High Level Design Document

Introduction

This High Level Design (HLD) document outlines the architecture and core components of **EduVerse - Adaptive Learning Management System**. EduVerse is a scalable, open-source frontend platform designed to deliver adaptive learning paths, interactive quizzes, and real-time progress tracking for educational environments. The system leverages React, Redux Toolkit, and Tailwind CSS to provide a dynamic, secure, and user-friendly experience.

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1. System Architecture Overview

Architecture Description:
EduVerse is a single-page application (SPA) built with React, utilizing Redux Toolkit for state management and Tailwind CSS for UI styling. The system is modular, supporting dynamic routing, protected routes, and advanced form handling. It interacts with backend APIs for data persistence and real-time updates.

Module/Component	Role/Responsibility
App Shell	Root component, layout, and global providers
Authentication Module	User login, registration, protected route enforcement
Adaptive Learning Engine	Manages learning paths, adapts content per user
Quiz & Assignment Module	Interactive quizzes, assignment forms, feedback
Progress Tracker	Real-time progress visualization and updates
State Management (Redux)	Centralized state, async actions, caching
UI Layer (Tailwind)	Responsive, accessible, and consistent UI styling
Routing (React Router)	Dynamic and protected route management
API Integration Layer	Handles communication with backend services

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2. Component Interactions

Sequence Step	Interaction Description
1	User accesses EduVerse via browser; App Shell initializes and loads global state
2	Authentication Module verifies user and manages protected routes
3	Upon login, Adaptive Learning Engine fetches user profile and learning path from API
4	User interacts with quizzes/assignments; data is managed via Redux and sent to backend
5	Progress Tracker updates UI in real-time based on user actions and backend responses
6	All UI components styled and rendered responsively using Tailwind CSS

3. Data Flow Overview

Data Flow Source	Destination	Data Type/Content
User Actions (UI)	Redux Store	Quiz answers, assignment submissions
Redux Store	API Integration Layer	Auth tokens, user progress, feedback
API Integration Layer	Backend Services (API)	REST/GraphQL requests/responses
Backend Services (API)	Redux Store	User data, learning paths, progress
Redux Store	UI Components	State-driven rendering and updates

4. Technology Stack

Layer/Functionality	Technology/Framework
UI Framework	React (TypeScript)
State Management	Redux Toolkit
Styling	Tailwind CSS
Routing	React Router
Form Handling	React Hook Form / Custom
API Communication	Fetch API / Axios
Language	TypeScript, JavaScript, HTML, CSS

5. Scalability & Reliability

- **Scalability:**
  - Modular React components and Redux slices enable feature expansion and codebase maintainability.
  - Stateless frontend allows horizontal scaling via CDN and static hosting.
- **Reliability:**
  - Protected routes and authentication ensure secure access.
  - Centralized error handling and optimistic UI updates improve user experience.
  - Responsive design ensures accessibility across devices.

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