



Reinventing game development

How game studios use AWS to build with flexibility, scalability, and speed



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Today's game development challenges

Players are always on the lookout for the next great game, driving constant demand for new, innovative experiences. But production teams face a number of hurdles, including:

- Compressed timelines
- Constant content updates
- Multiplatform game development
- Multiversion code and asset maintenance
- Player expectations for sophisticated gameplay, including:
 - Innovative mechanics
 - Low-latency experiences
 - Elaborate 3D worlds

Studios are on tight timelines to provide fun, bug-free experiences with regular updates to content and features, and many outsource content creation to keep projects on time and on budget. Also, studio team members often work remote or hybrid schedules.

Accommodating distributed workforces, however, requires IT and DevOps teams to implement solutions that give developers access to a studio's tools and pipelines—regardless of their location and without generating network bottlenecks. Teams also need to collaborate and iterate on their game quickly and easily.



Cloud technology

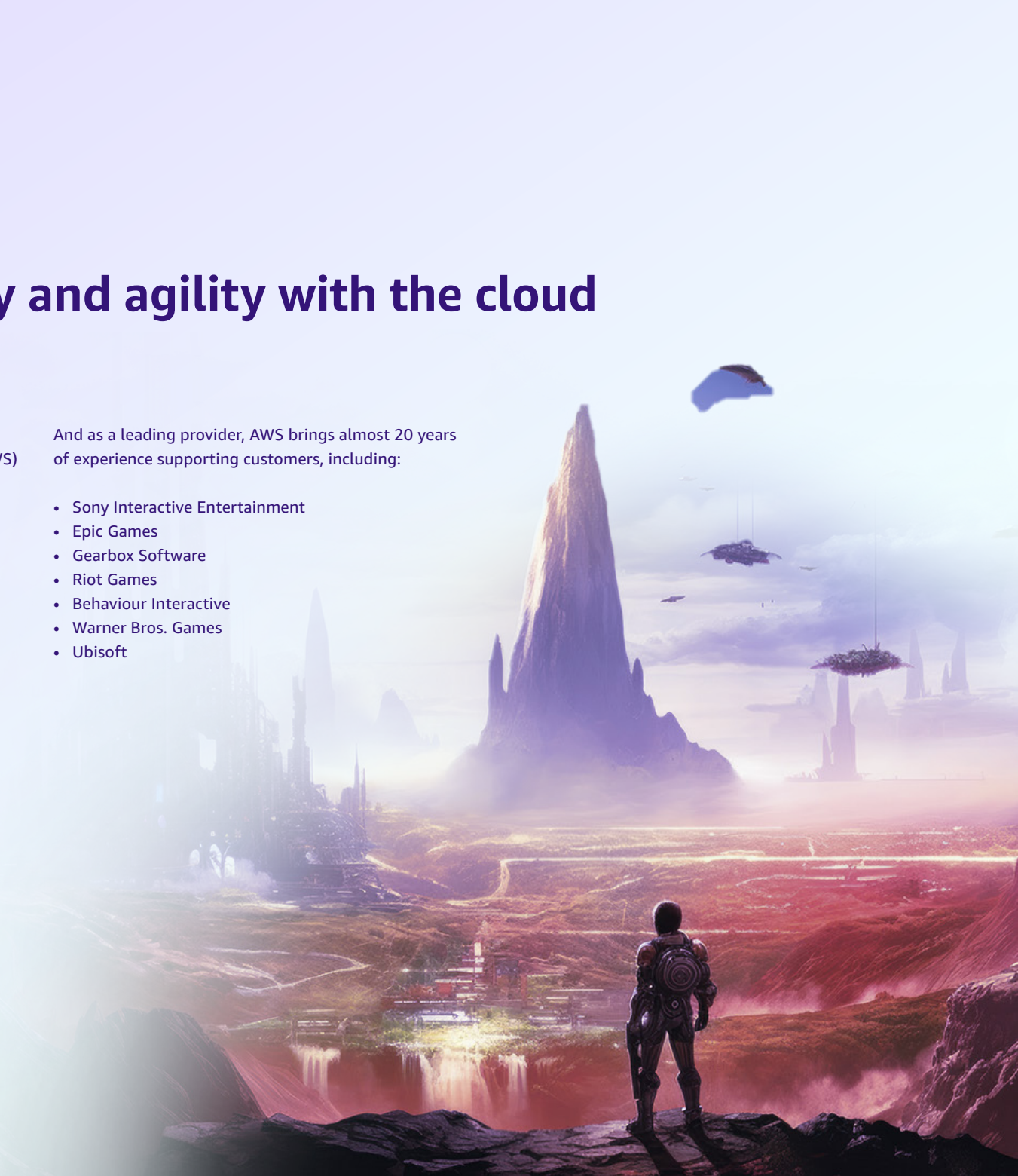
Increase flexibility and agility with the cloud

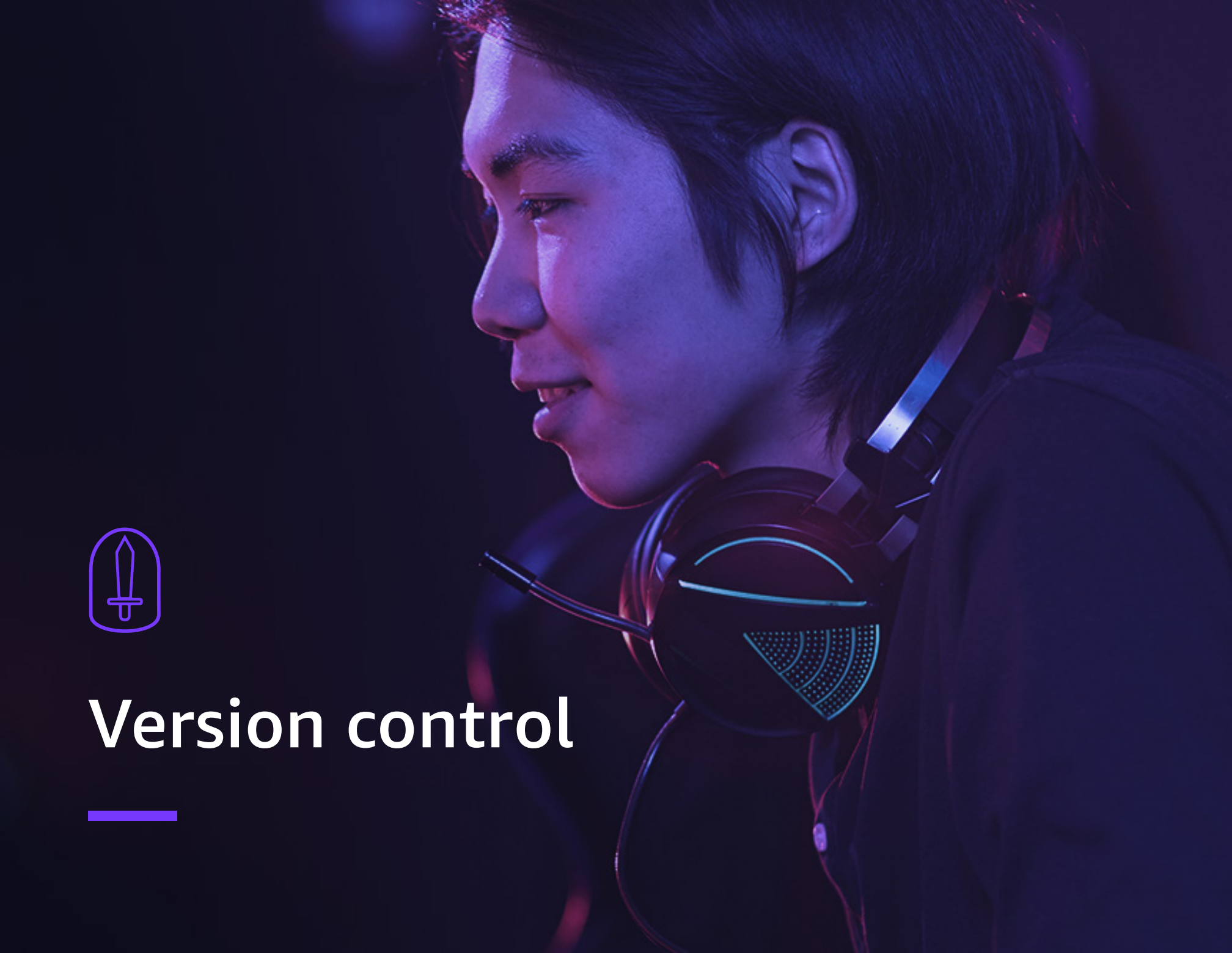
Game studios are meeting today's challenges with cloud-based technologies. Amazon Web Services (AWS) supports the most in-demand tools and solutions to help developers:

- Provision version control systems to a distributed workforce
- Use continuous integration and deployment (CI/CD) build pipelines to meet increasing production demands
- Deploy virtual workstations that allow teams to work anywhere and keep intellectual property (IP) safe

And as a leading provider, AWS brings almost 20 years of experience supporting customers, including:

- Sony Interactive Entertainment
- Epic Games
- Gearbox Software
- Riot Games
- Behaviour Interactive
- Warner Bros. Games
- Ubisoft





Version control



Avoid bottlenecks and improve data transfer performance

With project complexity and game scope continuing to increase, version control systems that provide high performance and availability are paramount. By moving to AWS, studios can:

- Reduce file synchronization wait times
- Increase productivity
- Improve build times

Additionally, with teams working in multiple locations, AWS solutions can help deploy hybrid and cloud-first version control systems, which scale with project size while ensuring game assets remain secure and available.



VERSION CONTROL

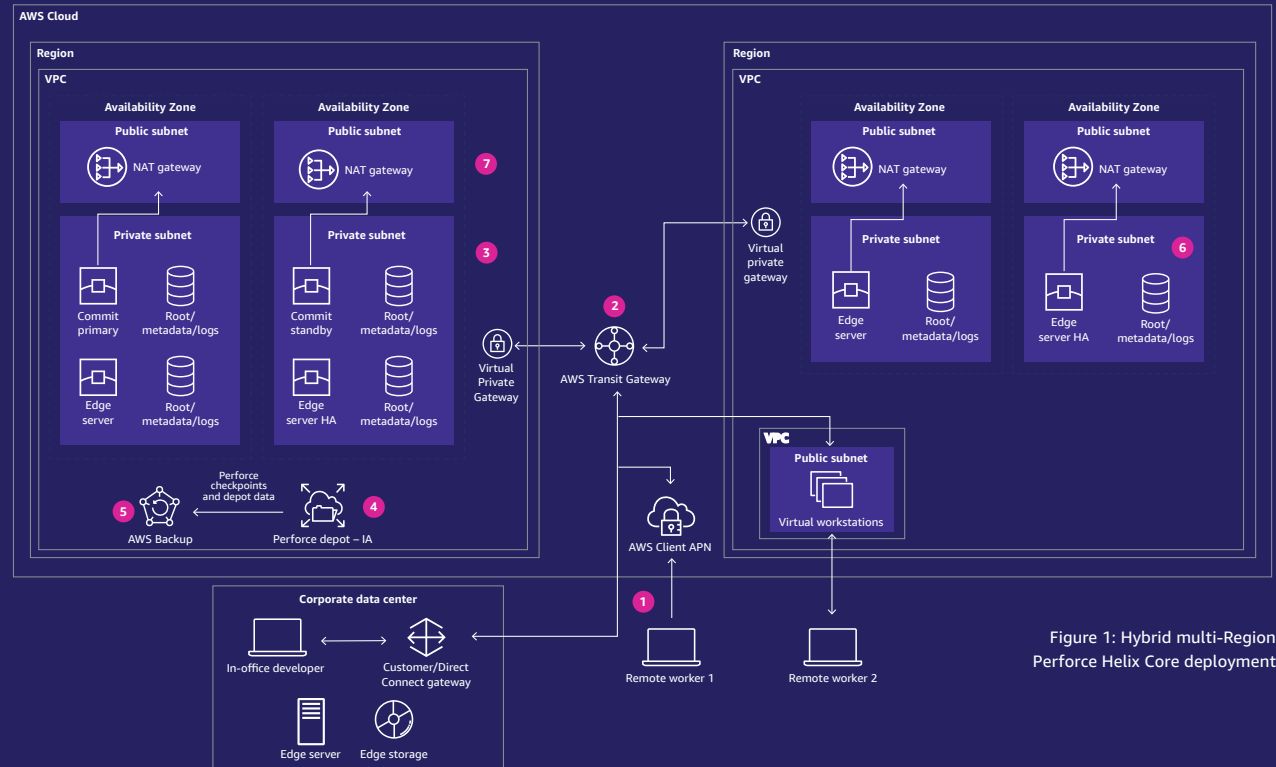


Figure 1: Hybrid multi-Region Perforce Helix Core deployment

- 01 > Connect a corporate data center edge server to the AWS primary Region with **AWS Direct Connect** or **AWS Site-to-Site VPN**, depending on bandwidth and connection stability needs. Connect remote users with **AWS Client VPN** or other virtual private network (VPN) solutions or virtual workstations on AWS.
- 02 > **AWS Transit Gateway** connects virtual private clouds (VPCs) and on-premises networks through a central hub-and-spoke model to simplify complex peering relationships and encrypt data in transit.
- 03 > Perforce's commit-edge architecture offers the best overall performance, with most commands running locally. The primary and replica high-availability (HA) servers run in separate Availability Zones for further high availability.
- 04 > If your depot is less than 16 TB, AWS recommends running Perforce on **Amazon Elastic Block Store (Amazon EBS)** GP3 volumes. The maximum **Amazon EBS** volume size is 16 TB, so storing the Perforce depot in the **Amazon Elastic File System (Amazon EFS)** is recommended for customers who have, or will soon have, a Perforce depot larger than 16 TB. AWS recommends using **Amazon EFS Standard-Infrequent Access (EFS Standard-IA)** for cost optimization because Perforce use is particularly well suited to the **Amazon EFS Standard-IA** cost model.
- 05 > **Amazon EFS** uses **AWS Backup** for backups. If you're only running Perforce on **Amazon EBS**, Amazon EBS snapshots are the standard backup mechanism. **AWS Backup** also works with **Amazon EBS** but isn't required.
- 06 > Edge server high availability is not required, depending on your recovery point and recovery time objectives. Restoring from an **Amazon EBS** snapshot is a slower, but more cost-effective, solution.
- 07 > Use a network address translation (NAT) gateway so that instances in a private subnet can connect to services outside your VPC, but external services cannot initiate a connection with those instances.

CASE STUDY: GEARBOX SOFTWARE

Gearbox turned to AWS and AWS Partner Perforce to move game production to the cloud, and it has since been able to build games more effectively with employees working from home.

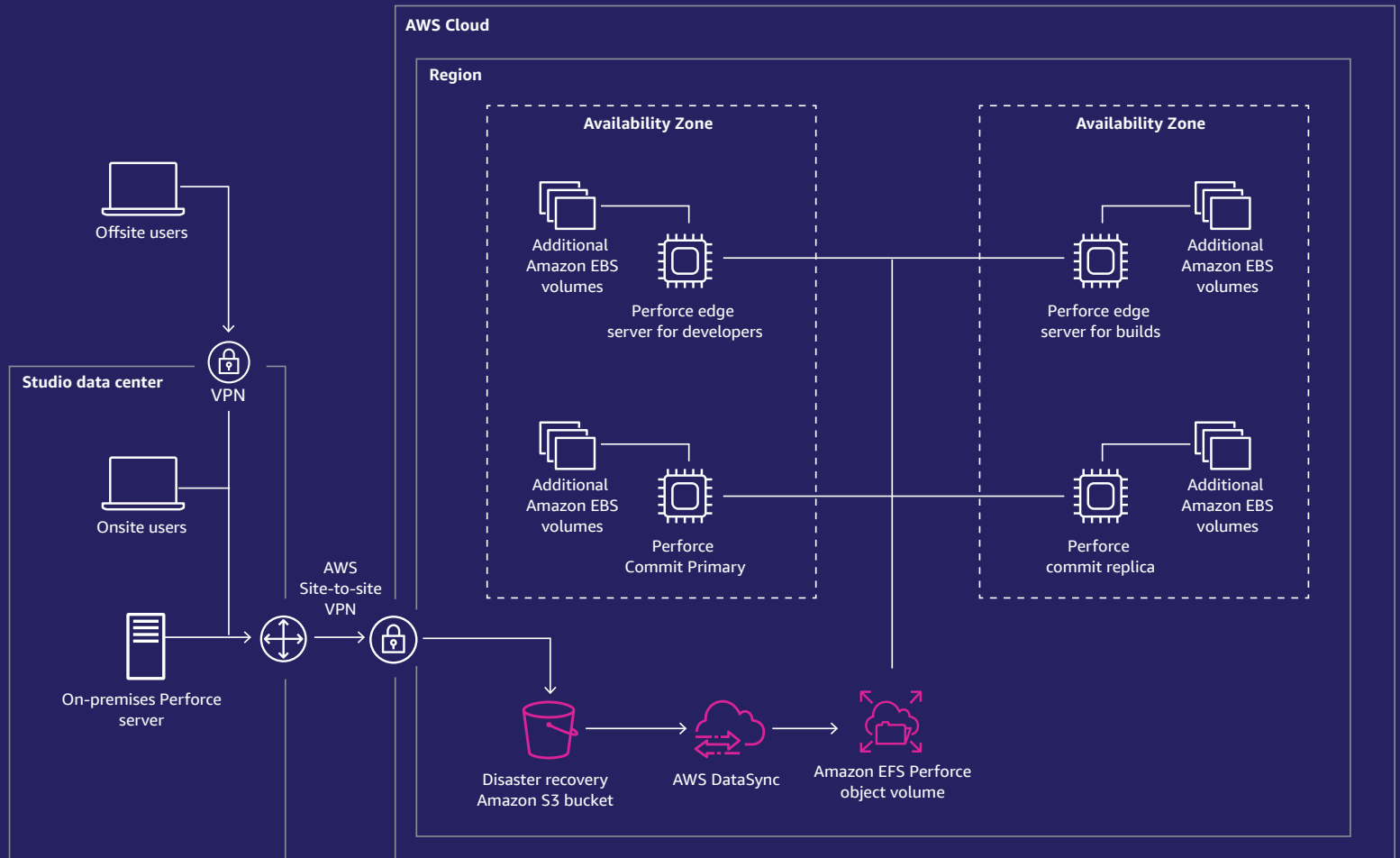
Read more about how [Gearbox Entertainment goes remote with AWS and Perforce.](#)



VERSION CONTROL

CASE STUDY: GEARBOX SOFTWARE

Figure 2: Gearbox example of Perforce Helix Core deployment



Accelerate development lifecycles with Perforce Helix Core

The **Perforce Helix Core Enhanced Studio Pack on AWS** contains the required tools for world-class development in a single, preconfigured environment. Deploying this solution for version control can deliver greater benefits compared to an on-premises server because it:

- Improves security
- Ensures high availability
- Facilitates collaboration for globally distributed teams

Using this solution helps centralize game production assets, so developers no longer need to build and maintain servers and storage infrastructure. As games grow larger in size and complexity, you need

to store assets in a central location while also providing access for remote developers. With AWS, studios that currently use Perforce can now lift and shift or extend their Perforce infrastructure to the cloud quickly, while those looking to get started with Perforce can deploy their first server in minutes.

RESOURCES

Read: Two easy ways to get started with Perforce on AWS today
Discover: Prebuilt Perforce Helix Core AMI on the AWS Marketplace
Download: AWS Perforce GitHub sample for advanced deployments
Best practices: This technical guide is based on the expertise of senior consultants at Perforce and AWS, as well as current Perforce and AWS customers

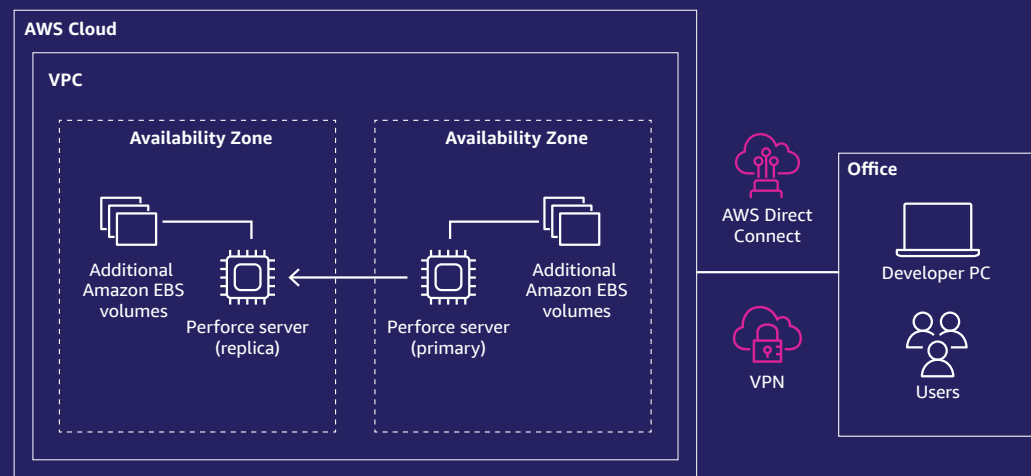
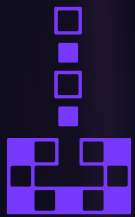


Figure 3: Perforce Helix Core deployment sample



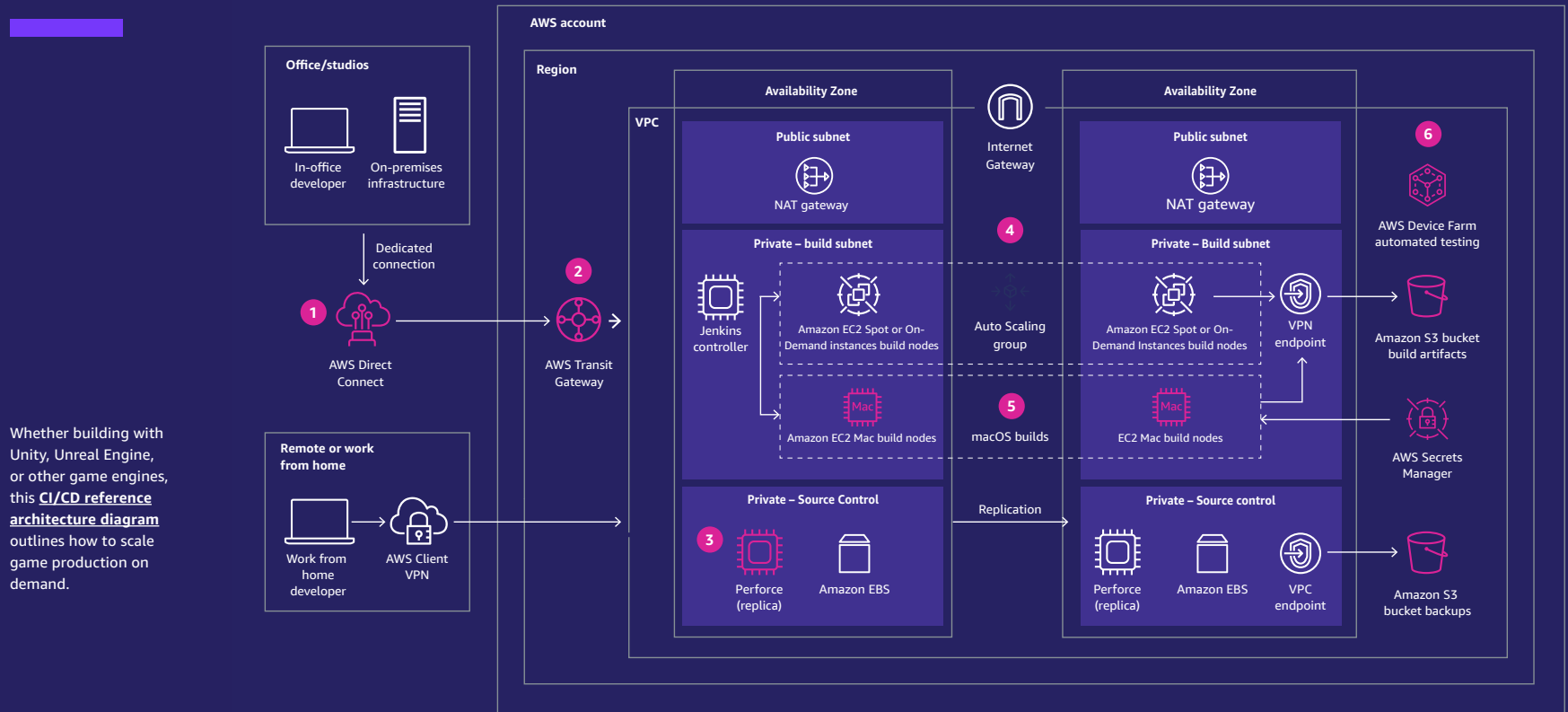
CI/CD build pipelines



Scale production on demand with CI/CD build pipelines

Game development demands highly scalable, highly available pipelines to meet evolving production demands. With pipeline solutions on AWS, development teams can build, test, and publish game versions that use managed elastic resources to scale on demand as builds are initiated. Implementing these solutions reduces the time spent on game build processes and minimizes errors, so developers can instead focus on creating standout experiences.





Whether building with Unity, Unreal Engine, or other game engines, this [CI/CD reference architecture diagram](#) outlines how to scale game production on demand.

- 01 > **AWS Direct Connect** provides a low-latency, private, dedicated connection to AWS for in-office developers. Remote developers use **AWS Client VPN**.
- 02 > **AWS Transit Gateway** simplifies network management for connectivity between VPCs and from on-premises networks.
- 03 > Perforce manages source and version control (CI) backed by **Amazon EBS** storage for quickly accessed, persistent data. Perforce Helix Core is available on **AWS Marketplace**.

- 04 > Commits start a build (CD) in Jenkins when developers push changes to Perforce that's tied to a branch. Perforce initiates POST a JSON payload to Jenkins. The Jenkins controller calls engine "headless" CLI commands to run and parallelize the build process across ephemeral Docker nodes, such as **Amazon EC2 Spot Instances** (one hour or less build time) or **Amazon EC2 On-Demand Instances**. Developers can increase availability with two Jenkins controllers, one in each AWS Availability Zone, behind a load balancer. For some engines, developers may need additional licensing infrastructure configured in additional subnets to vend licenses for the build context each time a concurrent build is run.

- 05 > The Xcode portion of iOS builds is offloaded to an **Amazon EC2 Mac instance** to sign, build, and export the .ipa file, splitting the process and reducing build times. **AWS Secrets Manager** holds provisioning profiles, private keys, and certificates.
- 06 > Build artifacts delivered to **Amazon Simple Storage Service** (Amazon S3) trigger third-party notice flows of successor failures. **AWS Device Farm** enables automated testing.

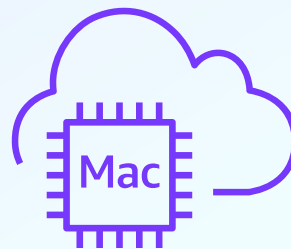
Expedite iOS game development with Amazon EC2 Mac instances

Amazon EC2 Mac instances support on-demand macOS workloads in the cloud, extending the flexibility, scalability, and cost benefits of AWS to all Apple developers. With Amazon EC2 Mac instances, developers can create apps for:

- iPhone
- iPad
- Mac
- Apple Watch
- Apple TV
- Safari

With the ability to provision and access macOS environments within minutes and dynamically scale capacity as needed, Amazon EC2 Mac instances facilitate faster-to-market game delivery. Taking this approach also allows for more consolidated

build pipelines across Android, Windows, and Apple environments to eliminate fragmented development workflows.

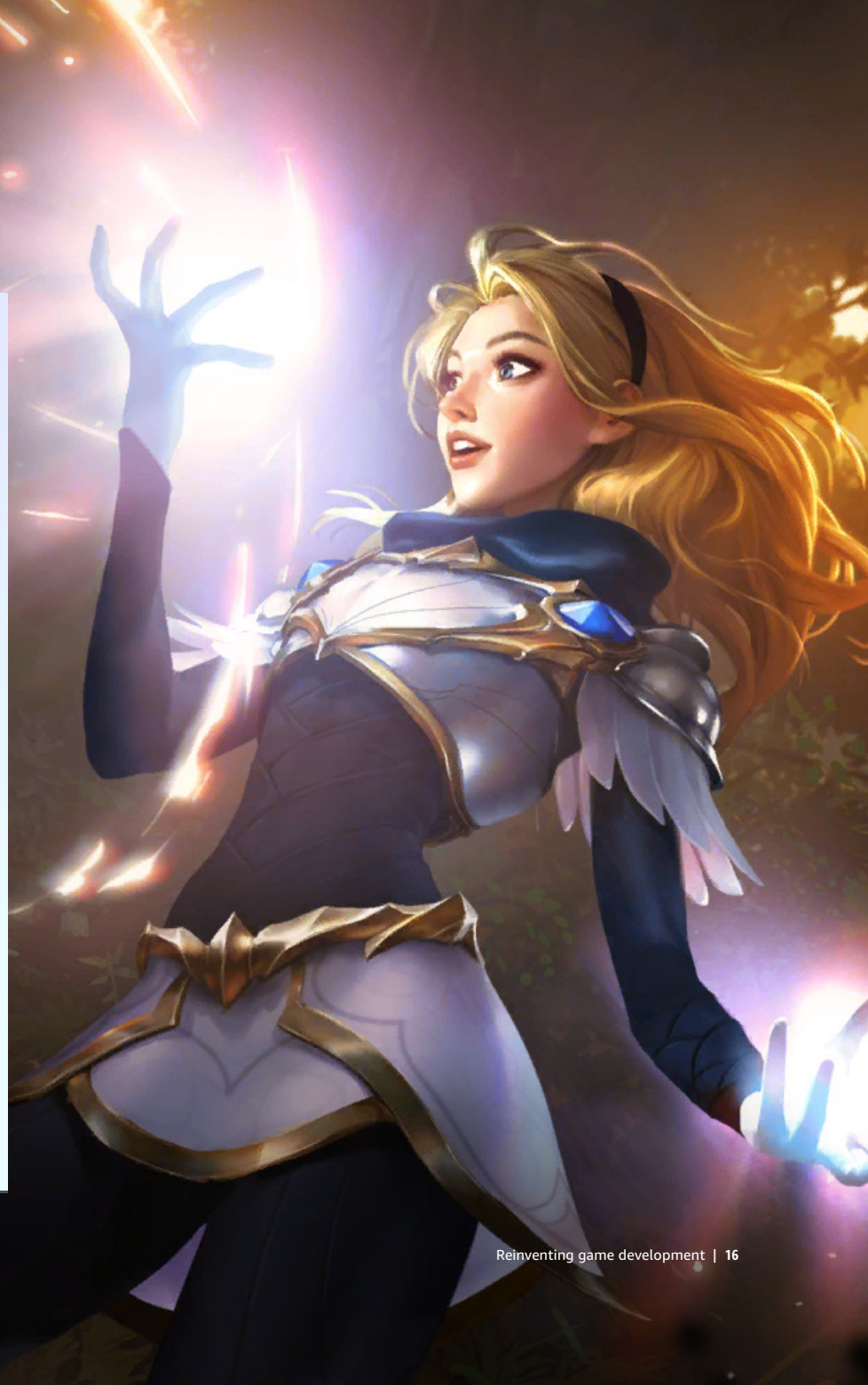


Tune into this [on-demand webinar](#) to learn more about the advantages of building games with Amazon EC2 Mac instances.

CASE STUDY: RIOT GAMES

"We consolidated our entire build pipeline on AWS (Windows, Linux, and now macOS). Our build pipeline currently supports ~100 builds per day, up to 3,000 builds per month, and our source control has over 270K commits to date. With Amazon EC2 Mac instances, our build pipeline delivers a complete end-to-end cross-platform build process for Unity CI/CD in the AWS Cloud."

Guy Kisel, Staff Software Engineer, LoR, Riot Games



Scale DevOps pipelines with TeamCity

TeamCity is a powerful, production-ready CI/CD solution that helps developers achieve quick development cycles through:

- Built-in pipeline optimizations
- Build reuse
- Intelligent test parallelization

With native, best-in-class support for Perforce Helix Core and bundled Unreal Engine and Unity build runners, TeamCity is a natural fit for game development studios, large and small. Customers like Gearbox Software, Playrix, Ubisoft, and many others rely on TeamCity to build, test, and release their games while effectively managing costs.

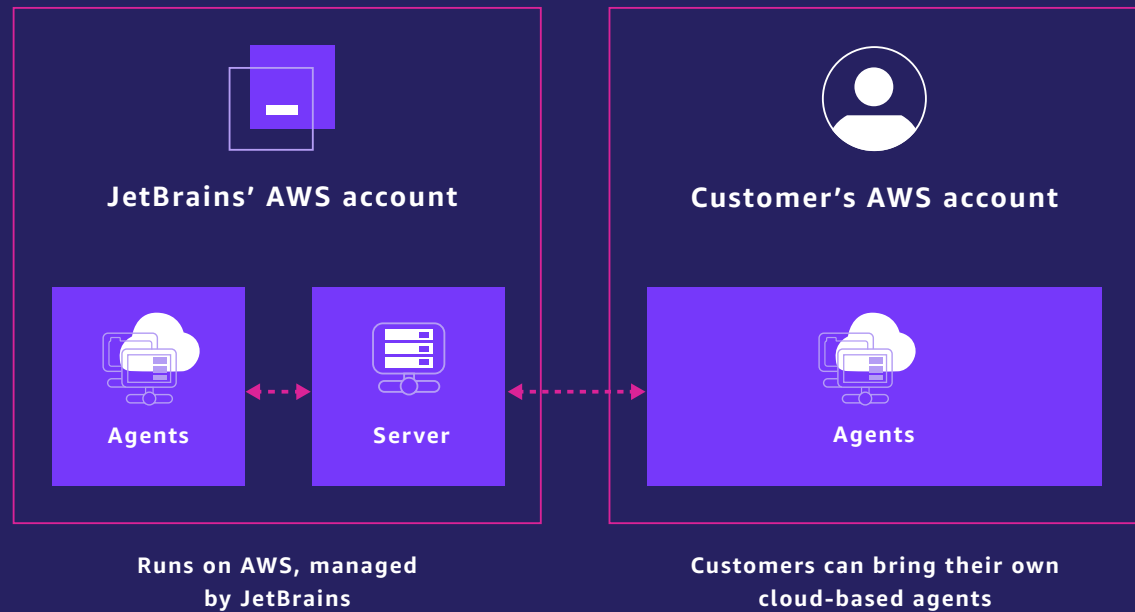


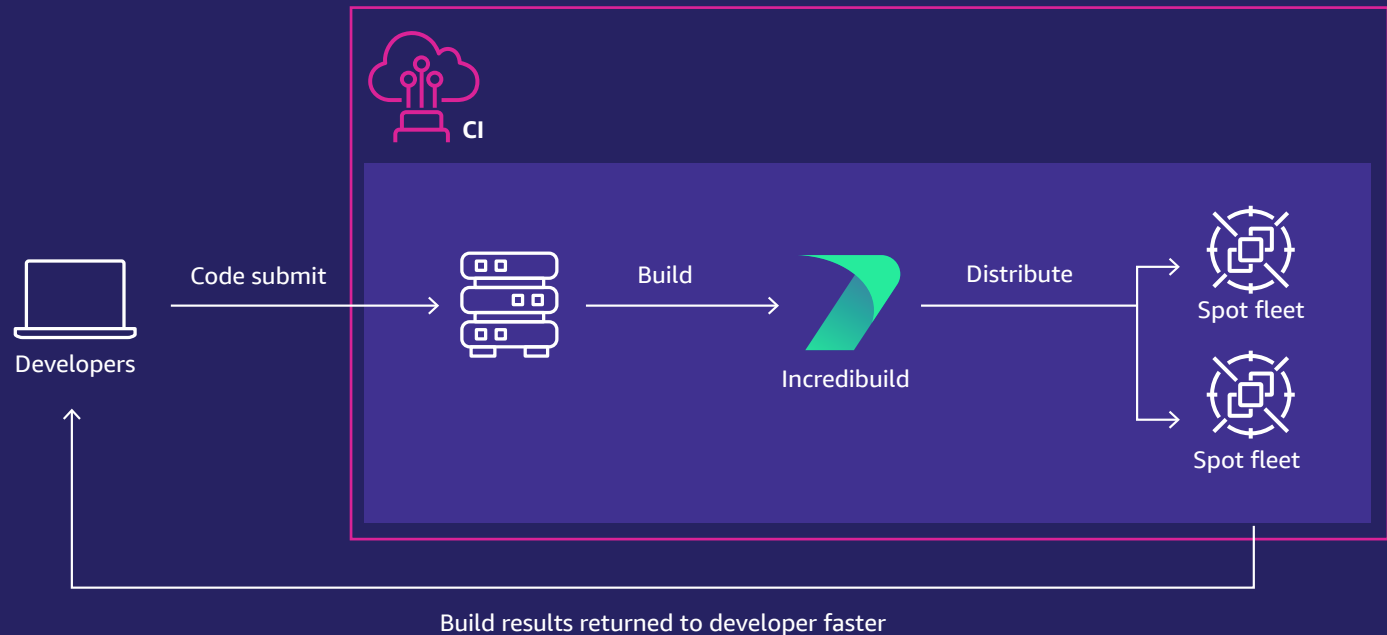
Figure 5: Team City Diagram

Increase productivity and optimize costs with Incredibuild

Figure 6: The CI pipeline and Incredibuild

Teamed with Incredibuild, AMD-based Amazon EC2 C5a and G4ad instances help slash game development wait times. The ability to harness hundreds of vCPUs on demand turbocharges traditionally time-consuming, repetitive tasks such as the compilation of shaders or engine code. It also eliminates interruptions for artists and developers, reclaiming hours of lost time.

Read more on how [AMD-powered Amazon EC2 instances and Incredibuild take the wait out of game development.](#)



Follow the sun with cloud-based file storage

With Nasuni's global file system on AWS, development teams can share projects with ease. Whether working remotely or from the office, a follow-the-sun development model helps pass projects between users anywhere and can help you stay ahead of the competition.

Nasuni for Game Builds, available on AWS Marketplace, uses [Amazon S3](#) as the backend object storage to:

- Advance collaboration
- Increase gameplay quality
- Decrease development and testing time
- Cut costs
- Minimize risk exposure

IP is securely protected with built-in automatic backup, disaster recovery, and rapid ransomware recovery capabilities.

To learn more about the benefits of Nasuni, [download the solution brief](#).



Workstations

Build bespoke workstations for creative teams

Today's game studios need flexible, secure, low-latency infrastructure. With teams co-developing games from different locations and studios hiring contractors, moving from physical to virtual workstations can help onboard new team members and minimize overhead. AWS remote solutions empower content creators of all types, including:

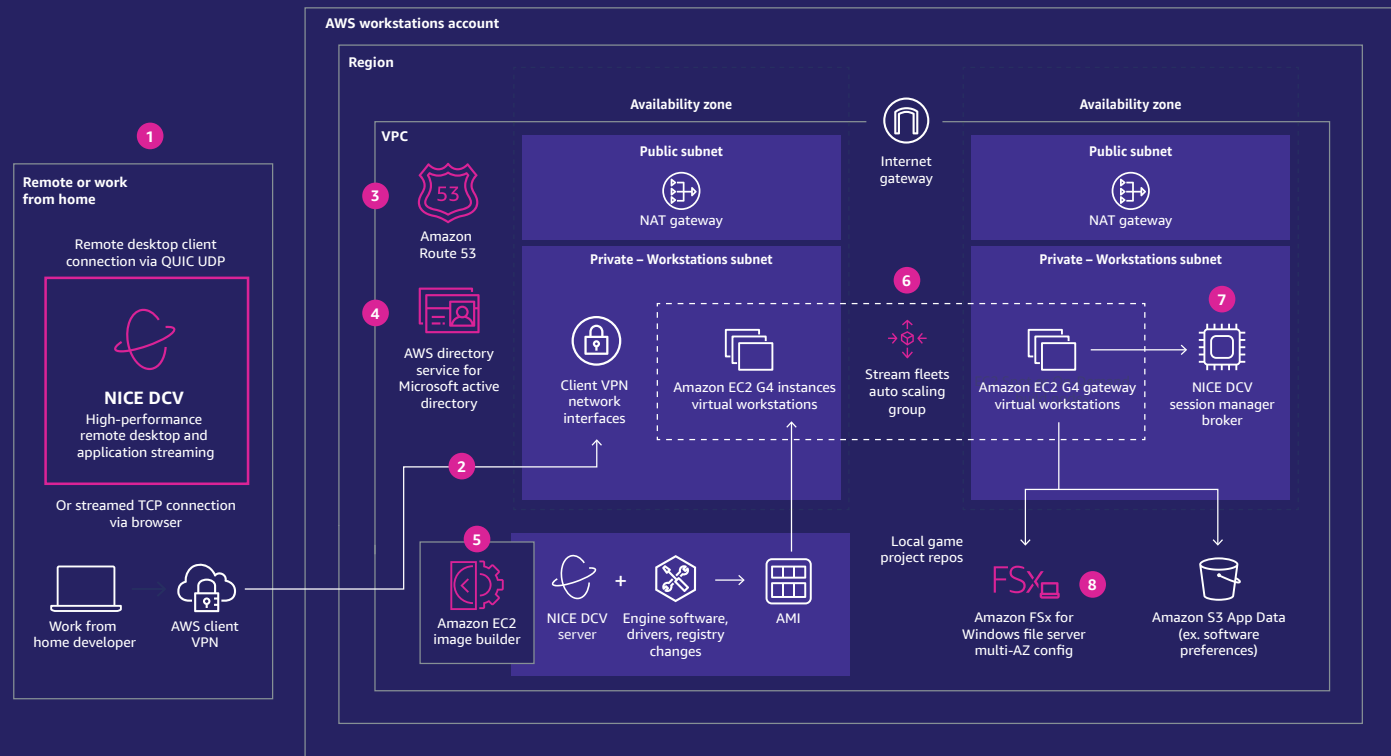
- Programmers
- Designers
- Artists
- Animators

PROTECT DATA

Intellectual property (IP) is everything for studios. Built for the cloud and designed to meet the most stringent security requirements in the world, the AWS global infrastructure is monitored 24/7 to help ensure data confidentiality, integrity, and availability. This means you can maintain control over your data, including the ability to encrypt it, move it, and manage retention at any time. Especially when working with contractors, virtual desktop infrastructure improves IP security by allowing you to lock assets into the workstation.

WORKSTATIONS

Figure 7: Game production in the cloud – workstations



01 > NICE DCV is a streaming protocol that supports 4K, 60 FPS streaming. Developers can use a browser to connect via TCP connections, whereas desktop clients can use QUIC UDP over port 8443 for increased performance.

02 > Developers use **AWS Client VPN** for a secure connection to network interfaces in the workstation subnets with source network address translation.

03 > **Amazon Route 53** provides private domain name service (DNS) for the resources in the VPC, as well as inbound and outbound DNS forwarding.

04 > **AWS Directory Service** provides managed **AWS Directory Service for Microsoft Active Directory** to enable local game project storage mapped to individual users.

05 > Workstations are created using an **Amazon Machine Image (AMI)** built with **Amazon EC2 Image Builder**. Images include the NICE DCV server, developer software, registry changes, and drivers, such as NVIDIA gaming drivers or peripheral drivers. **AWS Marketplace** includes common AMIs used for workstations.

06 > Fleets of workstations use **Amazon Elastic Compute Cloud (Amazon EC2)** instance types that provide GPUs and are scaled using **Amazon EC2 Auto Scaling** groups.

07 > A Session Manager Broker enables management of NICE DCV sessions.

08 > Workstation file storage of projects is hosted in **Amazon FSx for Windows File Server**. Developers commit to a separate continuous integration and continuous deployment (CI/CD) pipeline by pushing from workstation storage to source control.

Facilitate remote or hybrid work in a secure environment

Remāngu is a cloud-based game development platform that simplifies and accelerates the process of creating and releasing games. With Remāngu, game studios can hire, onboard, and collaborate with global talent and facilitate remote work in a secure environment. This AWS partner solution offers a variety of tools and services, including:

- Integrated CI/CD and playtest environments
- Powerful graphic workstations
- Scalable game development infrastructure built on AWS

Wevr Virtual Studio (WVS) is an easy-to-use managed solution that uses AWS for a range of CI/CD workflow automations, including:

- Builds and deployment to PC, console, and mobile platforms
- Rendering
- Asset validation and tracking
- QA testing

WVS is engine-agnostic—ideal for Unreal Engine, Unity, and Godot teams—and supports artist workflows with Autodesk Maya, Blender, and other tools. It also integrates with popular version control systems, including Perforce and GitHub, while providing native support for 100 percent Git-interoperable version control optimized for game development with in-editor plug-ins.

From code and asset changes to reviewable builds and artifacts, this solution delivers the fastest roundtrip, leaving more time for creative iteration. It provides out-of-the-box, preconfigured, and customizable hardware on AWS, so teams can securely and reliably scale their projects as needed with cost-effective, usage-based pricing by the minute.

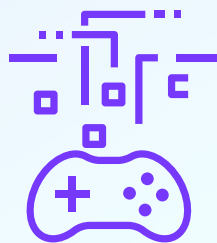
Scale creativity with virtual workstations on AWS

Using AWS for digital content creation has numerous benefits, including:

- Freeing artists and studios to scale their work as projects require
- Helping teams make workflow adjustments on the go
- Empowering studios to provision powerful resources on a project-by-project basis

Amazon EC2 GPU instances run software securely on virtual workstations, with only the encrypted pixels of the desktop display being streamed to the end user's PC or laptop. Creatives can use existing licenses for their favorite applications, such as Autodesk Maya or Autodesk 3ds Max, Blender, ZBrush, and Houdini. They can also connect to virtual workstations on AWS using streaming solutions, such as [NICE DCV](#) or those offered by HP Anyware.

Using cost-effective and versatile GPU instances for graphics-intensive applications, Amazon EC2 GPU instances help artists, animators, and editors build virtual workstations that meet high-spec requirements. Amazon EC2 GPU instances can be built with NVIDIA GPUs or AMD GPUs, providing studios with the flexibility to choose what best suits their application.



Go to [RETHINK CREATIVITY](#) to learn how to take on bigger projects, pay only for time and resources as needed, and work from anywhere and with anyone.

Take advantage of Amazon EC2 G5 instances featuring NVIDIA A10G GPUs

Used for a wide range of graphics-intensive and machine learning (ML) use cases, [Amazon EC2 G5 instances](#) are the latest generation of NVIDIA GPU-based instances. Compared to Amazon EC2 G4dn instances, they deliver:

- Up to 3x better performance for graphics-intensive applications and ML inference
- Up to 3.3x higher performance for ML training

Studios can use G5 instances for graphics-intensive applications, such as:

- Remote workstations
- Video rendering
- Gaming

Get high-performance, cost-efficient ML infrastructure to train and deploy larger, more sophisticated models for:

- Natural language processing
- Computer vision
- Recommender engine use cases

G5 instances feature up to eight NVIDIA A10G Tensor Core GPUs and second-generation AMD EPYC processors. They also support up to 192 vCPUs, up to 100 Gbps of network bandwidth, and up to 7.6 TB of local NVMe SSD storage.

Learn more about [how to use Amazon EC2 G5 and G5g instances](#) for graphics-intensive workloads.

Stream high-performance remote desktops and applications

For users to view and interact with applications running on a virtual workstation, a streaming solution is required. NICE DCV is a high-performance remote display protocol that provides customers with a secure way to deliver remote desktops and application streaming from any cloud or data center to any device over varying network conditions.

With NICE DCV and Amazon EC2, graphics-intensive applications can run remotely on virtual workstations, and the user interface can be streamed to simpler client machines, eliminating the need for expensive on-premises workstations. NICE DCV supports both Windows and Linux-based environments.

For clients who use Windows, Linux, macOS, and HTML5, it offers:

- Multiple monitors
- 4K resolution
- Features such as:
 - Stylus and touch
 - USB devices
 - Multichannel audio
 - Wacom tablets
 - Game controllers
 - Smart cards
 - File redirection

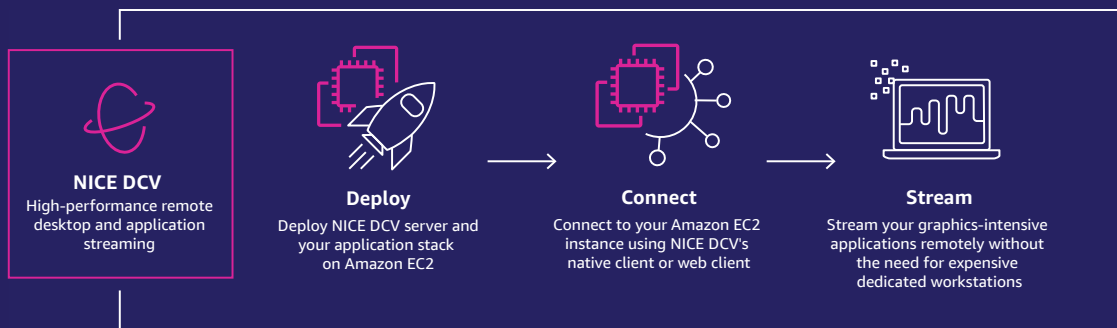


Figure 8: NICE DCV and Amazon EC2

Stay productive with the latest software

HP Anyware helps you stay in sync with the ever-evolving demands of:

- Infrastructure
- Network
- Hybrid workforce

This enterprise software does this with deployment flexibility for virtually any host environment or workload. Built on the same technology that won both HP and Teradici an Engineering Emmy Award in 2020,

HP Anyware creates a streamlined experience, so your teams can collaborate meaningfully from anywhere in the world.

Parsec is an ultra-low latency remote desktop application used by AWS customers, such as:

- Electronic Arts (EA)
- Blizzard
- Ubisoft
- Square Enix

It gives teams access to workstations in the cloud or on-premises with a multimonitor, over 60 frames per second (FPS), 4K connection while using minimal bandwidth and supporting peripheral devices like Wacom tablets and gamepads.



Get reliable virtual desktops for every workload

Amazon WorkSpaces family delivers a fully managed, secure, reliable virtual desktop for varied worker types, from any location. Improve IT agility and maximize user experience while only paying for the infrastructure you use. This solution set also helps you:

- **Strengthen security:** Store user data on AWS instead of on vulnerable endpoint devices
- **Stay cost-effective:** Take advantage of fixed-rate pricing with no overprovisioning and no up-front costs
- **Scale on demand:** Streamline IT operations by scaling when you need it
- **Maximize productivity:** Facilitate distributed team productivity with reliable, high-performance, globally distributed infrastructure

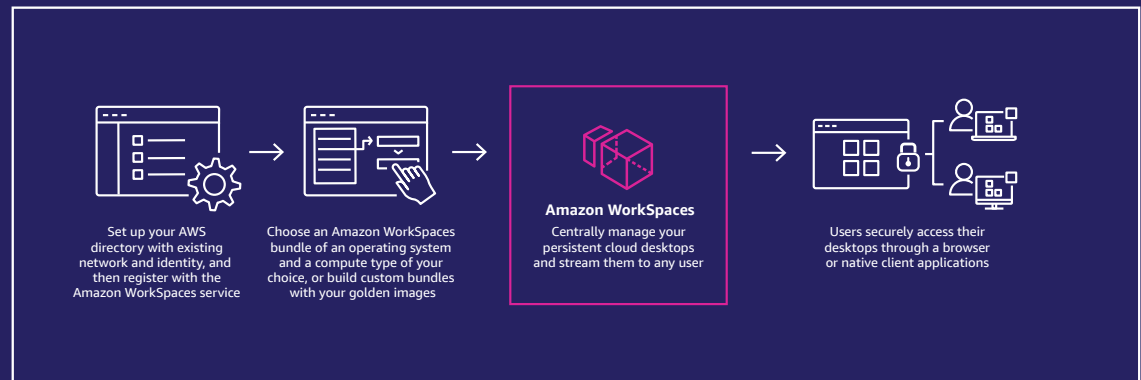
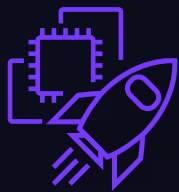


Figure 9: Amazon WorkSpaces



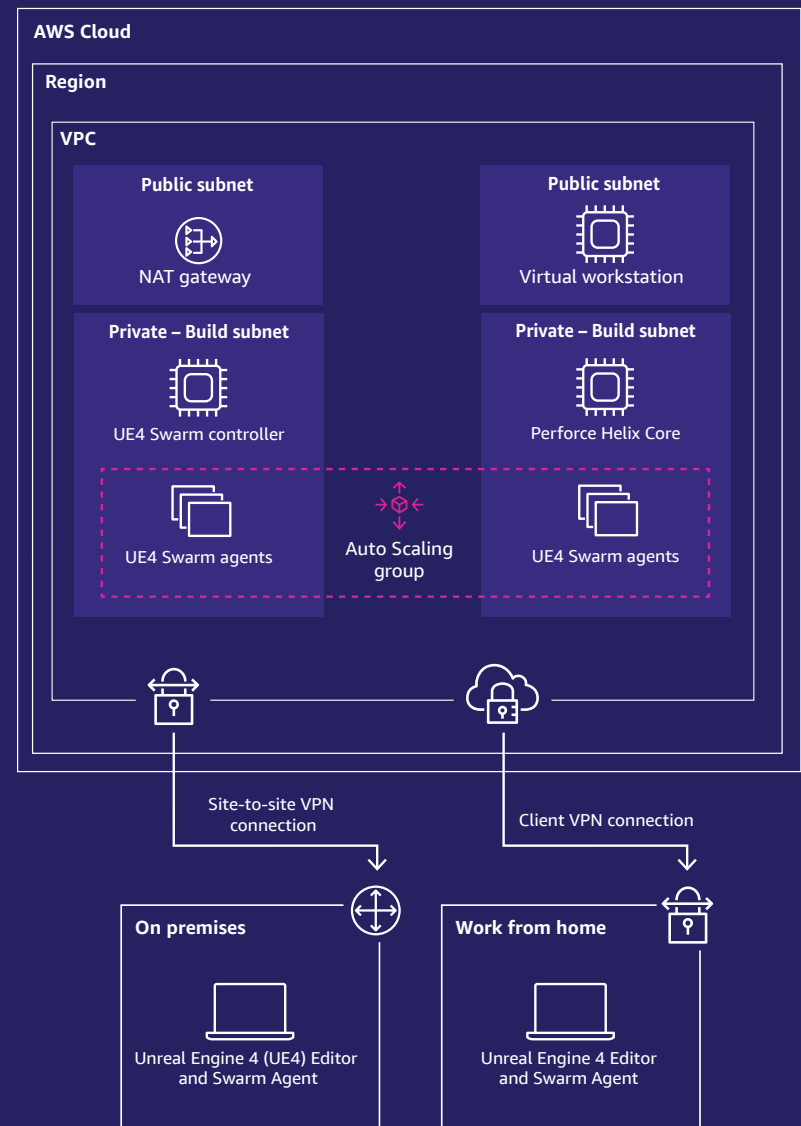
Next steps

NEXT STEPS

Build, run, and grow games with AWS for Games. Ready to get started? [Check out this quick-start guide to setting up a remote workstation, maintaining version control, and accelerating compute-intensive processes on AWS.](#)



Figure 10: Game production in the cloud sample



To learn more about how AWS can help improve game production, start by exploring the following resources covering every stage of game development:

VISIT OUR PAGE: [AWS for Games: Cloud Game Development](#)

VISIT OUR SOLUTIONS PAGE: [AWS for Games](#)

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