Motivation
- Fine grained location tracking enables new ways to monitor workflow
- Apply security models to location based services for workflow
- Focus on defining workflow models by tracking people and objects in building

Workflow Background
- Workflow: consists of a sequence of tasks that are organized and executed in some order to facilitate some business process specification
- Task can be a manual activity implemented by human or an automatic one implemented by computer
- Control dependency should be defined between tasks

LocFlow
- Task: a principal moves an object to some location
- LocFlow: a set of tasks required to be implemented to facilitate a goal
- No control dependence is defined between tasks
- Task instance: an execution of a task
- LocFlow instance: an execution of the LocFlow, that is, a set of task instances

Example
- A nurse Alice moves therapy machine A to surgery room 1
- An orderly Bob moves surgery tray A to surgery room 1
- A nurse Cathy moves a patient B to surgery room 1
- An orderly Danny moves ultrasound machine C to examination room 2

Authorization
- Each task is responsibility oriented, therefore a principal must have the authorization/responsibility to execute the task
- Role based access control is an appropriate candidate
  - Authorization to execute a task is associated with one or more roles: e.g., a nurse moves a therapy machine to a surgery room
  - Principals are associated with one or more roles: e.g., Alice is associated with the role nurse
- Besides role based access control, fine-grained access control on individual object is required as well
- A team of principals are assigned to a LocFlow instance, thus a principal cannot execute a task unless he/she is a member of this group: e.g., Alice, Bob, Cathy and Danny form a team

Model
- Types are defined for the objects: e.g., athletic machine is a type for an object
- Types are defined for locations: e.g., surgery room is a type for a location
- A task defines that an object with type is moved to a location with type
- Authorization Schema authorizes a role to perform a task in a specified time threshold: e.g., nurse is authorized to perform the task that moves therapy machine to surgery room, but should not be 20 minutes later than the Locflow starts
- Property of LocFlow is a type of an object: e.g., a Heart Attack Patient determines the tools, thus type Heart Attack Patient is the property
- Context includes the key object, which has the type of the property, the team of members to serve this key object, and the Locflow starting time and ending time
- A task instance is good if the particular object has been moved to the particular location by an authorized principal during the valid time threshold
- Theorem: a LocFlow completes iff each task instance is good

Ubisense Background
- Ubisense is a location tracking system developed by AT&T Labs. It uses ultra-wide band radio (UWB) to compute the location of an active tag to within 6 inches of its actual location
- The accuracy of the Ubisense data allows us to correlate the movement of objects with each other. For example, if the tag of a nurse and the tag of an ultrasound machine are sufficiently close and moving together we can conclude with high confidence that the nurse is moving the ultrasound machine

Future Work
- Analyze fine-grained location data streams in real time to determine tasks and LocFlows
- Based on the real data, determine the LocFlow authorization schema
- Develop a system that monitors tasks and checks compliance with a known LocFlow
- Detect and flag anomalies and issue alerts
- Determine if anomalies imply a change in the known Locflow