GDC

CLOUD GAMING:

Where Are We Now, Where Are We Going?

Adam Billyard CTO, Polystream

GAME DEVELOPERS CONFERENCE | July 19-23, 2021

THECLOUDS AN **INCREASINGLY** IMPORTANT PART OF OUR LIVES

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KEY TAKEAWAYS

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This talk will help in understanding what Cloud Streaming is. My hope is you will all:

- Gain insight into the successes and failures of cloud streaming to date, so you can...
- Ask better questions of vendors and...
- Evaluate potential uses / business opportunities to help you...
- Start developing the future of cloud-native experiences!

* Published my first game with Atari in 1983

* Co-Founder of Criterion, — Founder of Criterion, created the RenderWare game engine

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* CTO & VP of EA Tech

* CTO Polystream

WHY CARE? Cloud gaming revenues will pass the \$5BN mark by 2023

* Newzoo Cloud Gaming Report, March 2021

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SOWHAT EXACTLY IS CLOUD STREAMING?

Apps run in the cloud and stream to your device where they can be instantly accessed without downloads

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- WHY CLOUD STREAMINGSOD

- Instant access to content that is always up to date
- No need to manage storage / delete games to make space for your next one
- Ability to save your game progress from anywhere and pick up at the same point in the game across many devices
- Reduces piracy



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HOW DOES PIXEL STREAMWGRK?

- PixelStreaming sends images using VIDEO technology
- Read user inputs and run application loop on CPU
- Output is rendered by a **GPU** in the cloud
- When render is complete, it then gets encoded into a video stream
- Video packets are sent to the user
- User device decodes video packets to images



HOW DOES COMMAND STREAM CORK?

- Command Streaming sends DATA to draw the image
- Read user inputs and run application loop on CPU
- Drawing commands compressed on the fly (no GPU)
- Data packets are sent to the user

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- User device GPU executes **Draw** commands



CLOUD STREAMING

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* The biggest difference between the two ways is is in **how** the GPU is used; * Pixel streaming needs a **GPU** per user * Command streaming uses the GPU in your local device

TECHNOLOGY TIMELINE

The announcement of Stadia a**GDO**n 2019 was the first time many had heard of the cloud streaming concept,



But it didn't appear overnight...

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* X11 (MIT)
* NeWS (Sun Microsystems)
* App running in the cloud

* Interactivity

* "Thin Client"

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josh@tengwar:/home/josh josh@foofighter:~\$ ssh -X tengwar Linux tengwar 2.2.20 #1 Sat Apr 20 11:45:28 EST 2002 i686 GNU/Linux No mail.

Last login: Sun Mar 12 21:10:59 2006 from foofighter josh@tengwar:~\$ xeyes



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* Video On Demand (VOD)
* Choose movies to watch
* Streams compressed pixels
* VHS resolution ~3 Mbps
* Billions of \$ invested in video technology





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- * H.264 Video encoding standards
- * Dramatically better quality images =>*encoding* more compute intense
- * Broadband ~5 Mbps



- * Wider adoption of Youtube and Netflix services
- * Graphics cards in home computers becoming *commodity* items

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* Launch of OnLive at GDC

- * AAA games run in the cloud
- * Natural technology choice was existing video stream based solutions
- * Stream compressed pixel to consumers at HD
 resolution
 * Custom h/w *micro-console*connected to home display





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ONLIVE INSPIRED NUMEROUS OTHER PIXEL STREAMING SERVICES...

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"THE DEFINITION OF INSANITYS DOING THE SAME THING OVER AND OVER AND EXPECTING A DIFFERENT RESULT"

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Play any of these 22 games, starting November 19.

Coming by end of 2019



THEPROSOF PIXEL STREAMING

- Known technology from introduction of VOD
- Easy to onboard content
- Reduced up-front engineering
- Consumers already have (video) players
- Plays on a *potato*

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Existing network transport / firewalls



THECONSOF PIXEL STREAMING

- Cannot use CDNs or caching the very heart on which the internet is built
- Requires ongoing GPU upgrades
- Increasing display resolution = egress
- Time of Day
- Each user / player requires a GPU in the cloud for their session - it does not scale on demand!

THE CHALLENGES FOR PIXEL STREAMINGPOWERSCALE

* Ave costs ~50 cents / hr / user to run a GPU stream

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*Launch window numbers for a AAA game today run into the millions

*CCU capacity of the pixel streaming vendors is 1000s at best





WAIT! WHAT ABOUNETFLIX? THEY SERVE MILLIONS OF CUSTOMERS AT THE SAME TIME DON'T THEY???

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END OF PART ONE

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WHAT DO WE NEED TO DOSLOCCEE?

DELIVERY & CONTENT

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DELIVERY

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- COST: Pennies / hour / user
- REACH: You have to be physically close to the user
- SCALE: Elastically grow to deliver to millions of users on demand, wherever they are





CONTENT

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- Taking existing content and simply putting it in the cloud is *not enough*
- Reducing friction through 'instant play' is *not enough*
- Offering the same (old) content business model is *not enough*







STRENGTH OF THE MEDIUM

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THEDOSANDDON'TSOF BUILDING CLOUD - NATIVE EXPERIENCES DON'T

DO

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* Think beyond traditional game / win mechanics to create unique experiences

* Think beyond traditional audiences

* Leverage cloud compute AI

*Try to replicate a console in the cloud experience

* Think you can simply throw your game into the cloud once it has been made

THE FUTURE OF CLOUD GAMING:NEED

Business viable

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Scale with demand

MORE ABOUTCOMMAND STREAMING

- Choose stream visual fidelity based on each user device GPU
- Utilizes caching and CDN services => reduced egress
- Containerized workloads => dynamic scaling
- Cloud provider agnostic to be physically close to users => less hops
- Transport uses BBR-style RTT congestion control as well as burst mode chunking
- Cost To Serve (CTS) *shared* between Data Center and user device

WHATDOES ALL THIS MEAN?

Command streaming enables the creation of experiences for massive concurrent engagement, but they need to be built from the ground up

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- WHY COMMAND STREAMING HE FUTURE

- Low friction access to synchronous social experiences
- Bring in non-gamer participants
- Business models to monetise non-player participants
- Novel applications for interactive 3D social spaces
- Move beyond games / win-mechanics

CHALLENGESTHAT LIE AHEAD

- Moving from experience to experience will require interoperability between content vendors
- Shared industry standards
- Walled-gardens. How can they be incorporated?
- Supporting developers creating for Cloud Native / command streaming
- Reluctance to move away from expensive pixel streaming infrastructures

CLOUD NATIVEREDICTIONS

- Some games today have spectator-modes.
 The next step will be thousands of spectators viewing the action using cloud streaming
- Spectators become a *cohort* with their own play mechanic
- Meetings in virtual spaces
- Moving seamlessly from one experience to another
- Mass concurrency *across*multiple







KEY TAKEAWAYS

- Content needs to be*Cloud Native*
- Play to strengths of Cloud Compute
- Design to engage with millions of consumers
- Beyond traditional Games / Win mechanics / Gamers
- Huge opportunity for transactions between participants
- Content Delivery needs to scale to consumer-level numbers
- Now it's **up to you** to start developing the future of cloud-native experiences!

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THANK YOU!

Adam Billyard CTO, Polystream

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END OF PART TWO

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EXTRA RESOURCES

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For Business Plans, Marketing Plans, Project Proposals, Lessons, etc





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_ LOREM

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LOREM 2

LOREM 3

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LOREM 1

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LET'S REVIEW SOME CONCEPTS

Yellow

Is the color of gold, butter and ripe lemons. In the spectrum of visible light, yellow is found between green and orange.

Blue

Is the colour of the clear sky and the deep sea. It is located between violet and green on the optical spectrum.

Red

Is the color of blood, and because of this it has historically been associated with sacrifice, danger and courage.

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You can insert graphs from Excel or Google Sheets

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Show and explain your web, app or software projects using these gadget templates.





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GANTT CHART

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	Week 1							Week 2						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Task 1														
Task 2						•								
Task 3														
Task 4											•			
Task 5									•					
Task 6														
Task 7														
Task 8														

SWOT ANALYSIS



BUSINESS MODEL CANVAS

Cost Structure Insert your content Revenue Streams Insert your content	Key Partners Insert your content	Key Activities Insert your content Insert your content Insert your content	Value Propositi Insert your conte	ons 👬	Customer Relationships Insert your content Channels Insert your content	•	Customer Segments Insert your content	2
	Cost Structure Insert your content		-	Revenue Strea Insert your conte	ms nt			



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EXTRA ILLUSTRATIONS

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COMPETITOR MATRIX



_ WEEKLY PLANNER

	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
09:00 - 09:45	Task	Task	Task	Task	Task	Task	Task
10:00- 10:45	Task	Task	Task	Task	Task	Task	Task
11:00-11:45	Task	Task	Task	Task	Task	Task	Task
12:00- 13:15	✔ Free time	✔ Free time	✔ Free time	✔ Free time	✔ Free time	✔ Free time	✔ Free time
12:00- 13:15 13:30 - 14:15	✓ Free time Task	✓ Free time Task	✓ Free time Task	✓ Free time Task	✓ Free time Task	✓ Free time Task	✓ Free time Task
12:00- 13:15 13:30 - 14:15 14:30 - 15:15	 ✓ Free time Task Task 	✓ Free time Task Task	✓ Free time Task Task	✓ Free time Task Task			

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