**Definitions**

**Use Cases**

**Deliverables**

**Out of Scope**

**DEFINITIONS**

Building

1. A building has one or more elevator shafts.
2. A building has two or more contiguous elevator-accessible floors.
3. A building's ground floor is also referred to as the first floor.
4. A building's top floor is also referred to as the last floor.
5. A building receives N guests each day.
6. A building has zero or more occupants.
7. A building's occupant count is the sum of all the building's floors' occupant counts.

Floor

1. Each floor belongs to a single building.
2. Each floor is N feet tall.
3. A floor will have zero or more occupants.
4. A floor’s occupant count will change as occupants arrive and depart the floor.
5. The first floor will be a transient floor, not a working floor. It will have zero occupants.
6. At time T (e.g., 11am), 80% of a floor's existing occupants will depart their floor between time T and time T+2 hours and return 45 minutes later.
7. Over the course of a day, approximately 10% of a floor's occupants (guests and workers) transit to another random floor and return, with an average visit time of N minutes.
8. All a floor's occupants will need to have transited to the ground floor by EOD. (I.E., there will be zero floor occupants at the end of the day.) (AKA what goes up must come down.)
9. Each floor has one elevator lobby.

Elevator Lobby

1. An elevator lobby belongs to one floor.
2. An elevator lobby is a location where passengers wait in preparation to board an arriving elevator car.
3. Passengers departing an elevator car do not queue in the lobby.
4. An elevator lobby services any elevator car that arrives on its floor.
5. An elevator lobby will have one up and one down call button (except for the lobbies on the first and last floors, which will have a single up or down button, respectively).

Call Button

1. An active call button signals that an elevator car is required at that call button's floor.
2. An active Up call button indicates one or more passengers wish to go from that call button's floor to a higher floor.
3. An active Down call button indicates one or more passengers wish to go from that call button's floor to a lower floor.
4. An arriving elevator car will proceed in the direction indicated by call button once the arriving elevator car departs that floor.
5. All call buttons are independent of each other and can be pressed simultaneously.

Elevator Shaft

1. An elevator shaft is a vertical shaft that provides elevator services to floors of a building.
2. An elevator shaft can house zero or more elevator cars.
3. An elevator shaft has a starting floor (the lower floor) and an ending floor (the higher floor).

Elevator Car

1. An elevator car moves people between floors of a building.
2. An elevator car operates within an elevator shaft.
3. Each elevator car is independently controllable.
4. An elevator car can have zero or more passengers.
5. An empty elevator car is an elevator car with zero passengers.
6. An elevator car has a maximum passenger capacity and maximum passenger weight capacity.
7. An elevator car will move to each floor at a rate of N feet per second (FPS).
8. Each elevator car uses an average of X KW of electricity per foot for a given FPS rate of travel.
9. An elevator car can be taken out of service and can be placed into service.
10. An elevator car contains floor selection buttons corresponding to the floors of a building.
11. An elevator car has floors that it is permitted to stop at.
12. An elevator car will not stop at nor respond to calls from any non-permitted floor.
13. An elevator car can be directed to go to a specific floor (the destination floor).
14. An elevator car can have an active up or down direction of travel or can be stationary.
15. A stationary elevator car can be assigned any direction of travel.
16. When an empty elevator car receives its first passenger, its direction of travel is assigned.
17. The direction of travel of an occupied elevator car cannot be changed (except for fire recall to the ground floor which is presently out of scope for this spec).
18. An elevator car may have several destination floors.
19. An occupied elevator car may make stops along the way to a destination floor.
20. An elevator car arriving at a floor cancels that floor's call button activation corresponding to the elevator car's planned departing direction of travel.
21. When an elevator car discharges its last passenger, it can be assigned a new destination floor.
22. An elevator car in a 'hold' state is at a floor, contains no passengers, and whose doors are closed.
23. If an elevator car has no passengers and has no further instructions, it can be placed in a hold state.
24. An empty elevator car may be sent to a floor and hold without having received a call from that floor.
25. Passenger loading and exiting takes N seconds for each passenger.

Occupant

1. An occupant is a person in a building.
2. An occupant belongs to only one building and to only one floor in that building.
3. An occupant is either a worker or a guest.
4. Occupants press call buttons.
5. An occupant, whether worker or guest, is also a passenger while they are in an elevator car.
6. An occupant is either on a floor or is a passenger.

Worker

1. Each worker has a home floor.
2. A Worker arrives on the first floor between the hours of 7am to 9am and transits to their assigned higher floor.
3. A Worker departs their assigned floor between the hours of 4pm to 6pm and transits to the first floor.

Guest

1. Over the course of the day, the building will receive N guests randomly distributed.
2. Guests arrive at the ground floor and transit to a destination floor then reverse between the hours of 8am and 5pm.
3. Guests have an average stay on a work floor of N hours.

Passenger

1. A passenger is a building occupant that is in an elevator car.
2. A passenger leaves the occupancy of a floor when they enter an elevator car.
3. A passenger enters the occupancy of a floor when they depart an elevator car.
4. A passenger is still considered a building occupant while they are in an elevator car.
5. Passengers have an average weight of 172 pounds with a standard deviation of 29 pounds.

Trip

1. A trip is defined as the time from when a passenger presses a call button and that passenger arriving at their destination floor.

Misc

1. In addition to automated simulation, provide a command interface to perform the various operations (create a passenger, arrive a passenger, call an elevator, etc).
2. A building (and its elevator equipment) will have a simulation day. For example, it will be in operation from Xam (Start Of Day) to Ypm (End Of Day).

**USE CASES**

Building

Floor

Elevator Lobby

Call Button

Elevator Shaft

Elevator Car

Occupant

Worker

Guest

Passenger

Trip

Misc

**DELIVERABLES**

Hourly and Daily Performance Specs, totals and per elevator.

1. Feet travelled. (Relates to maintenance frequency; The more feet travelled, the more maintenance required.)
2. Electricity usage. (Relates to cost of operation.)
3. Completed passenger-floors (where one passenger-floor is one passenger moved one floor).
4. Passenger wait times (average and max). (Passenger satisfaction.)
5. Passenger trip times (average and max). (Passenger satisfaction.)
6. The elevator algorithm used will be listed along with the measurements.

There will be a debug mode that will display a status message for every step taken. For example, describing why a particular elevator was selected to answer a call, when an elevator arrives at a floor, when a passenger calls an elevator, etc.

**OUT OF SCOPE**

1. Mid-trip change of direction (e.g., fire recall to ground floor).
2. Electricity usage adjustments for elevator movement start, coasting, or braking.
3. Abandoned floor calls (i.e., there will always be a passenger waiting to board when an elevator arrives at a call).
4. Visual simulation.
5. Variable simulation speed.
6. Multiple elevator cars per elevator shaft.
7. Double-deck elevator car.
8. Entering a destination floor from the elevator lobby.