Adobe Captivate Prime Technical Overview

Captivate Prime is a new Learning Management System (LMS) that streamlines the process of setting up, delivering and tracking any form of learning content. This self-service cloud based tool is for specialists in learning and development, training and corporate HR departments to help them take charge of the learning environments they manage. This guide presents a technical overview of Adobe Captivate Prime Server architecture

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1. Modular design

Adobe Captivate Prime uses a highly scalable, secure, and flexible architecture hosted on AWS cloud. Adobe Captivate Prime Server offers enterprise-class scalability with clustered environments. It provides reliable redundant deployment that can support virtually infinite concurrent users.

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Access control	Reporting	User management
• AdobeID/SSO (via SAML 2.0) • Authentication • Role-based permissions • Group management	• Permission-based access • Dashboard reports • Customizable reports • Manager and group reports • Powerful real time reports • Automated reports via email	• User/Group management • Bulk user/group creation thru CSV • Automated CSV import via FTP • Self Registration

Scalability	Content Consumption	Content Support
• Clustering • Failover • Auto Scaling • CDN (Akamai)	• Fluidic player • Adaptive streaming • Http Live Streaming	• Adobe Captivate/Presenter authored content • All video formats • AICC, SCORM, TinCan/xAPI • PPTx, PDF, Docx

Security	Availiablity	Licensing
• VPC, public/private Subnet • All access via https • Security Audit Compliant • 27/7 monitoring by Adobe security response team	• Multi AZ • Daily Offline Backup • Automated Monitoring via Newrelic, Zabbix, CloudWatch • 24*7 NOC support	• On demand seat purchase • CC online payment • Purchase order/offline payment

Performance	Architecture	
• Unlimited simultaneous users • Fast content delivery via Akamai • Non-blocking UI thru Async workflows	• Futuristic technology stack • AWS platform SOA based on Microservice	

2. Server components

Adobe Captivate Prime is multi-tiered AWS hosted cloud solution which runs on multiple application servers providing the services related to different functions pertaining to Admin, Author, Manager and Learner like content creation, management & on demand delivery, user/group management, permissions and grants, client sessions, among other tasks.

Adobe Captivate Prime Business Logic Server

Create, manage, deploy, and track eLearning courses and curriculums, complete with enrollment, assessments, surveys, learner management, and reporting.

Adobe Captivate Prime Learning Record Server

Manage the learning records generated when a learner engages in a course. It also handles all requests pertaining to various real time customizable reports.

Adobe Captivate Prime Worker Server

Performs most of the heavy lifting and long running tasks in asynchronous mode, coordinated and brokered through Amazon SQS such as course content format conversion, communicating with other external web services such as Akamai, box etc., organizational hierarchy data import, report processing etc.

Authentication & Authorization Module

Every request is validated at the API gateway to check whether the requesting user has been authenticated earlier and has a valid session. API gateway also takes care of the Authorization and allows resource access to only privileged users (For example only author can create a course, only admin can add a learner)

Learner's login can be configured to either use Adobe ID or Single Sign On (SSO). An organization can configure the Captivate Prime system to integrate with its identity provider supporting SAML 2.0, to provide SSO functionality for the employees.

3. Solution architecture

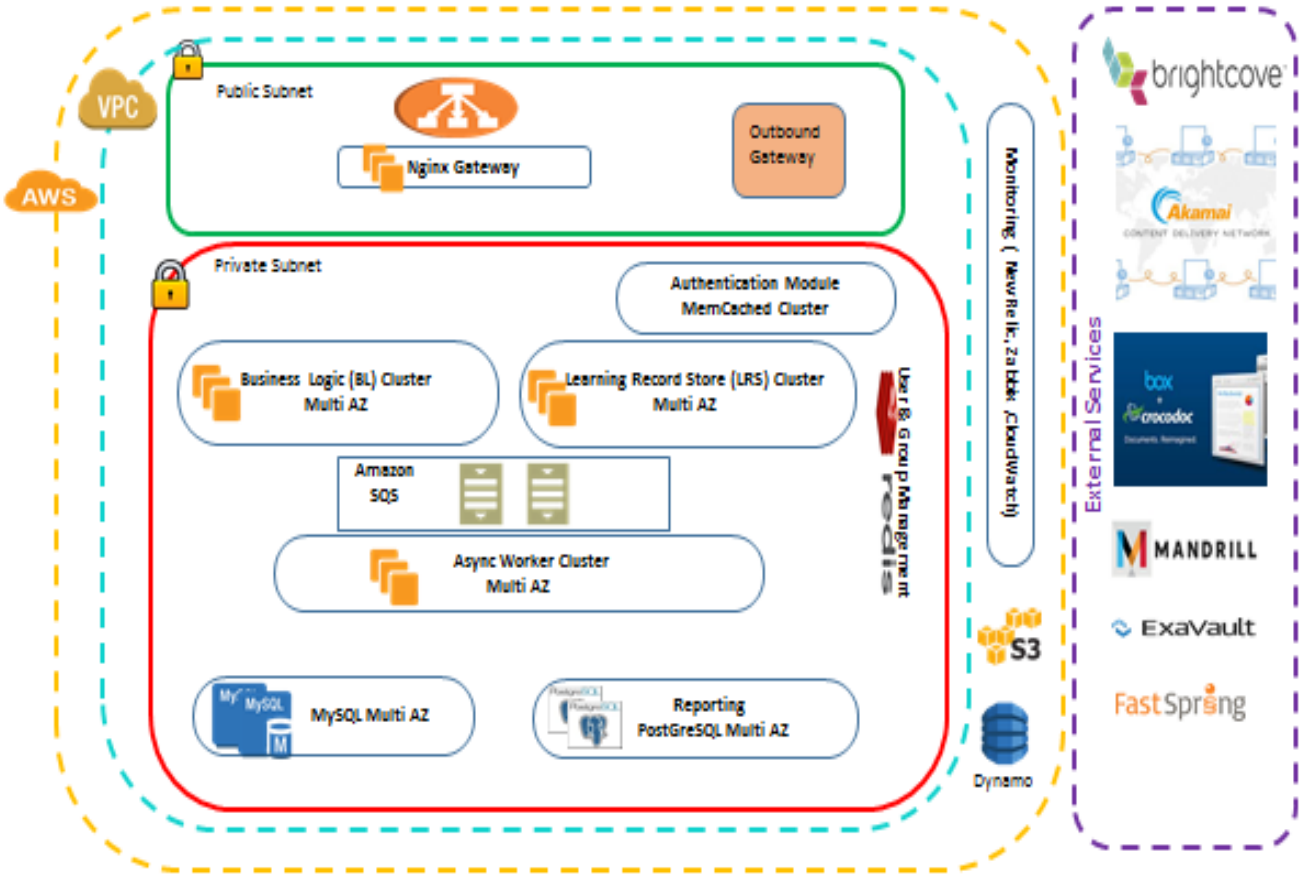
Adobe Captivate Prime is architected with the aim of being a highly scalable, highly available and highly secure SaaS. At each stage of design, implementation and deployment, the best practices have been institutionalized to make it most performant, scalable, reliable and secure system.

Security, redundancy, reliability, failover and performance are key considerations in the design, delivery, and regular improvements of the hosted service.

The transactional and application metadata that the application server manages, is stored in caching layer, relational, and NoSQL stores.

Adobe Captivate Prime Server is built on JEE stack using Apache Tomcat for the application layer. The solution is built on multi-tiered paradigm, separating logical functions such as presentation, application processing, and data management across independent processes.
The hosted model provides the following advantages:

- Service updates, infrastructure upgrades, and routine maintenance
- Reliable and redundant deployment with automated failover provisions
- Auto Scalable deployment


AWS
VPC
Public Subnet
Nginx Gateway
Outbound Gateway
Private Subnet
Authentication Module
MemCached Cluster
Business Logic (BL) Cluster
Multi AZ
Learning Record Store (LRS) Cluster
Multi AZ
Amazon
SQS
Async Worker Cluster
Multi AZ
MySQL Multi AZ
Reporting
PostGreSQL Multi AZ
Monitoring (NewRelic, Zabbix, CloudWatch)
S3
Dynamo
External Services
brightcove
Akamai
box
crocodoc
MANDRILL
ExaVault
FastSpring

4. Performance

Clustered server

The Adobe Captivate Prime application server is stateless and follows a service-oriented architecture (SOA) based on Micro services paradigm implemented using REST APIs. All the components and services are deployed in clustered server environment, delivering on-demand scalability and elasticity for all the workflows, either computational or data-intensive workloads.

As the application interaction design is stateless, the solution enjoys the advantage of the virtually limitless scalability.

Auto scaling

Auto Scaling helps to maintain application availability and allows to scale Amazon EC2 capacity up or down automatically according to the parameters defined. Auto Scaling can also automatically increase the number of Amazon EC2 instances during demand spikes to maintain performance and decrease capacity during lulls to reduce costs. Auto Scaling is well suited both to applications that have stable demand patterns or to applications that experience hourly, daily, or weekly variability in usage.

Initial cluster size is configured to two EC2 instances for each of the Adobe Captivate Prime servers and each of them can virtually scale to infinite instances triggered by alarmssuch as CPU, number of requests processed per second, etc. to facilitate elastic load balancing of request traffic resulting in high performance, even during heavy & unexpected load conditions.

Elastic Load Balancers can detect impaired Amazon EC2 instances and unhealthy applications, and replace the instances without manual intervention. This feature ensures that the application is getting the compute capacity that is needed.

Content delivery

The unique fluidic player running at learners device provides a unified playback experience for virtually any kind of content, so that they can play various videos format, PDFs, PPTs, DOCX, SCORM, AICC and xAPI-compliant packages, all within a single player without having to download any plugins.

Learning content is delivered using high quality video streaming and a distributed delivery mechanism that serves content with minimum latency using thousands of Akamai edge servers (CDN) and Brightcove video cloud, a leading online video platform.

All the non-video course contents are stored in Akamai content distribution network

(CDN) that uses edge caching to speed up the delivery of web content to end users by storing replicas of static text, image, audio, and video content in multiple servers around the "edges" of the internet, so that user requests can be served by a nearby edge server rather than by a far-off origin server. Akamai has world's largest premier content distribution network (CDN) spanning more than 175,000 servers in more than 100 countries around the world, which today delivers up to 30% of global internet traffic.

Video course content delivery is accelerated by multi-bitrate streaming feature which improves a learner's experience by delivering videos with the resolution and bit rate that best matches the viewer's connection speed. The fluidic player automatically selects the highest quality rendition that the viewer's download connection speed can support, taking into account the rendition's resolution and bit rate.

Caching

Session data is cached in clustered Elasticache, making every API request stateless. After authentication of API request, response is served.

For quick access to complex hierarchical records such as organizational users & groups, Redis caching is employed. Redis is configured for redundancy and failover.

5. Availability & monitoring

Availability

The hosted infrastructure uses a high-availability model. Multiple Adobe **Captivate** Prime Captivate servers are clustered behind a hardware load balancer. Connections on this deployment are fast because they are routed to the most available application server in the cluster. In the unlikely event of system failure of any application server, the client connection fails over to a healthy server.

Adobe **Captivate** Prime has multiple servers deployed in multiple data centers in different availability zones to allow great scalability and optimal customer experience.

Captivate Prime is deployed on AWS cloud North Virginia region. It uses multi-AZ deployment for resilience in case an AZ goes down.

Application monitoring

Health check URLs are set up for application health monitoring through New Relic which frequently involkes serviceAPIs and monitors page response time, page load time, error rate, etc. In case of any outage or abnormal monitored parameter value, it triggers an alarm to NOC/team via email.

Zabbix has been configured to monitor machine’s health like CPU, memory, network, disk space, processes etc.

Network Operation Center

Network Operation Center (NOC) in Adobe keeps monitoring system health related emails and other parameters of the AWS environment 24/7 and can take necessary actions to restore the service at the earliest with relevant teams help.

Database

Standard cluster and hot-swap configurations for MySQL database are supported for scalability and failover. MySQL is implemented with redundant database node to ensure high availability.

Learning records are transferred to Dynamo DB store and Amazon DynamoDB synchronously replicates data across three facilities within an AWS Region to achieve high availability and durability.

Granular data from Dynamo DB is fetched and sent to create intelligent data aware store to facilitate retrieving and creating reports faster.

Entire data is backed up daily and copies are stored in a secure AWS S3 location as well as Adobe in-premise.

Disaster recovery

Adobe Captivate Prime maintains documented and tested system recovery plans in event of force majeure.

All the databases and course contents periodic backup & snapshots are stored in AWS S3 as well as in Adobe Premise to facilitate quick recovery and restoration.

6. Security

Adobe Product Security Response Team

Adobe has been a leader in cloud technologies and delivering solutions to millions of users worldwide. Adobe has a dedicated security researcher team that works towards making the software delivered by Adobe secure & informing the product teams about new vulnerabilities found in their technology stack. This includes Architecture and design review right from the initial stages and mandatory approval from this team. This team has domain expertise with years of expertise in software security.

Cloud management

The cloud management for Adobe Captivate Prime is handled by an independent IT team in Adobe. This team specializes in creating and managing a secure cloud infrastructure. It involves stringent control processes about System access to prevent any unauthorized access to any system and databases. Change control to prevent any unauthorized change to any system and databases.

Cloud architecture

Adobe Captivate Prime is hosted on Amazon Web Services (AWS). AWS employs industry leading network security aspects like Firewalls, Access control lists and automated monitoring and ensures that these data centers are protected from various hostile acts like Distributed Denial of Service, IP Spoofing, Port Scanning, etc. Captivate Prime's set up is encased in a VPC (Virtual Private Connection) allowing access to servers only through a single designated route. This feature ensures that traffic coming only from the main load balancer gets through to all the machines in various clusters. All outbound traffic from application is routed through NAT server for higher security.

Third party services

A dedicated and independent team performs assessment of all the third party services that are used in Captivate Prime ensuring that data is secure throughout the complete system.

Transmission security

Any connection to Captivate Prime has to be via HTTPS using Secure Sockets Layer (SSL), a cryptographic protocol that is designed to protect against eavesdropping, tampering, and message forgery. Any communication with a third party service is also over HTTPS only.

Application and data design

The data for all the accounts in Captivate Prime is logically separated using distinct key for each account. Every call to the system must have the key for the account. Session based authentication mechanism ties a user with an account key. The Gateway architecture allows deep request inspection process at the beginning to ensure that only the semantically correct requests go through, and reject any spurious call. The deep inspection process establishes the session validity and consistency of account key of user and that of request.

All the databases are encrypted at runtime. The backups are also encrypted to keep the data secure even at rest.

Lifecycle

As part of the system development lifecycle, the entire code is scanned through static code analyzers to find various vulnerabilities in the code (For example, cross-site scripting and SQL injections). All the high severity issues are resolved before code is deployed on production servers.

Vulnerability Assessment & pen-testing are performed regularly to detect & fix any security issue on production environment. These tests are also performed on the stage environment prior to a release to make sure that only secure code goes to production.

All the components including libraries, databases and services are tracked for security updates. Any update is applied to the system as early as logistically possible depending

on the severity of issues addressed in that update.

Data centre security overview

Captivate Prime has been architected over Amazon Web Services (AWS) infrastructure which is the gold standard as far as hosted services are concerned. The IT infrastructure that AWS provides to its customers is designed and managed in alignment with best security practices.

Captivate Prime currently uses the Amazon Data center that is based on the East Coast of United States. Amazon has many years of experience in designing, constructing, and operating large-scale data centers. AWS data centers are housed in nondescript facilities. Physical access is strictly controlled both at the perimeter and at building ingress points by professional security staff utilizing video surveillance, intrusion detection systems, and other electronic means. Authorized staff must pass two-factor authentication a minimum of two times to access data center floors. All visitors and contractors are required to present identification and are signed in and continually escorted by authorized staff.

The Data Centers have elaborate and strict specifications that cover Fire Detection and Suppression, Power, Climate and Temperature Control, Active Management and Decommission of storage devices.

7. Requirements for client device

OS Specifications:
Captivate Prime is supported on following platforms:
Windows: Win 7, Win 8, Win 8.1 and Windows 10.1
Mac: Mac 10.10

Browsers Specifications: Captivate Prime is supported on

Google Chrome (version 43 and above)
Internet Explorer 11
Safari 9 and above
Win 10.1 Edge

Screen Resolution for Desktop: 1366x768

Device Specifications:
IOS: iOS 8 and above, 1024x768
Android: Lollipop (version 5) and above, 1024x768

Mobile phones are not supported for both iOS and Android devices.

Content Format:

Module Upload:
Author can upload various content formats into Captivate Prime as a module.
See below for list of supported content and the respective file extensions:

Content Type	Extensions
Documents	"pdf", "docx" ,"doc"
PowerPoint presentations	"pptx", "ppt"
Video	"mp4", "wmv","3gp", "3g2", "3gp2", "asf", "avi", "f4v", "h264", "mpe", "mpeg", "mpg", "mpg2", "m4v", "mov", "wmv"
SCORM 1.2	"zip"
SCORM 2004	"zip"
Adobe Captivate & Adobe Presenter generated output (CAPI)	"zip"
AICC	"zip"