FIT3142-Tutorial 5 - Solutions

2.1 Question 1 (25%)
Explain the behaviour of Amdahl's Law in Distributed Systems where $S_{comp} \gg S_{network}$, $S_{comp}{}' == S_{network}$ and $S_{comp} \ll S_{network}$. When can you neglect the effects of a network or fabric?

If the network provides extremely high capacity and thus short delays to transmit, then scomp >> snetwork and the distributed system behaves no differently from a conventional "bussed" multiprocessor.

2.2 Question 2 (25%)
Explain the network saturation problem. Why does it matter?

In terms of understanding grid performance degradations, we are most interested in what happens in a queueing system when the load (i.e. amount of traffic) approaches the limits of the queue's capacity to handle. This is termed "saturation" and results in a nonlinear and rapid increase in delays experienced waiting in the queue.

If the network is poorly matched to the grid application, third party background traffic may drive it into saturation, causing unpredictable traffic delays and thus unpredictable degradation in grid application performance. If the grid application produces large surges in traffic load across the network, it may drive the network into saturation, resulting in unwanted but predictable degradation in grid application performance

2.3 Question 3 (25%)
Explain the limitations of bandwidth reservation. When is bandwidth reservation useful?
If the application is highly sensitive to delays, then measures will be needed to control the delay through the network.
• Two basic strategies are possible:
   1. Install a network with very much higher throughput.
   2. Use bandwidth reservation techniques to ensure that the grid application does not have to compete for network bandwidth / capacity.
There are limitations in Bandwidth Reservation:
   – The grid middleware in use may not support this functionality well, or at all.
   – The operating system network protocol stack may not support this functionality well, or at all.
   – The network may not support QoS functions, or do so poorly.
   – Even if Bandwidth Reservation is available, the network may not have the performance to cope.
The best approach for dealing with network throughput and delay problems is always to understand and optimise the application first, then deal with the network if there is no other choice.

2.4 Question 4 (25%)
Explain the partitioning problem in a Distributed Application. Is the problem applicable to

parametric computing problems?

The most difficult applications are those with significant data dependencies, examples being two or three dimensional mesh computations. In a mesh computation, dependencies exist between individual cells in the mesh. The result is that the partitioning of the mesh into a grid will impact efficiency and parallel speedup. A smaller number of processors each doing more work might perform better than a larger number of processors each doing less work individually.