features:**
  - Periodic polling of the sensors by low-flying UAVs and relaying of the alarms to the remote command center
  - Integrated operation of the surveillance UAV and rescue groups through continuous communications between the UAV, groups and the sensor network
  - Integration of the detailed representation of the urban terrain in path loss calculations
  - Optimized dispatch and placement of bridging UAVs to maintain the connectivity of the network
  - Compatibility with OSC format (SAIC) for loading the SDF scenario format and displaying the results

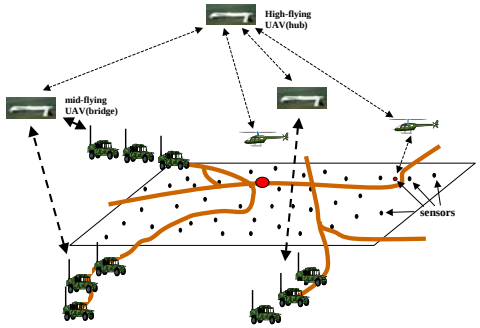
Scenario

- Rescue groups are initially stationed at different locations of Jakarta
- One of the sensor nodes in the city flags an alarm which is received by the helicopter and transmitted to the remote center
- All groups are dispatched towards the location of the event by receiving the best path from the planning algorithm
- Bridging UAVs are dispatched to optimal locations to maintain the connectivity of the network
- A single UAV is dispatched to follow the target and continuously transmit its location to the algorithm so that the best path for each node is updated periodically
- Upon an alarm by any sensor in the city, its neighboring streets are marked as closed and the paths are updated

UAV placement algorithm

- Node locations and their future positions are received by the algorithm
- The minimum number of UAVs and their locations are calculated to guarantee the connectivity of the network and the UAVs are dispatched to those locations

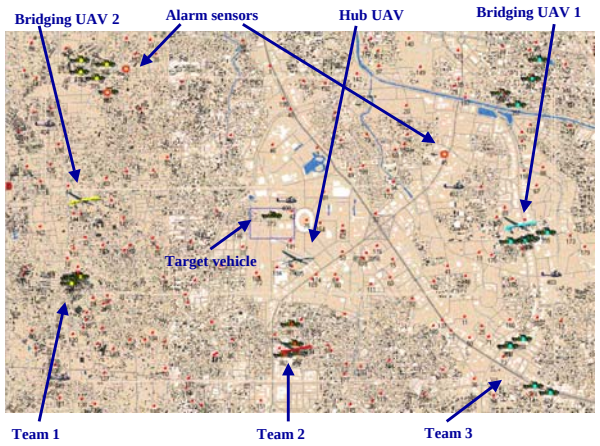
Communications hierarchy



Path planning algorithm

- The street map is stored as a graph and it is constantly updated based on the information received from the sensors and the UAVs
- The UAV that follows the target continuously transmits the location of the target to the ground nodes
- The algorithm periodically estimates the future position of the target and the best path towards the target for every node

Snapshot of the scenario



Terrain and propagation model

- **Terrain:** Jakarta area with major buildings and streets
- **Related propagation models:**
  - Langley-Rice
  - Welfish-Ikegami
  - TIREM