Billy Coughlin
Luke Lakstins
Kane Kenworthy
Joshua Pugh

The Future of Video Games and Cloud Computing

While many people do not play them, almost everybody today knows what video games are. Video games have proven themselves to advance as quickly as any other technology throughout the last fifty years. While their innovations may not be as groundbreaking or meaningful as, say, the work of NASA, they are still worthy of mention and analysis in today's recreational market. Video games began as simple as Pong and advanced over the years to incorporate new technology. One of the biggest changes to video games came when they adapted to the capabilities of the internet. The internet allowed for people to connect to a wide range of people and locations. This had implications for the design of video games that would change them forever.

When video games first came online they struggled with latency and bandwidth issues, but the concept was destined to succeed. As internet bandwidth improved, so did the games. Games could be played online via a computer, or through a console which connected to the internet. Xbox Live was revolutionary when it launched on November 15, 2002. It dominated the online console market and created a feasible way to connect people online.

With consoles and computers connecting gaming online, there were still requirements for the hardware and the user. Each user would run his game on his own hardware and then send the signal to a modem where it could be routed to a common host. This host would process the information and send it back. This meant that hardware was still necessary to purchase and the servers had flaws (many users complained that the host had a faster speed). A way around this was sure to come, but the question was how soon. "The cloud" seemed to come out of nowhere and caught the interest of technological companies everywhere.

Cloud computing is the use of computing resources (hardware and software) that are delivered as a service over a network (typically the Internet) ("Cloud"). This is a confusing concept that is hard to explain to anyone who is not technologically savvy. When we first started to research the future of video games on the cloud, we had to admit to ourselves that we did not fully understand how cloud computing worked. Basically, it eliminates the need for hardware, such as a gaming console or computer, and software, such as installing a game disc onto a computer hard drive. The hardware and software are stored on a server somewhere and the game is run and processed on this. After these calculations are done, the game is streamed to a user's remote screen. The screen has an internet connection and the user can play the game via an interface (controller, touchpad, motion capture, etc.). This sounds great in concept, but it is our mission to find out how feasible this really is with today's technology and interest from major companies.

Before we could analyze the progress of gaming in regards to cloud computing, we had to observe the capabilities of cloud computing as a storage location. Many major companies have been moving towards a cloud based storage system because it allows them easier access to their files. This

trend is still happening throughout the world and will continue due to the ease of use and stability. This stability is possible because storing and accessing most files on the cloud does not require extensive hardware, software, or bandwidth. The reason that gaming is different is because it requires a very high level of all three.

We began by conducting surveys to average people. This led us to the conclusion that cloud gaming is a very small portion of the gaming world today. Most people did not understand what it meant, which was to be expected. After researching the leaders in hosting their games on the cloud, we discovered that while they may not be well known to the average gamer, they are making technological advances at an outstanding rate. Gaikai, OnLive, and Steam have been testing the boundaries for what the cloud can handle. Steam has the most common use due to the fact that while it uses the cloud for some storage and distribution methods, it does not fully run games on the cloud. This has allowed Steam to become possible before the others. OnLive has focused on harnessing the full functionality of the cloud. Games are stored and processed on OnLive's server, then streamed to the user. Their success in this has proven that cloud gaming is possible in some locations where the internet bandwidth allows (onlive.com).

The security of storing everything for a game on a server was a serious doubt and question which we wanted to look into. Our research did not show any increase in security threats compared to any other form of gaming. However, we must keep in mind that since cloud gaming is so new and scarce, that hackers do not have much of an incentive in obtaining the information stored on the servers. Through interviews, we determined that there are currently very minimal security issues in regards to games stored on a cloud server. OnLive seems confident that their system is as secure as any other form of online gaming.

> "The greatest security concern we've found is that you can have the most secure platform in the world, but if someone shares their account info, all bets are off. The ease of acquiring game content immediately makes it an alluring prospect when someone promises you a free game in trade for your login credentials. To date, we have not been able to develop a system that protects against greed." –Nathan Barsetti, Senior Manager Customer Relations at OnLive

This response could be interpreted two ways. Firstly, it can be interpreted as a dodge to the question as he deters the focus to the consumers and their faults. Secondly, it can be interpreted as a confidence in cloud computing as a viable technology for hosting video games when compared to any past method. We prefer to view it as the latter, but maybe that is because we are optimistic about the gaming companies who are getting onboard with cloud computing.

As mentioned before, Gaikai has been a leader in cloud gaming research and implementation. After Sony purchased them for a large sum of money in August 2012, we gained optimism that this technology is possible. This purchase must surely have implications on the future actions of other gaming tycoons Microsoft and Nintendo.

Our approach to this research project began with background research and ended with predictions covering the next eighteen years. These predictions should not be taken as more than they are: predictions. They are not a guarantee for the future of this technology and market, but they make since

for many reasons. Our goal is to take the history of both video games and the internet in relation to their current situations, and use the trends and opinions of today's leaders in cloud computing and gaming to formulate a non-biased, plausible future for this underappreciated technology; and help inform people of what is really going on in the underground market of cloud gaming.

To begin researching cloud gaming, you must start at the components. The history of both cloud computing and gaming are both important to the future. Looking at past trends and missteps gives us ideas of which companies will prevail in the future.

The history of gaming starts in the late 50s. We are going to jump ahead to 1983, where a major market crash hit the industry due a glut of low-quality games. Everyone wanted to get to the market, and in doing so they crashed the console gaming market. US companies exited the console business, not returning until 2001.

After this crash, Nintendo, a small Japanese company, released the Famicom in Japan and the Nintendo Entertainment System(NES) in the US. Nintendo's popularity exploded. Much of the initial success of the NES was due to the popularity of Super Mario Bros. Nintendo capitalized on being the only console in the business by having outrageous fees for licensing a game on their system. Companies had to agree to not release the games anywhere else, such as an arcade box, for two years after it released on the NES. They also were limited to the production of five games a year. Nintendo had final say on whether or not they could actually publish the game once it was finished, and they turned away multiple games for partial nudity on a statue or excessive violence. There were many other hoops that companies had to jump through, and these third-party publishers would not forget their time under the Nintendo monopoly.

Some companies released consoles more advanced than the NES. The TurboGrafx-16 was released in 1987 by a Japanese company called NEC Corporation, beginning the next wave of consoles just four years after the previous one began.

Nintendo continued to dominate the next release of consoles with the Super Nintendo Entertainment System(SNES) in 1990. Other companies joined Nintendo in this era, releasing their own consoles in response to Nintendo's success. No one can challenge Nintendo's dominance in the game industry until they create their own competitor. Nintendo originally had an agreement with Sony to produce a CD-ROM add-on to the SNES. After making this agreement, Nintendo realized they were uncomfortable with some licensing agreements, as they felt there was not enough protection from piracy for their games. Emphasis on piracy protection is a common trend with Nintendo, influencing many of their choices throughout their time in the gaming industry. Sony then announced the "PlayStation" add-on to the SNES in 1991. Nintendo immediately announced that they were not working with Sony, but instead they were working with Phillips, an American company. This announcement was humiliating for Sony, as Nintendo chose a foreign company over them, implying that Sony is so bad they would rather do business with foreigners. Sony in response decided that they did not need Nintendo to produce the PlayStation.

Sony released the PlayStation in 1994. They came out with a very well thought out strategy. They sponsored the MTV Music Awards in 1995, pointing their console to the older crowds. They did little to

monitor game content, as opposed to Nintendo who still sometimes turned games down. They had extremely low rates for third-party companies that wished to publish games on their system.

Remembering what Nintendo had done to them and seeing the amazing deal that Sony was offering, many third-party publishers flocked to the PlayStation. Sales of the PlayStation exploded, pushing Sony into the spotlight as the leader of the console gaming industry.

During this time Nintendo released their console, the Nintendo 64. The technology of the system was behind the times. It still used cartridges as opposed to CD-ROMS. These cartridges did not hold anywhere near as much data as the PlayStation CD-ROMS. This limited game developers, and also it pushed most game developers towards the Sony PlayStation.

It is notable that during this console era, Valve Software released their first major hit, a first-person shooter called Half-Life. It was the first FPS game to introduce story-telling to the genre. It is mainly notable for our case as Valve becomes an important leader in gaming industry later on.

The next era began 6 years later in 2000. Sony released the PlayStation 2 and continued to dominate the industry for the same reasons it did the previous era. Nintendo released the Gamecube, a system that once again did not use a standard storage device. Instead of DVDs, the new industry standard, it used a custom disc to prevent piracy and avoid licensing fees. This once again limited the size that games could be on the console and made porting larger games from other systems more difficult.

What really changed the industry during this era was the release of Microsoft's Xbox. Microsoft became a major player in the game industry with this release, beating the Nintendo Gamecube in sales.

Microsoft started the next era of consoles in 2005 with the release of the Xbox 360, 5 years after the previous era. This establishes a trend in the gaming industry of 4 to 6 years between eras. The Xbox 360 is most notable for its expansion of Xbox Live, Microsoft's online service for their consoles. Xbox Live has expanded into cloud storage for saved games and other data.

The Nintendo Wii led this era by using a blue ocean strategy. They went for the market that didn't exist at the time; the casual game market. This won them the sales war, but in doing so they alienated many past customers. Once again though, this console was not the leader in graphics or technology. It did not have HD graphics, nor was their good support for online play.

The PlayStation 3 did not see the previous success it had the last two eras. The main reason for this was a high launch price. This caused it to quickly fall behind its competitors. The reason for this high launch price though was that it was by far the most powerful system of the three. Sony likes to lead the industry technologically.

On September 12, 2003, the Steam client was released (Steam). This marked the beginning of an era for PC gaming. This was the era of digital distribution. They are the current leader today in distribution of PC games. PC games have been disappearing from stores as more and more people switch

to digital distribution. Steam is extremely important in the cloud gaming market, as they have a wide user-base as well as experience in the cloud system.

Founded in 2003, OnLive is the current leader in cloud gaming. This company offers gaming as a service. The games are rendered on OnLive's servers and streamed to the device of the user's choosing (OnLive).

Founded in 2007, Gaikai was recently purchased by Sony for 380 million dollars. They were originally a cloud based gaming service that focused on giving game previews for users. They had a similar system to OnLive, but they also used it as an advertising tool. People could play games through the web browser on different sites such as Youtube and Facebook, allowing people to try games before being offered a chance to buy them. The acquisition by Sony has many implications for the future of the gaming market.

Similar to our research was a case study done by Arto Ojala and Pasi Tyrväinen. This study looked at a ten year period of the company "Game Cluster." They studied the business model that cloud gaming used. They concluded that many lessons learned from observing G-Cluster could benefit future companies in many other areas (Ojala).

What is cloud computing? Cloud computing is using servers elsewhere for data storage, application running, and other things that are normally done on a local computer. Many services have come up using cloud computing, such as storage as a service, software as a service, and infrastructure as a service. Cloud computing on the user end is as follows. Users say they want to use an application by double clicking it. Instead of having to install, it just opens and is run somewhere else. Indiana University recently released such a service. It is called IUanyWare, and allows students to stream programs such as Adobe Photoshop to their computer without having to download the software and install it (IUware).
Our research methodology consisted of surveys given to undergraduate students, graduate students, and even professionals in the field. One survey was organized through survey monkey and collected twenty seven responses from our Facebook friends. Many had no idea what Cloud Computing was and if surveyors did have an idea their description was very short. Our other survey conducted was given to graduate students in the school of Informatics and Computing, this survey was made through esurveypro.com and sent out to graduates purely by email. After analyzing the seven results we noticed that they matched up with the one given on Facebook. Even some graduates students didn't really have a general descrip0tion of the topic and what the future implications of cloud gaming were. After looking into what the major companies were up to in the following years we noticed cloud gaming is already upon our society generating a mass amount of revenue. We noticed a few complications with our research as well including the security risk in converting all data online without any hardware. Numerous other side effects were analyzed as well with implementing cloud computing in our society. Regardless at that cloud computing and gaming seems like the direction headed towards in the future.

Strong companies in the industry today don't want Cloud gaming apart of society because of the money coming in through selling hardware or games to their customers. They want future gaming systems such as Xbox 720 to dominate the market bringing in money through holiday sales. Currently switching to a cloud based internet now wouldn't work because of how much prominent companies are

opposed presently and the technology isn't up to the standards expected for users. However some professionals in the field strongly agree that we are ready for a cloud generation. One person who took our survey through reddit was an employee of Online and said "*We shown it works, and has 100% uptime since June 2010. Millions of accounts, hundreds of games, and clients all mainstream platforms proves to be the case.*" Nathan Barsetti who is a Senior Manager Customer Relations at Online gave this response answering our question of are we at a point technologically where cloud gaming is feasible. Nathan also gave a great response with the security concern of ours, his response from our question what security concerns do you have going forward in cloud services and specifically cloud gaming was very eye opening. He said " *The great security concern we've found is that you can have the most secure platform in the world, but if someone shares their account info, all bets are off. The ease of acquiring game content immediately makes it an alluring prospect when someone promises you a free game in trade for your login credentials. To date, we have not been able to develop a system t that protects against greed."* So informing the users about being careful with their information and sharing it with no one online is a major concern rather encryptions and decryptions. Users could make their selves vulnerable without realizing it and cause complications when accessing the any cloud based service. Our technology is already there with cloud gaming or computing but knowledge on how to work such services isn't there for consumers making them still want hardware to control private data. Once that problem is accomplished users could feel more comfortable with accessing Online or Gakia. This process will take a while but our predications consist of society switching to cloud services will around ten if twenty and that means major industries as well consumers agreeing it's time for a more technological approach for society.

Awareness seems to be a major issue as well judging from our survey results because most answers were accurate but very broad too. Yes cloud computing is many computers sharing processing power and data remotely. We also know cloud gaming refers to games that are streamed to internet-connected devices but both topics have a lot more concepts involved with them including how our generation could change immensely from this switch. This idea a lone has driven our group to outreach and coordinate with professionals across campus after this class is over. All of the group members including me were very interested in the topic and want to find more academic information from every aspect. I plan on talking to a professor more about what the cloud computing future has to offer right now and if he agrees upon the research conducted by us. We were originally going to plan out interviews in the first place but we didn't feel it would be necessary considering what we found already. Nathan obviously was a great help to us considering the professional opinion but the surveys we sent out to students across campus was also very helpful as well. The results gave us a great variation between how some students knew exactly what it was to others thinking we were actually talking about the weather instead of technology. Judging by these results we feel our generation presently isn't ready for cloud services meanly because the millenniums is the only era growing up with the internet. The change for us wouldn't be a problem at because we are used to having internet access available to us at all times. Previous generation most likely wouldn't be fond of a switch to cloud services because it's too much of a change for them and they might not be too fond of everything being online as well.

Even though we are not ready for a cloud based system amongst us the change is worth a lot of money right now. Many companies are making a immense amount of revenue off streaming online games and sell their companies for a large amount of money. So the user ability is not their but motivation from recent past business deals should the reason why people in the field should be more involved and willing

to accept cloud gaming/computing. Some professionals in the field already realize what is at stack directing their talents towards cloud computing. A few industries however don't want to hop on board which could mean billions of dollars lost in investing research in a new product ten years down the line. A great example of a company would have to be Nintendo seeing how they are always behind with what they create, including gaming devices which are not as advanced as an Xbox for example. We believe this company others strategically compared to them won't survive when cloud computing and gaming become a societal norm. So some companies will be left behind while others strive towards online gaming.

Understanding the overall complications with cloud services is very impotent if our generation is going to switch and have everything online. We need to be prepared for security risks, user ability issues, or even complication in running the service in general before our society would be to access cloud computing. As for cloud gaming, business transactions are already being created leading to a good amount of revenue. Steam is one of the highest played gaming applications coming from consoles and online gaming services. Slowly but surely cloud gaming will succeed if approach it the right way and introduce users to risks. Letting the users know the rewards would obviously be the main concerns for big industries but those rewards need to match up with risks user can face as well. We don't want our internet services becoming exposed to malicious attackers trying to seek user data for their own personal gain. We also don't want most users to dislike the changes being made regarding their internet access and the hobby of playing video games. Basically we need to take cloud services step by step so later in the future society will become adaptable to a technological prone atmosphere. A lot of professionals believe in cloud services but at the same time some professionals don't agree at all with the direction offered. Much of the background research we conducted has supported this analysis and predications we see coming from cloud gaming as well as cloud computing.

What do we foresee in the coming years of cloud gaming and the demise of the physical hardware running our games? It would seem quite outrageous to think that someday hardware will no longer be necessary but actually be a service that we pay for and never actually see. After conducting our research from the beginning of gaming and cloud computing to our collected responses and thoughts from the countless individuals who have partaken in our project, it was quite necessary for us to show our future predictions of where the cloud gaming system is heading and where we will find it in our homes over the next 20 years. From the past, to the present, all the way up to the future, we have seen quite a change in gaming with some companies sticking around since quite early on. The cloud is such a new thought and idea to so many people because it has not become popular until quite recently. It has become a mainstream form of storage and so it is not very surprising that it would have eventually reached the gaming community as it has done so over the past few years.

We have researched the history of gaming from the beginning and up to the point where it merged with the cloud. We have also researched the history of cloud computing and the point where it would merge with gaming. Beyond that we researched a combination of the two so that we could better represent in our project what exactly cloud gaming is, where it's been and where it's going. It was a necessary point of our project to see to it that we could figure out how cloud gaming would change the way we use hardware and software as a physical source. It seems that we may now simply collect data from some outside source and we would be paying a flat rate fee for not only the software but also the hardware as well. A very real and big question to most people who are not knowledgeable is "What about

the technology, are we even capable of doing this?" To most people, streaming an entire game to your computer screen or television seems completely absurd as it would be so much data sent at one time. But the technology is real, and yes we are very capable of doing so.

Before going into details about our predictions, it is necessary to point out that the gaming industry has followed a somewhat predictable pattern since the very beginning. Seeing as we are dealing with several corporations over the years, there is always reason for competition. This competition promotes corporations to release their new consoles and new platforms with somewhat similar technology, or at least technology that will appeal to a large enough market that will make them a competing contender. Typically we find that most platforms and consoles are released within a year of each other with the three top companies being, Nintendo, Xbox, and PlayStation. I would say that at this point in time, these companies all have continued to dominate the market over the last ten years or so. The typical span between each generation of consoles is about 5 to 6 years. It is quite safe to say that over the next twenty years, we will see drastic changes in the gaming world and more than likely witness some things that were never even imagined.

It appears that some of the larger gaming corporations have decided to take a shot at dipping their feet into the cloud gaming market. This year alone Sony purchased the cloud gaming service Gaikai at a whopping $420,000,000. It is a good sign that Sony would like to get the upper hand on Microsoft by buying such a young company for such a large amount of money. There has been lots of talk about this new partnership and the possibility of introducing some sort of a cloud gaming capability on the upcoming PS4. Microsoft who more than likely has felt at a somewhat disadvantage for not getting to Gaikai first, has taken up a cloud gaming company as well, known as Agawi. With these two companies neck and neck at each other's throats for the top place in the gaming community, with Nintendo becoming a less than favorable contender, it comes to no surprise that both of these companies would partake in the development of what is more than likely the future of gaming.

Currently, OnLive is the leader in cloud gaming. Our interview with the senior manager of customer relations at OnLive reinforced their active movement and strives to lead cloud gaming into the future standard of video gaming. They offer this service on their website and have been the host of millions of customers over the past few years.

Steam is currently the biggest distributor of digital downloads and is branching into television gaming. Since people can download full games to their hard drive directly from the servers of Steam, after paying a cost for their products of course, it comes to no surprise that they would want to branch their market out as they engage to the digital world instead of the physical.

Wii U and its release has been the beginning of the next generation of consoles. The standard of console gaming for the next 5 to 6 years along with the forerunners of Microsoft, with the release of the Xbox 720, and Sony, with the release of the PS4, both scheduled to launch in quite a near future. There is still little known of the Sony and Microsoft consoles, but in 2013, the official preview will be released in E3. There has been talk of Gaikai implementing some sort of cloud technology into the PS4 but there have certainly been no confirmation.

By the year 2017, the era of the Wii U, Xbox 720, and PS4 will be diminishing. The major gaming companies attempt to gain as much income as possible through the use of re-releases of consoles and online support. As the generation begins to fall, Sony releases their own cloud gaming platform using the resources attained from the purchase of Gaikai in 2012. They gain quick control of the market by including this platform within their Smart TVs and adding a PlayStation controller as part of the purchase, as well as paying other TV companies to install the app by default.

Around a year or so after the 8th generation of consoles slowly begin losing sales, a new competitor will appear to battle against Sony's sheer domination of the cloud gaming market. Steam will release their own platform, in an attempt to keep the PC gaming base they have maintained for the last decade. There is potential to partner with OnLive making them the best competition against the behemoth that Sony has become overnight.

If for some reason Steam decides they don't need a partner and for some reason that things don't work out very well with Agawi and Microsoft, perhaps Microsoft will make an offer to OnLive, creating a competition As Microsoft begins developing its new competing technology, the fight for the top tier gaming platform will continue.

By 2020, there will be three key competitors, Sony, Microsoft, and Onlive/Steam. The reason being, Nintendo has displayed a history of ineptitude when it comes to the internet. They are the furthest behind, and are most likely to continue their classic razor and blade strategy with their consoles and AAA titles. With little room for the hardcore gamers in Nintendo's thoughts and ideas, and their simplistic view on consoles and technology, it will become clear to their customer base that they are not going to be prepared for such a change to the gaming world and will in the end lose the race to be a feared leader in the gaming industry.

Around 2021, it is the beginning of yet another generation of consoles. Microsoft and Nintendo both release a new console, more than likely Nintendo's last as their customer base gradually deteriorates over the past few years. Sony then continues on with their new and better developed cloud gaming platform as they continue to lead the market in cloud gaming subscriptions. It is possible that at this time if Microsoft has not attained a strong cloud gaming support partner early on, they will not be at a stage of development where the release of a formidable cloud gaming platform can be released and be a viable competitor for the dominating Sony/Gaikai duo. Sony's thought for a console has expectation's that are deemed too powerful and in turn, too expensive for a customer base making them forget about the console indefinitely and solely rely on the graphical power of their own hardware and servers. With the thought of Sony forgetting the console and developing a strong cloud gaming platform, the customer base will not be scared to pay for such a powerful and vibrant style of gaming that the world has never seen without ever having to pay for some very expensive hardware.

By the year 2025, Nintendo will have finally caught up to Sony and Microsoft and decided that they should release some sort of cloud gaming network, if for some reason this doesn't pan out, they will have forgotten the platform idea completely and become focused on becoming a game developing company only. Nintendo as they have struggled over the past will decide that there is simply no market

left for them to continue to develop a platform. Like Sega, they will become a console of the past and the use of their consoles will be a flashback to what was and what will never be again.

By 2030, a clear winner among the cloud gaming companies will appear, for how long, that is a question that is almost impossible to answer. It is also unclear who the winner will be in this clash for cloud gaming domination. Only the future knows, and over the next few generations of gaming we will see where it goes and who will come up as the formidable competitors in the cloud gaming industry.

The timeline presented is not of fact, it is merely the best or smartest possibilities that could be attained from the research that is readily available on the cloud and gaming. If history tends to repeat itself as it seemingly always does, there is great potential for this timeline to be very correct. The future is too unpredictable to know for sure, but the best educated guess is what is presented. As cloud gaming rises up to be the highest standard of gaming, it is quite clear that the use of consoles and physical discs will no longer be necessary and most certainly be used for collecting purposes only. The biggest threats to cloud gaming are the publishers and die hard collectors. In time when the customer base builds a greater demand for cloud gaming, the reign of the console will die.

Works Cited

"Cloud Computing." *Wikipedia*. Wikimedia Foundation, 12 Dec. 2012. Web.

"Steam Client Released." *Steam*. Valve, 12 Sept. 2003. Web. 12 Dec. 2012. <http://store.steampowered.com/news/183/>.

Ojala, A. & Tryväinen, P. (2011). Developing cloud business models: A case study on cloud gaming. IEEE Software, 28 (4), 42-47. 12/12/12. <http://www.academia.edu/849172/Developing_cloud_business_models_A_case_study_on_cloud_gaming>.

IU T160 – History of Video Games

Onlive.com