Distributed Network: Assignment #Four

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Problem 1

Both Dcell and Bcube use miniswitches to scale out, why?

Solution

DCell uses only mini-switches to scale out, and it scales doubly exponentially with the server node degree. for DCell, because it's structure is recursively-defined, so it uses only mini-switches to scale out instead of using high-end switches to scale up. In practice, a DCell with a small degree can supp ort as many as several millions of servers without using exp ensive core-switches or core-routers.

In BCube, it only uses COTS mini-switches. Multiple layers of cheap COTS mini-switches are used to connect those servers.

The reason that both BCube and DCell use miniswitches to scale out, I think:

- the aim of BCube and DCell is to find a easy strategy way to scale up. so the network cannot be centralized, using a central-switches is not considerable.
- mini-switches is cheap and available, we can use plentiful mini-switches due to the low cost of mini-switches.
- mini-switches are affordable and wiring is a solvable issue for a container-based data center. data center

Problem 2

Why is the routing path in Dcell not the shortest path?

Solution

DCellRouting is not a shortest-path routing scheme. It can be shown by the following example. For a $Dcell_2$ with n=2 and k=2, the shortest path between nodes [0,2,1] and [1,2,1] is ([0,2,1],[6, 0,0],[6,0,1],[1,2,1]) with length 3. The path using DCellRouting is ([0,2,1], [0,2,0], [1,0,0], [0,0,0], [1,0,0], [1,0,1], [1,2,0], [1,2,1]) with length 7.

DCellRouting uses a divide-and-conquer approach. the algorithm will first find the link (n_1,n_2) connecting the two $DCell_{k-1}s$, and thus the routing is divided into two sub-paths: from source to n_1,and from n_2 to destination. the procedure is repeated until finally all the sub-paths are direct links. the shortest path between the sources and the destination is quite close to the shortest-path routing.

Problem 3

calculate the number of the nodes in Dcell(n,k) where n is the number of server(ports of switch) in Dcell(n,0) and k is the level of Dcell.

solution

due to the procedure to build a DCell, there exists these equations:

$$Dcell(n,k) = \begin{cases} n & k = 0 \\ Dcell(n,k-1) \times (Dcell(n,k-1)+1) & k \geq 1 \end{cases}$$

for definite n and k, the number of the nodes can be calculated by the equation recursively. but it can not be shown in polynomial of n and k.