Maher Khadim
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Professor Guzman

Long Term Paper

The tier and aggregation traffic systems used by IDC (Internet Data Centers, AKA older systems of data centers) has become antiquated and outdated. One reason is because they can neither efficiently nor quickly transmit big data used in modern apps and tech. “The emergence of big data makes it difficult for these data centers to incorporate big data service.” (Park, Yeo, Lee, Jang) These older IDC systems magnify the seriousness of traffic congestion. As a result, big data has forced these data centers to change their system architecture. Before we discuss the new improvements to data centers, we must first determine why exactly these IDC systems are unable to operate and function at an efficient and quick speed. This will help determine what aspects of the network architecture must be changed.

One research paper conducted by the Korean University of Science and Tech best explains how the speed of big data transmission, processing, and analyzation can be made quicker/faster. The paper also examines how the older data systems (IDC) are no longer useful/quick. “As the era of big data has arrived, the tiers and the aggregation systems are not functioning well anymore. In the big data environment, the tier and aggregation based network architecture magnifies the seriousness of traffic congestion and may extend the congested region because of the way big data moves around in the data center.” (Park, Yeo, Lee, Jang) This quote exemplifies the fact that large amounts of data cannot be processed quickly by IDC network architecture. According to the paper it took 6 months to move 200 TB of data via the Internet. This is highly inefficient, and the slow speed is due to the fact that tiered aggregation data centers are outdated. “The aim of the new network architecture is to reduce both the congested area and the congested time caused by big data traffic” (Park, Yeo, Lee, Jang) The main reason that big data causes traffic on these IDC networks, is because it demands extremely high amounts of bandwidth, or higher QoS from the routers/network devices. Big data transmission, analysis, and processing causes these systems to lag because they use grid computing along with thousands of CPUs. These processors value/prioritize ordinary internet traffic over that of big data, which means that regular internet users will get the larger portion of the network bandwidth. There are several methods/ways in which improvements can be made to older data center network architecture.

As previously mentioned, older IDC networks need to be updated/fixed. For starters the first way legacy systems can be improved (in terms of speed) is by avoiding collisions between big data traffic and other internet traffic (essentially divide networks amongst regular users and big data transmissions). Another method to increase IDC network speed is to reduce the influence of big data, by minimizing the space occupied by big data traffic. The final way to improve data centers is by reducing QoS cost that rises exponentially directly correlated to the amount of big data. Respectively these three paradigm shifts suggest that legacy network architecture should change their resource provisioning, service provisioning, and QoS provisioning. As previously mentioned, the first paradigm shift’s purpose is to separate big data traffic away from ordinary internet traffic. Big data is over a million times bigger than ordinary/regular traffic, thus we can’t separate big data by allocating virtual circuits. Big data traffic always utilizes full bandwidth capacity of the network devices.

Network Management Domain		
Small Data Service A	Small Data Service B	Small Data Service C
Logical Network A	Logical Network B	Logical Network C
Physical Network		

Fig. 2. The share use of virtual resource by the separation of logical network in legacy data center

Network Management Domain		
Big Data Service A	Big Data Service B	Big Data Service C
Logical Network A	Logical Network A	Logical Network A
Physical Network A	Physical Network B	Physical Network C

Fig. 3. The proprietary use of physical resource by dynamic allocation for big data center

Above we can see that the best way to allocate network resources is dynamically. This is especially useful with big data, because if an extremely large amount of data is being used, the ordinary traffic can be moved onto a different physical network (since there are multiple physical networks shown in figure 3).

The second shift on service provisioning as discussed earlier suggests that data centers should change the sequence of service processing. In IDC centers, data is usually attached to the computing server (data is hidden to users). But for BDC (newer data centers) big data should be first (the server is hidden to users).

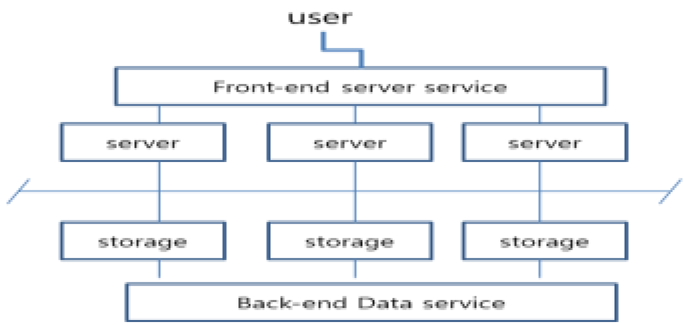

Fig. 4. Traditional client-server service architecture for menu-based service in legacy data center

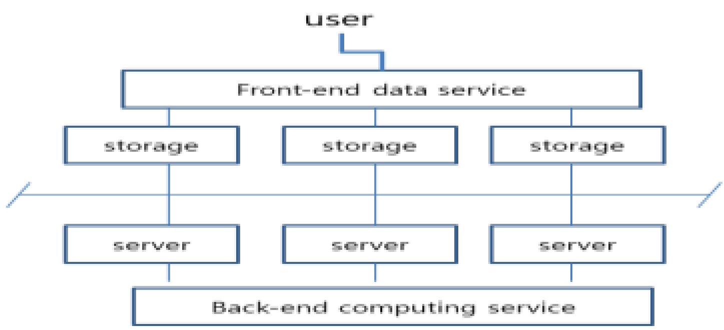

Fig. 5. User-defined service by data-driven computing architecture for big data center

The images above show that service provisioning is very beneficial for big data transfer. Because it ensures that large amounts of user data in storage can be moved onto a different server, if the current server being used has too much overload/data traffic (CPU overhead). It essentially changes network architecture from menu based/client-server service, to a more efficient data-driven/user-defined service.

The third and final shift to increase network speeds is related to QoS initiative. In IDCs, the QoS initiative is owned by ISP or network admin. This kind of QoS management requires more expensive network devices when handling, transmitting, analyzing, and processing big data. For newer BDC network architectures, the shift suggests moving QoS initiative away from ISP, and to user systems.

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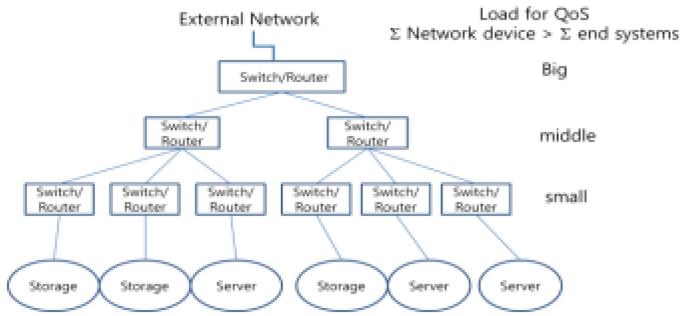

Fig. 6. Tree-like centralized QoS provisioning in traditional data center

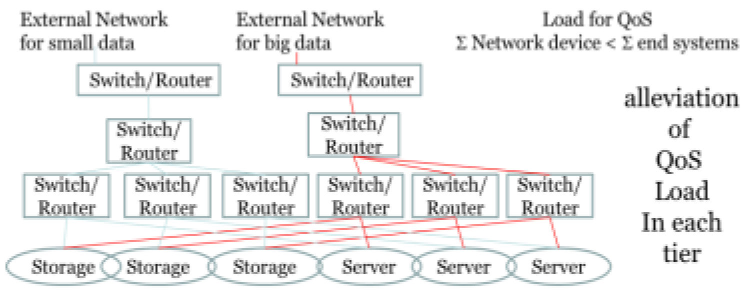

Fig. 7. Traffic separation based QoS provisioning by end system

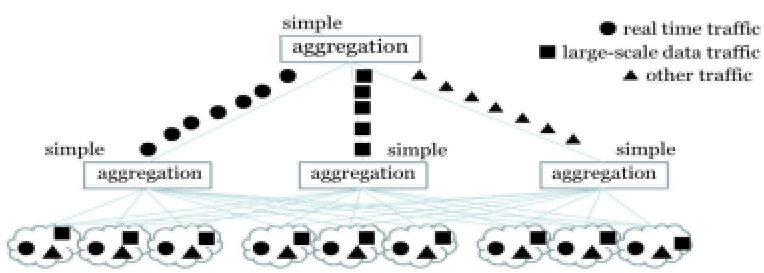

Fig. 8. Traffic separation based QoS provisioning by end system

The images above show that in older systems, the increase in overhead on lower levels would dramatically affect the speed of the higher levels, due to its tree-like structure (seen in Figure 6). Meanwhile Figure 7 shows that traffic QoS delay can be alleviated or improved if we reduce it by moving part of the load from network devices to user/end systems.

The overall speed of data centers is not the only aspect that can be improved in terms of data centers generally. The overall energy/power consumption of data centers can be reduced as well. This would increase the throughput/efficiency of data centers in terms of ecological/economical impact. “Most of the largest data centers are in hot or temperate climates, consuming vast amounts of energy to keep them from overheating.”(Pearce) This energy efficiency of data centers can certainly be improved and fixed. Instead of placing data centers in Nevada deserts, Georgia, Virginia and Bangalore, a more intuitive place would be to build them in cool/cold climates. That way money/power doesn't have to be spent on AC as well as systems cooling of CPUs. They would utilize much less energy if they were located in Scandinavia, Northern Russia, or Greenland. Thus data centers should not be located in hot or temperate climates. Because then less power will be used on cooling the systems to prevent overheating.

In conclusion, the data transfer of IDC (AKA older tier/aggregated data centers) can be made quicker and more energy efficient, especially for the information age of big data. It takes way too long for large amounts of information to be transferred on IDC systems, and thus several shifts are needed to increase data transfer speed. The overall energy efficiency/usage of these data systems can be improved as well. As a result BDCs (the newer systems) should be built in cold areas like Northern Russia and Northern Europe. Thus it'll require less power to cool down and maintain the systems. And we should change several aspects of the network architecture in general as well, to ensure that big data moves quickly/fast.

Bibliography

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