ALES i-eGress Use Case

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OUTLINE

- **Motivation**
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- **Questions**

MOTIVATION

- The recent advancements in information and communication technologies as well as innovative materials and building architectures offer a wide spectrum of opportunities to improve the evacuation time, safety and security. Dynamic signs that direct occupants based on the evolution of the emergency, mobile devices issued to hearing impaired occupants, protected elevators and intertwined staircases can be used to fasten the building evacuation.
- Intelligent navigation systems can drastically improve the evacuation of people during emergencies by providing dynamic directions to the evacuees based on the estimation of the building state, human distribution and threat development gathered through a network of sensing devices such as video cameras, motion and smoke sensors, access control points. Evacuation of or relocation within buildings may become necessary under several conditions, including fire, chemical pollution, earthquakes, power outages, severe weather, violent attacks. In some cases sheltering within the building is the right response to the emergency, in which case relocation within the building might be necessary.
- The main challenges connected with building evacuation or relocation are isolating the threats and making occupants take the right action, which includes gathering reliable information from the field, predicting the evolution of the emergency, and delivering the right information to occupants.

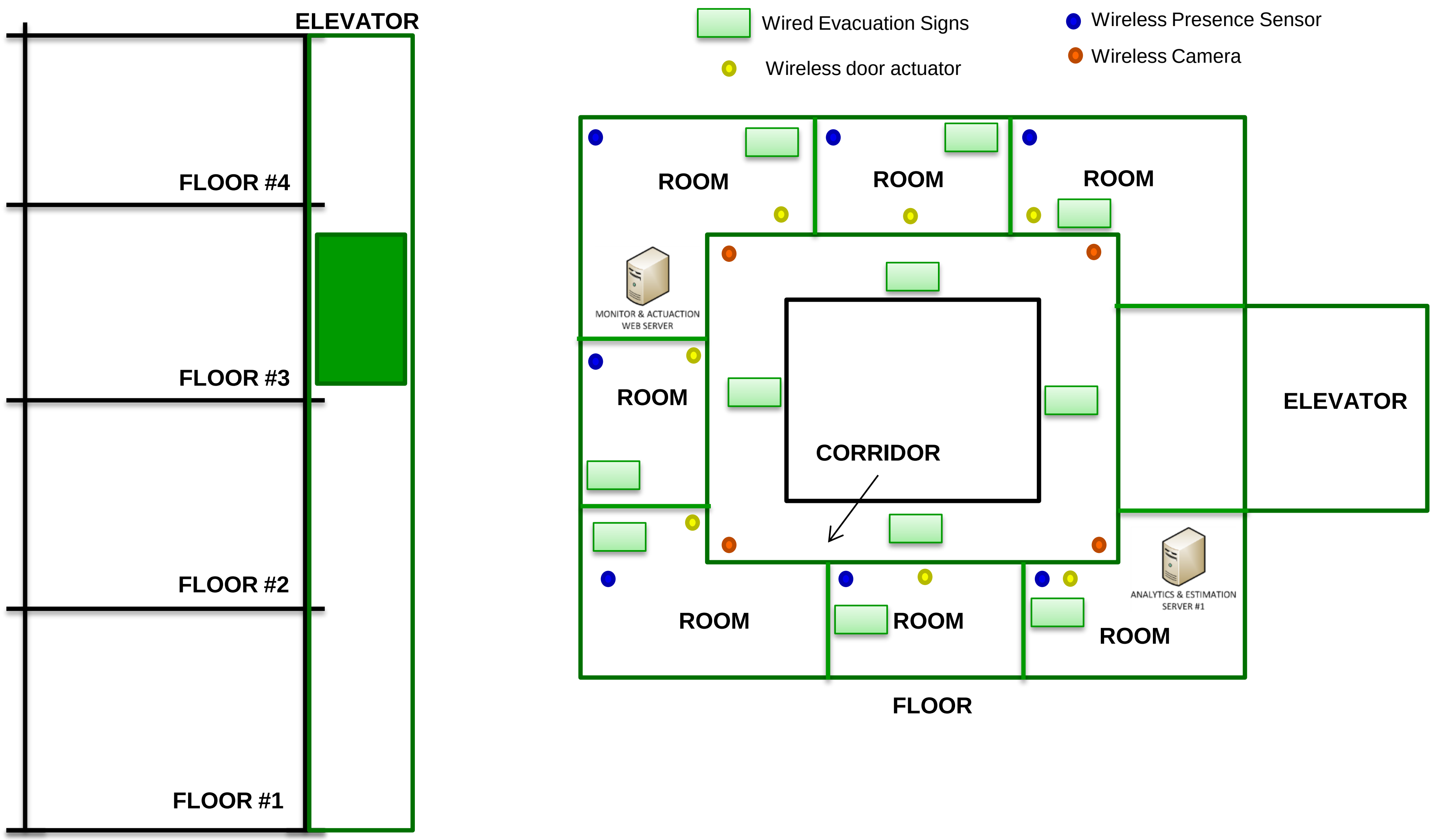
I-EGRESS

- The intelligent Egress system utilizes a network of sensors and dynamic intelligent signs distributed in the building. The sensors communicate with the nearby dynamic intelligent signs, which monitor the local area of the building and react to hazardous events. Sensors include video camera, motion and smoke sensors, and access control points. Coordination among dynamic intelligent signs ensures that each DIS reacts not only to local events by also to events occurring in other building areas for an effective coordination response. The status of each dynamic intelligent sign is monitored by human operators from the Emergency Control Center, where coordination with emergency response units of the fire, police and health care departments occurs.
- The system main objectives are two:
  - Before the arrival of first responders, based on the occupancy status and the effective threats, an evacuation plan is computed to minimize the time to evacuate the building
  - After first responder arrivals, allows for access information such as occupancy status and the evacuation plan so that evacuation can proceed safely guided by the first responders.

ARCHITECTURE

- **A building has** several floors and each floor has several rooms and a main corridor
- **Each room has**
  - a wireless presence detection sensors
  - a wired evacuation display to signal the directions in case of an evacuation
  - a wireless door actuator that lock/unlock doors in presence of an evacuation procedure
- **The corridor has**
  - several wireless cameras to enable using data analytics the estimation of the flow of persons in the building
  - wired display to be used to control the flow of persons during an evacuation
- **For each floor**
  - an analytics and estimation server collects data from the different sources (presence detection sensors, cameras) and compute an evacuation plan controlling doors locks and evacuation displays. In addition the elevator can be controlled.
  - a monitor and actuation web server allows for monitoring and controlling the evacuation using a web interface via secure connections. Every operation that is allowed for the Analytics and Estimation server can be performed via the web server

ARCHITECTURE



CHALLENGE PROBLEMS

- **Scenario #1: Cyber-attack**
  - A cyber-attack is performed with the objective of causing damage and losses to the building. Damage can be of three forms:
    - **Data and/or privacy violations**: the attacker aims at getting information related to the presence/absence of persons in the building or in particular rooms of the building
    - **False alarms:** the attacker triggers an evacuation procedure in absence of effective hazards causing economical damage
    - **System effectiveness degradation**: the attacker aims at degrading the functionality of the evacuation system

- **Scenario #2: Cyber-physical attack**
  - Combined safety and cyber-attack is performed before emergency response units arrive on site with the objective of causing both economic damage and physical damage to people.

QUESTIONS

- For each scenario, how do you analyse the security of the building and what type of attacks are possible?
- For the identified attacks, what counter-measures can be put in place and what is the effectiveness of such counter-measures?
- How privacy can be guaranteed? What kind of attacks are possible to violate privacy of users (e.g. know how many users are in the compound, what are the routes that are selected, what are the rooms that are accessible by an intruder during evacuation)?
- What attacker models and what are the threats that can violate the safety of the system in absence of physical threats? (e.g. trigger evacuation procedure in absence of a fire) And what in case of an effective threat? (e.g. block an evacuation in case of a presence of a fire)?
- How security protocols, encryption and policies could guarantee sufficient robustness security and privacy in this scenario assuming that the system we will in place for 10-20 years ?

PUBLICATIONS

- R.N. Tomastik, S. Narayanan, A. Banaszuk, S.P. Meyn, Model-based Real-Time Estimation of Building Occupancy During Emergency Egress, Pedestrian and Evacuation Dynamics 2008
- Amit Surana, S.P. Meyn, Y. Lin, S. M. Oggianu, T. A. Frewen, S. Narayanan, I. Fedchenia, Sensor-Utility-Network (SUN) Method for Estimating Occupancy in Buildings, 48th IEEE Conference on Decision and Control
- M. Massink, D. Latella, A. Bracciali, M. D. Harrison, A Scalable Fluid Flow Process Algebraic Approach to Emergency Egress Analysis, Software Engineering and Formal Methods (SEFM), 2010