A Mobile Communication System

- Problem Formulation
  - An operator in charge of a network covering a highway has been receiving complains from its subscribers regarding “QoS”.
  - The company expects even more subscribers in the future and is consequently worried about the situation!
  - So, the objective of this project is to simulate the network to determine if the system guarantees the QoS which is measured by:
    - *blocked calls* <2%
    - *dropped* calls <1%

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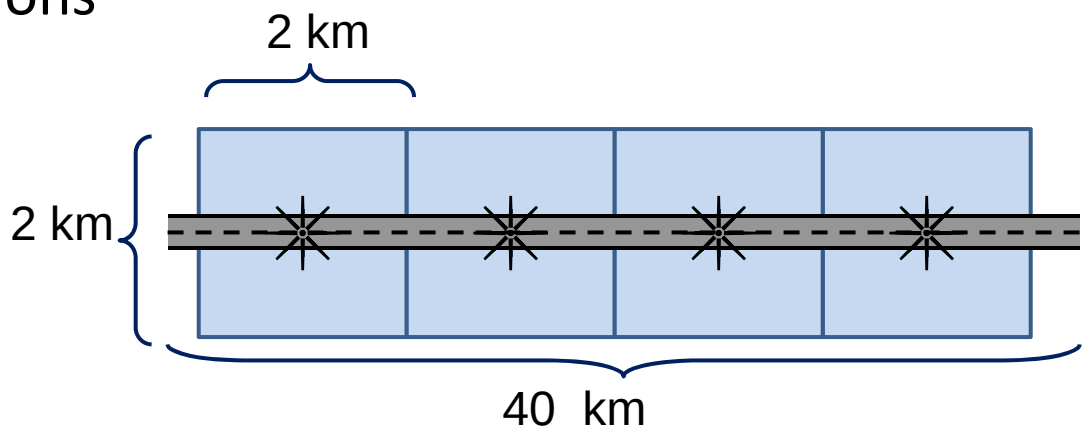
- Facts: The Network
  - The company owns 20 base stations
  - Each base station covers a range of 2 km
  - There is *no overlapping cells*. Where the reach of one base station ends, the reach of the next base station starts
  - Each base station has 10 channels
  - A 40 km long (*one-way*) highway is covered by the base stations



A Mobile Communication System

- Facts: Dropped or Blocked Call
  - Handovers: When a subscriber making calls cross cell boundaries, the channel being used must be released and a new channel has to be acquired.
  - If a channel is not available in the new base station during handover the call is *dropped*.
  - If no channels exist in a base station when a new call is initialized that call is *blocked*.

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- Input data
  - The company has provided the following measurements (traces):
    - Call initiation times and their first base stations
    - Call durations
    - Car speeds
  - (optional) Use input analysis methods to determine probability distributions for:
    - Call inter-arrival times
    - Call initiation base stations
    - Call durations
    - Car speeds

Read the following paper for simulation input analysis:
http://www.informs-sim.org/wsc10papers/006.pdf

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- Model Assumption
  - The highway is one-way
  - Each cell has a rectangular reach and the cells do not overlap (e.g., where the reach of base station 1 ends, base station 2 starts).
  - Cars maintain *the same speed* during a call
  - The position of the car initiating a call in a cell is *uniformly distributed* along the section of the highway covered by the base station.

Read the following page for sampling uniform distribution
http://en.wikipedia.org/wiki/Uniform_distribution_(continuous)#Sampling_from_a_uniform_distribution

A Mobile Communication System

- Event & States
  - Three types of events:
    - Call initiation [*time, speed, station, position, duration*]
    - Call termination [*time, station*]
    - Call handover [*time, speed, next_station, remaining_duration*]
  - State for each base station:
    - Channel status,
      - 10 channels (busy/free)
    - Statistics:
      - Number of Handovers
      - Number of Dropped calls
      - Number of Blocked calls

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- Test & Evaluation
  - Run your simulator using trace (and optionally, distributions)
  - Run your simulator multiple times, each with *a warm-up period*. Then calculate the average values and indicate the statistical significance.
  - Discuss how you determine the "warm up period"

Read the following paper for simulation output analysis:
http://www.informs-sim.org/wsc07papers/009.pdf

A Mobile Communication System

- Project Requirements
  - Federated simulation
    - Source federate
      - Creates federation
      - Generates calls either based on the input trace file or probability distributions
    - Base stations federates
      - Each simulates four contiguous base stations
    - Interactions
      - between source and base stations federates
        - » One way, for getting the initiated calls
      - between base stations federates
        - » One way, for handing over calls
    - Time management
      - Federates are all time-managed
      - Event-driven time advancement should be used
    - Data distribution management (optional)
      - Using DDM to make sure interactions are received only by the required federates (e.g., if a call is initiated at base station 5, only should the federate that simulates base station 5 receive the interaction from the source federate)

A Mobile Communication System

- Project Requirements
  - Software
    - Portico RTI (http://porticoproject.org/index.php?title=Main_Page), or
    - Open HLA (http://ohla.sourceforge.net/)
  - Hardware
    - Network of PCs
  - Report
    - Design and implementation of your simulation
    - Pseudo-code (or flow-chart) of the event handling functions
    - Input analysis (optional)
    - Summary of simulation results
    - No more than 10 pages
    - Due on 2 Nov 2012 (week 11)
  - Demo
    - Demonstrates the working of your distributed simulation
    - Presentation on 6 Nov 2012 (week 12)