Loughborough University London

Cover Sheet for Coursework

Students must complete this cover sheet to accompany each piece of coursework submitted.

Student Number:	B620035
Programme Title:	Cyber Security and Big Data
Module Title:	20LLP111 – Cloud Applications and Services
Coursework Title:	Cloud Computing in Digital Creative Media
Word Count:	

If this coursework is part of a group activity, list the names of the other group members:

Declaration

By making this submission I confirm that the attached coursework is my own work and that anything taken from or based upon the work of others – or previous work of mine – has its source clearly and explicitly cited; I understand that failure to do so may constitute Academic Misconduct.

Submission Date: 09/04/2021

Signature: B620035

Contents

1 Introduction

1.1 Background

The digital revolution commonly spoken about nowadays has come with certain requirements. In today's world almost everything that is done involves the use of the internet and it is also important to mention that this 'internet' we speak of relies heavily on the functionality of certain infrastructures to be able to provide its service. Such infrastructures include communication networks (3G, 4G, etc.) & protocols (IP, TCP etc.), security mechanisms (encryption, digital signature etc.), cloud computing (storage, application, services etc.) to mention a few. The usage of the internet and digital devices to suit the varied lifestyles of humans (such as use of social media, high speed video streaming, video gaming etc.) has meant that more powerful technologies are needed and this is where a key advancement known as cloud computing has come into play.

A major beneficiary of cloud computing has been digital media [1] given the amount of media content being produced, consumed, transferred and utilised over the internet on a daily basis (which shows no slowing) due to its support for platforms which allow for seamless deployment, management, retrieval and retrieval of digital media services.

1.2 Cloud computing Services

Cloud computing can simply be said to be the provision/availability of computing services (such as storage, processing power etc.) via the internet [2]. They are provided using 3 main models:

- **Infrastructure-as-a-service (IaaS):** which provides users with raw computing resources (such as storage, servers, networking etc) virtually [3]. Examples are AWS, Google compute engine etc.
- **Software-as-a-service (SaaS):** which tend to be applications or software running on the internet often accessed using web browsers [3] with functionalities such as storage. Examples are OneDrive, DropBox, GoogleDrive etc.
- **Platform-as-a-service(PaaS):** which provides a platform with ready-made computing resources to allow users develop applications or software [3]. Examples include Heroku, GCP, Microsoft Azure, AWS elastic beanstalk etc.

1.3 Multimedia cloud services

Cloud computing technology also facilitates various multimedia cloud services. These include [4]:

Service	Description
Multimedia authoring-as-a-service	The process of editing segments of multimedia contents in the media cloud
Storage as-a-service	The advantage of being "always-on," higher level of reliability than local storage
Multimedia rendering as-a-service	Conducting multimedia rendering in the cloud, instead of on the mobile device
Multimedia streaming as-a-service	Potentially achieving much a lower latency and providing much a higher bandwidth due to a large number of servers deployed in the cloud
Multimedia adaptation-as-a-service	Conducting both offline and online media adaptation to different types of terminals
Multimedia retrieval-as-a-service	Achieving a higher search quality with acceptable computation time, resulting in better performance

Table 1: multimedia cloud services [4]

2 Discussion

2.1 Cloud-centric Digital media examples

A lot of software/applications being developed for our personal devices (e.g. laptops, phones etc.) make use of cloud services to be able to function. Some applications of cloud in digital creative media include:

- **Audio streaming & processing:**
  Cloud computing has completely revolutionized the music industry especially in the area of digital music. Long gone are the days where the main way to access audio media was through 'traditional' ways such as buying vinyl's, CD's, tapes etc. In today's world rather than buying and owning hardcopy's of audio music media, they are accessed through on-demand streaming services such as Tidal, YouTube Music, Spotify etc. Powered by Google Cloud, Spotify now offers over 248 million monthly users access to over 50 million songs and podcasts [5].

- **Video streaming & processing:**
  Cloud computing has really aided people and businesses around the world as video streaming is now a very popular means of communication, entertainment and education. Similar to audio media, video content used to be produced and accessed through physical means (such as tapes, DVD's etc) however, partially due to the advent of cloud computing, access to video content through live broadcasts or streaming has made its creation and consumption rather seamless. According to Forbes, YouTube is now the second largest search engine in the

world with Google taking top spot [6]. Other video streaming /communication platforms include Zoom, Netflix, Amazon Prime etc.

- **Video gaming:**
  A more recent beneficiary of cloud computing mainly due to its video processing and storage capabilities, gamers around the world are now able to play against each other remotely, access and/or store various forms of media using their consoles thanks to the power of cloud computing.

2.2 Pros & cons of cloud computing in digital creative media

2.2.1 Benefits of cloud computing

- **Environmental impact:** with recent laws/requirements being put in place by governments around the world and the need to take steps to conserve our environment, the adoption of cloud computing has only served to support initiatives like going green and combating global warming. E.g. in the entertainment industry, the availability of streaming platforms has automatically led to trends which conserve our planet (such as reduction in emissions caused by transporting CDs/DVDs, saving our trees due to less packaging requirements etc).
- **Availability:** the adoption of cloud computing (virtualisation) has meant that various forms of media are able to be accessed seamlessly when needed (baring factors such as technical difficulties, natural disasters etc.). IaaS & PaaS solutions have also supported the creation, processing and distribution of digital media.
- **Cost:** arguably one of the biggest advantages of cloud computing, the fact that media creation, processing, storage and distribution resources can be leased as at when needed have aided businesses in reducing initial, operational and maintenance costs.
- **Scalability:** based on the users requirements, they are able to scale-up / down instantaneously and also at a way lower expense given that everything is more or less like a service thereby fostering efficient utilisation of computing resources.
- Less burden in managing huge computing resources as this can be the responsibility of the cloud provider. This also means that it is a lot easier for people to content creation.

2.2.2 Disadvantages of adopting cloud computing

- **Reliability**: a major downfall with the adoption of cloud services is its reliance/dependence on the internet. It is also important to understand/remember that certain parts of the world do not currently have infrastructures to support the efficient use of cloud services and in those parts of the world movements towards cloud services is limited. Unforeseen circumstances such as natural disasters, technical difficulties also affect access to cloud services thereby limiting its effectiveness in those cases.
- **Security/Privacy**: a major issue with anything put on the internet is security. Just as there are technological advancements, developments in ways by which people (i.e. bad guys) are able to leverage security loopholes to their advantage occur thereby leading to a continuous difficulty in trying to provide adequate security of resources over the internet.
- **Disruptive**: an unpopular opinion however, the disruptive nature of technology to people at times makes its adoption rather difficult at times. E.g. it may mean training requirements for users which can be costly to businesses and upsetting to users.

2.3 Digital creative media on cloud challenges

- **Devices**: media content is usually accessed using various forms of devices (e.g. phones, TV's, PCs etc.) which process media in different ways. As a result it is important for cloud architectures to adapt so as to satisfy the requirements for each of these devices [7].
- **Scalability:** with more and more (order of millions) media content being produced on a daily basis, cloud architectures need to be designed so as to cope with its demand and supply as well as provide the capacity to support future applications and services [8].
- **Network resource infrastructure**: media content delivery through different network channels poses a challenge to cloud as it needs to be able to adapt to different network properties (e.g. bandwidth, throughput, speed etc.) for efficient delivery to the different kinds of devices and their network capabilities [7].
- **Making cloud profitable:** one of the most complicated challenges [8], this entails making sure that a suitable cloud solution is chosen for a particular application/ market product in order to maximise profit (the sole aim of most businesses). It is important that cloud architectures are properly designed using high quality technologies to ensure great performance is achieved in a cost effective manner [8].
- **Privacy & security**: anything on the internet is not particularly secure. Due to the threats posed by attackers looking to take advantage of cloud providers and users there is a constant security challenge associated with the adoption of cloud

services especially due to the fact that data is an asset to companies and making sure it doesn't fall in the wrong hands is key to them being able to function.

2.4 Technologies fostering cloud for digital media

The media cloud architecture in figure 1 [8] shows a brief overview of the various processes involved in utilising cloud for digital media and in order for these processes to be carried out successfully, technological infrastructure needs to be available to support them.

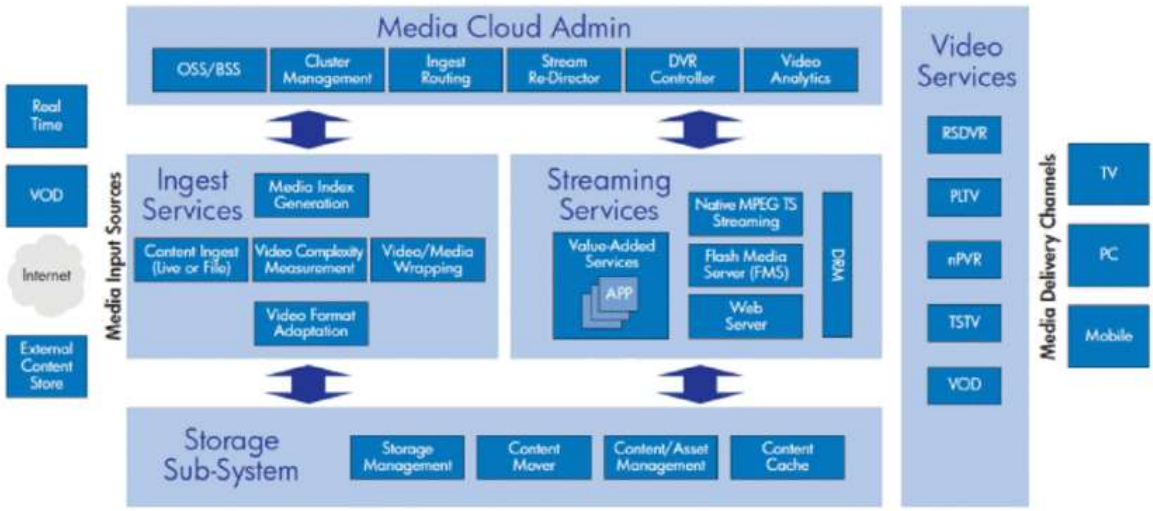

Figure 1: cloud computing architecture for digital media [8]

In this report, a brief overview of some technologies involved in media storage and delivery are discussed.

2.4.1 Storage/Big data

One of the main benefits of cloud computing for digital media is its ability to process huge amounts of data (Big data) through parallel processing in a cost-effective manner.

Technologies such as Direct Attached Storage (DAS), Network Attached Storage (NAS) and Storage Area Network (SAN) have been made to satisfy big data requirements [1] however most widely used for digital media is the Hadoop Distributed File system (HDFS) [8]. This is because : it can support applications with large datasets/files; it can be used on cheap hardware; it has a high fault tolerance; it minimizes bandwidth consumption; and it supports faster data processing as it has a high data throughput [8].

HDFS also has limitations which restrict its use in applications needing real-time processing-then-delivery such as batch processing, poor dynamic load balancing and as such it is not always the best choice [8]. Future works are hence needed to try to improve HDFS (e.g. proposing solution which can be integrated with HDFS to handle load balancing, improving data read latency etc.)

2.4.2 Media processing

Cloud is utilised for digital media processing due to the ease and low cost of accessing computing/processing resources. This also allows it to be used for applications with high processing requirements. Media processing on cloud can be thought of as a service with its own cloud service models [1]:

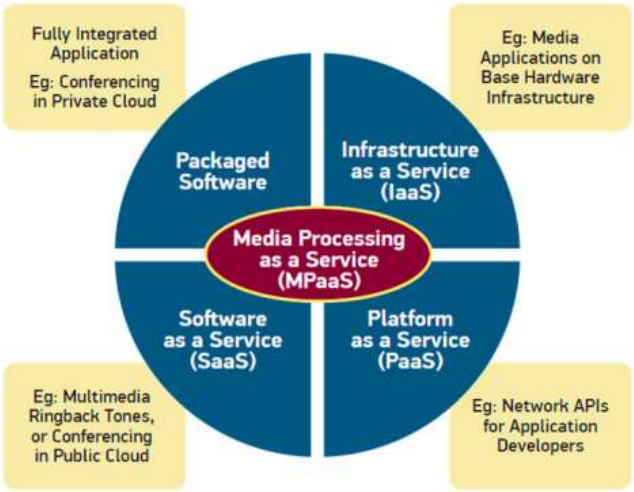

Figure 2: Media processing cloud service models [1]

Media processing entails operations video transcoding, adaptation, scaling, ingest, audio processing etc. Some examples of media streaming technologies include HyperText Transfer Protocol (HTTP) and Dynamic Adaptive Streaming over HTTP (DASH) [1].

DASH is preferred to HTTP due to limitations such as its inability to support adaptive bit rate streaming & live streaming and bandwidth wastage in HTTP [1]. The advantages of using DASH include: video quality/resolution adaptation, firewall penetration, short start-up delay, web caching support etc [1]. Shortcomings in distributed storage of digital media contents and accurate prediction of TCP throughput however limit its performance [1].

3 Conclusion & future work

An analysis of the how cloud applications and services are used in the area of digital creative media has been presented in this report. A brief introduction and background to cloud computing for digital media is provided. The report then goes on to expatiate on some of benefits, disadvantages, applications and challenges of adopting cloud computing for digital media. Finally some of the technologies supporting the adoption of cloud computing in digital media are introduced.

Due to the scope of the research only a brief discussion was made in terms of technologies involved in digital media, cloud architectures and so this would be an area to be explored/improved on in future work.

4 References

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