STUDENT PATHWAYS ARCHITECTURE
(FORMERLY PORTFOLIUM)

Engineering, Security, and Operations

April 2023

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CANVAS
BY INSTRUCTURE

Canvas Student Pathways Architecture

It goes without saying — we live in a highly competitive world. No matter what career pathway a student seeks, no matter what dreams they may have, showcasing academic achievements to prospective employers has become an important step on that journey. Firstly, it provides evidence of a student's capabilities and competencies, demonstrating their academic accomplishments, knowledge and skills in a tangible way. This helps to build credibility with potential employers and increases the chances of being considered for job opportunities. By showing academic achievements through an online portfolio platform students stand out from other candidates in a competitive job market. Employers are increasingly looking for candidates who have a track record of success, and an online portfolio that showcases academic achievements can help demonstrate this.

Canvas Student Pathways, formerly Portfolium, offers a variety of student activities as milestones and plays an important role in supporting learning pathways. It offers a solution for digital student portfolios where students can connect with each other and apply for a job. Both of these features help institutions offer different learning paths and enable students and employees to acquire new competencies through online programs. These two features are so critical in a modern, highly competitive world that institutions are fast adopting Pathway and Credentialing products (such as Canvas Credentials) in order to have these capabilities in their ecosystem. And speaking of ecosystem, Canvas Student Pathways is fully integrated with the Canvas LMS, making it easy for students to share their portfolios with their instructors and peers. This innovative platform is transforming the way students manage their academic and professional careers, empowering them to take control of their future success.

The following supplemental document describes the Canvas Student Pathways platform architecture for those curious technical types who love getting into the detail of just how we help students from all walks of life reach those dreams.

Hosting

Instructure's product family, including Canvas Student Pathways, is hosted in the cloud by Instructure and delivered over the internet through the world's most trusted public cloud provider, Amazon Web Services (AWS). The basic building blocks of AWS include services such as Elastic Compute Cloud (EC2), Elastic Load Balancing (ELB), Auto Scaling Groups (ASG), Simple Storage Service (S3), Elastic Block Store (EBS), Virtual Private Cloud (VPC), Simple Email Service (SES), and Identity and Access Management (IAM). We also use advanced AWS platform capabilities including Amazon Kinesis, AWS Lambda, AWS Fargate, AWS Elastic Kubernetes Service ("EKS"), and Amazon Relational Database Services ("RDS"). Instructure's products are designed to make full use of the real-time redundancy and capacity capabilities offered by AWS, running across multiple availability zones in regions throughout the world. Primary storage is provided by Amazon S3, which is designed for durability exceeding 99.99999999%.

Hosting Regions

For Canvas Student Pathways customers, Instructure uses Amazon Web Services (AWS) regions, ensuring that client data is not stored outside of our customer's region*. The current regions in use for Canvas Student Pathways are:

- USA: Virginia

- Europe: Dublin

- Australia: Sydney

Network Architecture

Canvas Student Pathways utilizes Amazon VPC (Virtual Private Cloud) to isolate and control access, both into and out of its network. On top of the AWS network, all DNS traffic is routed through CloudFlare's world-renowned private DNS network, enhancing performance and security as it prevents DDoS and other known attacks.

Data Storage

Canvas Student Pathways utilizes Amazon S3 (Simple Storage Service) to store user-uploaded artifacts (documents, images, etc.). Amazon S3 provides a highly durable storage infrastructure designed for mission-critical and primary data storage. Objects are redundantly stored on multiple devices across multiple facilities in an Amazon S3 region.

Amazon S3 also regularly verifies the integrity of data stored using checksums. If Amazon S3 detects data corruption, it is repaired using redundant data. In addition, Amazon S3 calculates checksums on all network traffic to detect corruption of data packets when storing or retrieving data.

Amazon S3's standard storage is:

- Backed with the Amazon S3 Service Level Agreement

- Designed to provide 99.999999999% durability and 99.99% availability of objects over a given year

- Designed to sustain the concurrent loss of data in two facilities

Load Monitoring

Canvas Student Pathways uses New Relic at the server and application layer to probe and test various layers of the platform. If there is an alert, and email will be triggered, then after 5 minutes if nothing was resolved, a text message will be sent out. Pingdom is used as a secondary ping check on platform domains.

We have a stateless web architecture that grows horizontally. Using AWS OpsWorks based on load, memory usage, or CPU level, the system can automatically spin up a new web server and add it to the layer whether it be at the web layer or API layer.

Canvas Student Pathways successfully scales to launch multiple 30K+ student universities in a single day, alongside their 100K+ alumni networks.

File Storage

All files that are uploaded to Canvas Student Pathways are stored on a private S3 bucket in AWS (Amazon Web Services). When requested to view and/or download, based on authentication and access rules of the artifact, the application generates an access token for the browser to download the file from the file store. e-Portfolio data is encrypted over HTTPS with a TLS v1.2 SSL cert. Password data at rest is 1-way salted then one-way hashed with a SHA-1 algorithm.

e-Portfolio data backups are encrypted using enterprise-grade encryption (AES 256-bit key). The data is encrypted before it leaves the server, and remains encrypted while stored. Canvas Student Pathways servers, from power supplies to the internet connection to the air purifying systems, operate at full redundancy. Our systems are engineered to stay up and online even if multiple servers fail

Our state-of-the-art servers are protected by biometric locks and round-the-clock interior and exterior surveillance monitoring. Only authorized personnel have access to the data center.

24/7/365 onsite staff provides additional protection against unauthorized entry and security breaches. Our software infrastructure is updated regularly with the latest security patches. While perfect security is a moving target, we work with security researchers to keep up with the state-of-the-art in web security.

Backup Environment

Canvas Student Pathways uses various techniques to provide system redundancy, including an available backup environment.

Each AWS service used (EC2, RDS, etc) is configured to be redundant and available in different Availability Zones within the AP-SOUTHEAST-2 region. Each Availability Zone is designed as an independent failure zone. This means that Availability Zones are physically separated within a typical metropolitan region and are located in lower risk flood plains (specific flood zone categorization varies by AWS Region). In addition to discrete uninterruptible power supply (UPS) and onsite backup generation facilities, they are each fed via different grids from independent utilities to further reduce single points of failure. Availability Zones are all redundantly connected to multiple tier-1 transit providers.

US-based Clients

Canvas Student Pathways' multi-tenant database is backed up via RDS services and stored in the US-EAST-1 region (primary). Daily database backups are sent to US-WEST-2.

Canvas Student Pathways' server configuration is scripted using AWS OpsWorks and Chef. In the event of a cataclysmic disaster in US-EAST-1, the system would be able to use the RDS backups in US-WEST-2 and spin up a new stack and update the DNS in CloudFlare to point to the new Load Balancers in US-WEST-2.

Australia-based Clients

Canvas Student Pathways' multi-tenant database is backed up via RDS services and stored in the AP-SOUTHEAST-2 region (primary). Daily database backups are sent to AP-SOUTHEAST-1.

Canvas Student Pathways' server configuration is scripted using AWS OpsWorks and Chef. In the event of a cataclysmic disaster in AP-SOUTHEAST-2, the system would be able to use the RDS backups in AP-SOUTHEAST-1 and spin up a new stack and update the DNS in CloudFlare to point to the new Load Balancers in AP-SOUTHEAST-1.

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