IPv4 Addresses and Address Resolution Protocol

1) Your computer with the IP address 134.226.36.18 wants to transmit an http-request to a server at Google with the IP address 173.194.37.104. For http-requests, your machine uses a proxy with the IP address 134.226.32.54 (see figure on next page). Your computer is connected through an IEEE 802.11 access point to the sub-network 134.226.36.0. The two sub-networks 134.226.36.0 and 134.226.32.0 are separate Ethernet broadcast domains, both of them are connected through a router in the School of Computer Science and Statistics with at least two interfaces for 134.226.32.254 and 134.226.36.254. The computers in the sub-networks use these addresses as the addresses for the default gateway.

   Describe the journey of the http-request and the exchanges of information at the Network and Link Layer i.e. using IPv4 and Ethernet from your computer to the server at Google. The description should include the information that is necessary for the computers and routers to process the IPv4 packets and Ethernet frames. You can assume that the routers have a full view of the internal network of TCD and do not have to update their routing information.

   - The sender discovers that the destination is not in its local network
   - and that it needs to communicate with the default gateway
   - An ARP request from 134.226.36.18 for the hardware address of the default gateway
   - An ARP response from default router to 134.226.36.18
   - Transfer of the IPv4 packet in an 802.11/Ethernet frame addressed to the default router with the IP address of the proxy server as destination address
   - ARP request for hardware address of proxy server
   - ARP reply from proxy server
   - Transfer of HTTP request to proxy server
   - Transfer of HTTP request by proxy server to default gateway addressed to IP address of Google server
   - Transfer of HTTP by default gateway to next router and so on until the IP packet is delivered to the router at the network of the Google server
   - ARP request for hardware address of Google server
   - ARP response from Google server
   - Delivery of HTTP request to Google server

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2) Explain the advantages and disadvantages of a data centre where the hardware of the data centre may consist of 512 racks using a fat-tree topology in comparison to a traditional 4-post router approach.

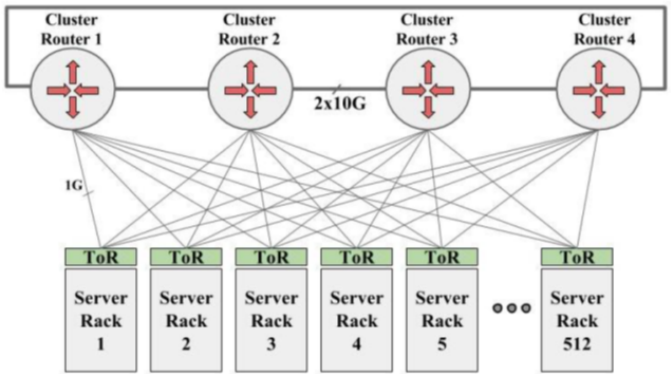

Figure 1: Data centre scenario with 512 racks and 4 routers*

In a 4-post router topology, the connections from top-of-rack switches to router are limited and this may lead to the competition by various flows for the use of these connections. The move from a 4-post router topology to a fat-tree topology increases the number of possible paths between servers in a rack to other server. This increase in potential paths and multiple devices in aggregation and spine blocks provides alternative paths that can be exploited to avoid competition for the use of individual connections.

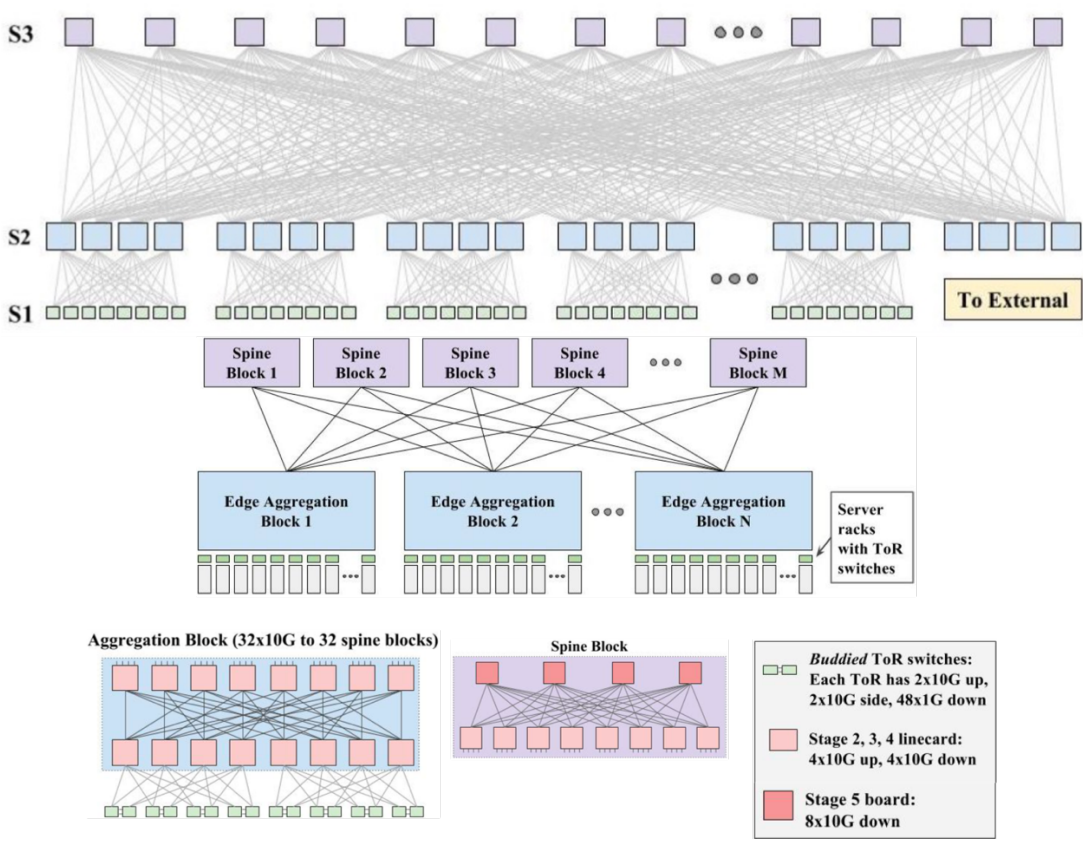

Figure 2: The diagrams above give an overview of the increase of links between network elements in comparison to a 4-post router topology.