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Network Managers as Hidden Gatekeepers in Online Education: A case study in Streaming Video

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Abstract

Teaching, learning and research for educators and students in the 21st century has changed. This change is attributed to various reasons but foremost amongst them is the internet and a valid learning technology within it called streaming video. Research into multimedia as a learning tool shows it has the ability to boost cognitive response and improve overall learning in students. Streaming video is well-known and utilized for everything from entertainment to education. What is not as well-known is the influence that network managers have on the online education experience through their control of available bandwidth and related technology functions. The case study presented uses the network gatekeeping salience theory by Barzilai Nahon to expose the network manager as a gatekeeper in the network environment. The case at one university is complemented by showcasing additional studies. Together these studies contribute to a foundational understanding of the power of these gatekeepers and the impact of their actions on online video and student learning experiences. This understanding provides libraries, schools and universities additional tools in their efforts to improve learning experiences.

Introduction

Today's learning system has changed from the teacher-student relationship to include learning through the use of media. One of such media is the streaming video online, streaming video is the simultaneous download and play of video from an online video database (Hartsell and Yuen., 2006; Siemens and Tittenberger, 2009). Streaming of video is a resultant effect of technological advancement and the Internet, these videos help learners comprehend complex concepts and procedures that would otherwise be difficult to explain with simple text and graphics. Hartsell and Yeun (2006) posited that streaming media plays a dramatic role in delivering course materials to students as it brings the subject material alive thereby allowing students to use their visual and auditory senses to learn complex concepts and difficult procedures''. Other merits of these streaming video is the learner's control of his learning environment, online media provides the avenue for the learner to become active with the ability to control content by pausing, stopping, skipping, and/or rewinding sections to review problematic content until understanding is achieved (Boekaerts, 2010). Streaming video also allows students the capacity to choose what to watch, when to watch, and where to watch. Online teaching and learning have become imperative particularly with the COVID-19 pandemic, which resulted in the ban of most-face-to-face activities, including teaching, hence a total lockdown of all institutions of learning temporarily (Duraku H.Z and Hoxha L. 2020). Researchers have argued that online and remote learning are very necessary in times of lock downs and social distancing due to COVID-19 (Ali W. 2020).

In view of this educational institutions in Nigeria resolved to adapt online and remote teaching and learning as a strategy to curtail the spread of COVID-19. This has resulted in an upsurge of online video for teaching, research and learning remotely. The use of these online videos involves the availability of networks particularly the valuable resource called "bandwidth". Personnel in charge of these bandwidth and infrastructure are now having to deal with network traffic from within and outside their Institutions. Bandwidth here being the total data carrying capacity of the channels in a network and this serves as one of the key requirements to play online videos (Routray et al., 2019). Bandwidth is a term which refers to the data transmission rate or the maximum amount of information that can be transmitted along a channel. The band part of the word bandwidth comes from "broadband" (Maru. 2011). Which means a large range of frequencies that are available to transmit information. Sharma, Thakur, & Vikram (2011), opined that bandwidth is responsible for data transfer speeds, therefore the bigger the bandwidth quota, the faster online video can be streamed. These bandwidth speeds however great, if not managed correctly would

still be inadequate. In order that video be streamed seamlessly on our networks it is imperative to understand the perceptions of network managers on video. Bandwidth management here is a set of activities, which are undertaken by organizations which have obtained bandwidth, to ensure the efficacy and control of their communication lines as well as efficient usage of said bandwidth. Streaming videos being a relevant multimedia source in any learning environment is crucial and requires bandwidth for their seamless viewing than regular text (Kim and Varshney, 2005; Ying and Basu, 2005), hence the need for plans and policies to be in place on to cater for this. Libraries from time have stood as hubs to unfettered information access, this is especially true in the case of accessing online video because libraries have always provided and fought for the provision of free internet access, learning content and multimedia to all their clientele. However, the unhindered access to online videos can only be achieved when there is an understanding of the underlying issues within the information network that will ensure effective management of the bandwidth and network infrastructure

Problem Statement

The benefits of online video to the educational system are numerous. Students everywhere in the world access and use these online videos as long as the Internet bandwidth is managed properly. Countries of the developing world have begun to understand that the internet plays a vast role in the teaching, learning and research of their university students. Which is why they go to great lengths, develop policies and ensure the availability of this facility in their institutions. Upon acquiring this network resource and related infrastructure, they further ensure that the network resources and infrastructure are well managed to guarantee the seamless streaming of online videos and usage of other information resources and services that would run on the network. This is because poorly managed networks and infrastructure are problematic and greatly impacts the smooth flow of video traffic on networks. Despite efforts in the management of the bandwidth and infrastructure, students and faculty still face challenges while trying to stream and access online video for their scholarly work. Grizzle (2019) further postulated that bandwidth limitations were becoming more prevalent with the recent net neutrality rollback and cord cutting movement as consumer requests on a daily basis were on the consumption of video content across a variety of devices, and consumers wanted to view that content in the best possible quality. Scholars have investigated the problem and proffered solutions like download of the videos as opposed to streaming (Nielsen 1999) and peering and interconnection between countries to reduce transfer

delays on the networks (Makoni, 2016). However the problem still persists with students particularly at the receiving end in the use of these online video resources (Jensen, 2002; Niu, 2013; Hoba, 2017; and Wang, 2018). Could the perceptions of the network manager be responsible for the slow playback times experienced?

Research Objective

The research was focused around one major research objective; to ascertain how network managers with the use of information control mechanisms, influence access to online video content in Universities. It highlights perceptions drawn from a study conducted in the Ahmadu Bello University Zaria, in a bid towards understanding possible underlying issues within information network that could be responsible for the setbacks experienced within networks whilst streaming online videos.

Literature Review

The literature for this research was grouped under these headings' the networking salience theory, online video and libraries and the role of network managers. The network gatekeeping salience theory was used as a means of understanding the network manager. The network gatekeeping salience was borne from the network gatekeeping theory. Network Gatekeeping Salience delves on the degree to which gatekeepers give priority to competing gated claims (Barzilai-Nahon, 2008). Being a normative theory, it can be used to understand the interactions among network managers, the information service and the user. Network gatekeeping salience showcases relationship by evaluating the political power, information production, and alternatives available to the gated, as well as the presence of a relationship with the gatekeeper.

Theoretical Constructs of Network Gatekeeping Salience

Barzilai-Nahon, (2008) proposes identifying gated and their salience to gatekeepers by four attributes:

- i. Their power in relation to the gatekeeper
- ii. Their Information production ability
- iii. Their relationship with the gatekeeper
- iv. Their alternatives in the context of gatekeeping

Power in Relation to Gatekeeper

The core of gatekeeping is centered on control, control of information and persons. Such control in many instances is a reflection of the power struggle of stakeholders to achieve their interests.

Gatekeeping is a dynamic state that can change at any given moment, contingent upon the social context from which it evolves. The power construct, assumes that A has power over B to the extent that A can get B to do something that B would not otherwise do (Barzilai-Nahon, 2008). Barzilai-Nahon (2011) asserts that affiliation with powerful circles or elites increases one's chances to play or influence the role of a gatekeeper. In essence gated and gatekeeper's roles are not fixed but dependent on social and relational factors.

Information Production Ability of the Gated

Literature on Management, Journalism and Communication emphasizes mainly the ability of elites, leaders or individual gatekeepers to produce information (Bagdikian, 2004; Shumsky & Pinker, 2003). New frameworks from Information Science however emphasize changes occurring as part of the information society which enable gated to produce information. Information production by the gated translate into an undermining of the entire gatekeeping as a process (Barzilai-Nahon, 2008). The appearance of multiple methods and technologies, that are ready-to-use and easy-to-use tools to produce and design content empower the gated with greater autonomy, and change the interplay of gatekeeper-gated.

Relationship with the Gatekeeper

The emergence of multiple ready-to-use technologies and easy-to-use tools to produce and design content empower the gated with greater autonomy and change the dynamics of the gatekeeper/gated relationship. Barzilai-Nahon proposes relationships can be researched in various directions: reciprocity, specificity, immediacy, directionality and tie or network focus. Direct network ties between gatekeeper and gated allows for interaction and negotiation giving rise to changes in status. It is also important to note a connection between Information Production and Relationship. The given ability of the gated to produce information creates a circulatory effect between gated-gatekeeper which produce relational reactions and feedbacks from gatekeepers and other stakeholders. At the same time gatekeepers are affected by the information produced and in effect change their stances.

Alternatives in the context of gatekeeping

The emergence of the networked information economy increased individual's autonomy by increasing "the range and diversity of things that individuals can do for and by themselves" and by providing " alternative sources of communication capacity and information, alongside the old platforms of mediated communications" (Benkler, 2006). In networks, a compound situation in

which the gated can circumvent the gatekeeping mechanism arises more frequently and more profoundly. The ability of the gated to produce information does not necessarily ensure that information will reach other people. Gated autonomy in many cases is contingent upon the gatekeeper rules and technologies provided (Barzilai-Nahon, 2008).

In an article by Macciò & Cristofoli, (2017), titled “How to support the endurance of long-term networks: The pivotal role of the network manager”. The study focused on interorganizational networks in an attempt to contribute to research on network endurance. Specifically, on service delivery, configuration of the modes of network governance, the formalization of coordination mechanisms and the concentration of managerial skills in the network manager. Their results show that a Network Administrative Organization alone is not sufficient to enable network endurance. Having skillful network managers who can activate formalized coordination mechanisms is important. Skillful network managers seem to be pivotal for long-term public networks, thanks to their ability to link network structures to network mechanisms and bring about network endurance. Bui (2010) posits further that the power of a gatekeeper over a gated is highest when the gated has little political power, less ability to produce information, minimal relationship with the gatekeeper, and fewer alternatives to circumvent gatekeeper’s control; it is lowest when all four of these attributes are present on the side of the gated. The transformation of the gated into gatekeeper is not achieved through the possession of one of the attributes (political power, information production, alternatives, relationship). Each of these simply represents the potential for gatekeeping. Also, in the digital era, the relationship of gatekeepers-gated is intriguing, due to the gated’s ability to circumvent the power dynamics relationship between the gated and the gatekeepers. This makes Network Gatekeeping Salience a great framework to analyze the network managers view on Online Video.

Online Video and Libraries

Online video allows students the capacity to choose what to watch, when to watch, and where to watch. The Joint Information Systems Committee (2002), opined some of the importance of online videos to students; “students can access the material (online video) asynchronously and independent of their location. Libraries have for long been activist in the use of media for entertainment, recreational, learning and edutainment. In the last two decades the internet and its technologies have dramatically changed the delivery of media to the public and academia from old VHS tapes and compact discs to online video. Online and streaming video have saturated the public

scene through online video delivery systems like YouTube, Videlectures.net, Netflix, Hulu gaining unprecedented popularity on the internet. These online delivery systems have eased the jobs of libraries and librarians who previously had to deal with issues of fair use limitations and allowances, institutional rights, public performance rights, and other questions of licensing, copyright, and access with old media (DeCesare, 2014). However, with online video delivery systems the library deals only with subscription and enabling access to these online providers. Libraries have varied reasons for providing access to these online providers such as a platform for informing their users, an entertainment tool and a vast learning platform for latest trends and technologies. Users of online video are no longer bounded by the traditional classroom environment or the library to view these visual materials provided by an instructor. Online video provides a control element in the choice over which material to observe on-demand in other words the choice of what to watch. Fujimoto (2014), further validates some of the uses of online videos to learners; Serves as a motivation tool to learners: Video is visually and auditory stimulating, and watching video can be an engaging experience for people of all ages. Choi and Johnson (2005) support this assertion by stating that “Using video for instruction improves the attention span of learners for video-based instruction as opposed to text-based instruction. Promotes active learning; video has been found to enhance effective learning because it allows for participation whilst viewing. Kamin, O’Sullivan, Deterding, and Younger (2003) found out that;

- a. Students who learned using digital video engaged in more critical thinking than those who did not.
- b. Video stimulated cognitive processes that helped facilitate active learning.

Online video enhanced cognition: the use of online video can help improve the students’ own thoughts on a particular subject matter. Video can also generate metacognition by presenting concrete examples that allow viewers to reflect on their own understanding of concepts or procedures, video also promotes metacognitive thinking by allowing viewers to compare themselves to experts or peers performing tasks in the video (Choi & Johnson., 2007; Wouters., Tabbers., & Paas., 2007; Homer., Plass., & Blake., 2008). Some scholars (Means., Toyama., Murphy., Bakia., & Jones 2010) summed up an evaluation of evidence based practices in online learning for the united states department of education which showed that students given the privilege for online video conditions performed moderately better, on average than those learning the same thing with just traditional face-to-face instruction. With the current crowded media

landscape, technology challenges have to be addressed in order to retain viewers of video and profitability of streaming video providers. While it is imperative for streaming video providers to maintain high content, such content is worthless if viewers cannot find it or don't have a smooth viewing experience once they do. Ensuring that massive video files can be delivered quickly, without lags and viewed on any device is paramount to a streaming provider's success (Grizzle, 2019).

The Role of Network Managers

Networks are designed and established to achieve specific purposes, some are meant to run for short periods while others are long term networks such as service driven networks like those in Universities and Campuses. The creation and management of a robust network with good connectivity to ensure seamless flow of the video is a major responsibility of network managers (Macciò & Cristofoli, 2017). As stated earlier, these networks provide a powerful platform for the advancement in teaching learning and research and promote resource sharing amongst faculty and students alongside having tremendous impact on the visibility of the university. In 2007 the American Library Association (ALA), conducted a study on library internet bandwidth issues and realized that basic internet connectivity was not a problem but management of the available bandwidth as the user population grew was one key barrier to adequate internet bandwidth utilization (Bertot, Jaeger, McClure, Wright, & Jensen, 2009). Grizzle (2019) proffered a solution to preventing video latency in areas of limited bandwidth, according to him tapping into more than one content delivery network, allowed for intelligent players that can analyze user activity and determine when switching networks will improve the viewing experience. These multi-CDNs and SD-CDNs would act as load balancers across enabling multiple ingest points and optimized delivery and helping to make the overall process extremely resilient and robust.

Bandwidth management is a set of activities which are undertaken by organization, to ensure the efficacy and control of their communication lines. Flickenger., Belcher., Canessa., & Zennaro (2006), stated that for a network connection of any size to continuously remain optimal, organizations must take a multifaceted approach that includes effective monitoring and analysis, a policy that defines acceptable behaviour and a solid implementation that enforces these rules. Lockias (2012), referred to the term as a generic term that describes the various techniques, technologies, tools and policies employed by an organization to enable the most efficient use of its bandwidth resources. Achieving this, falls in the hands of the network manager. Part of the role

of the network manager involves aiding in the attainment of their parent institution primary goal, which includes security of the network and ensuring optimal quality of service and experience whilst on such networks (Metzler, 2011; Odigie & Gbaje, 2017). The network manager on any network is the gatekeeper and is placed in control of all bandwidth and devices and services that are to run on that defined network. Hence, he sometimes solely develops policies to be approved by other stakeholders (Metzler, 2011). With the global pandemic (COVID 19) the network manager's role has been saddled with greater responsibility with institutions, library directors, teachers and students having to migrate to online classrooms and the use of video for their learning activities (Bao, 2020).

Methodology

This study adopted a qualitative research methodology and a case study design because according to Dezin and Lincoln (2011) qualitative research involves an interpretative, naturalistic approach to the world; meaning the researcher studies things in their natural settings, attempting to make sense of or interpret phenomena in terms of the meaning people bring to them. The use of these methods and designs therefore helped in understanding network managers and the online video dilemma in their traditional settings. The population of the study comprised of all twenty-one (21) members of Staff at the network and security services unit within the university campus. The purposive sample was chosen with the use of criteria, based on the criteria a sample of four (4) network managers emerged. Purposive sampling strategy was used as it allowed for the collection of data from participants that had a direct bearing on the research topic under study. The research made use of interviews and observations in the collection of data for the study, the interviews were in-depth in nature and involved the researcher personally interviewing network managers based on a set of structured interview questions, whilst the observations was for a period of three weeks. This enabled the researcher elaborate on questions and avoid ambiguity in certain questions that were not well understood by the participants thus tapping into the participants view and knowledge.

Data Analysis

The study used a Thematic Content Analytical approach, which allows researchers to make sense of data generated (Marks & Yardley, 2004; Caulfield, 2019). It involved inspecting the data for emerging themes, coding the data, developing categories from the coded data and interpretation of data. The data generated from the interview sessions were recorded and transcribed in detail. The

data which was collected through the use of semi-structured interviews (using the study’s interview guide) with a digital recorder lasted approximately 6 hours, 40 minutes and 15 seconds in total. The data collected from interview sessions were examined and transcribed verbatim.

The transcribed interviews were re-read and further cross-checked against the audio recordings to retain originality and speech context and lastly imported into qualitative research coding software (Nvivo) for the coding process. The coding was an iterative process of reading and re-reading the transcript in order to obtain pertinent or relevant codes, which were highlighted giving a total of one hundred and seven (107) codes. Subsequently, categorization of these free nodes or open codes was done with the aim of grouping together all codes which answered the research question into themes, categories and sub-categories as shown in table 1. The categorization aided the answering of the research objectives.

No.	Sample Free Codes	Sub-categories	Categories	Themes
1	the amount of traffic or request overwhelms the switch	Traffic overwhelms Switch	Network devices	Network devices
2	if the devices have exhausted their lifespan	Life span of devices		
3	Nfsens is the application that we use for network monitoring, monitoring end users and types of services that end users are Using	Nfsens monitoring device		
4	using devices that have a fast ethernet port instead of gigabit port definitely your streaming would be affected	Streaming affected by difference of port	Port speed	
5	the link between this core switch and the other switches on the network is 10gigabit, but they cannot handle that capacity there is going to be issues	Device port capacity difference		
6	there is no point of prioritizing any traffic.	Priority of Video		
7	due to limited capacity the only thing we can do is just not to allow everybody to use the whole bandwidth			
8	That’s not our job our job is just to provide the service not to tell staff			
9	NO, because when you see prioritizing that means you have a limited capacity			

Table 1: Template for grouping of codes or free nodes into themes
Findings and Discussion

Grouping of codes into categories led to a convergence on two themes reflecting how network manager behavior with information control and network devices influences online video content.

Network Devices for Information Control

This theme shed light on network devices for gatekeeping being a mechanism or devices within the network that aid information control, it also showcases how they can affect online video. Responses obtained from the interview indicate that port speed of network devices impacted video streaming. An excerpt from the interview states “*the use of Fast Ethernet port as against a Gigabit port would affect online video streaming*”. Disparity in port speed between fast Ethernet and gigabit submit that port speed results in what is known as a bottleneck restriction on the network (Carter & Crovella, 1996). The responses further indicate that these devices (gatekeeping mechanisms) used in the gatekeeping task had life expectancy and as they age, their overall performance with regards to video packet transfer is impacted. Network devices for information control and gatekeeping were not exclusive to hardware alone as the responses indicated threat management software and network monitoring software such as unified threat management and Nfsens were utilized in the management and gatekeeping process. Excerpts from the interview show that this software were used in the protection of the network as well as logging and monitoring of sites visited. The implication of this monitoring is that the network managers were constantly observant of user behavior and change their rules and protocols to adapt to user actions. The gatekeeping principle informs on the actions of the gatekeeper being the network manager on his gated (users). Hence activities or decisions based on monitoring by network managers on the network can be influenced by power of the users in relation to the network manager or any relationship the user might have with the network manager. The implication being that certain users, by virtue of their proximity or relationship to the network managers could have unfair advantage on the bandwidth usage over other users. All network devices have ethernet ports with varying speeds, these port speeds differ from the overall bandwidth speed which are purchased from an internet service provider. They dictate the speed or throughput between the various network devices. Simply put the on any network with varying ports speed like the 10/100 fast ethernet and the 10/100/1000 gigabit ports, devices with the 10/100 fast ethernet speed would be unable to optimally cater as user packet requests increase. Since these network devices have

varying port speed utilizing devices with unsimilar speeds would negatively impact the streaming of online video. Understanding networks and the power of the network manager is helpful now with the global rise in use of video for educational purposes as a result of the COVID 19 pandemic. Such understanding would aid the network managers and users in the identification of potential bottleneck hotspots as seen in Fig. 1.

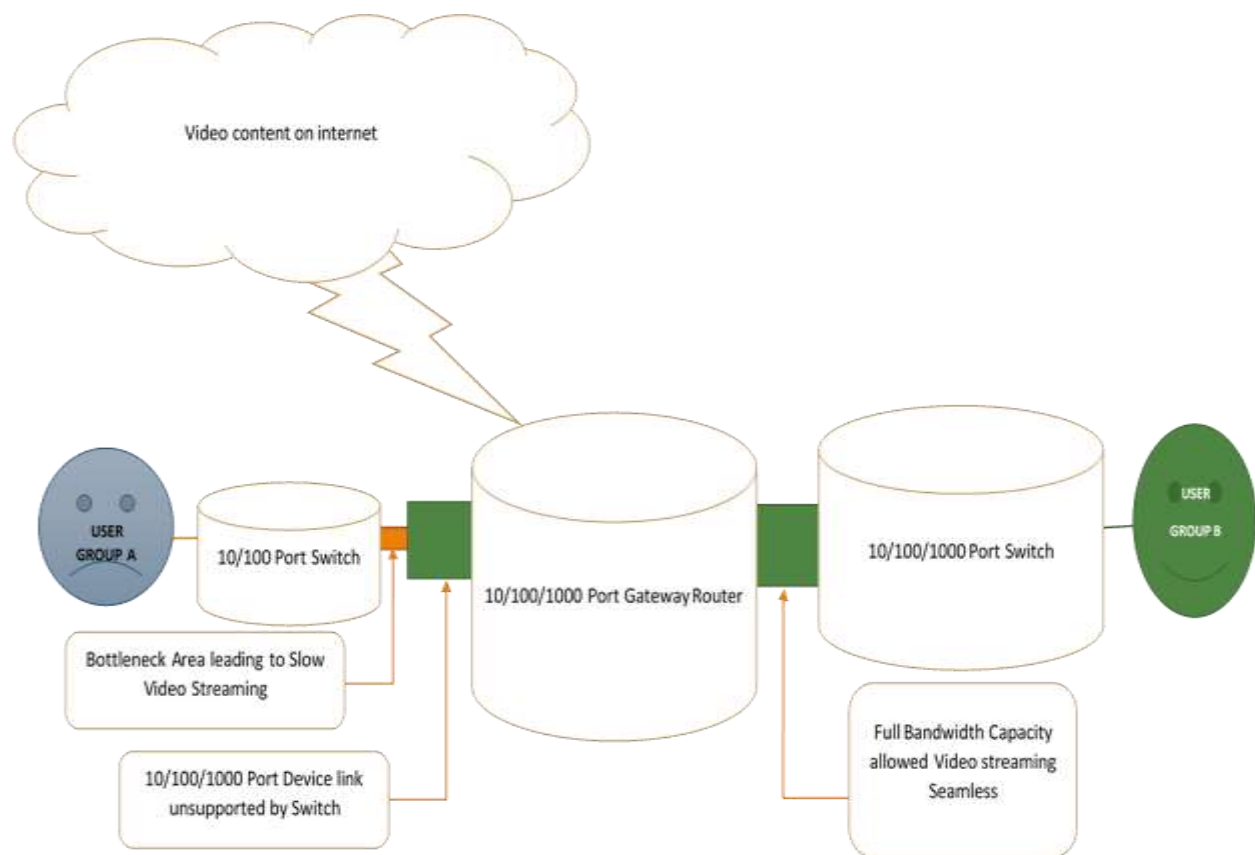


Fig 1: Devices and potential bottleneck zones

Since user behavior on the network was already observed by network managers, the study also informs of the user's potential to lobby for favorable network conditions and highlights the potentials of these managers that have otherwise been overlooked or ignored in the network environment. Therefore libraries, departmental heads need to foster a social relationship with these gatekeepers due to the likelihood and susceptibility to bias from external forces based on power and relational influence.

Priority of Video

This theme shed light on the prioritization of data packets within networks. Questions were raised on the process of bandwidth management and allocations of traffic within the Network

environment. Responses showed bandwidth management meant giving video and text traffic priority on a network. *“In doing bandwidth management, you are saying give priority ... but this doesn't ensure quality of service (QoS)”*. Other responses obtained from excerpts of the interview indicated that network managers felt prioritization of video traffic was not necessary and not a fix to ensuring overall quality of experience on their networks. This is contrary to the findings of Ying & Basu, (2005), Macciò & Cristofoli, (2017) & Grizzle, (2019). The implication of network managers not prioritizing traffic means that video packets would need to compete on the network thus quality of experience for users would be dwindled. As video packets are much larger in size than text it directly implies that the information production ability of users was not accounted for in the overall network management process. Which leads to undermining of the entire management process and seeking of alternatives to the bandwidth management process by users. The necessity for higher bandwidth allocation in video than text would imply that network managers take vital steps for the quality of video to be enhanced. A bandwidth management process begins from the choice of devices to be included on the network to the prioritization by the network manager given to user traffic activities. Network managers felt the prioritization of traffic was not necessary which offers explanations to the relevance placed on video. The non-prioritization of video leads users to have to lobby for better bandwidth and exploit their power and relationships with network managers. Knowledge of networks and networking leads to better bandwidth management and an avoidance of bottlenecks on the part of the network manager however for users their choice of network access points improves hence impacting their experience while using video content.

Limitation

The study was a case study scenario drawn from the Ahmadu Bello University and therefore cannot be assumed to be representative of all network environments. It can however be used as a model for the evaluation and improvement of other educational institutions.

Conclusion and Recommendation

In any network environment, there are varying dynamics at play that hinder video streams, well managed network resources and infrastructure guarantees the seamless streaming of online videos. This is because online video and technologies are predicated on the availability of bandwidth and the effective management of these bandwidth for all users. The perceptions a network manager holds, influences their actions which cannot be overstated especially in management and streaming

of online video. The research has highlighted how effective bandwidth management and prioritization ensures the free flow of video traffic. In addition, this research provides a case study for universities to consider in the management of their own networks for the seamless flow of online video.

Recommendation

Having examined and highlighted the various dynamics at play on an information network and their influences of control as it affects the smooth streaming of online video, the following are recommendations that institutions can adopt.

1. The development of a bandwidth management policy to include the periodic upgrade of devices within the network to cater for disparity in port speed thus aiding the delivery of video content.
2. The study also recommends that same policy should indicate how the network manager and users are checked to negate human bias on the basis of power or relationship.
3. Bandwidth prioritization for video packets based on monitoring and logging patterns observed by the network managers.

As a result of the COVID-19 global pandemic, the study is particularly important due to the increased demand for online content for learning outside the classroom. The study highlights the current issues being faced daily in the network environment drawing from perceptions of network managers. The setbacks with the current bandwidth management process which if not handled will further mitigate access as a result of the increasing demand for these online video content. Finally, it highlights the importance of video to the learning process with the current crisis and sets the stage for improvement upon the streaming of video through the prioritisation of video traffic on all educational networks.

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