Homework 2 [Ch 7-8]

This written homework focusses on Chapters 7 and 8 (including the extra material we covered as a part of Chapter 8). Your response should be well-thought-out, coherent, and concise. Quality of written expression will be a factor in the grading (please use full sentences). Short, to-the-point answers are preferred.

For this Homework, consider a general disaster management domain (e.g. Robocup Rescue): Lewes, DE has suffered a devastating Kaiju attack and you are the DEMA coordinator. Some basic shared assumptions *(I don't think all this is necessary but I wanted everyone on a similar page at least*):

- The city can be represented as a graph with places on the vertices and roads on the edges.
  - Roads have a travel time, and may be blocked (infinite travel time)
- Places may be on fire, and will burn to the ground some fixed rate.
- Victims, located in places, are hurt at various severities and will die in some estimated time (e.g. lose health at some fixed rate)
  - Victims can not move themselves.
  - Victims in a place on fire will die at the sooner of (building burns, death by injury)
- You have 2 Firefighters initially located at specific places (fire stations)
  - Firefighters put out fires at some fixed rate
  - Victims can not be treated by Ambulance or Police at a Fire place unless Firefighters are present (or fire is extinguished)
- You have 2 Hospitals (located at specific places) that repair hurt victims
  - Each hospital has 1 Ambulance which can be used to transport victims
  - Victims lose health more slowly when in an ambulance
  - Ambulance carries only 1 victim
  - Ambulances may deliver to any Hospital (if more than one)
- You have 3 Police initially located at specific places (police stations)
  - Police can clear blocked roads at some rate
  - Police can apply first aid one time to victims (victims lose health more slowly)
- Partial Observability: You initially know where the Hospital(s), Fire Station(s), and Police Station(s) are.
  - Fire can be observed from any location within 2 nodes in the graph
  - Victims can only be observed if in the same location.

Any other assumptions you can make if it is important to your answer (just document them)..

1. [20 pts] Assume Police Car 1 is at Place Zwaanendael, which is on fire and contains 3 victims. Give an example of a use of the contract net in this domain. You should explain how the contract net is used to do task allocation in that scenario. Your description should cover all the stages of the contract net.

2. [20 pts] Write down a dialogue between four agents, using the FIPA ACL, that could occur in the scenario you explained in the previous question.
Your answer should include the content of all performatives, and you should explain what each agent is achieving with each performative that it passes, in terms of the mental state of the other agents (you don't need to be excessively formal, just be clear what each performative is expected to achieve in your example).

3. [20 pts] Model the task allocation task of the previous two problems in TÆMS. Recall that TÆMS focusses on the underlying tasks, subtasks, and their relationships but not on the coordination method (e.g. Contract Net). What are Cost, Quality, and Durations of tasks? Do Min/AND, Max/OR, SUM and XOR cover the needed quality accumulations? If not, explain the semantics of any other subtask quality accumulation functions you use. Do Enables and Facilitates (or their opposites, Disables and Hinders) serve for non-local effects? If not, explain any new NLEs you invent (don't worry about formal definitions).

4. [20 pts] Given this underlying model of the task you previously coordinated using the contract net, compare and contrast solving this problem using (a) GPGP (with the PGP set of mechanisms: update non-local viewpoints, communicate results, handle simple redundancy, handle hard and soft coordination relationships), and (b) STEAM (Tambe's implementation of Cohen & Levesque's Joint Intentions approach)

5. [20 pts] Consider 3 agents (A,B,C) that as a group need to achieve:
- Three local tasks (one for each agent, TA TB, TC) that individually take 1 hour.
- One task T2 that requires B and C to work together simultaneously for 30 minutes.
- One task T3 hat requires A do something for 30 minutes (T3A) and then B do something for 30 minutes after A finishes (T3B).
- One task T4 that also requires two subtasks (T4.1, T4.2) that are 30 minutes each, but can be done by any agent in any order (T4.1A, T4.1B, T4.1C, T4.2A, T4.2B, T4.2C).

Represent this problem as a DCOP and solve to optimize both that all tasks must be completed, and that the finish time (makespan) is minimized *[hint: one approach is to represent start times, as all tasks are known durations.]*