For the following 3 models, the only changing variable is the slot utilization percentage and hence the total capacity of both customer and network facing sides. The maximum traffic utilization per router is 75%. All other router configurations are assumed to be constant. The network facing capacity for all routers will be 75% since the amount of traffic coming the other way is unknown, and because this falls in line with the above criteria and provides some redundancy as well. For redundancy, it is best to use a slot utilization percentage of 50% since it can accommodate the traffic of the other half. However, in the following scenarios, additional routers would have to be added to achieve a 50% slot utilization percentage, which would greatly contribute to the total cost. A 75% slot utilization percentage provides enough redundancy and will be used for all routers unless otherwise stated.

Scenario 1 [Figure 1]

Firstly, to accommodate 2Tbps customer traffic, no new distribution routers are needed from the default configuration. By utilizing approximately 75% of the customer facing slots capacity, we can get a capacity of 525Gbps [(total customer facing capacity) * (0.75) = 700Gbps*0.75 = 525Gbps]. Thus, 525Gbps*4 = 2.1Tbps, which can handle the customer traffic.

Second, no new edge routers are added. By utilizing approximately 75% of the DR facing slot capacity, the total capacity will be about 3000Gbps [4000Gbps*0.75 = 3000Gbps]. This is more than enough to handle 2Tbps customer traffic incoming, and if each DR router were to aggregate and transmit 1500Gbps, the edge router would still be able to handle the traffic.

Lastly, 1 core router needs to be added for redundancy. If one were to fail, the traffic can be transferred to the other. By using 75% of the slots, we get an edge and core facing capacity of 7500Gbps. Which is more than enough to handle 2Tbps customer traffic, and if each edge router were to aggregate and transmit 3750Gbps, the core routers would still be able to handle the traffic.

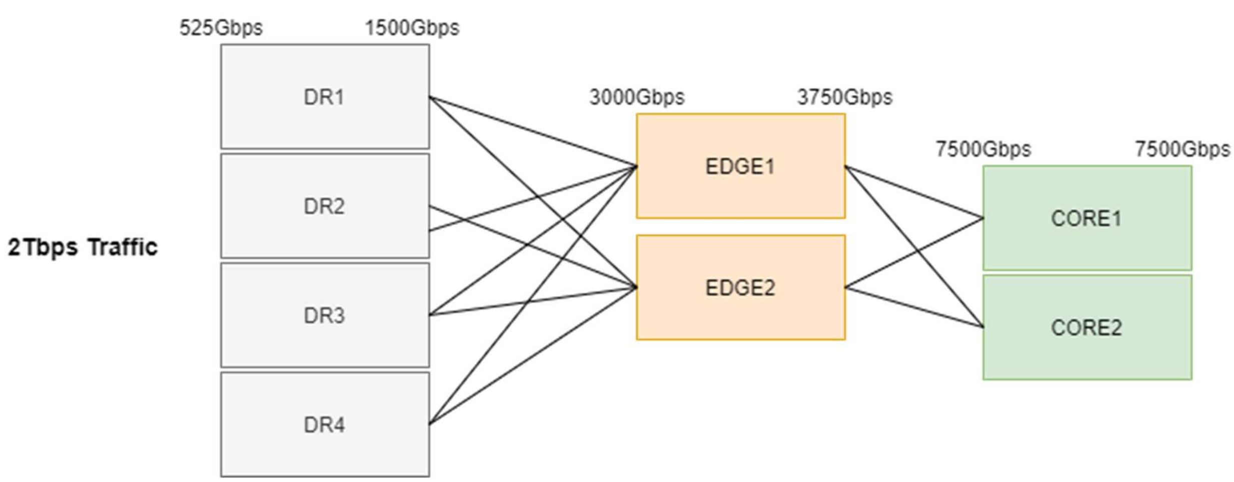

Figure 1. Diagram of routers with 2Tbps injected traffic. Values on top of routers represent customer facing and network facing capacity.

Scenario 2 [Figure 2]

Firstly, to accommodate 9Tbps customer traffic, 18 distribution routers are needed. By utilizing approximately 75% of the customer facing slots capacity, we get a capacity of 525Gbps per router [(total customer facing capacity) * (0.75) = 700Gbps*0.75 = 525Gbps]. Thus, 525Gbps*18 = 9.45Tbps, which can handle the customer traffic.

Second, 10 edge routers are needed. By utilizing approximately 75% of the DR facing slot capacity, the capacity per router will be about 3000Gbps [4000Gbps*0.75 = 3000Gbps] for 8 routers. The other 2 edge routers utilize 50% of the slots on both ends and have a DR facing capacity of 2000Gbps and core facing capacity of 2500Gbps. The reason for this is that there are only 2 distribution routers and it would be a bit of an overkill to have the edge routers at 75% capacity. By using 50%, the traffic demands are still met, and more redundancy occurs. Total DR facing capacity = 3000Gbps*8 +2000Gbps*2 = 28Tbps. This is more than enough to handle 9Tbps customer traffic incoming, and if each DR router were to aggregate and transmit 1500Gbps, the edge routers would still be able to handle the traffic [1500Gbps*18 DR = 27Tbps]. In addition, by having 4 or 2 DR's connected to 2 edge routers redundancy is achieved in the event one of the routers fail.

Lastly, 10 core routers are needed. By utilizing approximately 75% of the edge facing slot capacity, the capacity per router will be about 7500Gbps [10,000Gbps*0.75 = 7500Gbps] for 8 routers. The other 2 core routers utilize 50% of the slots on both ends and have an edge facing capacity of 5000Gbps and core facing capacity of 5000Gbps. The reason for this is that there are only 2 distribution routers on the left side, which leads to less capacity required for the edge and core routers. By using 50%, the traffic demands are still met, and more redundancy occurs. Total edge facing capacity = 7500Gbps*8 +5000Gbps*2 = 70Tbps. This is more than enough to handle 9Tbps customer traffic incoming, and if the edge routers were to aggregate and transmit 3750Gbps and 2500Gbps, the core routers would still be able to handle the traffic [3750Gbps*8 + 2500Gbps*2 = 35Tbps]. In addition, by having 2 edge routers connected to 2 core routers, redundancy is achieved in the event one of the routers fail.

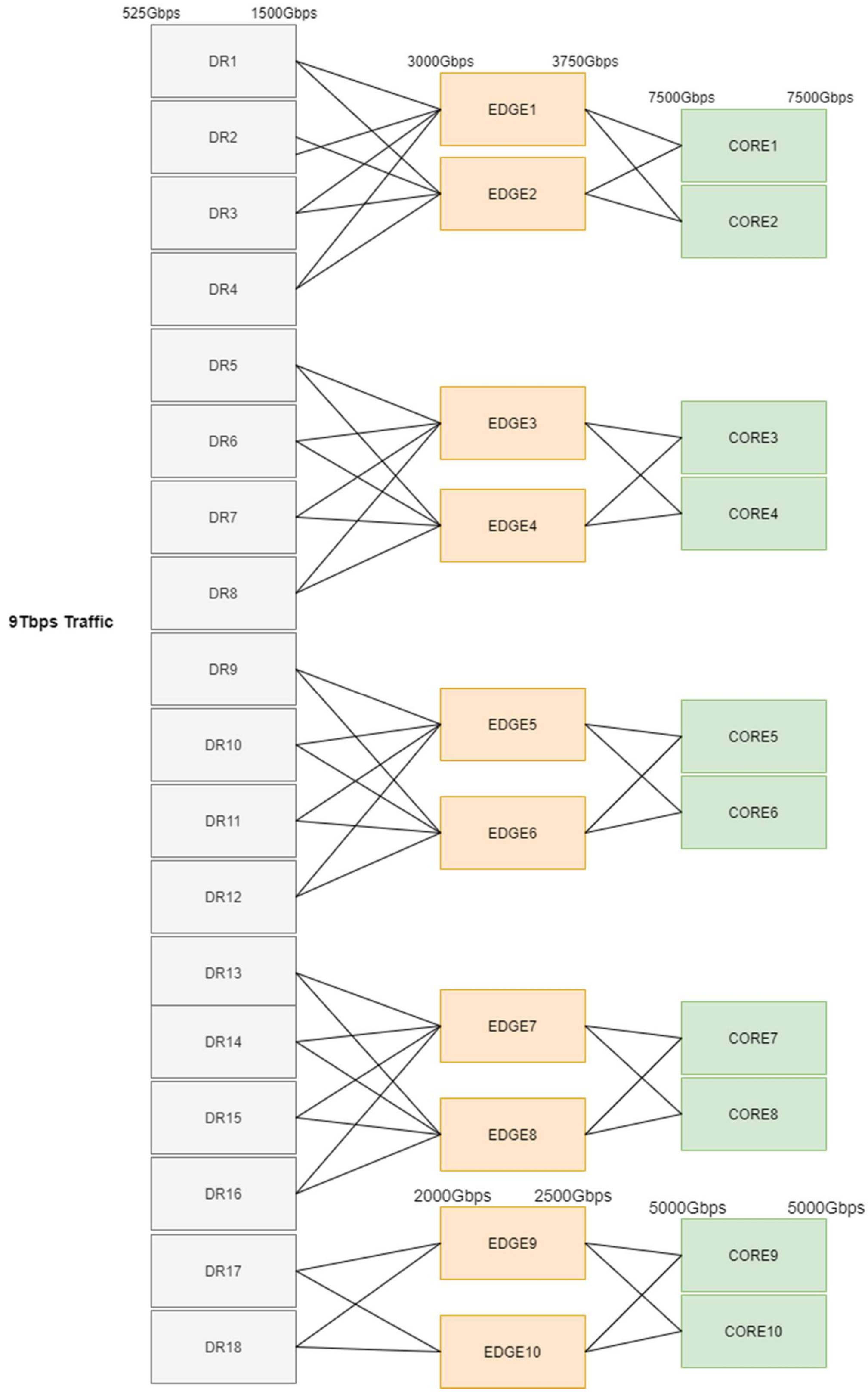

Figure 2. Diagram of routers with 9Tbps injected traffic. Values on top of routers represent customer facing and network facing capacity.

Scenario 3 [Figure 3]

Scenario 3 is very similar to scenario 2 in terms of the model structure. The only difference is that there are 3 more distribution routers, 2 more edge routers, and 2 more core routers.

To accommodate 11Tbps customer traffic, 21 distribution routers are needed. Capacity is 525Gbps per router [calculation shown in other models]. Thus, 525Gbps*21 = 11.025Tbps, which can handle the customer traffic.

Second, 12 edge routers are needed. By utilizing approximately 75% of the DR facing slot capacity, the capacity per router will be about 3000Gbps [4000Gbps*0.75 = 3000Gbps] for 10 routers. The other 2 edge routers utilize 50% of the slots on both ends and have a DR facing capacity of 2000Gbps and core facing capacity of 2500Gbps. The reason for this is that there is only 1 distribution router on the left, and it would be a bit of an overkill to have the edge routers at 75% capacity. By using 50%, the traffic demands are still met, and more redundancy occurs. Total DR facing capacity = 3000Gbps*10 +2000Gbps*2 = 34Tbps. This is more than enough to handle 11Tbps customer traffic, and if each DR router were to aggregate and transmit 1500Gbps, the edge routers would still be able to handle the traffic [1500Gbps*21 DR = 31.5Tbps]. In addition, by having 1 DR connected to 2 edge routers redundancy is achieved if one of the edge routers fail.

Lastly, 12 core routers are needed. By utilizing approximately 75% of the edge facing slot capacity, the capacity per router will be about 7500Gbps [calculated above] for 10 routers. The other 2 core routers utilize 50% of the slots on both ends and have an edge facing capacity of 5000Gbps and core facing capacity of 5000Gbps. The reason for this is that there is only 1 distribution router on the left side, which leads to less capacity required for the edge and core routers. By using 50%, the traffic demands are still met, and more redundancy occurs. Total edge facing capacity = 7500Gbps*10 +5000Gbps*2 = 85Tbps. This is more than enough to handle 11Tbps customer traffic, and if the edge routers were to aggregate and transmit 3750Gbps and 2500Gbps, the core routers would still be able to handle the traffic [3750Gbps*10 + 2500Gbps*2 = 42.5Tbps]. In addition, by having 2 edge routers connected to 2 core routers, redundancy is achieved in the event one of the routers fail.

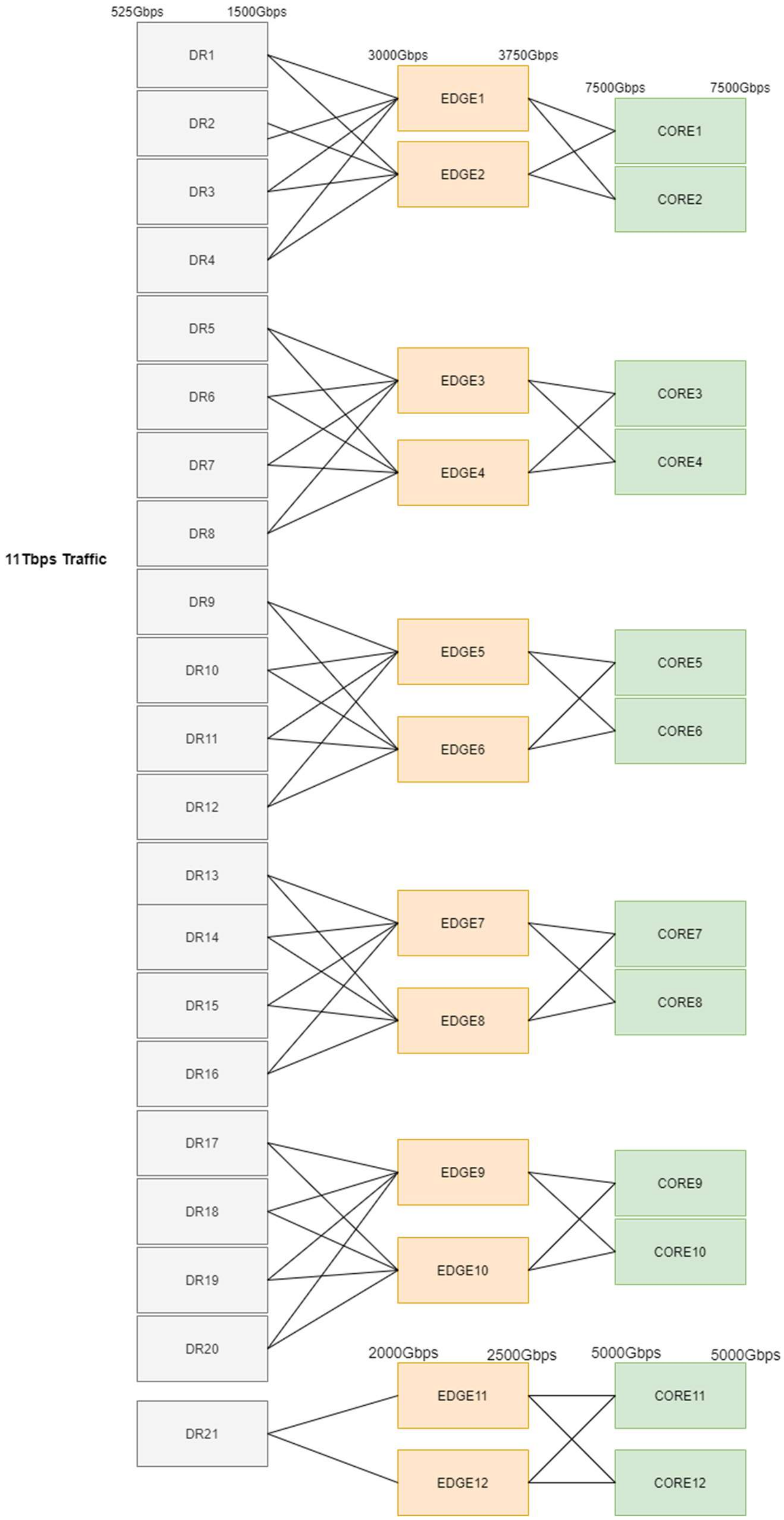

Figure 3. Diagram of routers with 9Tbps injected traffic. Values on top of routers represent customer facing and network facing capacity.