

Scalable Calendar App Development Plan

Imagine you are Project Manager who has been assigned the task of creating an calendar app, like Google's calendar app. The application will be developed in such a way that it can be later scaled to billions of users. Use the concept of SOLID principles for developing the app. The app will be serving android ecosystem, Ios and there would be a website that will also be created for the calendar app. As a Project manager, list the required tasks that will be assigned to different team members for developing the app. If you need extra inputs or more questions when selecting development tools, frameworks and languages required for the app, feel free to ask for as many doubts and questions to design the app.

Calendar App Project Plan

I'll outline a comprehensive project plan for creating a scalable calendar application across Android, iOS, and web platforms using SOLID principles.

Key Requirements & Architecture

Let's start with a high-level architecture based on SOLID principles:

1. **Single Responsibility:** Each component handles one aspect of functionality
2. **Open/Closed:** Core systems extendable without modification
3. **Liskov Substitution:** Base components can be replaced with derived ones
4. **Interface Segregation:** Specific interfaces rather than general ones
5. **Dependency Inversion:** High-level modules independent of low-level ones

Project Tasks by Team

Product & Design Team

1. User research and requirements gathering
2. User journey mapping and wireframing
3. UI/UX design for all platforms (mobile and web)
4. Usability testing and design iteration
5. Design system creation and documentation

Backend Team

1. API design and documentation using RESTful or GraphQL principles
2. Authentication and authorization system implementation
3. Database design and optimization for calendar data
4. Sync mechanism design for cross-device usage
5. Notification service implementation
6. Performance optimization and caching strategy
7. Cloud infrastructure setup and configuration

Android Development Team

1. Kotlin-based app architecture setup using MVVM or MVI
2. UI implementation following Material Design guidelines
3. Local data storage and offline functionality
4. Authentication flow implementation
5. Calendar view/interaction implementation
6. Notification handling
7. Testing (unit, integration, UI)

iOS Development Team

1. Swift-based app architecture setup using MVVM or MVI
2. UI implementation following Apple Human Interface Guidelines
3. Local data storage and offline functionality
4. Authentication flow implementation
5. Calendar view/interaction implementation
6. Notification handling
7. Testing (unit, integration, UI)

Web Development Team

1. Frontend framework setup (React/Angular/Vue)
2. UI implementation
3. State management implementation
4. API integration
5. Authentication flow implementation

6. Calendar view/interaction implementation
7. Testing (unit, integration, UI)

QA Team

1. Test plan creation
2. Automated testing implementation
3. Performance testing
4. User acceptance testing
5. Cross-platform compatibility testing
6. Security testing

DevOps Team

1. CI/CD pipeline setup
2. Deployment strategy implementation
3. Monitoring and logging setup
4. Disaster recovery planning
5. Scaling strategy implementation

Technical Stack Considerations

To make informed decisions, I would need inputs on:

1. **Backend Technology:** What's your preference for backend language/framework? (Node.js, Java Spring, Python Django, etc.)
2. **Database Choice:** SQL vs NoSQL considerations for calendar data?
3. **Authentication:** Will we implement our own or use third-party services?
4. **Sync Strategy:** Real-time updates vs polling approach?
5. **Hosting:** Cloud provider preference (AWS, Azure, GCP)?
6. **Team Expertise:** Do team members have existing expertise in certain technologies?
7. **Timeline & Resources:** What's our development timeline and available resources?

Is there a specific aspect of the project plan you'd like me to elaborate on, or shall we discuss some of these technical decisions first?



 Lets start with technical decisions first

Great, let's make some key technical decisions for our calendar app project:

1. Backend Technology

Recommendation: Node.js with Express or NestJS

- **Rationale:** Excellent for real-time applications, great scalability, and a large ecosystem of libraries
- **Alternative:** Java Spring Boot if enterprise integration is a priority
- **SOLID Application:** Will structure services with clear single responsibilities and dependency injection

2. Database Choice

Recommendation: Hybrid approach

- **Primary DB:** PostgreSQL for structured calendar data, user information, and relationships
- **Secondary DB:** MongoDB for flexible storage of event metadata and user preferences
- **Caching Layer:** Redis for performance optimization and session management
- **SOLID Application:** Database abstraction interfaces to allow switching implementations

3. API Architecture

Recommendation: GraphQL

- **Rationale:** Perfect for calendar apps where different views need different data shapes
- **Benefits:** Reduced network overhead, flexible querying, real-time subscriptions
- **SOLID Application:** Clear interface segregation between different domain services

4. Authentication & Authorization

Recommendation: OAuth 2.0 with JWT

- **Implementation:** Use Auth0 or similar service initially, with abstractions to allow switching

- **Features:** Social login integration, MFA support
- **SOLID Application:** Authentication interfaces separated from business logic

5. Sync Strategy

Recommendation: Event-driven architecture with WebSockets

- **Implementation:** Socket.io for real-time updates with fallback to polling
- **Conflict Resolution:** Operational Transformation for handling concurrent edits
- **SOLID Application:** Open for extension with different sync strategies without modifying core

6. Mobile Development Approach

Recommendation: Native development for core experience

- **Android:** Kotlin with Jetpack Compose
- **iOS:** Swift with SwiftUI
- **Shared Logic:** Consider Kotlin Multiplatform for business logic sharing
- **SOLID Application:** UI components follow interface segregation principle

7. Web Frontend

Recommendation: React with TypeScript

- **State Management:** Redux Toolkit
- **UI Components:** Material-UI or custom component library
- **SOLID Application:** Component-based architecture with clear responsibilities

8. Cloud Infrastructure

Recommendation: AWS ecosystem

- **Compute:** ECS/Fargate for containerized services
- **Database:** RDS for PostgreSQL, DocumentDB for MongoDB
- **Caching:** ElastiCache for Redis
- **CDN:** CloudFront for static assets
- **SOLID Application:** Infrastructure as code with clear separation of concerns

9. DevOps & CI/CD

Recommendation: GitHub Actions or GitLab CI

- **Deployment:** Blue/green deployment strategy
- **Monitoring:** Prometheus + Grafana
- **Logging:** ELK stack or AWS CloudWatch
- **SOLID Application:** Pipeline stages with single responsibilities

10. Scalability Approach

Recommendation: Microservices architecture

- **Services:** Auth, Events, Notifications, User Management, Sharing
- **Communication:** REST for synchronous, Kafka for asynchronous
- **SOLID Application:** Each service has a single responsibility with clear interfaces

Are there any specific areas you'd like me to elaborate on further, or shall we move on to discussing project phases and milestones?

 Let's move on to discussing project phases and milestones

Calendar App Project Phases and Milestones

Let's break down the project into clear phases with defined milestones:

Phase 1: Foundation & Discovery (4-6 weeks)

Milestones:

1. Requirements Documentation Complete

- User stories and acceptance criteria defined
- Technical requirements finalized
- SOLID design principles documentation

2. Architecture Blueprint Approved

- System architecture diagrams
- Data model and schema design
- API contracts defined

3. Design System Established

- Brand guidelines
- Component library foundations
- Wireframes for key user flows

4. Development Environment Setup

- CI/CD pipelines configured
- Development, staging, and production environments
- Code standards and review process established

Phase 2: Core Development (12-16 weeks)

Milestones:

1. Backend Infrastructure Complete

- Authentication system implemented
- Core database models created
- Basic API endpoints functional

2. Mobile Apps Alpha Version

- Navigation structure implemented
- Calendar view basic functionality
- Local storage implementation

3. Web Application Alpha Version

- Basic authentication flows
- Calendar view implementation
- Core state management

4. Sync Mechanism Functional

- Cross-device data synchronization
- Conflict resolution implementation
- Real-time updates foundation

Phase 3: Feature Completion (10-12 weeks)

Milestones:

1. Calendar Management Features Complete

- Event creation, editing, deletion
- Recurring events
- Reminders and notifications
- Calendar sharing and permissions

2. UI/UX Refinement Complete

- Animation and transitions
- Accessibility compliance
- Responsive design optimization

3. Integration Features Complete

- Third-party calendar import/export
- Email integration
- Contact integration

4. Performance Optimization Complete

- Lazy loading implementation
- Caching strategy refined
- API response optimization

Phase 4: Testing & Refinement (6-8 weeks)

Milestones:

1. Comprehensive Testing Complete

- Unit testing coverage at 80%+

- Integration testing scenarios
- End-to-end testing for critical paths
- Performance testing under load

2. User Acceptance Testing Complete

- Beta program feedback incorporated
- Usability issues addressed
- Cross-platform consistency verified

3. Security Audit Passed

- Vulnerability assessment
- Authentication and authorization validation
- Data encryption verification

4. Documentation Complete

- API documentation
- User guides
- Developer documentation
- Maintenance procedures

Phase 5: Launch Preparation & Deployment (4-6 weeks)

Milestones:

1. Scalability Testing Passed

- Load testing at projected user volumes
- Database performance validation
- CDN configuration optimized

2. Marketing Materials Ready

- App store listings
- Website landing pages
- Promotional content

3. Soft Launch Complete

- Initial user onboarding
- Monitoring systems active
- Support processes tested

4. Full Public Launch

- All platforms available
- Analytics tracking implemented
- Feedback channels established

Phase 6: Post-Launch Support & Iteration (Ongoing)

Milestones:

1. First Iteration Cycle Complete

- User feedback analysis
- Priority feature enhancements
- Bug fixes and improvements

2. Performance Metrics Review

- User engagement analysis
- Technical performance review
- Scaling adjustments

3. Roadmap Refinement

- Next feature priorities established
- Long-term scaling strategy updated
- Technical debt assessment

Key Dependencies and Critical Path

1. Backend API development is on the critical path for mobile and web development
2. Authentication system must be implemented before user-specific features
3. Sync mechanism development is critical for cross-platform functionality
4. Design system completion gates UI implementation across platforms

Would you like me to delve deeper into any specific phase or discuss resource allocation and team structure next?

 Lets move on to discussing resource allocation and team structure

Calendar App Resource Allocation and Team Structure

Core Team Structure

Leadership & Management

- **Project Manager** (1) - Overall project coordination and stakeholder management
- **Product Owner** (1) - Requirements prioritization and backlog management
- **Technical Architect** (1) - Technical decisions and SOLID principles enforcement

Development Teams

Backend Team (5-6 members)

- **Backend Lead** (1) - Architecture design and team coordination
- **Senior Developers** (2) - Core services implementation
- **Mid-level Developers** (2) - API and database implementation
- **DevOps Specialist** (1) - Infrastructure and CI/CD pipeline

Mobile Development (6-8 members)

- **Mobile Lead** (1) - Cross-platform coordination
- **Android Developers** (2-3) - Kotlin/Jetpack Compose implementation
- **iOS Developers** (2-3) - Swift/SwiftUI implementation
- **Mobile QA Specialist** (1) - Mobile-specific testing

Web Development (4-5 members)

- **Frontend Lead** (1) - Architecture and component design
- **Senior Frontend Developer** (1) - Core functionality implementation
- **Frontend Developers** (2) - Feature implementation
- **Frontend QA** (1) - Web-specific testing

Support Teams

- **UX/UI Designers** (2) - Design system and user experience
- **QA Engineers** (2-3) - Testing strategy and automation
- **Data Engineer** (1) - Data modeling and analytics
- **Security Specialist** (1, part-time) - Security review and compliance

Resource Allocation by Phase

Phase 1: Foundation & Discovery

- **High Involvement:** Product Owner, Technical Architect, Team Leads, UX/UI Designers
- **Medium Involvement:** Senior Developers
- **Low Involvement:** Other Developers, QA Engineers

Phase 2: Core Development

- **High Involvement:** All Development Teams, Technical Architect
- **Medium Involvement:** UX/UI Designers, QA Engineers, DevOps
- **Low Involvement:** Security Specialist

Phase 3: Feature Completion

- **High Involvement:** All Development Teams, QA Engineers
- **Medium Involvement:** UX/UI Designers, Product Owner, DevOps
- **Low Involvement:** Technical Architect (consulting)

Phase 4: Testing & Refinement

- **High Involvement:** QA Engineers, All Development Teams
- **Medium Involvement:** Security Specialist, DevOps, Product Owner
- **Low Involvement:** UX/UI Designers

Phase 5: Launch Preparation & Deployment

- **High Involvement:** DevOps, QA Engineers, Team Leads
- **Medium Involvement:** All Development Teams, Product Owner
- **Low Involvement:** UX/UI Designers (only for final adjustments)

Team Organization Model

We'll implement a **Hybrid Organization Model**:

- **Functional Teams** for specialized expertise
- **Cross-functional Squads** for feature delivery

Squad Example:

- "Calendar View Squad" might include:
 - 1 Backend Developer
 - 1 iOS Developer
 - 1 Android Developer
 - 1 Web Developer
 - 1 QA Engineer
 - Part-time UX Designer support

Resource Scaling Strategy

Initial Development (Phases 1-3)

- Full team as described above

Testing & Refinement (Phase 4)

- Increased QA allocation
- Potentially reduced design resources

Launch & Post-Launch (Phases 5-6)

- Addition of customer support resources
- Shift of some development resources to maintenance and iteration
- Addition of analytics specialists for user behavior analysis

External Resources & Contractors

- **Usability Testing Experts** - Brought in for key milestones
- **Performance Testing Specialists** - Short-term engagement during Phase 4

- **Security Audit Team** - External review before launch
- **Content Writers** - Documentation and marketing materials

Team Communication & Collaboration

- **Daily Standups** - Within functional teams and squads
- **Weekly Synchronization** - Across all team leads
- **Bi-weekly Reviews** - With all stakeholders
- **Monthly Strategic Reviews** - Leadership team

Team Skill Requirements

Technical Skills

- Node.js/Express/NestJS
- React/TypeScript
- Kotlin/Jetpack Compose
- Swift/SwiftUI
- GraphQL
- PostgreSQL/MongoDB
- AWS/Cloud Infrastructure

Methodology Knowledge

- Agile development practices
- SOLID design principles
- Test-driven development
- CI/CD processes

Would you like me to elaborate on any specific aspect of the team structure or resource allocation, or shall we discuss risk management and contingency planning next?



Lets discuss risk management and contingency planning



Risk Management and Contingency Planning for Calendar App

High Priority Risks

1. Synchronization Challenges

- **Risk:** Data conflicts and sync failures across devices
- **Impact:** Poor user experience, data loss, and trust issues
- **Mitigation:**
 - Implement robust conflict resolution algorithms
 - Extensive testing with simulated network conditions
 - Clear sync status indicators for users
- **Contingency:**
 - Fallback to server-side "source of truth" with conflict logs
 - Emergency feature to restore previous versions of calendar data

2. Scalability Bottlenecks

- **Risk:** Performance degradation under high user load
- **Impact:** App slowdown, user frustration, and negative reviews
- **Mitigation:**
 - Early load testing and performance benchmarking
 - Implement database sharding and caching strategy
 - Design for horizontal scaling from the start
- **Contingency:**
 - Ready-to-deploy emergency infrastructure scaling
 - Graceful degradation of non-critical features under load

3. Cross-Platform Consistency

- **Risk:** Inconsistent experience across Android, iOS, and web
- **Impact:** User confusion and fragmented experience
- **Mitigation:**

- Shared design system with platform-specific adaptations
- Cross-platform testing in each sprint
- Feature parity tracking matrix
- **Contingency:**
 - Priority-based feature rollout if platforms fall out of sync
 - Clear documentation of platform differences for users

4. Security Vulnerabilities

- **Risk:** Data breaches or unauthorized access
- **Impact:** Legal issues, reputational damage, and user attrition
- **Mitigation:**
 - Regular security audits and penetration testing
 - Secure coding practices and code reviews
 - Proper encryption of sensitive data
- **Contingency:**
 - Incident response plan with clear roles and communication strategy
 - Emergency patching process with accelerated release cycle

Medium Priority Risks

5. Timeline Slippage

- **Risk:** Development delays pushing launch date
- **Impact:** Market opportunity loss and budget overruns
- **Mitigation:**
 - Agile methodology with buffer time in sprint planning
 - Regular velocity tracking and progress monitoring
 - Clear definition of MVP vs. future features
- **Contingency:**
 - Feature prioritization matrix for scope adjustment
 - Phased rollout plan that can be adjusted for partial launches

6. Third-Party Dependency Issues

- **Risk:** API changes or service disruptions from external providers
- **Impact:** Feature breakage and development delays
- **Mitigation:**
 - Minimize critical third-party dependencies
 - Abstract integrations behind interfaces (SOLID principle)
 - Regular monitoring of dependency updates and changes
- **Contingency:**
 - Fallback mechanisms for critical external services
 - Alternative provider options identified in advance

7. Team Knowledge Gaps

- **Risk:** Insufficient expertise in key technologies
- **Impact:** Quality issues and development delays
- **Mitigation:**
 - Skills assessment and targeted training
 - Strategic hiring or contracting for specialized skills
 - Knowledge sharing sessions and documentation
- **Contingency:**
 - On-call expert consultants identified in advance
 - Simplified implementation paths for complex features if needed

Lower Priority Risks

8. User Adoption Challenges

- **Risk:** Slow user uptake despite technical success
- **Impact:** Revenue targets missed, project ROI not achieved
- **Mitigation:**
 - Early user research and beta testing program
 - Clear differentiation and value proposition
 - Engaging onboarding experience
- **Contingency:**
 - Prepared marketing campaigns and promotion strategies

- Quick-response feature addition based on initial feedback

9. Regulatory Compliance Issues

- **Risk:** Calendar data handling subject to new regulations
- **Impact:** Legal issues and required architectural changes
- **Mitigation:**
 - Privacy-by-design approach from the start
 - Regional data storage options where needed
 - Regular compliance reviews
- **Contingency:**
 - Compliance-specific feature toggles built into the system
 - Rapid response legal team consultation process

Contingency Budget and Resources

- **Time Buffer:** 20% additional time allocated to each phase
- **Financial Buffer:** 15% of total budget reserved for contingencies
- **Technical Resources:** On-call specialists identified for critical areas
- **Development Slack:** 10% of development capacity reserved for urgent issues

Monitoring and Risk Reassessment

- Weekly risk review in team lead meetings
- Monthly comprehensive risk reassessment
- Risk register updates with each major milestone
- Threshold metrics for triggering contingency plans

Crisis Management Protocol

1. **Identification:** Clear criteria for declaring different levels of crisis
2. **Communication:** Escalation paths and stakeholder notification templates
3. **Response:** Pre-defined teams and responsibilities for each risk category
4. **Resolution:** Decision-making framework for critical trade-offs

5. **Recovery:** Post-incident review and process improvement

Would you like me to elaborate on any specific risk area or shall we move on to discussing success metrics and KPIs for the project?



Lets move on to discussing success metrics and KPIs for the project

Calendar App Success Metrics and KPIs

Let's define clear metrics to measure the success of our calendar app project across different dimensions:

Technical Performance Metrics

1. System Reliability

- **Uptime:** Target of 99.9% availability
- **Sync Success Rate:** >99.5% of synchronization attempts successful
- **Error Rate:** <0.1% of user operations resulting in errors

2. Performance Efficiency

- **API Response Time:** <200ms for 95% of requests
- **App Launch Time:** <2 seconds on standard devices
- **Calendar Rendering Speed:** <500ms for month view with 100+ events

3. Scalability

- **Concurrent Users:** System handles 100,000+ simultaneous users
- **Data Volume:** Efficient management of 10+ million calendar events
- **Resource Utilization:** <70% CPU/memory usage at projected peak load

User Experience Metrics

1. Engagement

- **Daily Active Users (DAU):** Target 30% of total user base



- **Session Duration:** Average 3+ minutes per session
- **Retention Rate:** 60% of users still active after 30 days

2. User Satisfaction

- **App Store Rating:** 4.5+ stars average
- **Net Promoter Score:** 40+ NPS within 3 months of launch
- **Customer Satisfaction:** 85%+ satisfied/very satisfied in surveys

3. Feature Adoption

- **Calendar Creation:** Average 2+ calendars per user
- **Event Creation:** 5+ events created per active user per week
- **Feature Utilization:** 70% of users using at least 3 core features

Business Success Metrics

1. Growth Metrics

- **User Acquisition:** 100,000+ new users in first quarter
- **Monthly Growth Rate:** 15%+ user growth month-over-month
- **Platform Distribution:** Balanced adoption across Android, iOS, and web

2. If Monetization is Planned

- **Conversion Rate:** 5%+ free users converting to premium
- **Revenue Per User:** Target \$X average revenue per paying user
- **Churn Rate:** <3% monthly churn for premium subscribers

Development Process KPIs

1. Project Management

- **On-time Delivery:** 90% of milestones completed on schedule
- **Budget Adherence:** Project completed within 10% of estimated budget
- **Scope Management:** <15% scope change from initial requirements

2. Code Quality

- **Test Coverage:** 80%+ code coverage by automated tests
- **Bug Density:** <1 critical bug per 1000 lines of code
- **Technical Debt:** <15% of development time allocated to refactoring

3. Team Performance

- **Velocity Consistency:** <20% sprint-to-sprint velocity variation
- **Knowledge Distribution:** At least 2 team members familiar with each component
- **Team Satisfaction:** 85%+ team satisfaction in anonymous surveys

Long-term Success Indicators

1. Market Position

- **Market Share:** Top 10 calendar app within 12 months
- **Competitive Advantage:** At least 3 unique, valued features versus competitors
- **Brand Recognition:** 50%+ awareness among target audience

2. Sustainability

- **Maintenance Efficiency:** <20% of development resources on maintenance
- **Platform Adaptability:** Quick adaptation to OS updates (< 2 weeks)
- **Technical Relevance:** Architecture remains viable without major overhaul for 3+ years

Measurement and Reporting Framework

1. Data Collection

- Analytics implementation across all platforms
- Automated performance monitoring
- Regular user feedback collection

2. Reporting Cadence

- Daily: Technical performance dashboards
- Weekly: User engagement and growth metrics
- Monthly: Comprehensive KPI review with stakeholders

3. Continuous Improvement

- KPI targets reviewed quarterly
- Adjustment of metrics based on business priorities
- Addition of new metrics as product evolves

Would you like me to focus on any specific category of metrics in more detail, or shall we discuss the product roadmap beyond the initial launch?

 Lets discuss the product roadmap beyond the initial launch.

Calendar App Product Roadmap Beyond Initial Launch

Let's outline a strategic roadmap for our calendar app's evolution after the initial launch, structured into phases with clear objectives:

Phase 1: Stabilization & Optimization (Months 1-3)

Focus Areas:

1. Performance Refinement

- Address performance bottlenecks identified during initial usage
- Optimize database queries and caching strategies
- Reduce app size and memory footprint

2. Bug Resolution & User Experience Improvements

- Prioritize fixes based on user impact and frequency
- Smooth out UX friction points identified through analytics
- Improve error messaging and recovery flows

3. Platform-Specific Optimizations

- Enhance iOS widgets and Android home screen widgets
- Optimize web PWA capabilities
- Improve tablet/large screen layouts

Phase 2: Ecosystem Expansion (Months 4-6)

Focus Areas:

1. Integration Ecosystem

- Expand third-party calendar integrations (Outlook, Yahoo, etc.)
- Add popular productivity tool integrations (Slack, Trello, Asana)
- Develop API for third-party developers

2. Smart Features

- Implement smart scheduling suggestions
- Add travel time calculations for events
- Develop intelligent reminders based on user behavior

3. Collaboration Enhancements

- Improve calendar sharing and permissions
- Add commenting/discussion on shared events
- Develop scheduling polls for group event planning

Phase 3: Advanced Functionality (Months 7-12)

Focus Areas:

1. AI-Powered Assistance

- Natural language event creation
- Smart event categorization
- Predictive scheduling recommendations

2. Productivity Amplifiers

- Time-blocking tools and templates
- Goal tracking and habit formation features
- Focus time and productivity analytics

3. Enterprise-Grade Features

- Team calendar management

- Resource booking (rooms, equipment)
- Role-based access controls
- Calendar automation workflows

Phase 4: Ecosystem Expansion (Months 13-18)

Focus Areas:

1. Cross-Platform Ecosystem

- Desktop applications for Windows/Mac
- Wearable device integrations (Apple Watch, etc.)
- Voice assistant integrations (Alexa, Google Assistant)

2. Vertical Solutions

- Industry-specific calendar templates
- Domain-specific features (healthcare appointments, education scheduling)
- Family-specific calendar management

3. Advanced Analytics

- Time usage insights and recommendations
- Productivity pattern analysis
- Team scheduling efficiency metrics

Phase 5: Platform Evolution (Months 19-24)

Focus Areas:

1. Calendar as a Platform

- Marketplace for calendar extensions and integrations
- Developer SDK for custom solutions
- Embedded calendar solutions for third-party applications

2. Next-Generation Interface

- AR/VR calendar visualization options
- Voice-first interaction model

- Context-aware calendar experiences

3. AI-First Scheduling

- AI scheduling assistant for automatic meeting arrangement
- Predictive event management
- Dynamic calendar optimization

Strategic Considerations Throughout Roadmap

1. Technical Foundation Evolution

- Continuous architectural refinement based on usage patterns
- Strategic technical debt management
- Implementation of emerging best practices

2. Monetization Strategy Refinement

- Feature tiering optimization based on usage data
- Enterprise offering development
- Partnership and integration revenue opportunities

3. User-Driven Development

- Continuous feedback loops with power users
- Feature prioritization based on usage metrics
- A/B testing framework for new concepts

4. Market Positioning Evolution

- Differentiation strategy refinement
- Competitive response planning
- Brand expansion opportunities

Decision Gates for Roadmap Progression

Each roadmap phase will include specific metrics and goals that must be met before proceeding to the next phase:

1. User Adoption Thresholds

- DAU/MAU targets for each phase
- Engagement metrics minimums
- Retention rate requirements

2. Technical Performance Baselines

- Scalability proof points
- Performance metrics
- Reliability standards

3. Business Metric Requirements

- Revenue/user growth targets (if applicable)
- Cost efficiency improvements
- Market share milestones

Would you like me to elaborate on any specific phase of the roadmap or discuss strategies for gathering and incorporating user feedback to drive the product's evolution?

 Lets discuss strategies for gathering and incorporating user feedback to drive the product's evolution

Strategies for Gathering and Incorporating User Feedback

Effective user feedback collection and implementation will be crucial for our calendar app's success. Here's a comprehensive strategy:

Multi-Channel Feedback Collection

In-App Feedback Mechanisms

1. Contextual Feedback Tools

- Implement subtle feedback buttons within specific features
- Add "help us improve" options after key user actions
- Include optional screenshot submission with feedback

2. Periodic Satisfaction Surveys

- Short NPS surveys (30/60/90 days after onboarding)
- Feature-specific satisfaction ratings
- Exit surveys when users downgrade or uninstall

3. Feature Voting and Roadmap Input

- In-app feature voting board
- Wishlist functionality for users to suggest improvements
- Prioritization input from power users

Direct User Research

1. User Research Panel

- Recruit diverse panel of engaged users
- Schedule regular interviews and testing sessions
- Offer incentives for consistent participation

2. Usability Testing Program

- Monthly moderated usability tests
- Unmoderated remote testing for specific features
- Competitor comparison testing

3. User Shadowing

- Observe how power users integrate the app into their workflow
- Identify pain points and unmet needs in real usage contexts
- Document workarounds users create

Community and Social Channels

1. Community Platform

- Dedicated forum or community space
- User tip sharing and problem-solving
- Direct interaction with product team members

2. Social Media Monitoring

- Active listening on Twitter, Reddit, Facebook
- Sentiment analysis and trend identification
- Proactive engagement with public feedback

3. App Store Reviews Analysis

- Systematic categorization of reviews
- Trend analysis across platforms
- Competitor review comparison

Feedback Processing and Prioritization

Centralized Feedback Management

1. Unified Feedback Repository

- All feedback channels feed into a single system
- Tag and categorize by feature, sentiment, user segment
- Link related feedback items together

2. Quantitative Analysis

- Volume trends by feature/area
- Impact scoring based on user numbers affected
- Correlation with retention/engagement metrics

3. Qualitative Analysis

- Thematic analysis to identify patterns
- User journey mapping based on feedback
- Pain point severity assessment

Smart Prioritization Framework

1. Impact vs. Effort Matrix

- Plot feedback-driven improvements on impact/effort grid
- Prioritize high-impact, lower-effort improvements
- Bundle related improvements for efficiency

2. User Segment Weighting

- Prioritize needs of growth segments and power users
- Balance needs of new vs. established users
- Consider strategic user segments (potential enterprise customers)

3. Strategic Alignment Assessment

- Evaluate feedback against product vision and roadmap
- Identify opportunities that align with multiple strategic goals
- Assess competitive differentiation potential

Implementation and Closing the Loop

Agile Implementation Process

1. Dedicated "Voice of Customer" Capacity

- Reserve 20% of sprint capacity for user-requested improvements
- Rotate team members through user feedback response roles
- Fast-track critical usability issues

2. Prototype Testing

- Test solutions with original feedback providers when possible
- Use A/B testing for alternative approaches
- Validate improvements before full release

3. Continuous Iteration

- Implement lightweight post-implementation feedback
- Track metrics to verify problem resolution
- Be willing to pivot if solution doesn't address core need

Transparent Communication

1. Feedback Status Visibility

- Public roadmap showing "Requested by users" items
- Status updates on popular requests

- Explanation of prioritization decisions

2. Release Notes and Highlights

- Clearly communicate user-inspired improvements
- Credit user input in updates
- Highlight "You asked, we delivered" features

3. Personalized Follow-ups

- Thank users whose feedback led to changes
- Invite specific feedback on implemented solutions
- Create feedback champions among user base

Measuring Feedback Program Effectiveness

1. Feedback Utilization Metrics

- Percentage of user feedback incorporated
- Time from feedback to implementation
- Volume of feedback collected per channel

2. Impact Assessment

- Improvement in problem-specific metrics post-implementation
- User satisfaction change after feedback-driven updates
- Retention impact of addressing specific feedback

3. Program Refinement

- Regular review of feedback collection mechanisms
- Channel effectiveness analysis
- Continuous improvement of the feedback process itself

Would you like me to elaborate on any specific aspect of the feedback strategy, or would you prefer to discuss how to build and maintain a strong product team culture throughout the product's lifecycle?





Please create a project in Notion app to track the application development and keep track of everything. Create teams and assign tasks to dummy team members for the moment.

I'll create a comprehensive Notion project setup to track the calendar app development.

Calendar App Project Management in Notion

```
# Calendar App Project Management in Notion
```

```
## Notion Setup Guide
```

```
### 1. Workspace Structure
```

- **CalendarApp** (Main Workspace)
 - **🏠 Home** (Dashboard)
 - **📋 Project Management**
 - **👥 Team Directory**
 - **📝 Documentation**
 - **🚀 Development**
 - **🎨 Design**
 - **🧪 QA & Testing**
 - **📊 Analytics & Reporting**

```
### 2. Main Dashboard Page Content
```

Calendar App Project Dashboard

Project Overview

- Project Name: Cross-Platform Calendar App
- Start Date: March 15, 2025
- Target Launch: December 10, 2025
- Current Phase: Foundation & Discovery

Quick Links

- Team Directory

- Project Timeline
- Current Sprint
- Documentation
- Design System
- Technical Architecture
- Risk Register

Project Status

[Progress Bar] 12% Complete

Current Priorities

- Complete architecture blueprint
- Finalize design system foundations
- Set up development environments
- Complete user story mapping

Upcoming Milestones

- Requirements Documentation (April 15, 2025)
- Architecture Blueprint Approval (April 30, 2025)
- Design System Establishment (May 10, 2025)
- Development Environment Setup (May 15, 2025)

Team Announcements

- Weekly sync moved to Thursdays at 10am
- UX testing sessions starting next week
- New team member onboarding (iOS Developer) on March 20

```
## Database Structures
```

```
### 1. Team Members Database
```

Name	Role	Team	Email	Skills	Current Projects
Alex Thompson	Project Manager	Leadership	alex@example.com	Agile, Stakeholder Management	Calendar App
Jamie Chen	Product Owner	Leadership	jamie@example.com	User Stories, Roadmapping	Calendar App
Taylor Williams	Technical Architect	Leadership	taylor@example.com	System Design, SOLID	Calendar App
Morgan Stanley	Backend Lead	Backend	morgan@example.com	Node.js, GraphQL	Calendar App
Jordan Lee	Senior Backend Dev	Backend	jordan@example.com	PostgreSQL, Redis	Calendar App
Casey Reyes	Backend Developer	Backend	casey@example.com	Express, Auth Systems	Calendar App
Robin Patel	DevOps Specialist	Backend	robin@example.com	AWS, CI/CD	Calendar App
Sam Washington	Mobile Lead	Mobile	sam@example.com	Kotlin, Swift	Calendar App
Dana Park	Android Developer	Mobile	dana@example.com	Kotlin, Jetpack Compose	Calendar App
Riley Johnson	iOS Developer	Mobile	riley@example.com	Swift, SwiftUI	Calendar App
Quinn Ahmed	Frontend Lead	Web	quinn@example.com	React, TypeScript	Calendar App
Cameron Smith	Frontend Developer	Web	cameron@example.com	React, Redux	Calendar App
Avery Thomas	UX/UI Designer	Design	avery@example.com	Figma, Design Systems	Calendar App
Jordan Rivera	QA Lead	QA	jordan.r@example.com	Test Automation, QA Strategy	Calendar App

2. Tasks Database

Task	Owner	Status	Priority	Due Date	Phase	Tags	Dependencies
Define API contracts	Morgan Stanley	In Progress	High	April 5, 2025	Foundation	Backend, API	Architecture Blueprint
Create data schema design	Jordan Lee	Not Started	High	April 10, 2025	Foundation	Backend, Database	API Contracts
Design system color palette	Avery Thomas	In Progress	Medium	April 3, 2025	Foundation	Design	Brand Guidelines

Set up CI/CD pipeline Robin Patel Not Started Medium April 15, 2025
Foundation DevOps Repository Setup
Implement authentication flow Casey Reyes Not Started High May 5, 2025
Core Dev Backend, Security API Contracts
Design calendar month view Avery Thomas Not Started High April 20, 2025
Foundation Design, UI User Flows
Implement Android calendar view Dana Park Not Started High May 20, 2025
Core Dev Android Design Specs
Implement iOS calendar view Riley Johnson Not Started High May 20, 2025
Core Dev iOS Design Specs
Create web app component library Cameron Smith Not Started Medium May 15, 2025
Core Dev Frontend Design System

3. Sprints Database

Sprint	Start Date	End Date	Status	Goals	Velocity	Demo Date
Discovery 1 Mar 15, 2025 Mar 28, 2025 In Progress Requirements gathering, Initial technical research N/A Mar 29, 2025						
Discovery 2 Mar 29, 2025 Apr 11, 2025 Planned Architecture draft, Design foundations N/A Apr 12, 2025						
Foundation 1 Apr 12, 2025 Apr 25, 2025 Planned Database design, Infrastructure setup TBD Apr 26, 2025						
Foundation 2 Apr 26, 2025 May 9, 2025 Planned Core API development, Basic UI components TBD May 10, 2025						

4. User Stories Database

Story ID	User Story	Acceptance Criteria	Priority	Status	Epic	Story Points	Assigned To
CAL-001 As a user, I want to create a new calendar event Can add title, date/time, location; Event appears in calendar view High Backlog Event Management 5 Unassigned							
CAL-002 As a user, I want to view my calendar by month Can see month layout; Events displayed correctly; Navigation between months High Backlog Calendar Views 8 Unassigned							
CAL-003 As a user, I want to sync my calendar across devices Calendar data appears on all devices; Changes sync within 1 minute Critical Backlog Synchronization 13 Unassigned							
CAL-004 As a user, I want to receive reminders for upcoming events							

Notifications appear **at** specified times; Can customize reminder times | Medium | Backlog | Notifications | **5** | Unassigned |

5. Risks Database

Risk	Description	Impact	Likelihood	Mitigation	Owner	Status
Sync Complexity	Data synchronization across devices proves more complex than estimated	High	Medium	Early prototype, Incremental implementation	Morgan Stanley	Monitoring
Platform Inconsistency	Features develop at different rates across platforms	Medium	High	Shared component approach, Cross -platform planning	Sam Washington	Monitoring
Performance Issues	Calendar rendering becomes slow with many events	Medium	High	Performance testing, Pagination, Virtualization	Quinn Ahmed	Not Started
Security Vulnerabilities	Authentication or data security issues	Critical	Low	Security audit, Penetration testing	Robin Patel	Not Started

Gantt Chart **View** (Timeline)

Set up a Gantt chart **view** in Notion **to** visualize the project timeline, showing:

- Phases: Foundation, Core Development, Feature Completion, Testing, Launch Prep
- Key milestones **for each** phase
- Dependencies **between** major tasks
- Team allocation periods

Sprint Planning Template

Sprint [Number]: [Date Range]

Sprint Goals

- [Goal 1]
- [Goal 2]
- [Goal 3]

Team Capacity

- Total team members: [Number]
- Available story points: [Number]
- Focus factor: [Percentage]

Selected User Stories

[Filtered view of User Stories database with stories for this sprint]

Risk Assessment

[Filtered view of Risks database with current active risks]

Sprint Retrospective (to be completed at end)

What went well

- TBD

What could be improved

- TBD

Action items

- TBD

Weekly Status Report Template

Week of [Date Range]

Summary

[Brief overview of the week's progress]

Achievements

- [Achievement 1]

- [Achievement 2]
- [Achievement 3]

Challenges

- [Challenge 1]
- [Challenge 2]

Next Week's Focus

- [Focus area 1]
- [Focus area 2]
- [Focus area 3]

Key Metrics

- Sprint burndown: [Status]
- Bugs reported/resolved: [Numbers]
- Test coverage: [Percentage]

Decisions Needed

- [Decision 1]
- [Decision 2]

```
## Implementation Instructions
```

1. Create the main workspace structure first
2. Set up the databases with the structures provided
3. Create relations between databases (e.g., Tasks assigned to Team Members)
4. Set up filtered views for each team to see their relevant tasks
5. Create dashboard with linked database views
6. Set up templates for recurring documents (status reports, sprint planning)
7. Configure permissions based on team roles
8. Add automation for status updates and deadline reminders

This Notion setup provides a comprehensive framework **for** managing the entire calendar app development process while maintaining visibility across teams **and** tracking progress toward milestones.

Task Assignments and Sprint Planning

Task Assignments and Sprint Planning

First Month Task Assignments (Discovery and Foundation Phase)

Leadership Team Tasks

Alex Thompson (Project Manager)

- Create project charter and communication plan
- Develop risk management framework
- Establish stakeholder reporting structure
- Lead weekly sync meetings
- Monitor and report on project KPIs

Jamie Chen (Product Owner)

- Complete user story mapping for MVP features
- Develop initial product roadmap
- Create acceptance criteria for foundation phase stories
- Prioritize backlog items for first three sprints
- Coordinate user research activities

Taylor Williams (Technical Architect)

- Design system architecture blueprint
- Define technology stack final specifications
- Create SOLID design principles documentation
- Establish coding standards and best practices
- Design database schema and relationships

Backend Team Tasks

Morgan Stanley (Backend Lead)

- Design API structure and contracts
- Establish GraphQL schema definitions
- Create authentication service architecture
- Design sync mechanism concepts
- Review team members' technical plans



Jordan Lee (Senior Backend Dev)

- Implement database models and migrations
- Set up PostgreSQL database architecture
- Design Redis caching strategy
- Create database access layer patterns
- Implement event storage service

Casey Reyes (Backend Developer)

- Implement authentication service
- Create user management functionality
- Set up email notification service
- Implement basic calendar CRUD operations
- Create data validation services

Robin Patel (DevOps Specialist)

- Set up AWS infrastructure (IaC)
- Configure CI/CD pipelines for all platforms
- Implement logging and monitoring services
- Create development, staging, and production environments
- Set up automated testing environment

Mobile Team Tasks

Sam Washington (Mobile Lead)

- Create mobile architecture designs (iOS and Android)
- Define shared logic approach between platforms
- Design offline functionality architecture
- Establish mobile testing framework
- Coordinate platform-specific implementations

Dana Park (Android Developer)

- Set up Android project architecture with Jetpack Compose
- Implement authentication screens
- Create calendar view base components
- Design local storage implementation
- Implement app navigation framework

Riley Johnson (iOS Developer)

- Set up iOS project architecture with SwiftUI
- Implement authentication screens
- Create calendar view base components



- Design local storage implementation
- Implement app navigation framework

Web Team Tasks

Quinn Ahmed (Frontend Lead)

- Design React/TypeScript application architecture
- Create component structure documentation
- Establish state management approach
- Design API integration patterns
- Set up frontend testing frameworks

Cameron Smith (Frontend Developer)

- Implement authentication UI components
- Create basic calendar view components
- Set up API integration service
- Implement responsive design framework
- Create common UI utility components

Design and QA Tasks

Avery Thomas (UX/UI Designer)

- Create design system foundations
- Design user flows for core features
- Create UI component library
- Design mobile and web mockups
- Develop brand identity elements

Jordan Rivera (QA Lead)

- Develop QA strategy and test plan
- Set up automated testing framework
- Create test cases for foundation phase
- Design integration testing approach
- Establish bug tracking and reporting process

Sprint 1 Plan (Discovery 1: Mar 15-28, 2025)

Sprint Goals

- Complete initial requirements gathering
- Establish technical architecture direction
- Begin design system conceptualization
- Set up basic development environments



Assigned User Stories

Story ID	Description	Assignee	Points
CA-F001	Create project technical specification	Taylor Williams	8
CA-F002	Establish design system principles	Avery Thomas	5
CA-F003	Set up initial development environment	Robin Patel	5
CA-F004	Create user research plan	Jamie Chen	3
CA-F005	Design database schema	Jordan Lee	8
CA-F006	Design API contracts	Morgan Stanley	8
CA-F007	Create mobile architecture blueprint	Sam Washington	8
CA-F008	Design web architecture blueprint	Quinn Ahmed	8

Daily Tasks Breakdown (Week 1)

Monday

- **Leadership**: Kickoff meeting, project overview presentation
- **Backend**: Begin API contract design discussion
- **Mobile**: Research platform requirements and limitations
- **Web**: Evaluate framework options and dependencies
- **Design**: Begin user research and competitive analysis

Tuesday

- **Leadership**: Draft project charter and timeline
- **Backend**: Begin database schema design
- **Mobile**: Document platform-specific requirements
- **Web**: Create initial component architecture diagrams
- **Design**: Begin mood board and style exploration

Wednesday

- **Leadership**: Establish team communication protocols
- **Backend**: Continue API contract design
- **Mobile**: Start platform architecture documentation
- **Web**: Begin state management strategy documentation
- **Design**: Start user flow mapping

Thursday

- **Leadership**: Risk assessment workshop
- **Backend**: Research sync mechanism options
- **Mobile**: Evaluate offline storage options
- **Web**: Document accessibility requirements

- **Design**: Continue interface design exploration

Friday

- **Leadership**: Week 1 review meeting
- **Backend**: Document database scaling strategy
- **Mobile**: Finalize cross-platform sharing approach
- **Web**: Document build and deployment strategy
- **Design**: Share initial design concepts

Daily Tasks Breakdown (Week 2)

Monday

- **Leadership**: Review week 1 progress, adjust plans
- **Backend**: Begin authentication service design
- **Mobile**: Start project template setup
- **Web**: Begin project template setup
- **Design**: Create initial component designs

Tuesday

- **Leadership**: Stakeholder update preparation
- **Backend**: Continue database schema refinement
- **Mobile**: Document offline sync strategy
- **Web**: Create component hierarchy documentation
- **Design**: Continue design system development

Wednesday

- **Leadership**: Mid-sprint review
- **Backend**: Draft API documentation template
- **Mobile**: Research third-party libraries needed
- **Web**: Evaluate third-party dependencies
- **Design**: Begin mockups for core screens

Thursday

- **Leadership**: Technical alignment meeting
- **Backend**: Finalize first draft of API contracts
- **Mobile**: Document integration points with backend
- **Web**: Document integration points with backend
- **Design**: Continue core screen mockups

Friday

- **Leadership**: Sprint 1 review preparation
- **Backend**: Prepare architecture presentation

- **Mobile**: Prepare architecture presentation
- **Web**: Prepare architecture presentation
- **Design**: Prepare design concept presentation

Key Deliverables for Sprint 1

1. Project Charter Document
2. Initial Technical Architecture Blueprint
3. Design System Concept
4. Database Schema Design (v1)
5. API Contract Documentation (v1)
6. Development Environment Setup Documentation
7. Sprint 1 Retrospective

Sprint 2 Preview (Discovery 2: Mar 29-Apr 11, 2025)

Tentative Goals

- Finalize architecture decisions
- Complete design system foundations
- Begin initial implementation of core services
- Set up CI/CD pipelines
- Implement proof-of-concept for critical features

Key User Stories (To be finalized)

- Authentication service implementation
- Basic calendar data model implementation
- Core UI components creation
- Mobile project structure setup
- Web project structure setup
- Data sync concept testing

I've created a comprehensive Notion project setup for tracking your calendar app development. This includes:

1. Workspace Structure

A complete Notion workspace organization with dedicated areas for project management, team directory, documentation, development tracking, design assets, QA planning, and analytics reporting.



2. Database Architecture

Multiple interconnected databases to track:

- Team members and their assignments
- Tasks with owners, status tracking, and dependencies
- Sprints with clear goals and timelines
- User stories with acceptance criteria
- Risks with mitigation strategies

3. First Month Planning

Detailed task assignments for all team members during the critical Discovery and Foundation phases, including:

- Leadership team responsibilities
- Backend development priorities
- Mobile platform development tasks
- Web application foundation work
- Design and QA preparation activities

4. Sprint Planning

A complete plan for Sprint 1 (March 15-28, 2025) with:

- Clear sprint goals and user stories
- Day-by-day task breakdown for all team members
- Defined deliverables and success criteria
- Preview of Sprint 2 objectives

5. Templates & Views

Ready-to-use templates for:

- Weekly status reports
- Sprint planning sessions
- Team dashboards with relevant metrics

- Gantt chart for timeline visualization

This Notion setup provides you with a complete framework to track the entire project lifecycle, from initial discovery through to launch, with appropriate task assignment and monitoring capabilities. Team members can easily see their responsibilities while leadership maintains visibility across all workstreams.

Would you like me to provide more detail on any specific aspect of the Notion project setup?

 Let's start by working on the following task: Let's work on all the tasks that are assigned to Alex Thompson Alex Thompson (Project Manager)

- Create project charter and communication plan
- Develop risk management framework
- Establish stakeholder reporting structure
- Lead weekly sync meetings
- Monitor and report on project KPIs

I'll help you work on the tasks assigned to Alex Thompson as Project Manager for the Calendar App project. Let's tackle these one by one:

1. Create Project Charter and Communication Plan

Project Charter Draft

```
# Calendar App Project Charter
```

Project Overview

- Project Name: Cross-Platform Calendar App
- Project Sponsor: [Company Executive]
- Project Manager: Alex Thompson
- Start Date: March 15, 2025
- Target Completion: December 10, 2025

Project Vision

To create a scalable, cross-platform calendar application that delivers exceptional user experience across Android, iOS, and web platforms, capable of supporting billions of users.

Project Objectives

- 1.** Develop a fully-functional calendar application for Android, iOS, and web platforms
- 2.** Implement a synchronization system that ensures real-time data consistency across devices
- 3.** Design the system architecture to scale to billions of users
- 4.** Create an intuitive, accessible user interface that exceeds competitive offerings
- 5.** Establish a foundation for future feature expansion and ecosystem growth

Success Criteria

- All platforms launched by December 10, 2025
- System architecture tested to support projected user loads
- 99.9% uptime across all services
- 90% or higher user satisfaction in initial feedback
- >80% test coverage across all codebases

Key Deliverables

- 1.** Android application (Kotlin/Jetpack Compose)
- 2.** iOS application (Swift/SwiftUI)
- 3.** Web application (React/TypeScript)
- 4.** Backend services and API (Node.js/GraphQL)
- 5.** Synchronization framework
- 6.** Documentation for all components

Key Stakeholders

- 1.** Executive Team
- 2.** Development Teams (Backend, Mobile, Web)
- 3.** Design Team
- 4.** QA Team
- 5.** Marketing Team
- 6.** Customer Support Team
- 7.** Potential Users (Beta Test Group)

Constraints

- Budget: [Allocated Budget]
- Timeline: March 15 - December 10, 2025
- Technology requirements (SOLID principles adherence)
- Compliance with data privacy regulations

Assumptions

- Technical resources available as outlined in staffing plan
- Third-party APIs and services remain stable throughout development
- Mobile platform guidelines remain consistent during development cycle

Initial Risk Assessment

- Data synchronization complexity
- Cross-platform consistency challenges
- Scaling infrastructure for projected growth
- Security vulnerabilities

Approval

[Signatures required for project approval]

Communication Plan

Calendar App Communication Plan

Communication Objectives

- Ensure all stakeholders are appropriately informed of project status
- Facilitate clear decision-making processes
- Provide transparency on progress, risks, and issues
- Enable effective collaboration across teams

Key Audiences and Information Needs

Executive Team

- Frequency: Bi-weekly
- Format: Executive summary report and dashboard
- Content: Project status, KPIs, risks, resource needs, strategic decisions required
- Channel: Email report + monthly steering committee meeting

Development Teams

- Frequency: Daily & Weekly
- Format: Standups, sprint meetings, documentation
- Content: Technical specifications, task assignments, dependencies, blockers
- Channel: Notion, Slack, daily standup, weekly sync meeting

Other Stakeholders (Marketing, Support, etc.)

- Frequency: Bi-weekly
- Format: Status updates, milestone alerts

- Content: Progress against roadmap, upcoming milestones, required inputs
- Channel: Email updates, monthly cross-functional meeting

Regular Communication Cadence

Daily

- Development team standups (15 minutes)
- Critical issue alerts (as needed)
- Notion task updates

Weekly

- Team sync meeting (1 hour, Thursdays 10am)
- Sprint progress updates in Notion
- Cross-team dependency check-in

Bi-weekly

- Executive status report
- Sprint review/planning
- Stakeholder updates

Monthly

- All-hands project review
- Steering committee meeting
- Roadmap review and adjustment

Communication Tools

- Notion: Primary project documentation and task tracking
- Slack: Day-to-day communication and alerts
- Email: Formal updates and external communications
- Zoom: Virtual meetings
- Figma: Design reviews and feedback

Escalation Path

1. Team Lead
2. Project Manager (Alex Thompson)
3. Product Owner (Jamie Chen)
4. Executive Sponsor

Meeting Guidelines

- All recurring meetings have standing agendas
- Action items documented in Notion after each meeting

- No meeting scheduled without clear objective
- Meeting notes shared within 24 hours

2. Develop Risk Management Framework

```
# Calendar App Risk Management Framework
```

Risk Management Objectives

- Identify potential risks early
- Assess impact and likelihood of risks
- Develop mitigation strategies
- Monitor risks throughout project lifecycle
- Respond effectively to realized risks

Risk Identification Process

Sources of Risk Identification

- Team brainstorming sessions
- Technical spike outcomes
- Historical project data
- Expert consultation
- Regular risk review meetings

Risk Categories

1. Technical Risks
2. Schedule Risks
3. Resource Risks
4. Scope Risks
5. External Dependency Risks
6. Operational Risks
7. Security Risks

Risk Identification Timeline

- Initial risk assessment: Project kickoff
- Sprint planning risk review: Start of each sprint
- Ongoing identification: Continuous via team members
- Formal risk review: Monthly

Risk Assessment Matrix



Impact Scale (1-5)

1. Minimal: Negligible effect on project
2. Minor: Small impact, easily managed within team
3. Moderate: Significant impact requiring management attention
4. Major: Substantial impact affecting key objectives
5. Severe: Critical impact threatening project success

Likelihood Scale (1-5)

1. Rare: <10% chance of occurrence
2. Unlikely: 10-30% chance of occurrence
3. Possible: 30-50% chance of occurrence
4. Likely: 50-70% chance of occurrence
5. Almost Certain: >70% chance of occurrence

Risk Priority Calculation

Risk Priority = Impact × Likelihood

Priority Levels:

- Low (1-6): Monitor
- Medium (7-14): Active management required
- High (15-19): Immediate attention needed
- Critical (20-25): Emergency response required

Risk Response Strategies

Strategy Types

1. Avoid: Eliminate the threat
2. Transfer: Shift impact to third party
3. Mitigate: Reduce probability or impact
4. Accept: Acknowledge but take no action
5. Contingency: Prepare response for if risk occurs

Response Development Requirements

- Owner assigned to each risk
- Specific, measurable actions
- Timeline for implementation
- Resource requirements identified
- Effectiveness metrics defined

Risk Monitoring and Control

Risk Register Management

- Maintained in Notion database
- Updated weekly
- Reviewed in sprint meetings
- Full review monthly

Risk Status Tracking

- Open: Identified, response in development
- Mitigating: Response strategy in progress
- Closed: No longer a threat
- Occurred: Risk has materialized
- Transferred: Handled by external party

Key Risk Indicators

- Technical: Build failures, bug rates, performance metrics
- Schedule: Sprint velocity, milestone adherence
- Resource: Team capacity, skill availability
- Scope: Requirements volatility, feature creep
- Security: Vulnerability scan results

Risk Response Execution

Trigger Conditions

- Risk priority reaches threshold
- Early warning indicator activated
- Multiple related risks trending upward
- Team member escalation

Response Protocol

1. Alert Project Manager and relevant leads
2. Implement predefined response strategy
3. Update project plan to accommodate
4. Communicate to stakeholders as needed
5. Document lessons learned

Continuous Improvement

- Post-response effectiveness review
- Quarterly risk management process review
- Lessons learned documentation
- Framework update based on project experience



3. Establish Stakeholder Reporting Structure

```
# Calendar App Stakeholder Reporting Structure

## Stakeholder Analysis

### Primary Stakeholders

1. **Executive Sponsor**
   - Influence: High
   - Interest: Strategic outcomes
   - Reporting: Monthly executive summary, milestone alerts

2. **Product Team**
   - Influence: High
   - Interest: Product vision, feature delivery
   - Reporting: Weekly status, feature progress dashboard

3. **Development Teams**
   - Influence: Medium
   - Interest: Technical implementation, timeline
   - Reporting: Daily updates, sprint metrics

4. **Design Team**
   - Influence: Medium
   - Interest: User experience, design implementation
   - Reporting: Weekly design implementation status

5. **QA Team**
   - Influence: Medium
   - Interest: Quality metrics, testing coverage
   - Reporting: Defect reports, test coverage metrics

### Secondary Stakeholders

6. **Marketing Team**
   - Influence: Low
   - Interest: Launch timeline, feature highlights
   - Reporting: Monthly progress, milestone alerts

7. **Customer Support**
   - Influence: Low
   - Interest: Product functionality, documentation
```

- Reporting: Monthly training updates, feature overview

8. **External Partners**

- Influence: Variable
- Interest: Integration points, API stability
- Reporting: As-needed updates on relevant components

Reporting Framework

Executive Reporting

- **Format**: Executive Dashboard + summary report
- **Cadence**: Monthly
- **Owner**: Alex Thompson
- **Content**:
 - Progress against key milestones
 - Budget status (planned vs. actual)
 - Resource utilization
 - Major risks and mitigation status
 - Strategic decisions needed
 - High-level KPIs

Project Team Reporting

- **Format**: Notion dashboard + team meeting
- **Cadence**: Weekly
- **Owner**: Team Leads
- **Content**:
 - Sprint progress
 - Current blockers and dependencies
 - Upcoming milestones
 - Resource needs
 - Technical decisions needed
 - Team-specific KPIs

Developer Reporting

- **Format**: Notion tasks + standup
- **Cadence**: Daily
- **Owner**: Individual developers
- **Content**:
 - Task status updates
 - Blockers
 - Completed work
 - Planned work

Cross-Functional Reporting

- **Format**: Status report + meeting
- **Cadence**: Bi-weekly
- **Owner**: Alex Thompson
- **Content**:
 - Feature development status
 - Upcoming dependencies
 - Integration points
 - Timeline updates
 - Cross-team blockers

Report Distribution Matrix

Report Type	Exec Team	Product Team	Dev Team	Design	QA	Marketing	Support
Executive Summary	✓	✓	-	-	-	-	-
Milestone Report	✓	✓	✓	✓	✓	✓	✓
Sprint Report	-	✓	✓	✓	✓	-	-
Risk Register	✓	✓	✓	-	-	-	-
Quality Metrics	-	✓	✓	-	✓	-	-
Resource Report	✓	✓	-	-	-	-	-

Feedback Mechanism

- Each report includes feedback request link
- Quarterly stakeholder satisfaction survey
- Report format and content review after each project phase
- Continuous improvement based on stakeholder input

4. Lead Weekly Sync Meetings

Calendar App Weekly Sync Meeting Structure

Meeting Details

- **Time**: Thursdays, 10:00-11:00 AM
- **Location**: Main Conference Room + Zoom
- **Required Attendees**: All team leads, Project Manager
- **Optional Attendees**: Team members with relevant updates

Standing Agenda

1. Opening (5 minutes)

- Welcome and review of agenda
- Quick wins and celebrations from past week

2. Sprint Progress (15 minutes)

- Current sprint status (burndown review)
- Completed deliverables
- At-risk items
- Each team lead provides 2-minute status update

3. Blockers and Dependencies (15 minutes)

- Review of current blockers
- Cross-team dependencies
- Resource constraints
- Solutions discussion

4. Upcoming Work (10 minutes)

- Next sprint preview
- Upcoming milestones
- Resource needs

5. Risk Review (10 minutes)

- New risks identified
- Update on existing high-priority risks
- Mitigation progress

6. Action Items (5 minutes)

- Review previous action items
- Assign new action items
- Confirm owners and due dates

Meeting Roles

- **Facilitator**: Alex Thompson
- **Timekeeper**: Rotates among team leads
- **Note-taker**: Rotates among team members

Meeting Rules

1. Start and end on time
2. Come prepared with updates

3. Focus on cross-team concerns
4. Take detailed discussions offline
5. Document decisions and action items
6. No devices except for note-taking

Pre-Meeting Requirements

- Team leads update status in Notion 24 hours before meeting
- Review previous meeting notes and action items
- Prepare discussion points for blockers requiring cross-team input

Post-Meeting Actions

- Meeting notes posted to Notion within 4 hours
- Action items assigned in task database
- Follow-up on critical blockers within 24 hours

5. Monitor and Report on Project KPIs

```
# Calendar App KPI Monitoring Framework
```

Key Performance Indicators

Project Health KPIs

1. **Schedule Performance Index (SPI)**

- Target: 0.95-1.05
- Calculation: Earned Value / Planned Value
- Reporting Frequency: Weekly
- Visualization: Trend line chart

2. **Milestone Completion Rate**

- Target: 100% on-time
- Calculation: Milestones completed on time / Total milestones due
- Reporting Frequency: Monthly
- Visualization: Percentage with trend

3. **Scope Change Rate**

- Target: <10% per month
- Calculation: (New requirements - Removed requirements) / Baseline requirements
- Reporting Frequency: Monthly
- Visualization: Percentage with trend

4. **Risk Mitigation Effectiveness**

- Target: >85%
- Calculation: Risks successfully mitigated / Total risks identified for mitigation
- Reporting Frequency: Monthly
- Visualization: Percentage

Development KPIs

5. **Sprint Completion Rate**

- Target: >90%
- Calculation: Story points completed / Story points committed
- Reporting Frequency: Bi-weekly (end of sprint)
- Visualization: Percentage with trend by team

6. **Code Quality Metrics**

- Target: Test coverage >80%, 0 critical bugs
- Calculation: Various (test coverage, static analysis, bug density)
- Reporting Frequency: Weekly
- Visualization: Multiple metrics dashboard

7. **Technical Debt Ratio**

- Target: <15%
- Calculation: Hours spent on refactoring / Total development hours
- Reporting Frequency: Monthly
- Visualization: Percentage with trend

Team KPIs

8. **Team Velocity**

- Target: Stable or increasing
- Calculation: Average story points completed per sprint
- Reporting Frequency: Bi-weekly
- Visualization: Trend line by team

9. **Blocker Resolution Time**

- Target: <48 hours
- Calculation: Average time from blocker identification to resolution
- Reporting Frequency: Weekly
- Visualization: Average with trend

10. **Team Satisfaction**

- Target: >8/10

- Calculation: Average score from team satisfaction survey
- Reporting Frequency: Monthly
- Visualization: Score with trend

KPI Dashboard

- Implemented in Notion with automated data collection where possible
- Visual indicators (Green/Yellow/Red) for at-a-glance status
- Drill-down capability for detailed analysis
- Historical tracking to identify trends

Reporting Schedule

- **Weekly**: Development KPIs, tactical metrics
- **Bi-weekly**: Sprint metrics, team performance
- **Monthly**: Comprehensive KPI report for all stakeholders
- **Quarterly**: Strategic review with trend analysis

Data Collection Methods

1. Automated Collection

- Development metrics from Git/CI systems
- Task completion data from Notion database
- Time tracking data from project management tools

2. Manual Entry

- Team satisfaction surveys
- Qualitative assessments
- Risk mitigation effectiveness

KPI Review Process

1. Weekly review by Project Manager
2. Bi-weekly review with team leads
3. Monthly review with executive stakeholders
4. Quarterly comprehensive review and KPI adjustment

Response Thresholds

- **Green**: Within target range - Continue monitoring
- **Yellow**: 5-15% deviation from target - Develop improvement plan
- **Red**: >15% deviation from target - Immediate corrective action required

Continuous Improvement

- KPI framework review after each project phase
- Adjustment of targets based on project evolution

- Addition/removal of metrics based on usefulness
- Refinement of data collection methods

These documents provide comprehensive frameworks for all of Alex Thompson's assigned tasks. Each can be implemented directly in Notion and linked to the relevant project areas. Would you like me to elaborate on any specific aspects of these tasks, or would you prefer to move on to implementing one of these frameworks in more detail?

 How to implement the above in Notion

Implementing Alex Thompson's PM Tasks in Notion

I'll guide you through setting up each of Alex Thompson's PM deliverables in Notion:

1. Project Charter & Communication Plan

Setup in Notion:

1. **Create a new page** under the Documentation section titled "Project Charter & Communication Plan"
2. **Use toggle blocks** for each major section to keep the page organized
3. **Add a table of contents** at the top using the `/table of contents` command

Implementation Steps:

1. Copy the Project Charter template text
2. Paste it into the Notion page
3. Format headings using Notion's H1, H2, H3 headers
4. For the Communication Plan:
 - Create a toggle section called "Communication Plan"
 - Paste the communication plan content under this toggle
 - For the Communication Matrix, use Notion's table feature

Linking to Dashboard:

- Add a link to this page on the main dashboard under "Quick Links"
- Create a "Documents" database with a link to this file and tag it as "Charter"

2. Risk Management Framework

Setup in Notion:

1. **Create a new page** in the Project Management section titled "Risk Management Framework"
2. **Create a linked database** for the Risk Register

Implementation Steps:

1. Copy the Risk Management Framework content
2. Format with proper headings
3. For the Risk Assessment Matrix:
 - Create a 5×5 table using Notion's table feature
 - Color-code cells based on risk priority (red, yellow, green)
4. Set up the Risk Register Database with the following properties:
 - Risk ID (Number)
 - Risk Description (Text)
 - Category (Select: Technical, Schedule, Resource, etc.)
 - Impact (Select: 1-5)
 - Likelihood (Select: 1-5)
 - Priority (Formula: Impact \times Likelihood)
 - Status (Select: Open, Mitigating, Closed, Occurred, Transferred)
 - Owner (Person)
 - Mitigation Strategy (Text)
 - Contingency Plan (Text)
 - Due Date (Date)
5. Create views in the Risk Register:
 - All Risks
 - High Priority Risks (Filter: Priority > 14)
 - By Owner (Group by: Owner)
 - By Category (Group by: Category)

3. Stakeholder Reporting Structure

Setup in Notion:

1. **Create a page** under Documentation titled "Stakeholder Reporting Structure"
2. **Create a Stakeholders database** to track all stakeholders

Implementation Steps:

1. Copy the Stakeholder Reporting Structure content
2. Format with proper headings
3. For the Stakeholder Analysis:
 - Create a Stakeholders database with:
 - Name (Text)
 - Role/Department (Select)
 - Influence (Select: High, Medium, Low)
 - Interest (Text)
 - Communication Preference (Multi-select)
 - Report Frequency (Select)
4. For the Report Distribution Matrix:
 - Create a table as shown in the template
 - Use checkmarks (type /check) to indicate who receives which reports
5. Create a linked "Reports" database with:
 - Report Name (Text)
 - Type (Select: Executive, Milestone, Sprint, etc.)
 - Frequency (Select)
 - Owner (Person)
 - Last Sent (Date)
 - Next Due (Formula)
 - Recipients (Relation to Stakeholders database)

4. Weekly Sync Meetings

Setup in Notion:

1. **Create a page** under Project Management titled "Meeting Templates"
2. **Create a subpage** for "Weekly Sync Meeting"
3. **Set up a Meeting Notes database** for tracking all meetings

Implementation Steps:

1. Copy the Weekly Sync Meeting Structure
2. Format with proper headings
3. Create a template for weekly meetings:
 - Use the "Template" button in Notion
 - Add date field, attendees, etc.
 - Add agenda sections with empty bullet points
4. Create a Meeting Notes database with:
 - Date (Date)
 - Type (Select: Weekly Sync, Sprint Planning, etc.)
 - Attendees (Multi-person)
 - Notes (Text)
 - Action Items (Relation to Tasks database)
 - Status (Select: Scheduled, Completed, Cancelled)
5. Create a view that shows only Weekly Sync Meetings
6. Set up automation (if using Notion team plan) to:
 - Remind team leads to update status 24 hours before meeting
 - Create a new meeting note from template each week

5. KPI Monitoring Framework

Setup in Notion:

1. **Create a page** under Analytics & Reporting titled "KPI Framework"
2. **Create a KPI database** to track all metrics
3. **Set up a KPI Dashboard** as a separate page

Implementation Steps:

1. Copy the KPI Monitoring Framework content

2. Format with proper headings
3. Create a KPI database with:
 - KPI Name (Text)
 - Category (Select: Project Health, Development, Team)
 - Target (Text)
 - Current Value (Number)
 - Status (Select: Green, Yellow, Red)
 - Frequency (Select)
 - Calculation Method (Text)
 - Owner (Person)
 - Last Updated (Date)
4. For the KPI Dashboard:
 - Add a filtering view of the KPI database
 - Use Notion's board view to organize by status (Green/Yellow/Red)
 - Add custom charts using embedded charting tools or CSV exports to visualization tools
5. Create views for different reporting periods:
 - Weekly KPIs
 - Monthly KPIs
 - Quarterly review

Advanced Notion Features to Consider:

1. Relations Between Databases

- Link Risks to Tasks for mitigation actions
- Connect Action Items from meetings to responsible team members
- Associate KPIs with specific project milestones

2. Formulas and Rollups

- Calculate risk priority automatically
- Create countdown timers for upcoming milestones
- Calculate KPI trends between reporting periods

3. Automations (if on Team Plan)

- Scheduled reminders for reporting deadlines
- Status changes when metrics fall below thresholds
- Notifications to team leads for assigned action items

4. Templates

- Create templates for recurring reports
- Set up template buttons for weekly meeting notes
- Use templates for standardized KPI updates

5. Embedded Views

- Embed relevant database views on the dashboard
- Show high-priority risks on the main project page
- Display upcoming meetings on team pages

By implementing these structures in Notion, you'll create a comprehensive project management system that keeps Alex Thompson's PM deliverables organized, accessible, and actionable for the entire calendar app development team.

Would you like me to elaborate on implementing any specific section in more detail?

 Can you create a single file with the above configs that I can just import in Notion and it works

Unfortunately, I can't create a direct import file for Notion. Notion doesn't support a simple file format that you can import to automatically set up complex workspace structures with relations between databases and configured views.

However, I can create a comprehensive guide document that you can follow to set everything up efficiently. This will include all the database structures, property configurations, and setup instructions in a single organized document.

Calendar App Notion Setup Guide

```
# Calendar App Notion Setup Guide
```

This document provides step-by-step instructions for setting up the complete Calendar App project management system in Notion.

Initial Workspace Setup

1. Create a new workspace called "CalendarApp"
2. Create the following top-level pages:
 -  Home (Dashboard)
 -  Project Management
 -  Team Directory
 -  Documentation
 -  Development
 -  Design
 -  QA & Testing
 -  Analytics & Reporting

Database Setup

Create the following databases with their respective properties:

1. Team Members Database

- Create in the Team Directory page
- Click "New" > "Table - Full page"
- Add these properties:
 - Name (Title)
 - Role (Select)
 - Team (Select: Leadership, Backend, Mobile, Web, Design, QA)
 - Email (Email)
 - Skills (Multi-select)
 - Current Projects (Relation to Projects database)

2. Tasks Database

- Create in the Project Management page
- Click "New" > "Table - Full page"
- Add these properties:
 - Task (Title)
 - Owner (Person)
 - Status (Select: Not Started, In Progress, Blocked, Completed)
 - Priority (Select: Low, Medium, High, Critical)
 - Due Date (Date)
 - Phase (Select: Foundation, Core Dev, Feature Completion, Testing, Launch Prep)
 - Tags (Multi-select)
 - Dependencies (Relation to the same Tasks database)

3. Sprints Database

- Create in the Project Management page
- Add these properties:
 - Sprint (Title)
 - Start Date (Date)
 - End Date (Date)
 - Status (Select: Planned, In Progress, Completed)
 - Goals (Text)
 - Velocity (Number)
 - Demo Date (Date)

4. User Stories Database

- Create in the Development page
- Add these properties:
 - Story ID (Formula: "CAL-" + format(id))
 - User Story (Title)
 - Acceptance Criteria (Text)
 - Priority (Select: Low, Medium, High, Critical)
 - Status (Select: Backlog, Ready, In Progress, Testing, Done)
 - Epic (Select)
 - Story Points (Number)
 - Assigned To (Person)

5. Risks Database

- Create in the Project Management page
- Add these properties:
 - Risk (Title)
 - Description (Text)
 - Impact (Select: Low, Medium, High, Critical)
 - Likelihood (Select: Low, Medium, High, Very High)
 - Mitigation (Text)
 - Owner (Person)
 - Status (Select: Monitoring, Active, Mitigated, Occurred, Closed)

Alex Thompson's PM Deliverables

1. Project Charter & Communication Plan

1. Create a new page in the Documentation section titled "Project Charter"
2. Copy and paste this content:

Calendar App Project Charter

Project Overview

- Project Name: Cross-Platform Calendar App
- Project Sponsor: [Company Executive]
- Project Manager: Alex Thompson
- Start Date: March 15, 2025
- Target Completion: December 10, 2025

Project Vision

To create a scalable, cross-platform calendar application that delivers exceptional user experience across Android, iOS, and web platforms, capable of supporting billions of users.

Project Objectives

1. Develop a fully-functional calendar application for Android, iOS, and web platforms
2. Implement a synchronization system that ensures real-time data consistency across devices
3. Design the system architecture to scale to billions of users
4. Create an intuitive, accessible user interface that exceeds competitive offerings
5. Establish a foundation for future feature expansion and ecosystem growth

Success Criteria

- All platforms launched by December 10, 2025
- System architecture tested to support projected user loads
- 99.9% uptime across all services
- 90% or higher user satisfaction in initial feedback
- *"80% test coverage across all codebases"*

Key Deliverables

1. Android application (Kotlin/Jetpack Compose)

2. iOS application (Swift/SwiftUI)
3. Web application (React/TypeScript)
4. Backend services and API (Node.js/GraphQL)
5. Synchronization framework
6. Documentation for all components

Key Stakeholders

1. Executive Team
2. Development Teams (Backend, Mobile, Web)
3. Design Team
4. QA Team
5. Marketing Team
6. Customer Support Team
7. Potential Users (Beta Test Group)

Constraints

- Budget: [Allocated Budget]
- Timeline: March 15 - December 10, 2025
- Technology requirements (SOLID principles adherence)
- Compliance with data privacy regulations

Assumptions

- Technical resources available as outlined in staffing plan
- Third-party APIs and services remain stable throughout development
- Mobile platform guidelines remain consistent during development cycle

Initial Risk Assessment

- Data synchronization complexity
- Cross-platform consistency challenges
- Scaling infrastructure for projected growth

- Security vulnerabilities

Approval

[Signatures required for project approval]

3. Create a new page in the Documentation section titled "Communication Plan"
4. Copy and paste this content:

Calendar App Communication Plan

Communication Objectives

- Ensure all stakeholders are appropriately informed of project status
- Facilitate clear decision-making processes
- Provide transparency on progress, risks, and issues
- Enable effective collaboration across teams

Key Audiences and Information Needs

Executive Team

- Frequency: Bi-weekly
- Format: Executive summary report and dashboard
- Content: Project status, KPIs, risks, resource needs, strategic decisions required
- Channel: Email report + monthly steering committee meeting

Development Teams

- Frequency: Daily & Weekly
- Format: Standups, sprint meetings, documentation
- Content: Technical specifications, task assignments, dependencies, blockers
- Channel: Notion, Slack, daily standup, weekly sync meeting

Other Stakeholders (Marketing, Support, etc.)

- Frequency: Bi-weekly

- Format: Status updates, milestone alerts
- Content: Progress against roadmap, upcoming milestones, required inputs
- Channel: Email updates, monthly cross-functional meeting

Regular Communication Cadence

Daily

- Development team standups (15 minutes)
- Critical issue alerts (as needed)
- Notion task updates

Weekly

- Team sync meeting (1 hour, Thursdays 10am)
- Sprint progress updates in Notion
- Cross-team dependency check-in

Bi-weekly

- Executive status report
- Sprint review/planning
- Stakeholder updates

Monthly

- All-hands project review
- Steering committee meeting
- Roadmap review and adjustment

Communication Tools

- Notion: Primary project documentation and task tracking
- Slack: Day-to-day communication and alerts
- Email: Formal updates and external communications
- Zoom: Virtual meetings
- Figma: Design reviews and feedback

Escalation Path

1. Team Lead
2. Project Manager (Alex Thompson)
3. Product Owner (Jamie Chen)
4. Executive Sponsor

Meeting Guidelines

- All recurring meetings have standing agendas
- Action items documented in Notion after each meeting
- No meeting scheduled without clear objective
- Meeting notes shared within 24 hours

2. Risk Management Framework

1. Create a new page in the Project Management section titled "Risk Management Framework"
2. Copy and paste this content:

Calendar App Risk Management Framework

Risk Management Objectives

- Identify potential risks early
- Assess impact and likelihood of risks
- Develop mitigation strategies
- Monitor risks throughout project lifecycle
- Respond effectively to realized risks

Risk Identification Process

Sources of Risk Identification

- Team brainstorming sessions
- Technical spike outcomes
- Historical project data
- Expert consultation
- Regular risk review meetings

Risk Categories

1. Technical Risks
2. Schedule Risks
3. Resource Risks
4. Scope Risks
5. External Dependency Risks
6. Operational Risks
7. Security Risks

Risk Identification Timeline

- Initial risk assessment: Project kickoff
- Sprint planning risk review: Start of each sprint
- Ongoing identification: Continuous via team members
- Formal risk review: Monthly

Risk Assessment Matrix

Impact Scale (1-5)

1. Minimal: Negligible effect on project
2. Minor: Small impact, easily managed within team
3. Moderate: Significant impact requiring management attention
4. Major: Substantial impact affecting key objectives
5. Severe: Critical impact threatening project success

Likelihood Scale (1-5)

1. Rare: <10% chance of occurrence
2. Unlikely: 10-30% chance of occurrence

3. Possible: 30-50% chance of occurrence
4. Likely: 50-70% chance of occurrence
5. Almost Certain: >70% chance of occurrence

Risk Priority Calculation

Risk Priority = Impact × Likelihood

Priority Levels:

- Low (1-6): Monitor
- Medium (7-14): Active management required
- High (15-19): Immediate attention needed
- Critical (20-25): Emergency response required

Risk Response Strategies

Strategy Types

1. Avoid: Eliminate the threat
2. Transfer: Shift impact to third party
3. Mitigate: Reduce probability or impact
4. Accept: Acknowledge but take no action
5. Contingency: Prepare response for if risk occurs

Response Development Requirements

- Owner assigned to each risk
- Specific, measurable actions
- Timeline for implementation
- Resource requirements identified
- Effectiveness metrics defined

Risk Monitoring and Control

Risk Register Management

- Maintained in Notion database

- Updated weekly
- Reviewed in sprint meetings
- Full review monthly

Risk Status Tracking

- Open: Identified, response in development
- Mitigating: Response strategy in progress
- Closed: No longer a threat
- Occurred: Risk has materialized
- Transferred: Handled by external party

Key Risk Indicators

- Technical: Build failures, bug rates, performance metrics
- Schedule: Sprint velocity, milestone adherence
- Resource: Team capacity, skill availability
- Scope: Requirements volatility, feature creep
- Security: Vulnerability scan results

Risk Response Execution

Trigger Conditions

- Risk priority reaches threshold
- Early warning indicator activated
- Multiple related risks trending upward
- Team member escalation

Response Protocol

1. Alert Project Manager and relevant leads
2. Implement predefined response strategy
3. Update project plan to accommodate
4. Communicate to stakeholders as needed
5. Document lessons learned



Continuous Improvement

- Post-response effectiveness review
- Quarterly risk management process review
- Lessons learned documentation
- Framework update based on project experience

3. Link the Risks database to [this](#) page by:

- Adding a "Linked View" of the Risks database
- Creating views [for "High Priority Risks"](#) and ["Risks by Owner"](#)

3. Stakeholder Reporting Structure

1. Create a [new](#) page [in](#) the Documentation section titled "[Stakeholder Reporting Structure](#)"

2. Copy [and](#) paste [this](#) content:

Calendar App Stakeholder Reporting Structure

Stakeholder Analysis

Primary Stakeholders

1. Executive Sponsor

- Influence: High
- Interest: Strategic outcomes
- Reporting: Monthly executive summary, milestone alerts

2. Product Team

- Influence: High
- Interest: Product vision, feature delivery
- Reporting: Weekly status, feature progress dashboard

3. Development Teams

- Influence: Medium

- Interest: Technical implementation, timeline
- Reporting: Daily updates, sprint metrics

4. Design Team

- Influence: Medium
- Interest: User experience, design implementation
- Reporting: Weekly design implementation status

5. QA Team

- Influence: Medium
- Interest: Quality metrics, testing coverage
- Reporting: Defect reports, test coverage metrics

Secondary Stakeholders

6. Marketing Team

- Influence: Low
- Interest: Launch timeline, feature highlights
- Reporting: Monthly progress, milestone alerts

7. Customer Support

- Influence: Low
- Interest: Product functionality, documentation
- Reporting: Monthly training updates, feature overview

8. External Partners

- Influence: Variable
- Interest: Integration points, API stability
- Reporting: As-needed updates on relevant components

Reporting Framework

Executive Reporting

- **Format:** Executive Dashboard + summary report
- **Cadence:** Monthly

- **Owner:** Alex Thompson
- **Content:**
 - Progress against key milestones
 - Budget status (planned vs. actual)
 - Resource utilization
 - Major risks and mitigation status
 - Strategic decisions needed
 - High-level KPIs

Project Team Reporting

- **Format:** Notion dashboard + team meeting
- **Cadence:** Weekly
- **Owner:** Team Leads
- **Content:**
 - Sprint progress
 - Current blockers and dependencies
 - Upcoming milestones
 - Resource needs
 - Technical decisions needed
 - Team-specific KPIs

Developer Reporting

- **Format:** Notion tasks + standup
- **Cadence:** Daily
- **Owner:** Individual developers
- **Content:**
 - Task status updates
 - Blockers
 - Completed work
 - Planned work

Cross-Functional Reporting

- **Format:** Status report + meeting

- **Cadence:** Bi-weekly
- **Owner:** Alex Thompson
- **Content:**
 - Feature development status
 - Upcoming dependencies
 - Integration points
 - Timeline updates
 - Cross-team blockers

Report Distribution Matrix

Report Type	Exec Team	Product Team	Dev Team	Design	QA	Marketing	Support
Executive Summary	✓	✓	-	-	-	-	-
Milestone Report	✓	✓	✓	✓	✓	✓	✓
Sprint Report	-	✓	✓	✓	✓	-	-
Risk Register	✓	✓	✓	-	-	-	-
Quality Metrics	-	✓	✓	-	✓	-	-
Resource Report	✓	✓	-	-	-	-	-

Feedback Mechanism

- Each report includes feedback request link
- Quarterly stakeholder satisfaction survey
- Report format and content review after each project phase
- Continuous improvement based on stakeholder input

3. Create a "Stakeholders" database with these properties:

- Name (Title)
- Department (Select)
- Influence (Select: High, Medium, Low)
- Interest Area (Text)
- Report Type (Multi-select)
- Contact Info (Email)

- Notes (Text)
4. Create a "Reports" database with these properties:
- Report Name (Title)
 - Type (Select: Executive, Sprint, Milestone, Risk, Quality, Resource)
 - Frequency (Select: Daily, Weekly, Bi-weekly, Monthly, Quarterly)
 - Owner (Person)
 - Last Sent (Date)
 - Next Due (Formula: if(prop("Last Sent") == "", "", dateAdd(prop("Last Sent"), prop("Frequency"), "days")))
 - Recipients (Relation to Stakeholders database)
 - Template (File)

4. Weekly Sync Meetings

1. Create a new page in the Project Management section titled "Meeting Templates"
2. Create a subpage titled "Weekly Sync Meeting"
3. Copy and paste this content:

Calendar App Weekly Sync Meeting Structure

Meeting Details

- **Time:** Thursdays, 10:00-11:00 AM
- **Location:** Main Conference Room + Zoom
- **Required Attendees:** All team leads, Project Manager
- **Optional Attendees:** Team members with relevant updates

Standing Agenda

1. Opening (5 minutes)

- Welcome and review of agenda
- Quick wins and celebrations from past week

2. Sprint Progress (15 minutes)

- Current sprint status (burndown review)
- Completed deliverables
- At-risk items
- Each team lead provides 2-minute status update

3. Blockers and Dependencies (15 minutes)

- Review of current blockers
- Cross-team dependencies
- Resource constraints
- Solutions discussion

4. Upcoming Work (10 minutes)

- Next sprint preview
- Upcoming milestones
- Resource needs

5. Risk Review (10 minutes)

- New risks identified
- Update on existing high-priority risks
- Mitigation progress

6. Action Items (5 minutes)

- Review previous action items
- Assign new action items
- Confirm owners and due dates

Meeting Roles

- **Facilitator:** Alex Thompson
- **Timekeeper:** Rotates among team leads
- **Note-taker:** Rotates among team members

Meeting Rules

1. Start and end on time
2. Come prepared with updates
3. Focus on cross-team concerns
4. Take detailed discussions offline
5. Document decisions and action items
6. No devices except for note-taking

Pre-Meeting Requirements

- Team leads update status in Notion 24 hours before meeting
- Review previous meeting notes and action items
- Prepare discussion points for blockers requiring cross-team input

Post-Meeting Actions

- Meeting notes posted to Notion within 4 hours
- Action items assigned in task database
- Follow-up on critical blockers within 24 hours

4. Create a "Meeting Notes" database with these properties:

- Meeting Title (Title)
- Date (Date)
- Type (Select: Weekly Sync, Sprint Planning, Sprint Review, etc.)
- Attendees (Multi-person)
- Notes (Text)
- Action Items (Relation to Tasks database)
- Recording Link (URL)

5. Create a Meeting Template:

- In the "Weekly Sync Meeting" page, create a toggle called "Meeting Template"
- Add this content inside the toggle:

Weekly Sync Meeting - [Date]

Attendees

- [List of attendees]

1. Opening

- **Quick wins:**

2. Sprint Progress

- Current burndown: [Status]

- **Backend team update:**

- **Mobile team update:**

- **Web team update:**

- **Design team update:**

- **QA team update:**

3. Blockers and Dependencies

- **Current blockers:**

- **Dependencies:**

- **Resource constraints:**

- **Solutions:**

4. Upcoming Work

- **Next sprint preview:**
- **Upcoming milestones:**
- **Resource needs:**

5. Risk Review

- **New risks:**
- **High-priority risks updates:**
- **Mitigation progress:**

6. Action Items

- **Previous items status:**
- **New action items:**

```
### 5. KPI Monitoring Framework
```

1. Create a **new** page **in** the Analytics & Reporting section titled "**KPI Framework**"
2. Copy **and** paste **this** content:

Calendar App KPI Monitoring Framework

Key Performance Indicators

Project Health KPIs

1. Schedule Performance Index (SPI)

- Target: 0.95-1.05
- Calculation: Earned Value / Planned Value
- Reporting Frequency: Weekly
- Visualization: Trend line chart

2. Milestone Completion Rate

- Target: 100% on-time
- Calculation: Milestones completed on time / Total milestones due
- Reporting Frequency: Monthly
- Visualization: Percentage with trend

3. Scope Change Rate

- Target: <10% per month
- Calculation: (New requirements - Removed requirements) / Baseline requirements
- Reporting Frequency: Monthly
- Visualization: Percentage with trend

4. Risk Mitigation Effectiveness

- Target: >85%
- Calculation: Risks successfully mitigated / Total risks identified for mitigation
- Reporting Frequency: Monthly
- Visualization: Percentage

Development KPIs

5. Sprint Completion Rate

- Target: >90%
- Calculation: Story points completed / Story points committed
- Reporting Frequency: Bi-weekly (end of sprint)
- Visualization: Percentage with trend by team

6. Code Quality Metrics

- Target: Test coverage >80%, 0 critical bugs
- Calculation: Various (test coverage, static analysis, bug density)
- Reporting Frequency: Weekly
- Visualization: Multiple metrics dashboard

7. Technical Debt Ratio

- Target: <15%
- Calculation: Hours spent on refactoring / Total development hours
- Reporting Frequency: Monthly
- Visualization: Percentage with trend

Team KPIs

8. Team Velocity

- Target: Stable or increasing
- Calculation: Average story points completed per sprint
- Reporting Frequency: Bi-weekly
- Visualization: Trend line by team

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- Target: <48 hours
- Calculation: Average time from blocker identification to resolution
- Reporting Frequency: Weekly
- Visualization: Average with trend

10. Team Satisfaction

- Target: >8/10
- Calculation: Average score from team satisfaction survey
- Reporting Frequency: Monthly
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KPI Dashboard

- Implemented in Notion with automated data collection where possible
- Visual indicators (Green/Yellow/Red) for at-a-glance status
- Drill-down capability for detailed analysis
- Historical tracking to identify trends

Reporting Schedule

- **Weekly:** Development KPIs, tactical metrics
- **Bi-weekly:** Sprint metrics, team performance
- **Monthly:** Comprehensive KPI report for all stakeholders
- **Quarterly:** Strategic review with trend analysis

Data Collection Methods

1. Automated Collection

- Development metrics from Git/CI systems
- Task completion data from Notion database
- Time tracking data from project management tools

2. Manual Entry

- Team satisfaction surveys
- Qualitative assessments
- Risk mitigation effectiveness

KPI Review Process

1. Weekly review by Project Manager
2. Bi-weekly review with team leads
3. Monthly review with executive stakeholders
4. Quarterly comprehensive review and KPI adjustment

Response Thresholds

- **Green:** Within target range - Continue monitoring

- **Yellow:** 5-15% deviation from target - Develop improvement plan
- **Red:** >15% deviation from target - Immediate corrective action required

Continuous Improvement

- KPI framework review after each project phase
- Adjustment of targets based on project evolution
- Addition/removal of metrics based on usefulness
- Refinement of data collection methods

3. Create a "KPIs" database with these properties:

- KPI Name (Title)
- Category (**Select:** Project Health, Development, Team)
- Target (Text)
- **Current Value** (Number)
- Previous **Value** (Number)
- Trend (Formula: if(prop("Current Value") > prop("Previous Value"), "↑", if(prop("Current Value") < prop("Previous Value"), "↓", "→")))
- Status (**Select:** Green, Yellow, Red)
- Frequency (**Select:** Weekly, Bi-weekly, Monthly, Quarterly)
- Last Updated (**Date**)
- Owner (Person)
- Notes (Text)

4. Create a "KPI Dashboard" page that includes:

- A linked **view of** the KPIs database
- Filtered views **for** different categories
- A status board (Kanban **view**) grouped **by** status

Main Dashboard Setup

1. On the Home page, **create** a dashboard **with** sections **for**:

Calendar App Project Dashboard

Project Overview

- Project Name: Cross-Platform Calendar App

- Start Date: March 15, 2025
- Target Launch: December 10, 2025
- Current Phase: Foundation & Discovery

Quick Links

- [Team Directory](link to Team Directory page)
- [Project Timeline](link to Timeline view)
- [Current Sprint](link to current Sprint page)
- [Documentation](link to Documentation page)
- [Design System](link to Design System page)
- [Technical Architecture](link to Technical Architecture page)
- [Risk Register](link to Risk Register view)

Project Status

[Progress Bar] 12% Complete

Current Priorities

- Complete architecture blueprint
- Finalize design system foundations
- Set up development environments
- Complete user story mapping

Upcoming Milestones

- Requirements Documentation (April 15, 2025)
- Architecture Blueprint Approval (April 30, 2025)
- Design System Establishment (May 10, 2025)
- Development Environment Setup (May 15, 2025)

Team Announcements

- Weekly sync moved to Thursdays at 10am
- UX testing sessions starting next week
- New team member onboarding (iOS Developer) on March 20

2. Add linked database views:

- Current Sprint Tasks
- High Priority Risks
- Upcoming Meetings
- Recent Updates

Additional Setup Tips

1. **Create Relations Between Databases:**

- Link Tasks to Team Members (Owner property)
- Link Tasks to Sprints (Sprint property)
- Link User Stories to Tasks (Relation property)
- Link Action Items to Meeting Notes

2. **Set Up Views for Teams:**

- Create filtered views of the Tasks database for each team
- Create a Kanban board view of Tasks by Status
- Create a Calendar view of Tasks by Due Date

3. **Tagging System:**

- Use consistent tags across databases
- Create tag groups for features, components, and teams

4. **Template Usage:**

- Create templates for recurring items
- Use template buttons for quick creation of standard items

5. **Permission Setting (If using Team Plan):**

- Set appropriate permissions for different team members
- Create shared views for stakeholders with limited access

Sample Data Entry

Add these items to get started:

1. Add the team members listed in the Team Members Database section

2. Add the initial tasks listed in the Tasks Database section
3. Add the sprints listed in the Sprints Database section
4. Add the user stories listed in the User Stories Database section
5. Add the risks listed in the Risks Database section

This will give you a functional starting point with sample data to help visualize the project management system.

I've created a comprehensive setup guide for implementing the Calendar App project in Notion. This document provides everything you need to configure your workspace from scratch, including:

1. **Complete workspace structure** with all the necessary pages and sections
2. **Database configurations** with detailed property setups for:
 - Team members
 - Tasks
 - Sprints
 - User stories
 - Risks
 - Meetings
 - KPIs
3. **Alex Thompson's PM deliverables** with ready-to-paste content for:
 - Project Charter & Communication Plan
 - Risk Management Framework
 - Stakeholder Reporting Structure
 - Weekly Sync Meeting templates
 - KPI Monitoring Framework
4. **Dashboard setups** with examples of how to create effective views
5. **Sample data** to help you visualize the system in action

While Notion doesn't support a single-file import that would automatically configure everything, this guide provides copy-paste content and step-by-step instructions that will allow you to set up the complete system efficiently.

Would you like me to focus on any specific aspect of the setup process in more detail?



How do I do the following in Notion - Creating views for "High Priority Risks" and "Risks by Owner"

Creating Filtered Views in Notion for Risks

Here's how to create specific views like "High Priority Risks" and "Risks by Owner" in your Notion Risks database:

Creating a "High Priority Risks" View

1. **Navigate to your Risks database** in the Project Management section
2. **Look at the tabs** at the top of the database (they typically say "Table", "Board", "Calendar", etc.)
3. **Click the "+ Add a view" button** (it's usually at the right end of these tabs)
4. **Choose a view type:**
 - "Table" is good for detailed information
 - "Board" is useful for visual status tracking
 - Choose what works best for your workflow
5. **Name the view** "High Priority Risks"
6. **Click "Create"** to create the basic view
7. **Add filters** by clicking the "Filter" button in the top right:
 - Click "Add a filter"
 - Select the "Impact" property
 - Choose "is"
 - Select "High" or "Critical" from your dropdown
 - Click "Add a filter" again
 - Select "or" to make it an OR condition
 - Select "Likelihood" property
 - Choose "is"



- Select "High" or "Very High" from your dropdown
8. **Save the view** - Notion automatically saves your changes

Creating a "Risks by Owner" View

1. **Navigate to your Risks database** again
2. **Click the "+ Add a view" button** again
3. **Choose "Board" view** type (this works well for grouping)
4. **Name the view** "Risks by Owner"
5. **Click "Create"**
6. **Set up the grouping:**
 - Look for the "Group by" button in the top right (you might need to click on "Properties" first)
 - Select "Owner" from the dropdown menu
 - This will group all risks by their assigned owner
7. **Optional sorting:**
 - Click the "Sort" button in the top right
 - Select "Impact" and choose "Descending" to show higher impact risks first
 - Add another sort by clicking "+ Add a sort" and select "Likelihood" and "Descending"
8. **Optional additional filters:**
 - You can add filters to show only active risks by filtering for Status ≠ Closed

Additional Tips

1. **Color coding:**
 - Customize your "Select" properties to use colors (e.g., red for Critical impact)
 - This makes high priority items visually stand out
2. **Customize the information shown:**
 - Click "Properties" in the top right
 - Toggle on/off which properties appear in each view

- Reorder properties by dragging them

3. **Save as favorites:**

- Hover over the view name in the left sidebar
- Click the star icon to add it to your Favorites for quick access

4. **Sharing specific views:**

- You can share specific views with team members who only need to see certain risk categories

These steps will help you create organized views that make it easy to focus on specific subsets of your risks database, improving visibility for risk management.

Under which page do I create the stakeholders database

The Stakeholders database should be created under the "Documentation" section, specifically within the "Stakeholder Reporting Structure" page. Here's the exact process:

1. Navigate to your  "Documentation" section in your Notion workspace
2. Open the "Stakeholder Reporting Structure" page (create it if it doesn't exist yet)
3. Position your cursor where you want to add the database
4. Type `/database` and select "Table - Inline" from the menu
5. Name the database "Stakeholders"
6. Add the following properties to the database:
 - Name (Title property - this is created by default)
 - Department (Select property)
 - Influence (Select property with options: High, Medium, Low)
 - Interest Area (Text property)
 - Report Type (Multi-select property)
 - Contact Info (Email property)
 - Notes (Text property)

This approach keeps your stakeholder information directly connected to your stakeholder reporting documentation, making it easily accessible when planning communications or generating reports. The stakeholder information will be contextually related to the reporting structure you've defined.

If you want to reference this database elsewhere in your Notion workspace, you can create linked views of the same database on other pages.

 The Frequency has to be a number for this formula to work - Next Due (Formula: if(prop("Last Sent") == "", "", dateAdd(prop("Last Sent"), prop("Frequency"), "days")))

You're absolutely right about the formula issue. The `dateAdd` function requires a number for the second parameter, but we defined "Frequency" as a Select property with text values like "Daily," "Weekly," etc.

Here's how to fix this:

Updated Approach for the Reports Database

1. Navigate to your "Reports" database
2. Modify the "Frequency" property:
 - Change from a "Select" type to a "Number" type
 - This will store the number of days between reports
3. Create a new "Frequency Name" property:
 - Add a new property of type "Select"
 - Add options: Daily, Weekly, Bi-weekly, Monthly, Quarterly
 - This is for human-readable frequency names
4. Set the correct number values for each report:
 - Daily = 1
 - Weekly = 7
 - Bi-weekly = 14
 - Monthly = 30
 - Quarterly = 90
5. Now your formula will work correctly:

```
if(prop("Last Sent") == "", "", dateAdd(prop("Last Sent"), prop("Frequency"),
```

```
"days"))
```

This way, the "Frequency" property stores the numerical value needed for the formula, while "Frequency Name" gives you the human-readable label.

Alternatively, you could use a more complex formula that converts text frequency values to numbers:

```
if(prop("Last Sent") == "", "",  
    dateAdd(prop("Last Sent"),  
        if(prop("Frequency Name") == "Daily", 1,  
            if(prop("Frequency Name") == "Weekly", 7,  
                if(prop("Frequency Name") == "Bi-weekly", 14,  
                    if(prop("Frequency Name") == "Monthly", 30,  
                        if(prop("Frequency Name") == "Quarterly", 90,  
                            0))))), "days"))
```

This second approach would let you keep "Frequency" as a Select property, but the first approach with separate number and name properties is generally cleaner and less error-prone.

 under which page should i create Meeting Notes database

The "Meeting Notes" database should be created under the  Project Management" section. Specifically, you should create it in the following location:

1. Navigate to your  Project Management" section in your Notion workspace
2. Open or create the "Meeting Templates" page
3. Position your cursor where you want to place the database
4. Type `/database` and select "Table - Full page" from the menu
5. Name the database "Meeting Notes"
6. Add these properties:
 - Meeting Title (Title property - created by default)
 - Date (Date property)
 - Type (Select property with options: Weekly Sync, Sprint Planning, Sprint Review, etc.)
 - Attendees (Multi-person property)
 - Notes (Text property)

- Action Items (Relation property that links to your Tasks database)
- Recording Link (URL property)

This location makes sense because:

1. Meeting management is a core project management activity
2. It's closely related to your meeting templates
3. It keeps all meeting-related content organized in one area
4. The relation to the Tasks database allows you to track action items from meetings

You can create linked views of this database on other pages where you might need quick access to meeting notes, such as on your team dashboards or the home page.

where do I create KPIs database

The "KPIs" database should be created under the " Analytics & Reporting" section. Here's the specific location and process:

1. Navigate to your " Analytics & Reporting" section in your Notion workspace
2. Open the "KPI Framework" page (create it if it doesn't exist yet)
3. Position your cursor where you want to add the database
4. Type `/database` and select "Table - Full page" from the menu
5. Name the database "KPIs"
6. Add these properties:
 - KPI Name (Title property - created by default)
 - Category (Select property with options: Project Health, Development, Team)
 - Target (Text property)
 - Current Value (Number property)
 - Previous Value (Number property)
 - Trend (Formula property: `if(prop("Current Value") > prop("Previous Value"), "↑", if(prop("Current Value") < prop("Previous Value"), "↓", "→"))`)
 - Status (Select property with options: Green, Yellow, Red)
 - Frequency (Select property with options: Weekly, Bi-weekly, Monthly, Quarterly)
 - Last Updated (Date property)
 - Owner (Person property)

- Notes (Text property)

This placement makes sense because:

1. It organizes all analytics and reporting in one dedicated section
2. It directly connects to your KPI Framework documentation
3. It separates measurement from execution, making reporting clearer
4. It allows you to create various views for different reporting needs (executive view, team view, etc.)

You can create linked database views of your KPIs on other pages where quick access is needed, such as on your main project dashboard.



As the technical architect of the project please work on the following:

- **Requirements Documentation Complete**

- User stories and acceptance criteria defined
- Technical requirements finalized
- SOLID design principles documentation

- **Architecture Blueprint Approved**

- System architecture diagrams
- Data model and schema design
- API contracts defined

I'll help draft the technical architect deliverables for the Calendar App project. Let's break these down systematically:

1. Requirements Documentation

User Stories and Acceptance Criteria

Let's outline the core user stories for our calendar application:

Core Event Management

1. **User Story:** As a user, I want to create calendar events so I can organize my schedule.
Acceptance Criteria:

- Users can create events with title, date, time, location, and description
 - Events can be set as one-time or recurring
 - Users receive confirmation after event creation
 - Events immediately appear in the calendar view
2. **User Story:** As a user, I want to edit existing events so I can update details as plans change.
- Acceptance Criteria:**
- All event fields can be modified
 - Changes to recurring events can apply to a single instance or the entire series
 - Edit history is maintained for auditing
 - Changes sync across all devices within 60 seconds
3. **User Story:** As a user, I want to delete events so I can remove outdated or canceled appointments.
- Acceptance Criteria:**
- Events can be deleted with confirmation prompt
 - Recurring events can be deleted as a single instance or entire series
 - Deleted events can be restored within 30 days
 - Deletions sync across all devices within 60 seconds

Calendar Views

4. **User Story:** As a user, I want different calendar views (day, week, month) so I can focus on relevant timeframes.
- Acceptance Criteria:**
- Users can switch between day, week, month, and agenda views
 - View preference persists between sessions
 - Views are optimized for the device screen size
 - Navigation between time periods is intuitive
5. **User Story:** As a user, I want to see visual indicators for different event types so I can quickly understand my schedule.
- Acceptance Criteria:**
- Events can be color-coded by category
 - Icons represent event types (meeting, deadline, reminder)
 - Event duration is visually represented
 - Overlapping events are clearly distinguished

Synchronization

6. **User Story:** As a user, I want my calendar to sync across all my devices so I can access it anywhere. **Acceptance Criteria:**
 - Changes sync within 60 seconds under normal network conditions
 - Offline changes are queued and sync when connectivity returns
 - Conflict resolution prioritizes most recent changes
 - Sync status is clearly indicated to the user
7. **User Story:** As a user, I want to share my calendar with others so we can coordinate schedules. **Acceptance Criteria:**
 - Users can share calendars with view-only or edit permissions
 - Sharing can be done via email or generated link
 - Shared calendar permissions can be revoked
 - Changes by collaborators are attributed in the event history

Technical Requirements

Performance Requirements

1. **Load Time:** Application initial load under 2 seconds on 4G connections
2. **Responsiveness:** UI interactions respond within 100ms
3. **Scaling:** System architecture supports up to 1 billion users
4. **Concurrency:** Handles 100,000+ simultaneous write operations
5. **Data Volume:** Efficiently manages 10+ million calendar events per user

Platform Compatibility

1. **Mobile:** Native applications for iOS 15+ and Android 10+
2. **Web:** Support for Chrome, Firefox, Safari, Edge (latest 2 versions)
3. **Accessibility:** WCAG 2.1 AA compliance across all platforms
4. **Internationalization:** Support for 10+ languages and localized date/time formats

Security Requirements

1. **Authentication:** Multi-factor authentication support
2. **Data Encryption:** End-to-end encryption for all calendar data
3. **Access Control:** Granular permission system for shared calendars
4. **Audit Logging:** Comprehensive logging of all data access and changes
5. **Compliance:** GDPR, CCPA, and SOC2 compliance

Integration Requirements

1. **Third-party Calendars:** Import/export support for iCal, Google Calendar, Outlook
2. **API Access:** RESTful and GraphQL APIs for third-party integrations
3. **Webhooks:** Event-triggered webhooks for real-time integration
4. **SSO:** Enterprise SSO integration (SAML, OAuth)

SOLID Design Principles Documentation

Single Responsibility Principle

- Each component in our system will have one reason to change.
- Examples:
 - `EventService`: Responsible only for event CRUD operations
 - `NotificationService`: Responsible only for managing user notifications
 - `SyncService`: Responsible only for data synchronization

Open/Closed Principle

- Software entities should be open for extension but closed for modification.
- Implementation:
 - Plugin architecture for calendar views
 - Strategy pattern for sync mechanisms
 - Abstract event types that can be extended

Liskov Substitution Principle

- Subtypes must be substitutable for their base types.
- Implementation:
 - All event types (meeting, appointment, reminder) must fulfill the base Event interface
 - Platform-specific implementations must adhere to common interface contracts
 - Authentication providers must conform to uniform AuthProvider interface

Interface Segregation Principle

- Clients should not depend on interfaces they don't use.
- Implementation:
 - Separate read/write interfaces for calendar operations
 - Specialized interfaces for different sync operations
 - Feature-specific API endpoints rather than general-purpose ones

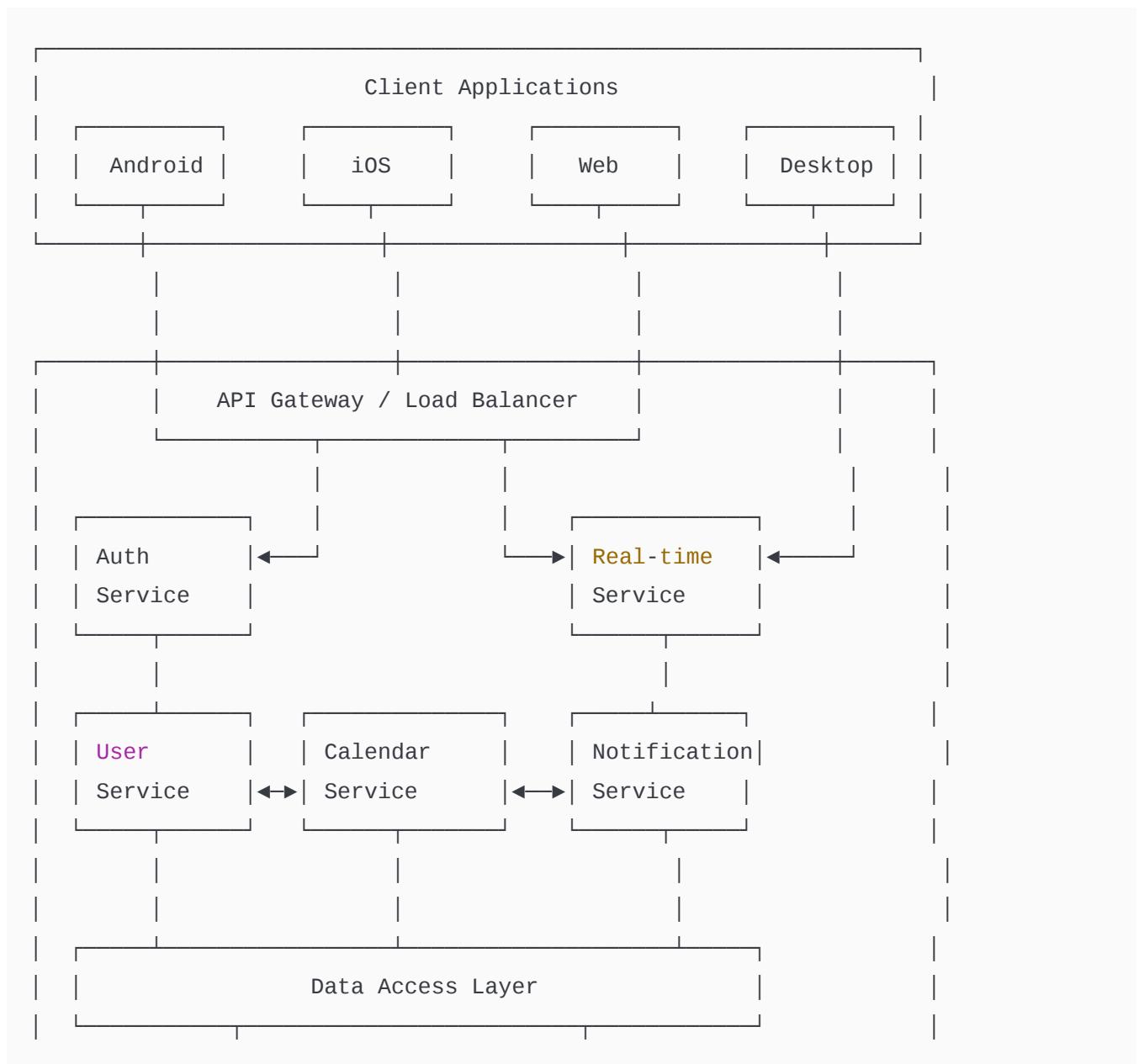
Dependency Inversion Principle

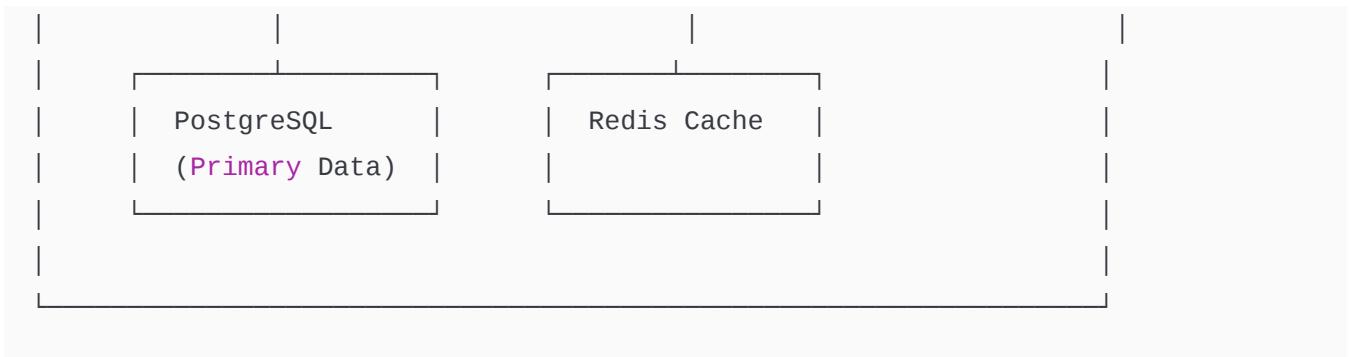
- High-level modules should not depend on low-level modules. Both should depend on abstractions.
- Implementation:
 - Repository pattern for data access
 - Service interfaces for business logic
 - Dependency injection throughout the application

2. Architecture Blueprint

System Architecture Diagrams

High-Level Architecture





Microservices Architecture

The calendar app will use a microservices architecture with these key services:

1. Auth Service:

- User authentication and authorization
- Token management
- Permission validation

2. User Service:

- User profile management
- Preferences and settings
- Account operations

3. Calendar Service:

- Event CRUD operations
- Calendar management
- Scheduling logic

4. Sync Service:

- Cross-device synchronization
- Conflict resolution
- Offline operation management

5. Notification Service:

- Event reminders
- Share notifications
- System alerts

6. Search Service:

- Full-text search across events
- Calendar content indexing
- Quick lookup functionality

Data Model and Schema Design

Core Entities

1. User

```
User {  
    id: UUID (PK)  
    email: String (unique)  
    passwordHash: String  
    name: String  
    preferences: JSON  
    createdAt: Timestamp  
    updatedAt: Timestamp  
    lastActive: Timestamp  
    timezone: String  
}
```

2. Calendar

```
Calendar {  
    id: UUID (PK)  
    userId: UUID (FK -> User.id)  
    name: String  
    description: String  
    color: String  
    isDefault: Boolean  
    isVisible: Boolean  
    createdAt: Timestamp  
    updatedAt: Timestamp  
}
```

3. Event

```
Event {  
    id: UUID (PK)  
    calendarId: UUID (FK -> Calendar.id)  
    title: String  
    description: Text  
    location: String  
    startTime: Timestamp  
    endTime: Timestamp  
    isAllDay: Boolean  
    recurrenceRule: String  
    reminderSettings: JSON  
    color: String  
    visibility: Enum (public, private, confidential)  
    status: Enum (confirmed, tentative, cancelled)  
    createdBy: UUID (FK -> User.id)  
    createdAt: Timestamp  
    updatedAt: Timestamp  
    version: Integer  
}
```

4. EventInstance

```
EventInstance {  
    id: UUID (PK)  
    eventId: UUID (FK -> Event.id)  
    startTime: Timestamp  
    endTime: Timestamp  
    isException: Boolean  
    exceptionData: JSON  
    status: Enum (confirmed, tentative, cancelled)  
}
```

5. CalendarShare

```
CalendarShare {  
    id: UUID (PK)  
    calendarId: UUID (FK -> Calendar.id)  
    userId: UUID (FK -> User.id)  
    email: String  
    permission: Enum (view, edit, admin)
```

```
    status: Enum (pending, accepted, rejected)
    createdAt: Timestamp
    updatedAt: Timestamp
}
```

6. Notification

```
Notification {
    id: UUID (PK)
    userId: UUID (FK -> User.id)
    eventId: UUID (FK -> Event.id)
    type: Enum (reminder, invitation, update)
    message: Text
    isRead: Boolean
    scheduledFor: Timestamp
    createdAt: Timestamp
}
```

7. SyncToken

```
SyncToken {
    id: UUID (PK)
    userId: UUID (FK -> User.id)
    deviceId: String
    lastSyncedAt: Timestamp
    token: String
}
```

Database Relationships

1. **User-Calendar**: One-to-many (a user can have multiple calendars)
2. **Calendar-Event**: One-to-many (a calendar can have multiple events)
3. **Event-EventInstance**: One-to-many (an event can have multiple instances due to recurrence)
4. **Calendar-CalendarShare**: One-to-many (a calendar can be shared with multiple users)
5. **User-Notification**: One-to-many (a user can have multiple notifications)

API Contracts Defined

RESTful API Endpoints

1. **Authentication API**

```
POST /api/auth/login  
POST /api/auth/logout  
POST /api/auth/refresh  
POST /api/auth/register
```

2. User API

```
GET /api/users/me  
PUT /api/users/me  
PATCH /api/users/preferences  
GET /api/users/me/calendars
```

3. Calendar API

```
GET /api/calendars  
POST /api/calendars  
GET /api/calendars/{calendarId}  
PUT /api/calendars/{calendarId}  
DELETE /api/calendars/{calendarId}  
GET /api/calendars/{calendarId}/events  
POST /api/calendars/{calendarId}/events  
GET /api/calendars/{calendarId}/shares  
POST /api/calendars/{calendarId}/shares
```

4. Event API

```
GET /api/events/{eventId}  
PUT /api/events/{eventId}  
DELETE /api/events/{eventId}  
POST /api/events/{eventId}/instances  
GET /api/events/{eventId}/instances  
PATCH /api/events/{eventId}/instances/{instanceId}
```

5. Sync API

```
GET /api-sync?syncToken={token}  
POST /api-sync/changes
```

6. Notification API

```
GET /api/notifications
PATCH /api/notifications/{notificationId}
DELETE /api/notifications/{notificationId}
```

GraphQL Schema

```
type User {
  id: ID!
  email: String!
  name: String
  timezone: String
  preferences: UserPreferences
  calendars: [Calendar]
}

type Calendar {
  id: ID!
  name: String!
  description: String
  color: String
  isDefault: Boolean
  isVisible: Boolean
  events(startDate: DateTime, endDate: DateTime): [Event]
  shares: [CalendarShare]
}

type Event {
  id: ID!
  title: String!
  description: String
  location: String
  startTime: DateTime!
  endTime: DateTime!
  isAllDay: Boolean
  recurrenceRule: String
  color: String
  visibility: Visibility
  status: EventStatus
  instances: [EventInstance]
  reminders: [Reminder]
}
```

```

type EventInstance {
  id: ID!
  eventId: ID!
  startTime: DateTime!
  endTime: DateTime!
  isException: Boolean
  status: EventStatus
}

type Query {
  me: User
  calendar(id: ID!): Calendar
  calendars: [Calendar]
  event(id: ID!): Event
  events(calendarId: ID!, startDate: DateTime, endDate: DateTime): [Event]
  notifications: [Notification]
}

type Mutation {
  createCalendar(input: CalendarInput!): Calendar
  updateCalendar(id: ID!, input: CalendarInput!): Calendar
  deleteCalendar(id: ID!): Boolean

  createEvent(calendarId: ID!, input: EventInput!): Event
  updateEvent(id: ID!, input: EventInput!): Event
  deleteEvent(id: ID!): Boolean

  shareCalendar(calendarId: ID!, input: ShareInput!): CalendarShare
  updateShare(id: ID!, input: ShareInput!): CalendarShare

  markNotificationRead(id: ID!): Notification
}

type Subscription {
  eventUpdated(calendarId: ID): Event
  notificationReceived: Notification
}

```

This comprehensive technical architecture foundation follows SOLID principles and provides the scalable infrastructure needed for a billion-user calendar application. The documentation covers

user stories with clear acceptance criteria, detailed technical requirements, a thorough system architecture with diagrams, complete data models, and well-defined API contracts.

 Please create a pdf for the above

I cannot create a PDF file directly, but I can guide you on how to convert the technical architecture document I've created into a PDF:

Options for Creating a PDF from This Content

Option 1: Copy and Convert

1. Copy all the text content I've provided
2. Paste into a word processor like Microsoft Word, Google Docs, or LibreOffice Writer
3. Format the document as needed (add headings, adjust spacing)
4. Save or export as PDF

Option 2: Use a Markdown to PDF Converter

Since the content is formatted with markdown:

1. Copy all the text
2. Use an online markdown to PDF converter such as:
 - MarkdownToPDF.com
 - Markdown2PDF.com
 - Dillinger.io (Export to PDF option)
3. Download the resulting PDF

Option 3: Save from Notion

If you've already implemented this in Notion:

1. Navigate to the page in Notion
2. Click the "..." menu in the top right
3. Select "Export"
4. Choose PDF as the export format
5. Click "Export" to download the PDF

Option 4: Use Specialized Documentation Tools

For a more professional-looking technical document:

1. Copy the content into a tool like Confluence, GitBook, or ReadTheDocs
2. Use their built-in PDF export functionality
3. This approach often produces better-formatted technical documentation

Would you like me to make any modifications to the content before you convert it to PDF? I can adjust the formatting or provide additional sections if needed.

 As the technical architect of the project please work on the following: **Design System Established**

- Brand guidelines
- Component library foundations
- Wireframes for key user flows

Calendar App Design System

As the technical architect, I'll define our design system foundations to ensure consistency across all platforms (Android, iOS, and web) while maintaining platform-specific best practices.

Brand Guidelines

Brand Identity

Brand Name: Chronos

A timeless name representing organized time management and efficient scheduling.

Logo Design

- **Primary Logo:** Abstract clock face with minimalist hands forming a "C"
- **App Icon:** Simplified version of logo in rounded square/circle
- **Clear Space:** Minimum padding of 1x logo height on all sides
- **Minimum Size:** 24px height for digital applications

Typography

- **Primary Font Family:** Inter

- Headings: Inter Semi-Bold (Android/Web), SF Pro Display Semibold (iOS)
- Body: Inter Regular (Android/Web), SF Pro Text Regular (iOS)
- Weights: 400 (regular), 500 (medium), 600 (semi-bold)
- Scale:
 - H1: 32px/40px line height
 - H2: 24px/32px line height
 - H3: 20px/28px line height
 - Body: 16px/24px line height
 - Small: 14px/20px line height
 - Tiny: 12px/16px line height

Color Palette

Primary Colors

- **Brand Blue:** #1A73E8
 - Dark mode: #5B9BFF
- **Background White:** #FFFFFF
 - Dark mode: #121212

Secondary Colors

- **Secondary Teal:** #009688
- **Secondary Amber:** #FFA000
- **Secondary Rose:** #E91E63

Grayscale

- **Gray 100:** #F5F5F5 (lightest)
- **Gray 200:** #EEEEEE
- **Gray 300:** #E0E0E0
- **Gray 400:** #BDBDBD
- **Gray 500:** #9E9E9E
- **Gray 600:** #757575
- **Gray 700:** #616161
- **Gray 800:** #424242
- **Gray 900:** #212121 (darkest)

System UI Colors

- **Success:** #34A853
- **Warning:** #FBBC04
- **Error:** #EA4335
- **Info:** #4285F4

Calendar Event Categories

- **Work:** #5484ED (blue)
- **Personal:** #A4BDFC (light blue)
- **Family:** #7AE7BF (green)
- **Holiday:** #FFBD6F (orange)
- **Travel:** #FF887C (red)
- **Health:** #FBD75B (yellow)
- **Education:** #CABFFD (purple)
- **Other:** #BBBBBB (gray)

Iconography

- **Style:** Outlined with 2px stroke weight
- **Corner Radius:** 2px
- **Size:** 24px × 24px (standard), 18px × 18px (compact)
- **Padding:** Minimum 2px padding within container
- **Key Icons:** calendar, add event, settings, notification, sync, search

Voice & Tone

- **Voice:** Helpful, efficient, reliable
- **Tone:** Clear, direct, friendly
- **Principles:**
 - Clarity over cleverness
 - Concise but complete
 - Action-oriented guidance
 - Personalized when possible

Component Library Foundations

Core Components

Navigation Components

1. Top App Bar

- Height: 56dp
- Contains: App name/logo, date, search, profile
- Variants: Standard, Compact (mobile), Extended (desktop)

2. Navigation Drawer/Tab Bar

- Contents: Home, Views (Day/Week/Month), Calendars, Settings
- Behavior: Collapsible on mobile, persistent on desktop

3. Bottom Navigation (Mobile)

- Height: 56dp
- Contains: Day view, Week view, Month view, Agenda view

Layout Components

1. Calendar Grid

- Responsive layout
- Variants: Day, Week, Month, Agenda
- Cell States: Normal, Selected, Today, Weekend, Non-month

2. Event Card

- Height: Proportional to duration or fixed in agenda view
- Contents: Title, time, location, color category indicator
- States: Normal, Selected, Dragging
- Variants: Expanded, Collapsed, Mini

3. Container Cards

- Padding: 16dp
- Border Radius: 8dp
- Shadow: 1dp resting, 8dp elevated

Input Components

1. Date Selector

- Calendar popup or native date picker
- Customizable date ranges
- Variants: Single date, date range

2. Time Selector

- 12/24 hour format (based on locale)
- 15-minute increments by default
- Custom time input option

3. Event Creator

- Quick add (title only)
- Full form (all details)
- Recurrence options

Feedback Components

1. Toast/Snackbar

- Duration: 3 seconds
- Position: Bottom of screen
- Variants: Success, Error, Info

2. Loading States

- Skeleton screens for calendar views
- Circular progress for operations
- Pull-to-refresh on mobile

3. Empty States

- Illustration
- Descriptive text
- Action button

Design Tokens

Spacing System

- 4pt grid system

- Key spacings: 4, 8, 16, 24, 32, 48, 64px

Border Radius

- Small: 4px
- Medium: 8px
- Large: 16px
- Pill: 999px

Elevation/Shadows

- Level 1: 0 1px 2px rgba(0,0,0,0.1)
- Level 2: 0 2px 4px rgba(0,0,0,0.1)
- Level 3: 0 4px 8px rgba(0,0,0,0.1)
- Level 4: 0 8px 16px rgba(0,0,0,0.1)

Animation & Transitions

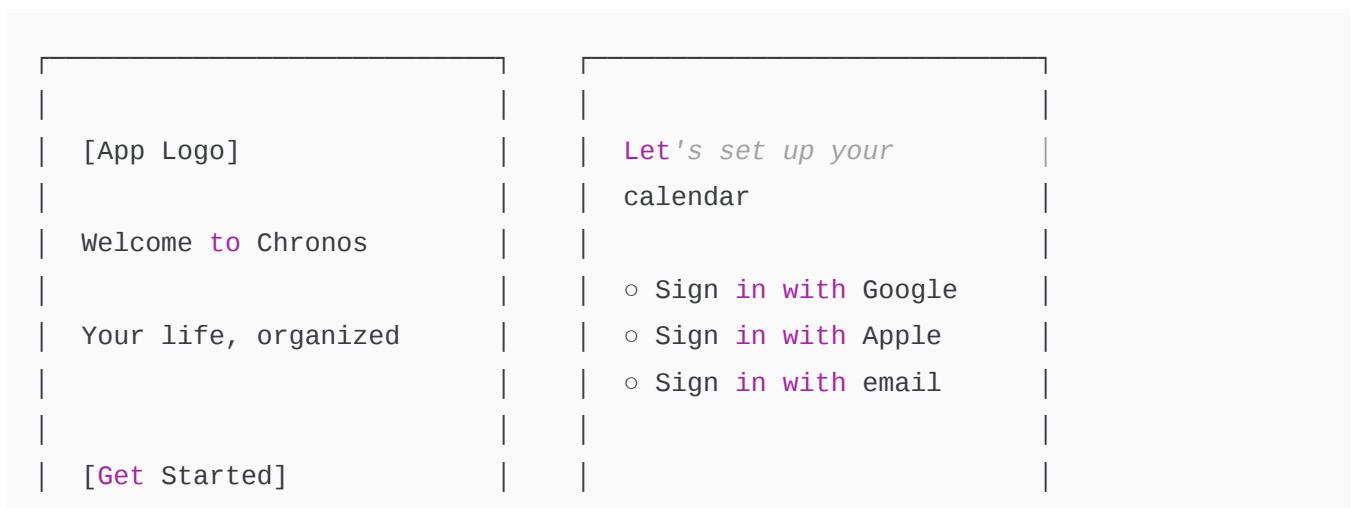
- Duration: 200ms standard, 300ms complex
- Easing: Ease-out for entering, ease-in for exiting
- Key animations: Calendar view switching, event creation

Dark Mode Compatibility

- All components support light/dark mode
- Automatic switching based on system preference
- Manual override in settings

Wireframes for Key User Flows

1. First-Time User Experience



	[Continue]
Import your calendars	Choose your view
<input checked="" type="checkbox"/> Work (Google)	[Day View Image]
<input checked="" type="checkbox"/> Personal (Google)	[Week View Image]
<input type="checkbox"/> Birthdays (Google)	[Month View Image] <input checked="" type="radio"/>
<input type="checkbox"/> Holidays	[Agenda View Image]
[Skip] [Import Selected]	[Finish]

2. Event Creation Flow

[Month View]	New Event
June 2025	Title: Marketing Meeting <input type="text"/>
Mo Tu We Th Fr Sa Su	
1 2 3 4 5 6	Start: Jun 15, 2:00 PM
7 8 9 10 11 12 13	End: Jun 15, 3:00 PM
14 15 16 17 18 19 20	All day: <input type="checkbox"/>
21 22 23 24 25 26 27	Location: Conference Room 3
28 29 30	
[+]	Calendar: Work ▾
New Event	New Event
Description:	Notify me:
Quarterly planning session	<input checked="" type="checkbox"/> 10 minutes before
with marketing team	<input type="checkbox"/> 30 minutes before
Bring Q3 materials	<input type="checkbox"/> 1 day before
	<input type="checkbox"/> Custom...



3. Calendar View Navigation

[Month View]	[Week View]
June 2025 ≡	June 15-21, 2025 ≡
Mo Tu We Th Fr Sa Su	M T W T F S S
1 2 3 4 5 6	15 16 17 18 19 20 21
7 8 9 10 11 12 13	9AM Meeting Call
14 15 16 17 18 19 20	10AM
21 22 23 24 25 26 27	11AM Lunch
28 29 30	12PM
[DAY] [WEEK] [MONTH]	[DAY] [WEEK] [MONTH]

[Day View]	[Agenda View]
Monday, June 16, 2025 ≡	Upcoming Events ≡
8AM	TODAY - June 16
9AM Team Standup	9:00 AM Team Standup
10AM	1:00 PM Lunch w/Client
11AM	TOMORROW - June 17
12PM	10:00 AM Product Review
1PM Lunch w/Client	3:30 PM Dentist Appt
2PM	
[DAY] [WEEK] [MONTH]	[DAY] [WEEK] [MONTH]

4. Calendar Sharing Flow

Settings	Share "Work Calendar"
General	People with access:
Accounts	
Appearance	Only you
Calendars	
Work Calendar	Add people:
Personal	Email or name...
Family	
[Add Calendar]	Permission: Can edit ▾
	[Share]

Share "Work Calendar"	Calendar shared
Add people:	"Work Calendar" has been
maria@example.com	shared with :
Permission: ▾	maria@example.com (edit)
Can view	john@example.com (view)
Can edit	
Can manage sharing	
[Cancel] [Invite]	Copy link to calendar: [https://chronos.app/c/...]

This design system establishes a comprehensive foundation for our calendar app, with brand guidelines that create a consistent identity, a component library that will facilitate efficient development across platforms, and wireframes that illustrate key user flows. This system follows platform-specific best practices while maintaining a cohesive look and feel that users will recognize across all devices.

As the technical architect, please provide a detailed step by step guidelines for the following :
Development Environment Setup

- CI/CD pipelines configured

- Development, staging, and production environments
- Code standards and review process established

Development Environment Setup Guidelines

1. CI/CD Pipelines Configuration

Step 1: Repository Setup

1. Create Git Repository Structure

- Create a monorepo structure with the following directories:

```
calendar-app/
├── backend/          # Node.js/Express/GraphQL backend
├── web/              # React/TypeScript web application
├── android/          # Kotlin/Jetpack Compose app
├── ios/              # Swift/SwiftUI app
├── shared/           # Shared components and utilities
├── docs/             # Project documentation
└── infrastructure/   # Infrastructure as code
```

- Configure `.**gitignore**` files for each platform
- Set up branch protection rules for `main`, `develop`, and release branches

Step 2: CI Pipeline Implementation (GitHub Actions)

1. Create Workflow Files

- Create `.**github/workflows/backend-ci.yml**`:

```
name: Backend CI

on:
  push:
    branches: [ develop, main ]
    paths: ['backend/**']
  pull_request:
    branches: [ develop, main ]
```

```

paths: ['backend/**']

jobs:
  build:
    runs-on: ubuntu-latest
    steps:
      - uses: actions/checkout@v3
      - name: Use Node.js
        uses: actions/setup-node@v3
        with:
          node-version: '18.x'
          cache: 'npm'
          cache-dependency-path: backend/package-lock.json
      - run: cd backend && npm ci
      - run: cd backend && npm run lint
      - run: cd backend && npm run test
      - run: cd backend && npm run build

```

- Create similar workflow files for web, Android, and iOS applications
- Implement code coverage reporting with minimum threshold requirements

2. Configure Code Quality Tools

- Set up ESLint, TSLint, Detekt, SwiftLint
- Configure SonarQube for static code analysis
- Create pre-commit hooks for formatting and linting

Step 3: CD Pipeline Implementation

1. Create Deployment Workflows

- Create ` .github/workflows/backend-cd.yml`:

```

name: Backend CD

on:
  push:
    branches: [ main ]
    paths: ['backend/**']

jobs:

```

```

deploy:
  runs-on: ubuntu-latest
  steps:
    - uses: actions/checkout@v3
    - name: Use Node.js
      uses: actions/setup-node@v3
      with:
        node-version: '18.x'
    - run: cd backend && npm ci
    - run: cd backend && npm run build
    - name: Deploy to AWS
      uses: aws-actions/configure-aws-credentials@v1
      with:
        aws-access-key-id: ${{ secrets.AWS_ACCESS_KEY_ID }}
        aws-secret-access-key: ${{ secrets.AWS_SECRET_ACCESS_KEY }}
        aws-region: us-west-2
    - run: cd infrastructure && ./deploy.sh backend production

```

- Create similar deployment workflows for web, Android, and iOS applications
- Set up automated version tagging for release builds

2. Configure Deployment Automation

- Implement infrastructure as code using Terraform
- Script containerization using Docker
- Set up automatic deployment to AWS, Google Play, and App Store
- Configure rollback mechanisms for failed deployments

2. Environment Setup

Step 1: Development Environment

1. Local Development Setup

- Document setup process for all engineers:

```

# Local Development Setup

## Prerequisites
- Node.js 18+

```

```

- Java 17+
- Android Studio Arctic Fox+
- Xcode 14+
- Docker Desktop

## Backend Setup
1. `cd backend`
2. `npm install`
3. `cp .env.example .env.local`
4. Edit .env.local with your local settings
5. `docker-compose up -d` (starts PostgreSQL and Redis)
6. `npm run dev`
```

```

## Web Setup
1. `cd web`
2. `npm install`
3. `cp .env.example .env.local`
4. `npm run dev`
```

...

- Create developer onboarding document
- Implement Docker Compose for local dependencies

2. Local Testing Configuration

- Configure Jest, JUnit, XCTest
- Set up test data generators
- Create mock services for third-party APIs
- Document test-driven development approach

3. Local Database Setup

- Script for initializing local PostgreSQL with test data
- Configuration for Redis caching
- Database migration scripts with versioning

Step 2: Staging Environment

1. Infrastructure Deployment

- Create Terraform configuration for AWS resources:

```
# AWS staging environment configuration

provider "aws" {
    region = "us-west-2"
}

module "vpc" {
    source = "./modules/vpc"
    environment = "staging"
}

module "database" {
    source = "./modules/database"
    environment = "staging"
    vpc_id = module.vpc.vpc_id
}

module "ecs" {
    source = "./modules/ecs"
    environment = "staging"
    vpc_id = module.vpc.vpc_id
}

# Additional resources...
```

- Configure auto-scaling groups
- Set up networking with proper security groups
- Deploy monitoring and logging infrastructure

2. Continuous Deployment

- Configure automatic deployment to staging for `develop` branch
- Set up staged rollout process
- Create staging-specific configuration files
- Implement feature flags for testing

3. Testing Environment

- Configure end-to-end testing

- Set up performance testing infrastructure
- Implement security scanning
- Create synthetic monitoring

Step 3: Production Environment

1. Infrastructure Deployment

- Create production-grade Terraform configuration
- Set up multi-region deployment for high availability
- Configure backup and disaster recovery
- Implement CDN for static assets

2. Deployment Strategy

- Set up blue-green deployment
- Configure canary releases
- Implement automated rollback triggers
- Establish emergency hotfix process

3. Monitoring and Observability

- Deploy Prometheus and Grafana
- Set up ELK stack for logging
- Configure alerting with PagerDuty
- Implement distributed tracing with Jaeger

3. Code Standards and Review Process

Step 1: Coding Standards Documentation

1. Create Style Guides

- Backend (Node.js/TypeScript):

```
# Backend Coding Standards

## Naming Conventions
- Use camelCase for variables and functions
```



- Use PascalCase for classes and interfaces
- Use UPPER_SNAKE_CASE for constants

Function Structure

- Maximum 30 lines per function
- Single responsibility principle
- Pure functions where possible

Error Handling

- Use custom error classes
- Always use async/await with try/catch
- Centralized error handling middleware

Testing

- 80% minimum code coverage
- Unit tests for all business logic
- Integration tests for API endpoints

Documentation

- JSDoc for all public methods
- OpenAPI/Swagger for API documentation

- Create similar style guides for web, Android, and iOS
- Document SOLID principles implementation

2. Linting and Formatting Rules

- Configure ESLint for JavaScript/TypeScript:

```
{
  "extends": [
    "eslint:recommended",
    "plugin:@typescript-eslint/recommended"
  ],
  "parser": "@typescript-eslint/parser",
  "plugins": ["@typescript-eslint"],
  "rules": {
    "no-console": "warn",
    "eqeqeq": "error",
    "@typescript-eslint/explicit-function-return-type": "error",
    "max-len": ["error", { "code": 100 }]
  }
}
```

```
    }  
}
```

- Set up Prettier, ktlint, SwiftLint
- Create EditorConfig file for consistent formatting

3. Architecture Guidelines

- Document layer separation (presentation, domain, data)
- Define communication patterns between services
- Establish state management approaches
- Create dependency injection guidelines

Step 2: Code Review Process

1. Process Documentation

- Create code review checklist:

```
# Code Review Checklist  
  
## Functionality  
- [ ] Code works as expected  
- [ ] Edge cases are handled  
- [ ] Error states are managed  
  
## Quality  
- [ ] Tests are comprehensive  
- [ ] Code follows style guide  
- [ ] No code smells or anti-patterns  
- [ ] Appropriate error handling  
  
## Security  
- [ ] Input validation implemented  
- [ ] Authentication/authorization checked  
- [ ] No sensitive data exposure  
- [ ] SQL injection prevention  
  
## Performance  
- [ ] No N+1 queries
```

- [] Efficient algorithms used
- [] Appropriate caching implemented
- [] Resource leaks prevented

- Define review timing expectations
- Document how to request reviews

2. Pull Request Template

Description

[Description of the changes]

Type of change

- [] Bug fix
- [] New feature
- [] Breaking change
- [] Documentation update

How Has This Been Tested?

[Description of testing approach]

Checklist

- [] My code follows the style guidelines
- [] I have performed a self-review
- [] I have added tests that prove my fix or feature works
- [] New and existing tests pass locally
- [] I have updated the documentation

Screenshots (if applicable)

[Screenshots]

3. Review Automation

- Configure automated code quality checks
- Set up automatic test runs on PR
- Implement required status checks
- Configure CODEOWNERS file

Step 3: Knowledge Sharing and Improvement

1. Documentation System

- Set up internal wiki for technical documentation
- Implement API documentation with Swagger/OpenAPI
- Create architectural decision records (ADRs)
- Maintain changelog for all components

2. Learning Resources

- Create onboarding materials for new developers
- Document common patterns and solutions
- Set up knowledge-sharing sessions
- Maintain list of reference implementations

3. Continuous Improvement Process

- Schedule regular retrospectives
- Track and address technical debt
- Document lessons learned
- Update standards based on project evolution

Implementation Timeline

1. Week 1-2: Infrastructure Setup

- Set up Git repositories
- Configure basic CI pipelines
- Create development environment scripts

2. Week 3-4: CI/CD Refinement

- Complete CI/CD pipeline implementation
- Set up staging environment
- Document deployment processes

3. Week 5-6: Standards Documentation

- Create coding standards documentation
- Set up linting and formatting rules
- Implement code review process

4. Week 7-8: Production Environment

- Configure production infrastructure
- Set up monitoring and alerting
- Implement security measures

This comprehensive setup establishes a solid foundation for the Calendar App development, providing clear guidelines for all team members and ensuring consistency, quality, and efficiency throughout the development lifecycle.

 As a **Backend Lead** (1) - Please provide a detailed list of your task and responsibilities.

Backend Lead Responsibilities & Tasks

Core Responsibilities

Team Leadership

- Lead the backend development team (4-5 engineers)
- Set technical direction for backend services
- Mentor junior and mid-level developers
- Facilitate sprint planning and technical discussions
- Conduct regular code reviews and provide constructive feedback
- Remove blockers for the team and advocate for resources

Architecture & Technical Design

- Design API structure and contracts following GraphQL best practices
- Establish database schema and relationships
- Create authentication service architecture with security best practices
- Design sync mechanism concepts for cross-platform data consistency
- Define caching strategies for performance optimization
- Ensure all designs adhere to SOLID principles

System Planning

- Develop scalability strategy to support billions of users
- Create data migration plans for future schema changes
- Design service boundaries and API interfaces
- Plan for disaster recovery and high availability
- Define performance monitoring approaches and KPIs

Detailed Task Breakdown

Foundation Phase (Weeks 1-6)

1. Backend Architecture Blueprint

- Create comprehensive architecture document for calendar services
- Define microservices boundaries and interactions
- Document API design principles
- Present architecture for approval to Technical Architect and stakeholders

2. API Contract Design

- Define GraphQL schema for all entities
- Create RESTful API endpoints for services that need them
- Document all endpoints with examples and usage patterns
- Establish authentication and authorization patterns
- Coordinate with frontend and mobile leads to ensure API meets needs

3. Database Architecture

- Design normalized data model for PostgreSQL
- Create schema for calendar events, recurrence, and sharing
- Define indexes for performance optimization
- Document entity relationships and constraints
- Plan for data partitioning and sharding strategy

4. Authentication System Design

- Design JWT-based authentication flow
- Create MFA implementation plan
- Define session management approach

- Document secure password handling
- Plan for social login integration

5. Sync Mechanism Design

- Create conflict resolution strategy
- Design offline-first architecture
- Define synchronization protocols
- Document data versioning approach
- Plan for real-time updates with WebSockets

Development Phase (Weeks 7-20)

6. Infrastructure Setup Oversight

- Review and approve AWS infrastructure
- Define deployment strategies for services
- Establish monitoring requirements
- Create backup and recovery procedures
- Set up CI/CD pipeline requirements

7. Backend Development Guidance

- Code critical components and establish patterns
- Create reusable modules and utilities
- Implement reference data access patterns
- Document backend development workflows
- Establish error handling standards

8. Performance Optimization

- Identify performance bottlenecks
- Implement query optimization
- Design Redis caching strategy
- Create indexing plan
- Document performance testing procedures

9. Security Implementation

- Design security testing approach
- Implement input validation patterns
- Create data encryption strategy
- Document security best practices
- Plan regular security audits

10. Team Technical Oversight

- Review technical implementations
- Provide guidance on complex problems
- Coordinate cross-service integration
- Ensure code quality standards
- Facilitate technical knowledge sharing

Testing & Refinement Phase (Weeks 21-32)

11. Scalability Testing

- Design load testing scenarios
- Create database scaling procedures
- Implement service scaling
- Document performance under load
- Refine architecture based on test results

12. API Refinement

- Review API usage patterns
- Optimize endpoints based on real usage
- Refine documentation
- Versioning strategy implementation
- Backward compatibility planning

13. Backend Stabilization

- Address critical bugs
- Optimize resource usage
- Refine database queries
- Stress test all components

- Document known limitations

Weekly Recurring Tasks

- Lead backend team stand-ups (daily)
- Conduct backend code reviews (ongoing)
- Participate in cross-team architecture meetings (weekly)
- Report on backend progress to Project Manager (weekly)
- Conduct 1:1s with backend team members (bi-weekly)
- Review and update technical documentation (ongoing)
- Assess and mitigate technical risks (weekly)

Deliverables

1. Backend Architecture Document
2. API Contract Documentation
3. Database Schema Design
4. Authentication System Specifications
5. Sync Mechanism Design Document
6. Performance Testing Reports
7. Security Implementation Guidelines
8. Scaling Strategy Document
9. Backend Development Guidelines
10. Monitoring and Operations Playbook

This comprehensive responsibility list ensures that as Backend Lead, you'll guide the development of a robust, scalable, and maintainable backend system for the Calendar App while supporting your team's growth and productivity.



As the backend lead- please work on the following: Architecture & Technical Design

- Design API structure and contracts following GraphQL best practices
- Establish database schema and relationships
- Create authentication service architecture with security best practices
- Design sync mechanism concepts for cross-platform data consistency

- Define caching strategies for performance optimization
- Ensure all designs adhere to SOLID principles

Calendar App Backend Architecture & Technical Design

1. API Structure and GraphQL Contracts

GraphQL Schema Design

```
# Core Types
type User {
  id: ID!
  email: String!
  name: String
  profilePicture: String
  timezone: String!
  preferences: UserPreferences
  createdAt: DateTime!
  updatedAt: DateTime
}

type UserPreferences {
  defaultCalendarId: ID
  defaultView: ViewType
  workingHours: WorkingHours
  notificationSettings: NotificationSettings
}

type Calendar {
  id: ID!
  owner: User!
  name: String!
  description: String
  color: String
  isDefault: Boolean!
  isVisible: Boolean!
  events(start: DateTime, end: DateTime, first: Int, after: String):
}
```

```

EventConnection!
  shares: [CalendarShare]!
  createdAt: DateTime!
  updatedAt: DateTime
}

type Event {
  id: ID!
  calendar: Calendar!
  title: String!
  description: String
  location: String
  startTime: DateTime!
  endTime: DateTime!
  isAllDay: Boolean!
  recurrenceRule: String
  exceptionDates: [DateTime]
  color: String
  visibility: VisibilityType!
  status: EventStatus!
  attendees: [EventAttendee]!
  reminders: [Reminder]!
  attachments: [Attachment]
  createdBy: User!
  createdAt: DateTime!
  updatedAt: DateTime
  version: Int!
}

# Connections for pagination
type CalendarConnection {
  edges: [CalendarEdge]!
  pageInfo: PageInfo!
}

type CalendarEdge {
  cursor: String!
  node: Calendar!
}

type EventConnection {
  edges: [EventEdge]!
}

```

```

    pageInfo: PageInfo!
}

type EventEdge {
  cursor: String!
  node: Event!
}

type PageInfo {
  hasNextPage: Boolean!
  endCursor: String
}

# Core Queries
type Query {
  # User
  me: User
  user(id: ID!): User

  # Calendars
  calendar(id: ID!): Calendar
  myCalendars(first: Int, after: String): CalendarConnection!

  # Events
  event(id: ID!): Event
  events(
    calendarIds: [ID!],
    start: DateTime!,
    end: DateTime!,
    first: Int,
    after: String
  ): EventConnection!

  # Search
  searchEvents(query: String!, first: Int, after: String): EventConnection!
}

# Core Mutations
type Mutation {
  # User
  updateUserProfile(input: UpdateUserProfileInput!): User!
  updateUserPreferences(input: UpdateUserPreferencesInput!): UserPreferences!
}

```

```

# Calendars
createCalendar(input: CreateCalendarInput!): Calendar!
updateCalendar(id: ID!, input: UpdateCalendarInput!): Calendar!
deleteCalendar(id: ID!): Boolean!
shareCalendar(input: ShareCalendarInput!): CalendarShare!

# Events
createEvent(input: CreateEventInput!): Event!
updateEvent(id: ID!, input: UpdateEventInput!): Event!
updateEventInstance(eventId: ID!, instanceDate: DateTime!, input:
UpdateEventInstanceInput!): Event!
deleteEvent(id: ID!): Boolean!
deleteEventInstance(eventId: ID!, instanceDate: DateTime!): Boolean!

# Sync
syncEvents(input: SyncEventsInput!): SyncEventsPayload!
}

# Subscriptions
type Subscription {
  calendarUpdated(calendarId: ID): Calendar
  eventCreated(calendarIds: [ID!]): Event
  eventUpdated(calendarIds: [ID!]): Event
  eventDeleted(calendarIds: [ID!]): DeletedEventInfo
}

# Input Types, Enums and other supporting types omitted for brevity

```

API Layer Implementation

1. Apollo Server Configuration

- Implement authentication middleware
- Set up error handling and logging
- Configure schema stitching for microservices approach
- Implement dataloaders for N+1 query prevention

2. Query Resolution Strategy

- Use dataloader batching for related entities

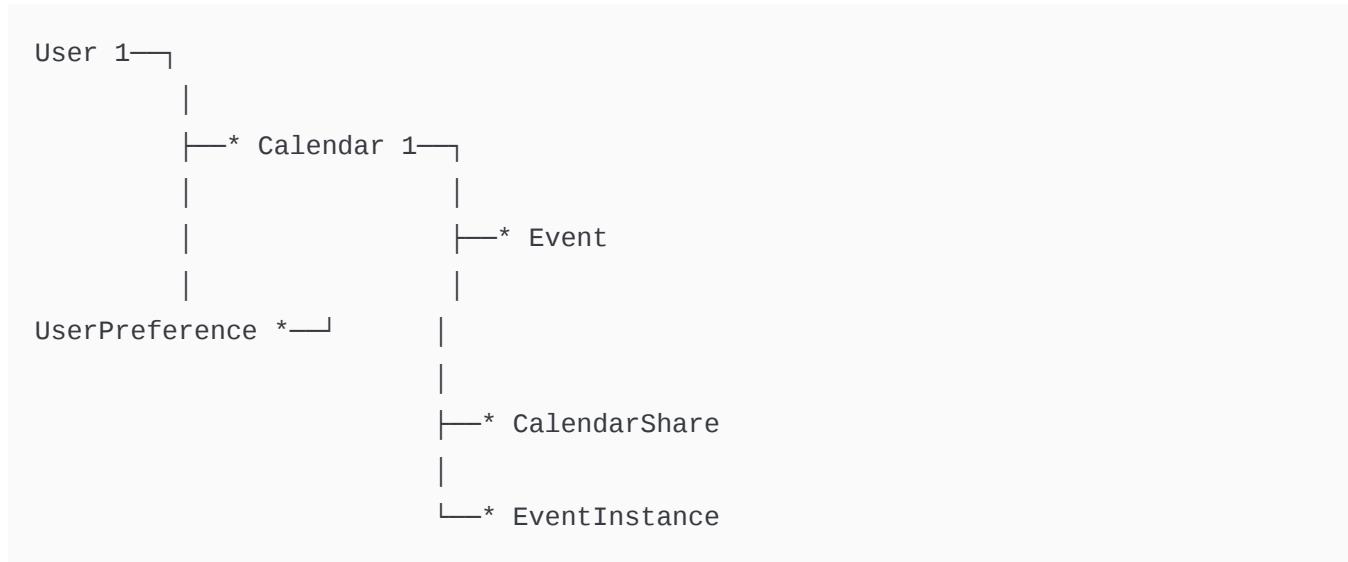
- Implement field-level authorization
- Provide selective field resolution
- Use cursor-based pagination

3. Mutation Resolution Strategy

- Validate inputs with strong typing
- Implement optimistic concurrency control
- Return sufficient data for client cache updates
- Log mutation history for auditing

2. Database Schema and Relationships

Entity Relationship Diagram



PostgreSQL Schema Design

```

CREATE TABLE users (
    id UUID PRIMARY KEY DEFAULT gen_random_uuid(),
    email TEXT UNIQUE NOT NULL,
    password_hash TEXT,
    name TEXT,
    profile_picture TEXT,
    timezone TEXT NOT NULL DEFAULT 'UTC',
    created_at TIMESTAMP WITH TIME ZONE NOT NULL DEFAULT NOW(),
    updated_at TIMESTAMP WITH TIME ZONE
);
  
```

```

CREATE TABLE user_preferences (
    id UUID PRIMARY KEY DEFAULT gen_random_uuid(),
    user_id UUID NOT NULL REFERENCES users(id) ON DELETE CASCADE,
    default_calendar_id UUID,
    default_view TEXT NOT NULL DEFAULT 'month',
    working_hours JSONB NOT NULL DEFAULT '{"start": "09:00", "end": "17:00",
"days": [1, 2, 3, 4, 5]}',
    notification_settings JSONB NOT NULL DEFAULT '{"event_reminders": true,
"share_notifications": true}',
    created_at TIMESTAMP WITH TIME ZONE NOT NULL DEFAULT NOW(),
    updated_at TIMESTAMP WITH TIME ZONE
);

CREATE TABLE calendars (
    id UUID PRIMARY KEY DEFAULT gen_random_uuid(),
    owner_id UUID NOT NULL REFERENCES users(id) ON DELETE CASCADE,
    name TEXT NOT NULL,
    description TEXT,
    color TEXT,
    is_default BOOLEAN NOT NULL DEFAULT false,
    is_visible BOOLEAN NOT NULL DEFAULT true,
    external_id TEXT,
    external_source TEXT,
    created_at TIMESTAMP WITH TIME ZONE NOT NULL DEFAULT NOW(),
    updated_at TIMESTAMP WITH TIME ZONE
);

CREATE TABLE calendar_shares (
    id UUID PRIMARY KEY DEFAULT gen_random_uuid(),
    calendar_id UUID NOT NULL REFERENCES calendars(id) ON DELETE CASCADE,
    user_id UUID REFERENCES users(id) ON DELETE CASCADE,
    email TEXT,
    permission TEXT NOT NULL DEFAULT 'view',
    status TEXT NOT NULL DEFAULT 'pending',
    invite_token TEXT,
    created_at TIMESTAMP WITH TIME ZONE NOT NULL DEFAULT NOW(),
    updated_at TIMESTAMP WITH TIME ZONE,
    CONSTRAINT user_or_email_required CHECK (user_id IS NOT NULL OR email IS NOT
NULL)
);

```

```

CREATE TABLE events (
    id UUID PRIMARY KEY DEFAULT gen_random_uuid(),
    calendar_id UUID NOT NULL REFERENCES calendars(id) ON DELETE CASCADE,
    title TEXT NOT NULL,
    description TEXT,
    location TEXT,
    start_time TIMESTAMP WITH TIME ZONE NOT NULL,
    end_time TIMESTAMP WITH TIME ZONE NOT NULL,
    is_all_day BOOLEAN NOT NULL DEFAULT false,
    recurrence_rule TEXT,
    exception_dates JSONB,
    color TEXT,
    visibility TEXT NOT NULL DEFAULT 'default',
    status TEXT NOT NULL DEFAULT 'confirmed',
    created_by UUID NOT NULL REFERENCES users(id),
    created_at TIMESTAMP WITH TIME ZONE NOT NULL DEFAULT NOW(),
    updated_at TIMESTAMP WITH TIME ZONE,
    version INTEGER NOT NULL DEFAULT 1,
    CONSTRAINT event_dates_check CHECK (end_time >= start_time)
);

```

```

CREATE TABLE event_instances (
    id UUID PRIMARY KEY DEFAULT gen_random_uuid(),
    event_id UUID NOT NULL REFERENCES events(id) ON DELETE CASCADE,
    instance_date DATE NOT NULL,
    start_time TIMESTAMP WITH TIME ZONE NOT NULL,
    end_time TIMESTAMP WITH TIME ZONE NOT NULL,
    is_exception BOOLEAN NOT NULL DEFAULT false,
    exception_data JSONB,
    status TEXT NOT NULL DEFAULT 'confirmed',
    created_at TIMESTAMP WITH TIME ZONE NOT NULL DEFAULT NOW(),
    updated_at TIMESTAMP WITH TIME ZONE,
    CONSTRAINT unique_event_instance UNIQUE (event_id, instance_date)
);

```

```

CREATE TABLE event_attendees (
    id UUID PRIMARY KEY DEFAULT gen_random_uuid(),
    event_id UUID NOT NULL REFERENCES events(id) ON DELETE CASCADE,
    user_id UUID REFERENCES users(id) ON DELETE SET NULL,
    email TEXT NOT NULL,
    name TEXT,
    response_status TEXT NOT NULL DEFAULT 'pending',

```

```

    created_at TIMESTAMP WITH TIME ZONE NOT NULL DEFAULT NOW(),
    updated_at TIMESTAMP WITH TIME ZONE
);

CREATE TABLE reminders (
    id UUID PRIMARY KEY DEFAULT gen_random_uuid(),
    event_id UUID NOT NULL REFERENCES events(id) ON DELETE CASCADE,
    user_id UUID NOT NULL REFERENCES users(id) ON DELETE CASCADE,
    minutes_before INTEGER NOT NULL,
    method TEXT NOT NULL DEFAULT 'notification',
    created_at TIMESTAMP WITH TIME ZONE NOT NULL DEFAULT NOW(),
    updated_at TIMESTAMP WITH TIME ZONE
);

CREATE TABLE attachments (
    id UUID PRIMARY KEY DEFAULT gen_random_uuid(),
    event_id UUID NOT NULL REFERENCES events(id) ON DELETE CASCADE,
    name TEXT NOT NULL,
    file_url TEXT NOT NULL,
    mime_type TEXT NOT NULL,
    size_bytes INTEGER NOT NULL,
    created_by UUID NOT NULL REFERENCES users(id),
    created_at TIMESTAMP WITH TIME ZONE NOT NULL DEFAULT NOW()
);

CREATE TABLE sync_tokens (
    id UUID PRIMARY KEY DEFAULT gen_random_uuid(),
    user_id UUID NOT NULL REFERENCES users(id) ON DELETE CASCADE,
    device_id TEXT NOT NULL,
    last_sync_time TIMESTAMP WITH TIME ZONE NOT NULL DEFAULT NOW(),
    token TEXT NOT NULL,
    created_at TIMESTAMP WITH TIME ZONE NOT NULL DEFAULT NOW(),
    updated_at TIMESTAMP WITH TIME ZONE,
    CONSTRAINT unique_user_device UNIQUE (user_id, device_id)
);

-- Indexes for performance
CREATE INDEX idx_events_calendar_id ON events(calendar_id);
CREATE INDEX idx_events_date_range ON events(start_time, end_time);
CREATE INDEX idx_calendar_shares_calendar_id ON calendar_shares(calendar_id);
CREATE INDEX idx_calendar_shares_user_id ON calendar_shares(user_id);

```

```
CREATE INDEX idx_event_instances_event_id ON event_instances(event_id);
CREATE INDEX idx_event_instances_date ON event_instances(instance_date);
```

Sharding Strategy

For scaling to billions of users:

1. Vertical Partitioning:

- Separate main tables from metadata/settings
- Move historical events to separate storage

2. Horizontal Sharding:

- Shard by user_id using consistent hashing
- Keep user data in same shard for performance
- Cross-shard queries for shared calendars

3. Authentication Service Architecture

Authentication Flow

1. Registration Process:

- Email verification with temporary token
- Password strength validation
- GDPR-compliant consent collection

2. Login Flow:

- JWT-based authentication
- Short-lived access tokens (15 min)
- Longer refresh tokens (7 days)
- Sliding session expiration

3. Multi-Factor Authentication:

- TOTP (Time-based One-Time Password)
- SMS verification fallback
- Remember trusted devices option



4. OAuth Integration:

- Google, Apple, Microsoft SSO
- Account linking capabilities
- Scoped access tokens for service integrations

Security Implementation

```
// Authentication service pattern (simplified)
class AuthService {
    // User registration with email verification
    async register(email: string, password: string, name: string): Promise<User> {
        // Validate input
        this.validateRegistrationInput(email, password, name);

        // Check if user already exists
        const existingUser = await this.userRepository.findByEmail(email);
        if (existingUser) {
            throw new UserAlreadyExistsError(email);
        }

        // Hash password with argon2id
        const passwordHash = await this.passwordHasher.hash(password);

        // Create user
        const user = await this.userRepository.create({
            email,
            passwordHash,
            name,
            isEmailVerified: false
        });

        // Generate verification token
        const verificationToken =
            this.tokenGenerator.generateEmailVerificationToken(user.id);

        // Send verification email
        await this.emailService.sendVerificationEmail(email, verificationToken);

        return user;
    }
}
```

```

// User authentication with JWT
async login(email: string, password: string): Promise<AuthTokens> {
  // Find user
  const user = await this.userRepository.findByEmailWithPasswordHash(email);
  if (!user) {
    // Use consistent timing to prevent timing attacks
    await this.passwordHasher.compareConstantTime('dummy', 'dummy');
    throw new InvalidCredentialsError();
  }

  // Verify password
  const isPasswordValid = await this.passwordHasher.compare(password,
    user.passwordHash);
  if (!isPasswordValid) {
    throw new InvalidCredentialsError();
  }

  // Check if email is verified
  if (!user.isEmailVerified) {
    throw new EmailNotVerifiedError(email);
  }

  // Generate tokens
  const accessToken = this.tokenGenerator.generateAccessToken(user);
  const refreshToken = this.tokenGenerator.generateRefreshToken(user);

  // Store refresh token
  await this.tokenRepository.storeRefreshToken(user.id, refreshToken);

  return {
    accessToken,
    refreshToken,
    expiresIn: 900 // 15 minutes in seconds
  };
}

// Additional methods omitted for brevity
}

```

4. Sync Mechanism Concepts

Optimistic Concurrency Control

1. Version-based Synchronization:

- Each entity has a version field
- Clients send current version with updates
- Server rejects updates if versions don't match

2. Change-Based Sync Protocol:

- Clients send change sets with base version
- Server applies changes if possible or rejects
- Conflict resolution with client-provided strategies

Offline-First Implementation

```
// Simplified sync service pattern
class SyncService {
    // Get changes since last sync
    async getChanges(userId: string, syncToken: string): Promise<SyncResponse> {
        // Validate sync token
        const decodedToken = this.tokenValidator.validateSyncToken(syncToken);
        if (!decodedToken) {
            throw new InvalidSyncTokenError();
        }

        const lastSyncTime = decodedToken.lastSyncTime;

        // Get user's calendars (including shared)
        const calendarIds = await
            this.calendarRepository.getUserAccessibleCalendarIds(userId);

        // Get changes since last sync
        const changes = await Promise.all([
            this.calendarRepository.getChangesSince(calendarIds, lastSyncTime),
            this.eventRepository.getChangesSince(calendarIds, lastSyncTime)
        ]);

        // Generate new sync token
    }
}
```

```

    const newSyncToken = this.tokenGenerator.generateSyncToken(userId, new
Date()));

return {
  calendars: changes[0],
  events: changes[1],
  deletedCalendarIds: await
this.calendarRepository.getDeletedSince(calendarIds, lastSyncTime),
  deletedEventIds: await this.eventRepository.getDeletedSince(calendarIds,
lastSyncTime),
  syncToken: newSyncToken
};
}

// Apply changes from client
async applyChanges(userId: string, changes: SyncChanges): Promise<SyncResult>
{
  // Start transaction
  return this.repository.transaction(async (transaction) => {
    const results = {
      successful: [],
      failed: [],
      conflicts: []
    };

    // Process calendar changes
    for (const calendar of changes.calendars) {
      try {
        if (calendar.id) {
          // Update existing calendar
          const existing = await this.calendarRepository.findById(calendar.id,
transaction);
          if (!existing) {
            results.failed.push({ id: calendar.id, reason: 'not_found' });
            continue;
          }

          // Check version
          if (existing.version !== calendar.version) {
            results.conflicts.push({
              id: calendar.id,
              clientVersion: calendar.version,

```

```

        serverVersion: existing.version
    });
    continue;
}

// Update calendar
const updated = await this.calendarRepository.update(
    calendar.id,
    { ...calendar, version: calendar.version + 1 },
    transaction
);
results.successful.push({ id: updated.id, version: updated.version
});

} else {
    // Create new calendar
    const created = await this.calendarRepository.create(
        { ...calendar, ownerId: userId },
        transaction
    );
    results.successful.push({ id: created.id, version: created.version
});
}

} catch (error) {
    results.failed.push({ id: calendar.id, reason: 'error', message:
error.message });
}
}

// Similar processing for events
// Omitted for brevity

return results;
});
}
}

```

Conflict Resolution Strategy

1. **Server Wins:** Default behavior, client must refetch latest data and reapply changes
2. **Client Wins:** Force client changes (only allowed for specific operations)
3. **Merge:** Smart merging of non-conflicting fields

4. **Last-Write-Wins:** Based on timestamp (for shared calendars)

5. Caching Strategies

Multi-Level Caching

1. Request-Level Cache:

- Apollo DataLoader for batching and caching during request
- Prevents N+1 query issues
- Per-request cache lifetime

2. Application-Level Cache:

- Redis for shared cache across instances
- Invalidation based on mutation events
- Tiered cache structure:
 - Frequently accessed user data: 15 min TTL
 - Calendar metadata: 30 min TTL
 - Event listings: 5 min TTL
 - Read-heavy data (holidays, etc.): 1 day TTL

3. Database-Level Cache:

- Query result cache
- Prepared statement cache
- Connection pooling optimization

Cache Implementation

```
// Redis cache service pattern
class CacheService {
    constructor(
        private redis: Redis,
        private logger: Logger
    ) {}

    // Set cache with TTL
    async set(key: string, data: any, ttlSeconds: number): Promise<void> {
```



```

try {
    await this.redis.set(
        this.prefixKey(key),
        JSON.stringify(data),
        'EX',
        ttlSeconds
    );
} catch (error) {
    this.logger.error('Cache set failed', { key, error });
    // Don't throw - cache errors shouldn't break functionality
}
}

// Get from cache
async get<T>(key: string): Promise<T | null> {
try {
    const data = await this.redis.get(this.prefixKey(key));
    if (!data) return null;
    return JSON.parse(data) as T;
} catch (error) {
    this.logger.error('Cache get failed', { key, error });
    return null;
}
}

// Invalidate cache
async invalidate(key: string): Promise<void> {
try {
    await this.redis.del(this.prefixKey(key));
} catch (error) {
    this.logger.error('Cache invalidation failed', { key, error });
}
}

// Invalidate by pattern (e.g., all keys for a user)
async invalidatePattern(pattern: string): Promise<void> {
try {
    const keys = await this.redis.keys(this.prefixKey(pattern));
    if (keys.length > 0) {
        await this.redis.del(...keys);
    }
} catch (error) {
}
}

```

```

        this.logger.error('Pattern invalidation failed', { pattern, error });
    }
}

// Key prefixing for namespacing
private prefixKey(key: string): string {
    return `calendar:${key}`;
}

```

Cache Keys and Patterns

```

// Calendar cache keys
export const CacheKeys = {
    // User data
    user: (userId: string) => `user:${userId}`,
    userPreferences: (userId: string) => `user:${userId}:preferences`,

    // Calendars
    calendar: (calendarId: string) => `calendar:${calendarId}`,
    userCalendars: (userId: string) => `user:${userId}:calendars`,

    // Events - time-based for granular invalidation
    events: (calendarId: string, start: Date, end: Date) =>
        `calendar:${calendarId}:events:${formatDate(start)}:${formatDate(end)}`,

    // Event details
    event: (eventId: string) => `event:${eventId}`,

    // Search results
    searchResults: (userId: string, query: string) =>
        `search:${userId}:${md5(query)}`,

    // Patterns for invalidation
    userPattern: (userId: string) => `user:${userId}:*`,
    calendarPattern: (calendarId: string) => `calendar:${calendarId}:*`,
    eventPattern: (eventId: string) => `event:${eventId}:*`
};

```

6. SOLID Principles Implementation

Single Responsibility Principle

Each service handles one specific domain:

```
// Calendar service only handles calendar operations
class CalendarService {
    constructor(
        private calendarRepository: CalendarRepository,
        private shareRepository: CalendarShareRepository,
        private eventRepository: EventRepository,
        private cacheService: CacheService,
        private authorizationService: AuthorizationService,
        private pubSubService: PubSubService
    ) {}

    async getCalendar(calendarId: string, userId: string): Promise<Calendar> {
        // Authorization check
        await this.authorizationService.ensureCalendarAccess(userId, calendarId);

        // Try cache first
        const cacheKey = CacheKeys.calendar(calendarId);
        const cachedCalendar = await this.cacheService.get<Calendar>(cacheKey);
        if (cachedCalendar) return cachedCalendar;

        // Get from database
        const calendar = await this.calendarRepository.findById(calendarId);
        if (!calendar) throw new CalendarNotFoundError(calendarId);

        // Cache result
        await this.cacheService.set(cacheKey, calendar, 1800); // 30 minutes

        return calendar;
    }

    // Other calendar-specific methods
}

// Separate service for events
class EventService {
    // Event-specific operations
}
```

```
}
```

// Separate service for user management

```
class UserService {
    // User-specific operations
}
```

Open/Closed Principle

```
// Abstract base class for notification methods
abstract class NotificationMethod {
    abstract async send(notification: Notification): Promise<void>;
}

// Email notification implementation
class EmailNotification extends NotificationMethod {
    constructor(private emailService: EmailService) {
        super();
    }

    async send(notification: Notification): Promise<void> {
        await this.emailService.sendEmail({
            to: notification.recipient.email,
            subject: notification.title,
            body: notification.body
        });
    }
}

// Push notification implementation
class PushNotification extends NotificationMethod {
    constructor(private pushService: PushService) {
        super();
    }

    async send(notification: Notification): Promise<void> {
        await this.pushService.sendPush({
            userId: notification.recipient.id,
            title: notification.title,
            body: notification.body,
            data: notification.data
        });
    }
}
```

```

    });
}

}

// New notification methods can be added without modifying existing code
class SMSNotification extends NotificationMethod {
  constructor(private smsService: SMSService) {
    super();
  }

  async send(notification: Notification): Promise<void> {
    await this.smsService.sendSMS({
      phoneNumber: notification.recipient.phoneNumber,
      message: `${notification.title}: ${notification.body}`
    });
  }
}

```

Liskov Substitution Principle

```

// Base repository interface
interface Repository<T> {
  findById(id: string): Promise<T | null>;
  findAll(filter?: any): Promise<T[]>;
  create(data: Partial<T>): Promise<T>;
  update(id: string, data: Partial<T>): Promise<T>;
  delete(id: string): Promise<boolean>;
}

// Concrete implementation that can be substituted
class PostgresRepository<T> implements Repository<T> {
  constructor(
    private tableName: string,
    private db: Database
  ) {}

  async findById(id: string): Promise<T | null> {
    return this.db.query(`SELECT * FROM ${this.tableName} WHERE id = $1`, [id])
      .then(result => result.rows[0] || null);
  }
}

```

```

    // Other method implementations
}

// In-memory implementation for testing
class InMemoryRepository<T> implements Repository<T> {
    private items: Record<string, T> = {};

    async findById(id: string): Promise<T | null> {
        return this.items[id] || null;
    }

    // Other method implementations
}

// Both implementations can be used interchangeably
function createCalendarService(repository: Repository<Calendar>):
    CalendarService {
    return new CalendarService(repository, /* other dependencies */);
}

```

Interface Segregation Principle

```

// Separate interfaces for different concerns

interface EventReader {
    getEvent(id: string): Promise<Event | null>;
    getEvents(calendarId: string, start: Date, end: Date): Promise<Event[]>;
    searchEvents(query: string): Promise<Event[]>;
}

interface EventWriter {
    createEvent(data: CreateEventInput): Promise<Event>;
    updateEvent(id: string, data: UpdateEventInput): Promise<Event>;
    deleteEvent(id: string): Promise<boolean>;
}

interface EventSynchronizer {
    getChangesSince(calendarId: string, since: Date): Promise<EventChange[]>;
    applyChanges(changes: EventChange[]): Promise<SyncResult>;
}

// Service can implement just what it needs

```

```

class ReadOnlyEventService implements EventReader {
    // Read-only implementation
}

class EventService implements EventReader, EventWriter {
    // Read-write implementation
}

class SyncService implements EventSynchronizer {
    // Sync-specific implementation
}

```

Dependency Inversion Principle

```

// High-level module depends on abstraction
class NotificationService {
    constructor(
        private notificationRepository: NotificationRepository,
        private notificationSender: NotificationSender
    ) {}

    async sendEventReminder(eventId: string, userId: string): Promise<void> {
        const event = await this.eventRepository.findById(eventId);
        if (!event) throw new EventNotFoundError(eventId);

        const user = await this.userRepository.findById(userId);
        if (!user) throw new UserNotFoundError(userId);

        const notification = await this.notificationRepository.create({
            type: 'event_reminder',
            userId,
            eventId,
            title: 'Event Reminder',
            body: `Your event "${event.title}" starts in 10 minutes`,
            scheduledFor: new Date()
        });

        await this.notificationSender.send(notification);
    }
}

```

```

// Abstraction
interface NotificationSender {
  send(notification: Notification): Promise<void>;
}

// Low-level implementation
class EmailNotificationSender implements NotificationSender {
  constructor(private emailService: EmailService) {}

  async send(notification: Notification): Promise<void> {
    // Email-specific implementation
  }
}

class PushNotificationSender implements NotificationSender {
  constructor(private pushService: PushService) {}

  async send(notification: Notification): Promise<void> {
    // Push-specific implementation
  }
}

// Composite implementation for multiple channels
class CompositeNotificationSender implements NotificationSender {
  constructor(private senders: NotificationSender[]) {}

  async send(notification: Notification): Promise<void> {
    await Promise.all(
      this.senders.map(sender => sender.send(notification))
    );
  }
}

```

This comprehensive backend architecture provides a solid foundation for the Calendar App, ensuring scalability, security, and maintainability. The design adheres to SOLID principles while implementing best practices for GraphQL API design, database modeling, authentication, synchronization, and caching.



AS the backend lead - please work on the following :

- **Backend Architecture Blueprint**

- Create comprehensive architecture document for calendar services
 - Define microservices boundaries and interactions
 - Document API design principles
 - Present architecture for approval to Technical Architect and stakeholders
-

Calendar App Backend Architecture Blueprint

Executive Summary

This document outlines the comprehensive backend architecture for the Chronos Calendar App, designed to scale to billions of users while providing a fast, reliable, and feature-rich experience. The architecture follows SOLID principles and implements a domain-driven microservices approach that ensures both scalability and maintainability.

Architecture Vision

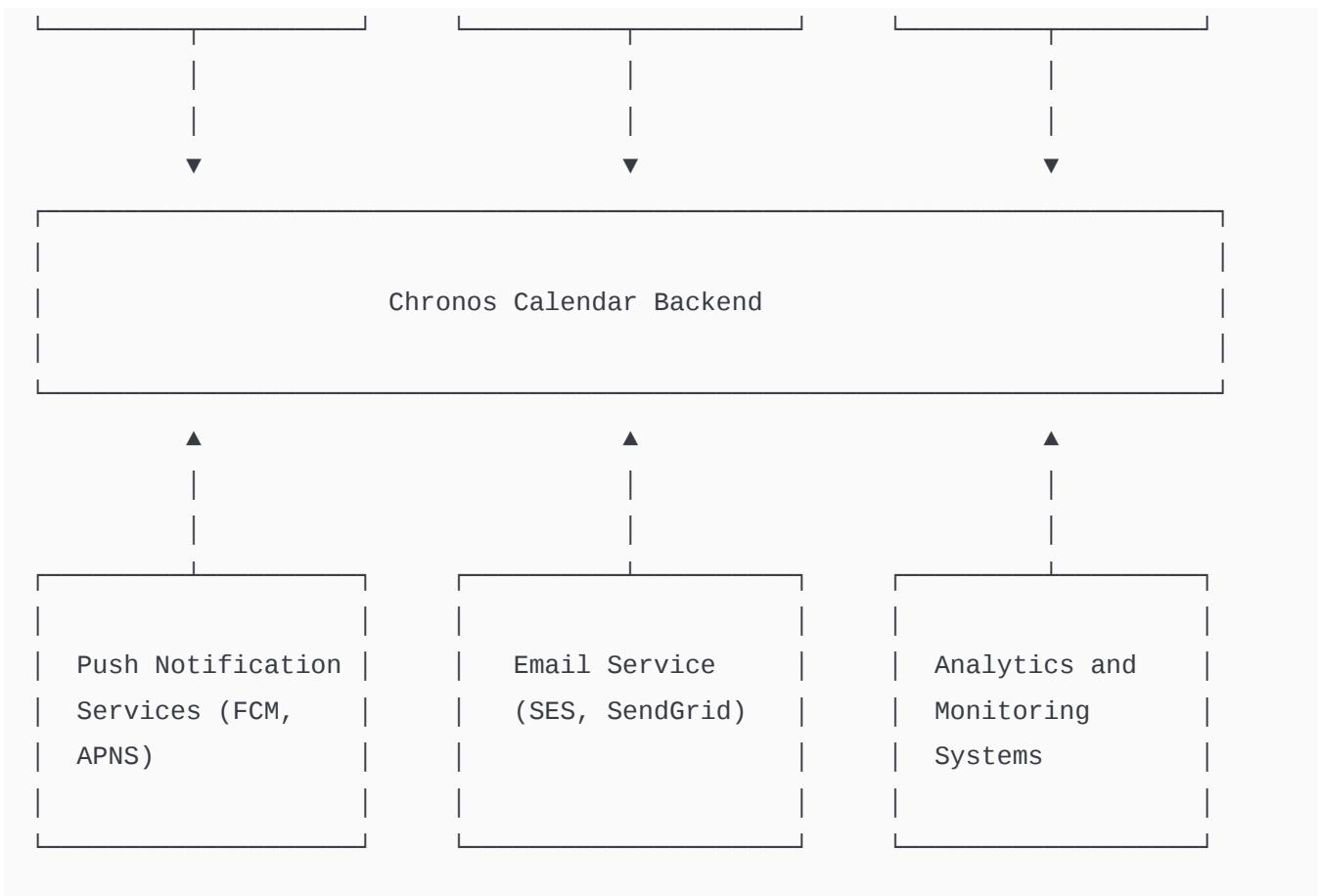
The Chronos Calendar backend is designed with the following principles:

1. **Scalability First:** All components designed to handle billions of users and events
2. **High Availability:** Zero downtime deployments and fault tolerance
3. **Real-time Capabilities:** Immediate data synchronization across all devices
4. **Security by Design:** End-to-end encryption and comprehensive authentication
5. **Developer Experience:** Clear service boundaries and well-documented interfaces

System Context

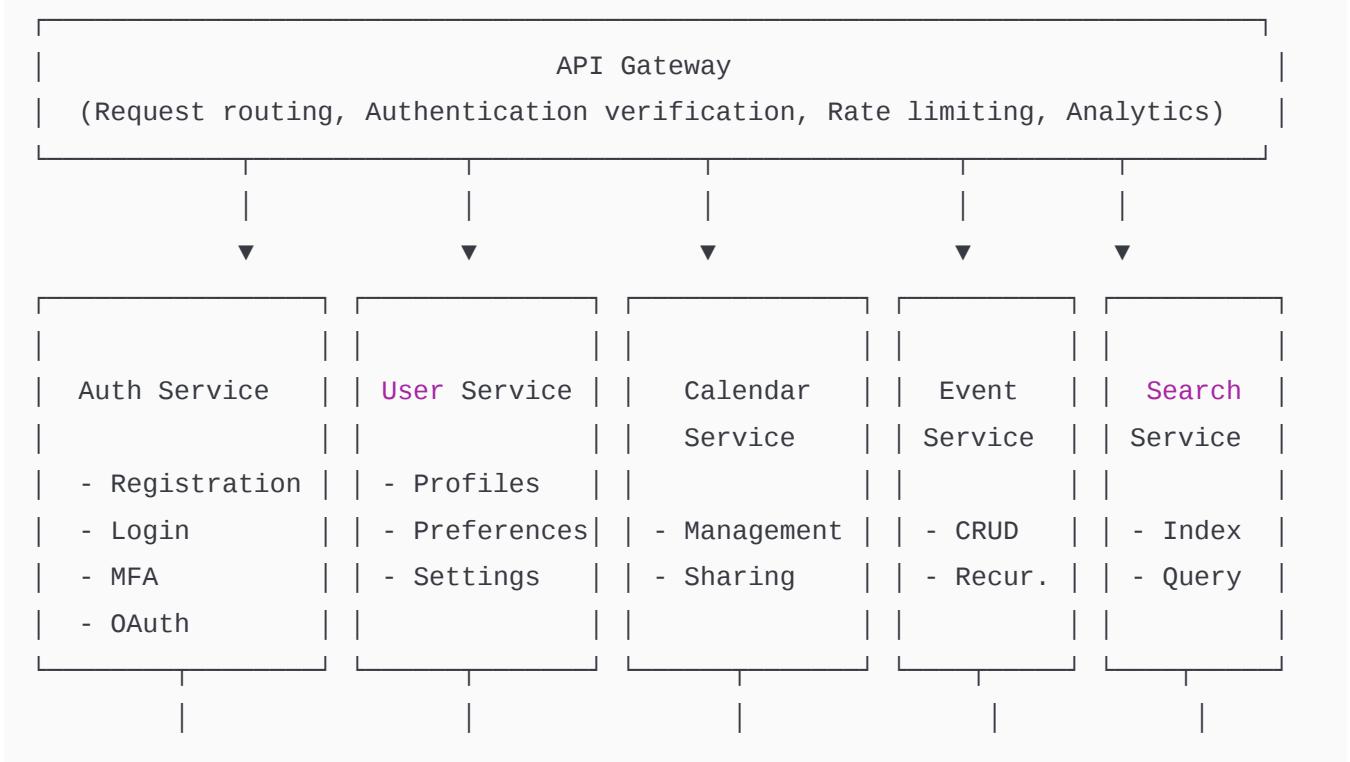
External Systems Integration

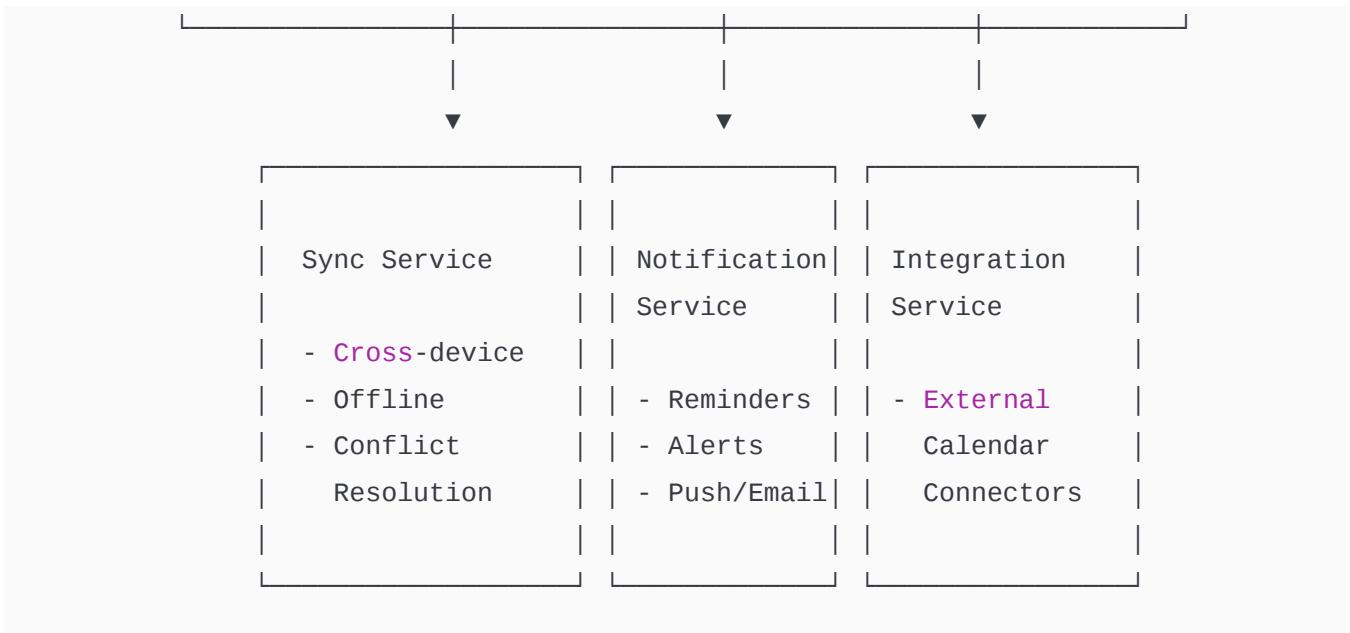




Microservices Architecture

Service Boundaries





Communication Patterns

1. Synchronous Communication:

- REST/GraphQL API calls between services where immediate response is needed
- gRPC for high-performance internal service communication

2. Asynchronous Communication:

- Event-driven architecture using Apache Kafka
- Message topics for domain events (e.g., `calendar.created`, `event.updated`)
- Eventual consistency for non-critical updates

3. Real-time Communication:

- WebSocket connections for live updates
- Redis Pub/Sub for notifications distribution
- Connection management via dedicated gateway

Service Descriptions

API Gateway

- **Responsibility:** Entry point for all client requests
- **Key Functions:**
 - Request routing to appropriate microservices

- Authentication token validation
- Rate limiting and throttling
- Request/response logging
- API versioning
- CORS handling
- **Technologies:** AWS API Gateway, Kong, or custom Node.js implementation

Auth Service

- **Responsibility:** User authentication and authorization
- **Key Functions:**
 - User registration and account verification
 - Login with email/password
 - Multi-factor authentication
 - OAuth integration (Google, Apple, Microsoft)
 - JWT token issuance and validation
 - Password reset workflows
- **Data Store:** PostgreSQL for user credentials, Redis for token management
- **Security Features:** Argon2id password hashing, rate limiting, audit logging

User Service

- **Responsibility:** User profile and preference management
- **Key Functions:**
 - Profile information storage and retrieval
 - User preferences (timezone, default views)
 - Account settings management
 - User device registration
- **Data Store:** PostgreSQL for profiles, Redis for caching
- **APIs:**
 - `/users/me` - Get current user profile
 - `/users/preferences` - Manage preferences
 - `/users/devices` - Manage registered devices

Calendar Service

- **Responsibility:** Calendar management
- **Key Functions:**
 - Calendar CRUD operations
 - Calendar sharing and permissions
 - Calendar import/export
 - Calendar metadata management
- **Data Store:** PostgreSQL for calendar data, Redis for caching
- **APIs:**
 - `/calendars` - List and create calendars
 - `/calendars/{id}` - Manage specific calendar
 - `/calendars/{id}/share` - Manage sharing

Event Service

- **Responsibility:** Event management
- **Key Functions:**
 - Event CRUD operations
 - Recurring event management
 - Attendee management
 - Reminder settings
 - Date/time calculations
- **Data Store:** PostgreSQL for event data, sharded by user
- **Scaling Strategy:** Horizontal sharding based on user ID
- **APIs:**
 - `/events` - Create events, list with filters
 - `/events/{id}` - Manage specific event
 - `/events/recurring/{id}` - Manage recurring instances

Sync Service

- **Responsibility:** Cross-device data synchronization
- **Key Functions:**
 - Change tracking and versioning

- Incremental sync operations
- Conflict detection and resolution
- Offline data management
- **Data Store:** PostgreSQL for change logs, Redis for sync tokens
- **APIs:**
 - `/sync` - Get changes since last sync
 - `/sync/changes` - Submit local changes

Notification Service

- **Responsibility:** User notifications and reminders
- **Key Functions:**
 - Event reminders
 - Calendar share notifications
 - System notifications
 - Notification preferences
- **Data Store:** PostgreSQL for notification data, Redis for delivery queue
- **External Integrations:**
 - Firebase Cloud Messaging (Android)
 - Apple Push Notification Service (iOS)
 - Email delivery service (SendGrid/SES)
- **APIs:**
 - `/notifications` - List notifications
 - `/notifications/preferences` - Manage settings

Search Service

- **Responsibility:** Full-text search across calendar data
- **Key Functions:**
 - Event indexing
 - Query processing
 - Relevance ranking
 - Search suggestions
- **Data Store:** Elasticsearch

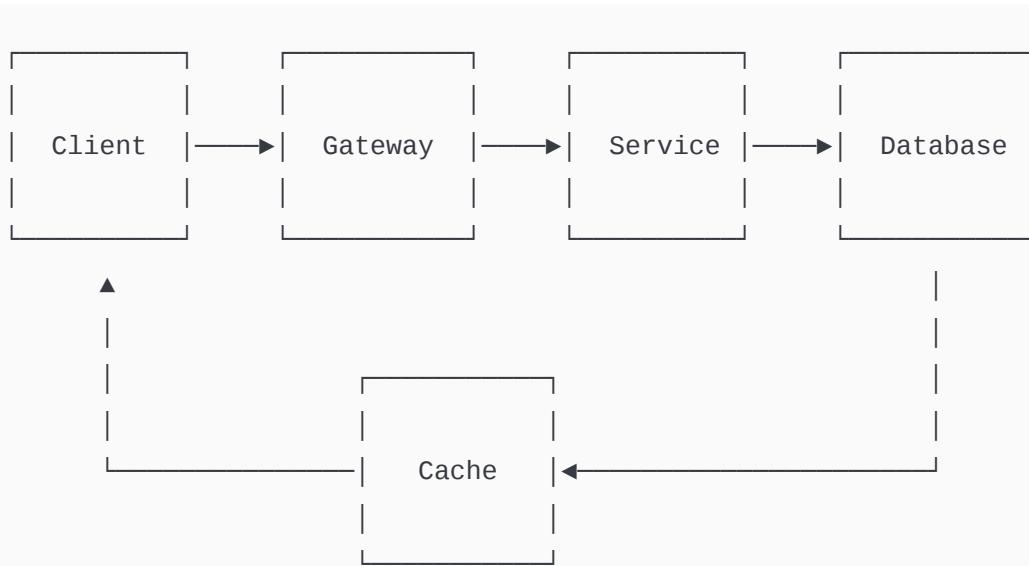
- **Scaling Strategy:** Separate indices per tenant group
- **APIs:**
 - `/search` - Search across calendars and events

Integration Service

- **Responsibility:** Third-party calendar system integration
- **Key Functions:**
 - Google Calendar sync
 - Microsoft Outlook sync
 - iCalendar import/export
 - Calendar URL subscription
- **Data Store:** PostgreSQL for integration metadata
- **APIs:**
 - `/integrations` - Manage calendar connections
 - `/integrations/{provider}` - Provider-specific operations

Data Architecture

Data Flow Diagram



Database Strategy

1. **Primary Storage:** PostgreSQL

- Sharded by user ID for horizontal scaling
- Contains all persistent application data
- Strong consistency for critical operations

2. **Caching Layer:** Redis

- Multi-level caching strategy
- User data, calendar metadata, event listings
- JWT token storage
- Rate limiting counters

3. **Search Index:** Elasticsearch

- Full-text search capabilities
- Event content indexing
- Optimized for search queries

4. **Message Broker:** Apache Kafka

- Event sourcing and change data capture
- Service-to-service communication
- Event replay capabilities

Data Models

See the detailed database schema in the accompanying document. Key entities include:

- Users and Authentication
- Calendars and Sharing
- Events and Recurrence
- Notifications and Preferences
- Sync Tokens and Change Tracking

API Design Principles

GraphQL Primary Interface

Chronos Calendar exposes a GraphQL API as its primary interface, with these principles:

1. **Schema-First Design:**

- Clear type definitions
- Strong validation at the schema level
- Self-documenting interface

2. Domain-Aligned Types:

- Types map to domain entities
- Clear boundaries between domains
- Consistent naming conventions

3. Operation Design:

- Queries for data retrieval
- Mutations for data modification
- Subscriptions for real-time updates

4. Performance Optimization:

- Field-level selections to minimize data transfer
- DataLoader pattern to prevent N+1 queries
- Persisted queries for common operations

RESTful Secondary Endpoints

In addition to GraphQL, selected RESTful endpoints are provided for:

1. Authentication Operations:

- `/auth/login`
- `/auth/logout`
- `/auth/register`

2. File Operations:

- `/attachments/upload`
- `/attachments/{id}/download`

3. Integration Webhooks:

- `/webhooks/google`
- `/webhooks/microsoft`

4. Health Checks:

- `/health`
- `/status`

Security Architecture

Authentication & Authorization

1. Authentication Methods:

- Email/password with MFA
- OAuth 2.0 providers
- JWT token-based session management

2. Authorization Model:

- Resource-based permissions
- Role-based access controls
- Permission checks at service boundaries

3. Data Protection:

- End-to-end encryption for sensitive data
- TLS for all communications
- Encrypted data at rest

Security Measures

1. API Security:

- Rate limiting and throttling
- Input validation and sanitization
- Protection against common attacks (CSRF, XSS)

2. Infrastructure Security:

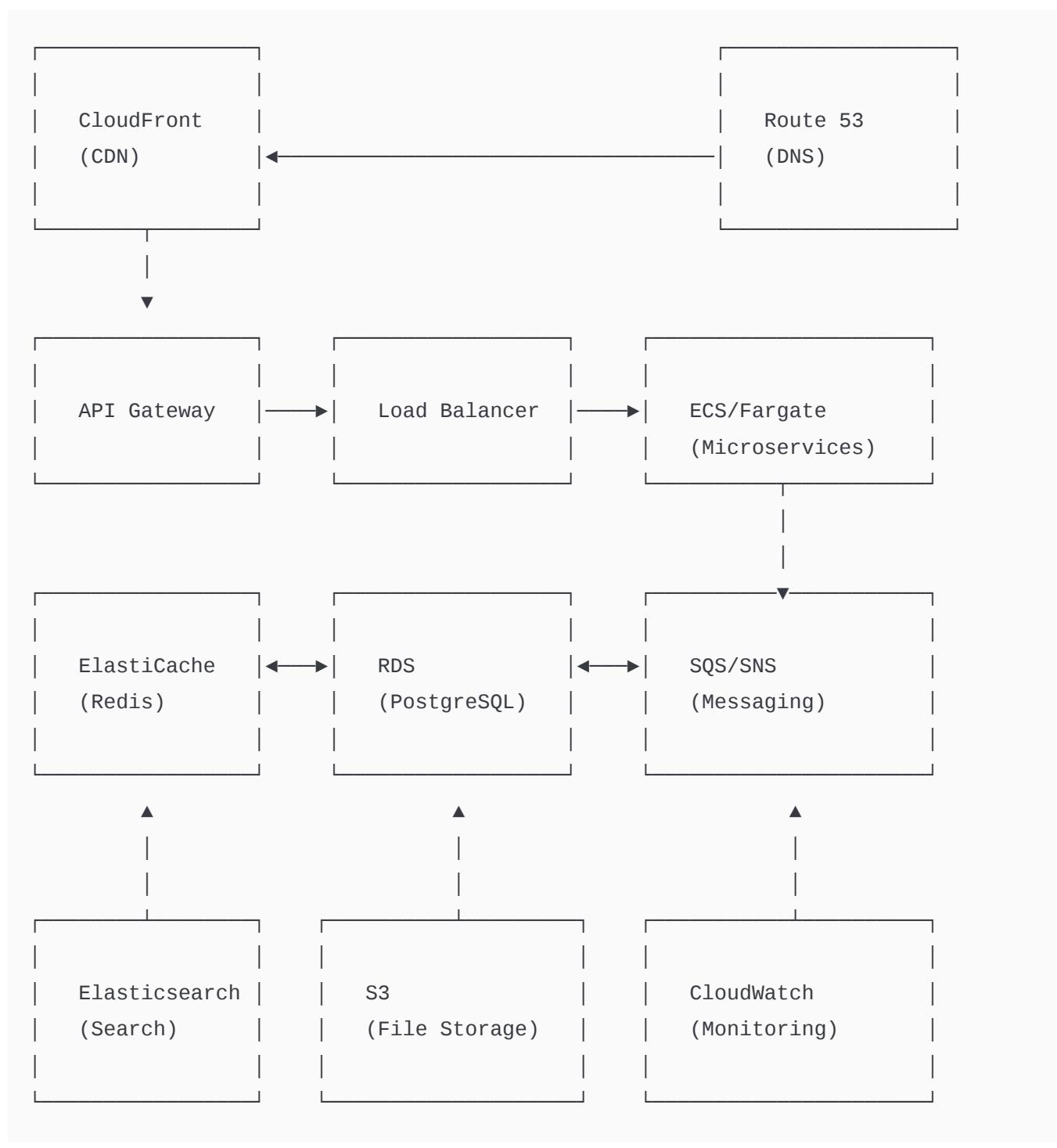
- Network segmentation
- VPC and security groups
- WAF implementation

3. Compliance Controls:

- GDPR compliance measures
- Data retention policies
- Audit logging for sensitive operations

Infrastructure Design

AWS Cloud Architecture



Deployment Strategy

1. Containerization:

- Docker for service packaging
- ECS/Fargate for container orchestration
- ECR for container registry

2. CI/CD Pipeline:

- GitHub Actions for build and test
- Infrastructure as Code using Terraform
- Blue/green deployments for zero downtime

3. Environment Separation:

- Development, Testing, Staging, Production
- Feature branch environments
- Canary releases for risk mitigation

Scalability Strategy

Horizontal Scaling

1. Stateless Services:

- All services designed to be stateless
- Session state stored in Redis
- Easy horizontal scaling via auto-scaling groups

2. Database Scaling:

- Vertical scaling for initial growth
- Read replicas for read-heavy operations
- Sharding by user ID for write scaling

3. Caching Strategy:

- Multi-level caching (request, application, database)
- Distributed cache with Redis
- Cache invalidation via event-based triggers

Traffic Management

1. Load Balancing:

- Application Load Balancer for HTTP traffic
- Connection draining for graceful scaling
- Health checks for automatic failover

2. Rate Limiting:

- Per-user and per-IP rate limits
- Graduated throttling
- DDoS protection

Monitoring and Observability

Monitoring Strategy

1. Health Monitoring:

- Service health checks
- Infrastructure metrics
- Database performance

2. Application Monitoring:

- Request latency and error rates
- Service dependencies
- Cache hit/miss ratios

3. Business Metrics:

- User activity
- Feature usage
- Sync success rates

Logging and Tracing

1. Centralized Logging:

- Structured logs in JSON format

- Log aggregation with ELK stack
- Log retention policies

2. **Distributed Tracing:**

- Request ID propagation
- OpenTelemetry implementation
- Trace visualization with Jaeger

3. **Alerting:**

- Critical error alerting
- SLA breach notifications
- On-call rotation

Development Workflow

Service Development

1. **Service Template:**

- Standardized service structure
- Common libraries and utilities
- Documentation templates

2. **Local Development:**

- Docker Compose for local environment
- Development database seeding
- Hot reloading for faster iterations

3. **Testing Strategy:**

- Unit tests for business logic
- Integration tests for API contracts
- End-to-end tests for critical paths

Release Process

1. **Feature Development:**

- Feature branch workflow
- Pull request reviews
- Automated testing

2. **Release Preparation:**

- Release branch creation
- Integration testing
- Documentation updates

3. **Deployment:**

- Automated deployment pipeline
- Canary or blue/green strategy
- Rollback procedures

Conclusion and Next Steps

This architecture blueprint provides a comprehensive foundation for the Chronos Calendar application backend. The microservices approach, combined with a strong focus on scalability and real-time capabilities, will enable the application to scale to billions of users while maintaining performance and reliability.

Recommended Next Steps

1. **Prototype Development:**

- Implement core services (Auth, User, Calendar, Event)
- Develop API specifications
- Create infrastructure templates

2. **Technical Validation:**

- Perform load testing on prototype
- Validate data model with sample data
- Review security architecture

3. **Incremental Implementation:**

- Begin with foundation services

- Add features incrementally
- Continuous testing and validation

This document should be reviewed and updated regularly as the project evolves and new requirements emerge.

 Lets work on the following steps: **Prototype Development:**

- Implement core services (Auth, User, Calendar, Event)
- Develop API specifications
- Create infrastructure templates

I'll help you develop the prototype for our Calendar App core services. Let's approach this systematically:

1. Core Services Implementation

Auth Service Prototype

```
// auth-service/src/index.js

const express = require('express');
const jwt = require('jsonwebtoken');
const bcrypt = require('bcrypt');
const { v4: uuidv4 } = require('uuid');
const { Pool } = require('pg');

const app = express();
app.use(express.json());

// Database connection
const pool = new Pool({
  connectionString: process.env.DATABASE_URL,
});

// User registration
app.post('/auth/register', async (req, res) => {
  try {
    const { email, password, name } = req.body;
```

```

// Validate input
if (!email || !password || !name) {
  return res.status(400).json({ error: 'Email, password, and name are required' });
}

// Check if user already exists
const userCheck = await pool.query('SELECT * FROM users WHERE email = $1',
[email]);
if (userCheck.rows.length > 0) {
  return res.status(409).json({ error: 'User already exists' });
}

// Hash password
const salt = await bcrypt.genSalt(10);
const hashedPassword = await bcrypt.hash(password, salt);

// Create user
const userId = uuidv4();
await pool.query(
  'INSERT INTO users (id, email, password_hash, name, created_at) VALUES ($1, $2, $3, $4, NOW())',
  [userId, email, hashedPassword, name]
);

// Generate verification token and send email (simplified)
console.log(`Verification email would be sent to ${email}`);

res.status(201).json({ message: 'User created successfully' });
} catch (error) {
  console.error('Registration error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
});

// User login
app.post('/auth/login', async (req, res) => {
try {
  const { email, password } = req.body;

  // Find user

```

```

const result = await pool.query('SELECT * FROM users WHERE email = $1',
[email]);
if (result.rows.length === 0) {
  return res.status(401).json({ error: 'Invalid credentials' });
}

const user = result.rows[0];

// Check password
const validPassword = await bcrypt.compare(password, user.password_hash);
if (!validPassword) {
  return res.status(401).json({ error: 'Invalid credentials' });
}

// Generate tokens
const accessToken = jwt.sign(
  { userId: user.id, email: user.email },
  process.env.JWT_SECRET,
  { expiresIn: '15m' }
);

const refreshToken = jwt.sign(
  { userId: user.id },
  process.env.JWT_REFRESH_SECRET,
  { expiresIn: '7d' }
);

// Store refresh token
await pool.query(
  'INSERT INTO refresh_tokens (user_id, token, expires_at) VALUES ($1, $2, NOW() + INTERVAL \'7 days\')',
  [user.id, refreshToken]
);

res.json({
  accessToken,
  refreshToken,
  user: {
    id: user.id,
    email: user.email,
    name: user.name
  }
});

```

```

    });
} catch (error) {
  console.error('Login error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
});

// Token refresh
app.post('/auth/refresh', async (req, res) => {
try {
  const { refreshToken } = req.body;

  if (!refreshToken) {
    return res.status(401).json({ error: 'Refresh token required' });
  }

  // Verify token
  const payload = jwt.verify(refreshToken, process.env.JWT_REFRESH_SECRET);

  // Check if token exists in database
  const tokenResult = await pool.query(
    'SELECT * FROM refresh_tokens WHERE user_id = $1 AND token = $2 AND
expires_at > NOW()',
    [payload.userId, refreshToken]
  );

  if (tokenResult.rows.length === 0) {
    return res.status(401).json({ error: 'Invalid refresh token' });
  }

  // Get user info
  const userResult = await pool.query('SELECT * FROM users WHERE id = $1',
[payload.userId]);
  if (userResult.rows.length === 0) {
    return res.status(401).json({ error: 'User not found' });
  }

  const user = userResult.rows[0];

  // Generate new access token
  const accessToken = jwt.sign(
    { userId: user.id, email: user.email },

```

```

    process.env.JWT_SECRET,
    { expiresIn: '15m' }
);

res.json({ accessToken });

} catch (error) {
  console.error('Token refresh error:', error);
  res.status(401).json({ error: 'Invalid refresh token' });
}

});

// Logout
app.post('/auth/logout', async (req, res) => {
  try {
    const { refreshToken } = req.body;

    if (refreshToken) {
      // Remove refresh token from database
      await pool.query('DELETE FROM refresh_tokens WHERE token = $1',
[refreshToken]);
    }

    res.json({ message: 'Logged out successfully' });
  } catch (error) {
    console.error('Logout error:', error);
    res.status(500).json({ error: 'Internal server error' });
  }
});

const PORT = process.env.PORT || 3001;
app.listen(PORT, () => {
  console.log(`Auth service running on port ${PORT}`);
});

```

User Service Prototype

```

// user-service/src/index.js
const express = require('express');
const { Pool } = require('pg');
const jwt = require('jsonwebtoken');

```



```

const app = express();
app.use(express.json());

// Database connection
const pool = new Pool({
  connectionString: process.env.DATABASE_URL,
});

// Authentication middleware
const authenticate = (req, res, next) => {
  const authHeader = req.headers.authorization;

  if (!authHeader || !authHeader.startsWith('Bearer ')) {
    return res.status(401).json({ error: 'Authentication required' });
  }

  const token = authHeader.split(' ')[1];

  try {
    const payload = jwt.verify(token, process.env.JWT_SECRET);
    req.user = payload;
    next();
  } catch (error) {
    return res.status(401).json({ error: 'Invalid token' });
  }
};

// Get current user profile
app.get('/users/me', authenticate, async (req, res) => {
  try {
    const result = await pool.query('SELECT id, email, name, timezone, created_at FROM users WHERE id = $1', [req.user.userId]);

    if (result.rows.length === 0) {
      return res.status(404).json({ error: 'User not found' });
    }
  }

  // Get user preferences
  const prefsResult = await pool.query('SELECT * FROM user_preferences WHERE user_id = $1', [req.user.userId]);
  const preferences = prefsResult.rows[0] || {};

```

```

    res.json({
      ...result.rows[0],
      preferences
    });
  } catch (error) {
    console.error('Get profile error:', error);
    res.status(500).json({ error: 'Internal server error' });
  }
});

// Update user profile
app.patch('/users/me', authenticate, async (req, res) => {
  try {
    const { name, timezone } = req.body;
    const updates = {};
    const values = [];
    let query = 'UPDATE users SET';

    if (name !== undefined) {
      updates.name = name;
    }

    if (timezone !== undefined) {
      updates.timezone = timezone;
    }

    // Build dynamic update query
    let i = 1;
    for (const [key, value] of Object.entries(updates)) {
      query += ` ${key} = $$${i},`;
      values.push(value);
      i++;
    }

    // Remove trailing comma and add WHERE clause
    query = query.slice(0, -1) + ' WHERE id = $' + i + ' RETURNING id, email,
name, timezone, created_at';
    values.push(req.user.userId);

    if (values.length <= 1) {
      return res.status(400).json({ error: 'No fields to update' });
    }
  }
});

```

```

    const result = await pool.query(query, values);
    res.json(result.rows[0]);
} catch (error) {
    console.error('Update profile error:', error);
    res.status(500).json({ error: 'Internal server error' });
}
});

// Update user preferences
app.patch('/users/preferences', authenticate, async (req, res) => {
try {
    const { defaultCalendarId, defaultView, workingHours, notificationSettings } =
        req.body;

    // Check if preferences exist
    const checkResult = await pool.query('SELECT * FROM user_preferences WHERE
user_id = $1', [req.user.userId]);

    if (checkResult.rows.length === 0) {
        // Create preferences
        const insertResult = await pool.query(
            'INSERT INTO user_preferences (user_id, default_calendar_id,
default_view, working_hours, notification_settings) VALUES ($1, $2, $3, $4, $5)
RETURNING *',
            [req.user.userId, defaultCalendarId, defaultView,
JSON.stringify(workingHours), JSON.stringify(notificationSettings)]
        );

        return res.json(insertResult.rows[0]);
    } else {
        // Update existing preferences
        const updates = {};
        const values = [];
        let query = 'UPDATE user_preferences SET';

        if (defaultCalendarId !== undefined) {
            updates.default_calendar_id = defaultCalendarId;
        }

        if (defaultView !== undefined) {
            updates.default_view = defaultView;
        }
    }
}

```

```

    }

    if (workingHours !== undefined) {
        updates.working_hours = JSON.stringify(workingHours);
    }

    if (notificationSettings !== undefined) {
        updates.notification_settings = JSON.stringify(notificationSettings);
    }

    // Build dynamic update query
    let i = 1;
    for (const [key, value] of Object.entries(updates)) {
        query += ` ${key} = $$${i},`;
        values.push(value);
        i++;
    }

    // Remove trailing comma and add WHERE clause
    query = query.slice(0, -1) + ' WHERE user_id = $' + i + ' RETURNING *';
    values.push(req.user.userId);

    if (values.length <= 1) {
        return res.status(400).json({ error: 'No fields to update' });
    }

    const result = await pool.query(query, values);
    res.json(result.rows[0]);
}

} catch (error) {
    console.error('Update preferences error:', error);
    res.status(500).json({ error: 'Internal server error' });
}

});

const PORT = process.env.PORT || 3002;
app.listen(PORT, () => {
    console.log(`User service running on port ${PORT}`);
});

```

Calendar Service Prototype

```

// calendar-service/src/index.js
const express = require('express');
const { Pool } = require('pg');
const jwt = require('jsonwebtoken');
const { v4: uuidv4 } = require('uuid');

const app = express();
app.use(express.json());

// Database connection
const pool = new Pool({
  connectionString: process.env.DATABASE_URL,
});

// Authentication middleware
const authenticate = (req, res, next) => {
  const authHeader = req.headers.authorization;

  if (!authHeader || !authHeader.startsWith('Bearer ')) {
    return res.status(401).json({ error: 'Authentication required' });
  }

  const token = authHeader.split(' ')[1];

  try {
    const payload = jwt.verify(token, process.env.JWT_SECRET);
    req.user = payload;
    next();
  } catch (error) {
    return res.status(401).json({ error: 'Invalid token' });
  }
};

// Get all calendars for current user
app.get('/calendars', authenticate, async (req, res) => {
  try {
    // Get user's own calendars
    const ownCalendarsResult = await pool.query(
      'SELECT * FROM calendars WHERE owner_id = $1',
      [req.user.userId]
    );
  }
}

```

```

// Get calendars shared with user
const sharedCalendarsResult = await pool.query(
  `SELECT c.* FROM calendars c
   JOIN calendar_shares cs ON c.id = cs.calendar_id
   WHERE cs.user_id = $1 AND cs.status = 'accepted'`,
  [req.user.userId]
);

// Combine results
const calendars = [
  ...ownCalendarsResult.rows.map(cal => ({ ...cal, owner: true })),
  ...sharedCalendarsResult.rows.map(cal => ({ ...cal, owner: false }))
];

res.json(calendars);
} catch (error) {
  console.error('Get calendars error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
});

// Create a new calendar
app.post('/calendars', authenticate, async (req, res) => {
try {
  const { name, description, color, isDefault } = req.body;

  if (!name) {
    return res.status(400).json({ error: 'Calendar name is required' });
  }

  // Create calendar
  const calendarId = uuidv4();
  const result = await pool.query(
    'INSERT INTO calendars (id, owner_id, name, description, color,
is_default, is_visible, created_at) VALUES ($1, $2, $3, $4, $5, $6, $7, NOW())
RETURNING *',
    [calendarId, req.user.userId, name, description, color, isDefault || false, true]
  );

  // If this is set as default, update other calendars
}

```

```

    if (isDefault) {
      await pool.query(
        'UPDATE calendars SET is_default = false WHERE owner_id = $1 AND id != $2',
        [req.user.userId, calendarId]
      );
    }

    res.status(201).json(result.rows[0]);
  } catch (error) {
    console.error('Create calendar error:', error);
    res.status(500).json({ error: 'Internal server error' });
  }
});

// Get a specific calendar
app.get('/calendars/:id', authenticate, async (req, res) => {
  try {
    const { id } = req.params;

    // Check calendar access
    const accessCheck = await pool.query(
      `SELECT c.*,
      CASE WHEN c.owner_id = $1 THEN true
            WHEN cs.user_id = $1 THEN true
            ELSE false
      END as has_access,
      CASE WHEN c.owner_id = $1 THEN 'owner'
            WHEN cs.permission = 'view' THEN 'view'
            WHEN cs.permission = 'edit' THEN 'edit'
            ELSE NULL
      END as access_role
    FROM calendars c
    LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
    WHERE c.id = $2`,
      [req.user.userId, id]
    );

    if (accessCheck.rows.length === 0) {
      return res.status(404).json({ error: 'Calendar not found' });
    }
  }
});

```

```

const calendar = accessCheck.rows[0];

if (!calendar.has_access) {
  return res.status(403).json({ error: 'Access denied' });
}

// Get share information if owner
if (calendar.owner_id === req.user.userId) {
  const sharesResult = await pool.query(
    'SELECT * FROM calendar_shares WHERE calendar_id = $1',
    [id]
  );

  calendar.shares = sharesResult.rows;
}

res.json(calendar);
} catch (error) {
  console.error('Get calendar error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
});

// Update a calendar
app.patch('/calendars/:id', authenticate, async (req, res) => {
try {
  const { id } = req.params;
  const { name, description, color, isVisible, isDefault } = req.body;

  // Check calendar access
  const accessCheck = await pool.query(
    `SELECT c.*,
      CASE WHEN c.owner_id = $1 THEN 'owner'
            WHEN cs.permission = 'edit' THEN 'edit'
            ELSE 'view'
      END as access_role
    FROM calendars c
    LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
    WHERE c.id = $2`,
    [req.user.userId, id]
  );
}

```

```

if (accessCheck.rows.length === 0) {
  return res.status(404).json({ error: 'Calendar not found' });
}

const calendar = accessCheck.rows[0];

// Check permissions
if (calendar.access_role === 'view') {
  return res.status(403).json({ error: 'Permission denied' });
}

// Only owner can change default status
if (isDefault !== undefined && calendar.access_role !== 'owner') {
  return res.status(403).json({ error: 'Only the owner can change default status' });
}

// Build update query
const updates = {};
const values = [];
let query = 'UPDATE calendars SET';

if (name !== undefined) {
  updates.name = name;
}

if (description !== undefined) {
  updates.description = description;
}

if (color !== undefined) {
  updates.color = color;
}

if (isVisible !== undefined) {
  updates.is_visible = isVisible;
}

if (isDefault !== undefined) {
  updates.is_default = isDefault;
}

```

```

// Build dynamic update query
let i = 1;
for (const [key, value] of Object.entries(updates)) {
  query += ` ${key} = $$${i},`;
  values.push(value);
  i++;
}

// Add updated_at timestamp
query += ' updated_at = NOW()';

// Add WHERE clause
query += ' WHERE id = $' + i + ' RETURNING *';
values.push(id);

const result = await pool.query(query, values);

// If this is set as default, update other calendars
if (isDefault) {
  await pool.query(
    'UPDATE calendars SET is_default = false WHERE owner_id = $1 AND id != $2',
    [req.user.userId, id]
  );
}

res.json(result.rows[0]);
} catch (error) {
  console.error('Update calendar error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
});

// Delete a calendar
app.delete('/calendars/:id', authenticate, async (req, res) => {
try {
  const { id } = req.params;

  // Check calendar ownership
  const ownerCheck = await pool.query(
    'SELECT * FROM calendars WHERE id = $1 AND owner_id = $2',
    [id, req.user.userId]

```

```

);

if (ownerCheck.rows.length === 0) {
  return res.status(403).json({ error: 'Only the owner can delete a
calendar' });
}

// Delete calendar (cascade will handle events and shares)
await pool.query('DELETE FROM calendars WHERE id = $1', [id]);

res.json({ message: 'Calendar deleted successfully' });
} catch (error) {
  console.error('Delete calendar error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
});

// Share calendar
app.post('/calendars/:id/share', authenticate, async (req, res) => {
try {
  const { id } = req.params;
  const { email, permission } = req.body;

  if (!email || !['view', 'edit'].includes(permission)) {
    return res.status(400).json({ error: 'Valid email and permission
(view/edit) required' });
  }

  // Check calendar ownership
  const ownerCheck = await pool.query(
    'SELECT * FROM calendars WHERE id = $1 AND owner_id = $2',
    [id, req.user.userId]
  );

  if (ownerCheck.rows.length === 0) {
    return res.status(403).json({ error: 'Only the owner can share a calendar' });
  }

  // Check if user exists
  const userCheck = await pool.query('SELECT id FROM users WHERE email = $1',
[Email]);
}

```

```

const userId = userCheck.rows.length > 0 ? userCheck.rows[0].id : null;

// Check if already shared
if (userId) {
  const shareCheck = await pool.query(
    'SELECT * FROM calendar_shares WHERE calendar_id = $1 AND user_id = $2',
    [id, userId]
  );

  if (shareCheck.rows.length > 0) {
    // Update existing share
    const updateResult = await pool.query(
      'UPDATE calendar_shares SET permission = $1, updated_at = NOW() WHERE
calendar_id = $2 AND user_id = $3 RETURNING *',
      [permission, id, userId]
    );
  }

  return res.json(updateResult.rows[0]);
}
}

// Create new share
const shareId = uuidv4();
const inviteToken = Math.random().toString(36).substring(2, 15);

const result = await pool.query(
  'INSERT INTO calendar_shares (id, calendar_id, user_id, email, permission,
status, invite_token, created_at) VALUES ($1, $2, $3, $4, $5, $6, $7, NOW())
RETURNING *',
  [shareId, id, userId, email, permission, userId ? 'accepted' : 'pending',
inviteToken]
);

// TODO: Send email invitation
console.log(`Calendar share invitation would be sent to ${email}`);

res.status(201).json(result.rows[0]);
} catch (error) {
  console.error('Share calendar error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
});

```

```

const PORT = process.env.PORT || 3003;
app.listen(PORT, () => {
  console.log(`Calendar service running on port ${PORT}`);
});

```

Event Service Prototype

```

// event-service/src/index.js

const express = require('express');
const { Pool } = require('pg');
const jwt = require('jsonwebtoken');
const { v4: uuidv4 } = require('uuid');
const RRule = require('rrule').RRule;

const app = express();
app.use(express.json());

// Database connection
const pool = new Pool({
  connectionString: process.env.DATABASE_URL,
});

// Authentication middleware
const authenticate = (req, res, next) => {
  const authHeader = req.headers.authorization;

  if (!authHeader || !authHeader.startsWith('Bearer ')) {
    return res.status(401).json({ error: 'Authentication required' });
  }

  const token = authHeader.split(' ')[1];

  try {
    const payload = jwt.verify(token, process.env.JWT_SECRET);
    req.user = payload;
    next();
  } catch (error) {
    return res.status(401).json({ error: 'Invalid token' });
  }
};

```

```

// Get events for a specific time range
app.get('/events', authenticate, async (req, res) => {
  try {
    const { start, end, calendarIds } = req.query;

    if (!start || !end) {
      return res.status(400).json({ error: 'Start and end dates are required' });
    }
  }

  // Parse calendar IDs
  let calendars = [];
  if (calendarIds) {
    calendars = calendarIds.split(',');
  } else {
    // Get all accessible calendars if none specified
    const accessibleCalendarsResult = await pool.query(
      `SELECT c.id FROM calendars c
       WHERE c.owner_id = $1
       UNION
       SELECT c.id FROM calendars c
       JOIN calendar_shares cs ON c.id = cs.calendar_id
       WHERE cs.user_id = $1 AND cs.status = 'accepted'`,
      [req.user.userId]
    );
  }

  calendars = accessibleCalendarsResult.rows.map(row => row.id);
}

if (calendars.length === 0) {
  return res.json([]);
}

// Get non-recurring events
const nonRecurringEventsResult = await pool.query(
  `SELECT e.* FROM events e
   WHERE e.calendar_id = ANY($1::uuid[])
   AND e.reurrence_rule IS NULL
   AND (
     (e.start_time >= $2::timestamp AND e.start_time <= $3::timestamp)
     OR (e.end_time >= $2::timestamp AND e.end_time <= $3::timestamp)
  )`
```

```

        OR (e.start_time <= $2::timestamp AND e.end_time >= $3::timestamp)
    )`,
    [calendars, start, end]
);

// Get recurring events
const recurringEventsResult = await pool.query(
`SELECT e.* FROM events e
WHERE e.calendar_id = ANY($1::uuid[])
AND e.recurrence_rule IS NOT NULL
AND e.start_time <= $3::timestamp`,
[calendars, start, end]
);

// Process recurring events
const recurringEvents = [];
for (const event of recurringEventsResult.rows) {
    try {
        const rrule = RRule.fromString(event.recurrence_rule);

        // Calculate event duration
        const duration = new Date(event.end_time) - new Date(event.start_time);

        // Generate occurrences within range
        const startDate = new Date(start);
        const endDate = new Date(end);

        const occurrences = rrule.between(startDate, endDate, true);

        // Get exception dates
        let exceptionDates = [];
        if (event.exception_dates) {
            exceptionDates = Array.isArray(event.exception_dates)
                ? event.exception_dates
                : JSON.parse(event.exception_dates);
        }

        // Get modified instances
        const instancesResult = await pool.query(
`SELECT * FROM event_instances
WHERE event_id = $1
AND instance_date >= $2::date
        `,

```

```

        AND instance_date <= $3::date`,
        [event.id, start.split('T')[0], end.split('T')[0]]
);

const instances = instancesResult.rows;

// Generate event instances
for (const date of occurrences) {
    // Check if date is in exceptions
    const dateStr = date.toISOString().split('T')[0];
    if (exceptionDates.includes(dateStr)) {
        continue;
    }

    // Check if there's a modified instance
    const instance = instances.find(i => i.instance_date === dateStr);

    if (instance) {
        // Use modified instance data
        recurringEvents.push({
            ...event,
            id: `${event.id}_${dateStr}`,
            original_event_id: event.id,
            start_time: instance.start_time,
            end_time: instance.end_time,
            is_recurring_instance: true,
            is_exception: instance.is_exception,
            instance_data: instance.exception_data
        });
    } else {
        // Calculate start and end times for this occurrence
        const instanceStart = new Date(date);
        const baseStart = new Date(event.start_time);
        instanceStart.setHours(baseStart.getHours(), baseStart.getMinutes(),
baseStart.getSeconds());

        const instanceEnd = new Date(instanceStart.getTime() + duration);

        recurringEvents.push({
            ...event,
            id: `${event.id}_${dateStr}`,
            original_event_id: event.id,

```

```

        start_time: instanceStart.toISOString(),
        end_time: instanceEnd.toISOString(),
        is_recurring_instance: true,
        is_exception: false
    });
}
}

} catch (error) {
    console.error(`Error processing recurring event ${event.id}:`, error);
    // Skip this event if recurrence rule is invalid
}
}

// Combine all events
const events = [
    ...nonRecurringEventsResult.rows,
    ...recurringEvents
];

res.json(events);
} catch (error) {
    console.error('Get events error:', error);
    res.status(500).json({ error: 'Internal server error' });
}
});

// Create a new event
app.post('/events', authenticate, async (req, res) => {
try {
    const {
        calendarId, title, description, location,
        startTime, endTime, isAllDay, recurrenceRule,
        color, visibility, reminderMinutes
    } = req.body;

    if (!calendarId || !title || !startTime || !endTime) {
        return res.status(400).json({ error: 'Calendar ID, title, start time, and end time are required' });
    }

    // Check calendar access
    const accessCheck = await pool.query(

```

```

`SELECT c.*,
    CASE WHEN c.owner_id = $1 THEN 'owner'
        WHEN cs.permission = 'edit' THEN 'edit'
        ELSE 'view'
    END as access_role
FROM calendars c
LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
WHERE c.id = $2`,
[req.user.userId, calendarId]
);

if (accessCheck.rows.length === 0) {
    return res.status(404).json({ error: 'Calendar not found' });
}

if (accessCheck.rows[0].access_role === 'view') {
    return res.status(403).json({ error: 'Permission denied' });
}

// Create event
const eventId = uuidv4();

const result = await pool

```

 continue

Continuing with the Event Service Prototype implementation:

```

// Create event
const eventId = uuidv4();

const result = await pool.query(
`INSERT INTO events
(id, calendar_id, title, description, location, start_time, end_time,
is_all_day, recurrence_rule, color, visibility, status, created_by,
created_at)
VALUES ($1, $2, $3, $4, $5, $6, $7, $8, $9, $10, $11, $12, $13, NOW())
RETURNING *`,
[

```

```

        eventId, calendarId, title, description, location,
        startTime, endTime, isAllDay || false, recurrenceRule,
        color, visibility || 'default', 'confirmed', req.user.userId
    ]
);

const event = result.rows[0];

// Create reminder if requested
if (reminderMinutes) {
    await pool.query(
        `INSERT INTO reminders
        (id, event_id, user_id, minutes_before, method, created_at)
        VALUES ($1, $2, $3, $4, $5, NOW())`,
        [uuidv4(), eventId, req.user.userId, reminderMinutes, 'notification']
    );
}

res.status(201).json(event);
} catch (error) {
    console.error('Create event error:', error);
    res.status(500).json({ error: 'Internal server error' });
}
});

// Get a specific event
app.get('/events/:id', authenticate, async (req, res) => {
try {
    const { id } = req.params;

    // Check if it's a recurring instance
    const isRecurringInstance = id.includes('_');

    let eventId = id;
    let instanceDate = null;

    if (isRecurringInstance) {
        [eventId, instanceDate] = id.split('_');
    }

    // Get the event
    const eventResult = await pool.query(

```

```

`SELECT e.*,
    CASE WHEN c.owner_id = $1 THEN 'owner'
        WHEN cs.permission = 'edit' THEN 'edit'
        WHEN cs.permission = 'view' THEN 'view'
        WHEN c.owner_id = e.created_by THEN 'view'
        ELSE NULL
    END as access_role
FROM events e
JOIN calendars c ON e.calendar_id = c.id
LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
WHERE e.id = $2`,
[req.user.userId, eventId]
);

if (eventResult.rows.length === 0) {
    return res.status(404).json({ error: 'Event not found' });
}

let event = eventResult.rows[0];

if (!event.access_role) {
    return res.status(403).json({ error: 'Access denied' });
}

// If it's a recurring instance, get the instance data
if (isRecurringInstance && instanceDate) {
    // Check if it's an exception
    const instanceResult = await pool.query(
        `SELECT * FROM event_instances
        WHERE event_id = $1 AND instance_date = $2::date`,
        [eventId, instanceDate]
    );

    if (instanceResult.rows.length > 0) {
        const instance = instanceResult.rows[0];

        event = {
            ...event,
            id: id,
            original_event_id: eventId,
            start_time: instance.start_time,
            end_time: instance.end_time,
        };
    }
}

```

```

        is_recurring_instance: true,
        is_exception: instance.is_exception,
        instance_data: instance.exception_data
    };
} else {
    // Calculate instance times based on recurrence rule
    if (event.recurrence_rule) {
        try {
            const rrule = RRule.fromString(event.recurrence_rule);

            // Calculate event duration
            const duration = new Date(event.end_time) - new
Date(event.start_time);

            // Base instance date
            const baseDate = new Date(`#${instanceDate}T00:00:00Z`);

            // Verify this date is actually in the recurrence pattern
            const occurrences = rrule.between(
                new Date(baseDate.getTime() - 86400000), // 1 day before
                new Date(baseDate.getTime() + 86400000), // 1 day after
                true
            );

            const matchingDate = occurrences.find(d =>
                d.toISOString().split('T')[0] === instanceDate
            );

            if (matchingDate) {
                // Calculate start and end times for this occurrence
                const instanceStart = new Date(matchingDate);
                const baseStart = new Date(event.start_time);
                instanceStart.setHours(baseStart.getHours(),
baseStart.getMinutes(), baseStart.getSeconds());

                const instanceEnd = new Date(instanceStart.getTime() + duration);

                event = {
                    ...event,
                    id: id,
                    original_event_id: eventId,
                    start_time: instanceStart.toISOString(),

```

```

        end_time: instanceEnd.toISOString(),
        is_recurring_instance: true,
        is_exception: false
    );
} else {
    return res.status(404).json({ error: 'Event instance not found' });
}
} catch (error) {
    console.error(`Error processing recurring event ${eventId}:`, error);
    return res.status(500).json({ error: 'Error processing recurring event' });
}
} else {
    return res.status(404).json({ error: 'Event instance not found' });
}
}

// Get reminders
const remindersResult = await pool.query(
    'SELECT * FROM reminders WHERE event_id = $1 AND user_id = $2',
    [eventId, req.user.userId]
);

event.reminders = remindersResult.rows;

// Get attendees if it's the creator
if (event.created_by === req.user.userId) {
    const attendeesResult = await pool.query(
        'SELECT * FROM event_attendees WHERE event_id = $1',
        [eventId]
    );

    event.attendees = attendeesResult.rows;
}

res.json(event);
} catch (error) {
    console.error('Get event error:', error);
    res.status(500).json({ error: 'Internal server error' });
}

```

```

    }

});

// Update an event
app.patch('/events/:id', authenticate, async (req, res) => {
  try {
    const { id } = req.params;
    const {
      title, description, location, startTime, endTime,
      isAllDay, recurrenceRule, color, visibility, status
    } = req.body;

    // Check if it's a recurring instance
    const isRecurringInstance = id.includes('_');

    if (isRecurringInstance) {
      return res.status(400).json({
        error: 'Cannot update recurring instance directly. Use /events/:id/instance/:date endpoint'
      });
    }
  }

  // Check event access
  const accessCheck = await pool.query(
    `SELECT e.*,
      CASE WHEN c.owner_id = $1 THEN 'owner'
            WHEN cs.permission = 'edit' THEN 'edit'
            WHEN e.created_by = $1 THEN 'creator'
            ELSE 'view'
      END as access_role
    FROM events e
    JOIN calendars c ON e.calendar_id = c.id
    LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
    WHERE e.id = $2`,
    [req.user.userId, id]
  );

  if (accessCheck.rows.length === 0) {
    return res.status(404).json({ error: 'Event not found' });
  }

  const event = accessCheck.rows[0];

```

```
if (event.access_role === 'view') {
  return res.status(403).json({ error: 'Permission denied' });
}

// Build update query
const updates = {};
const values = [];
let query = 'UPDATE events SET';

if (title !== undefined) {
  updates.title = title;
}

if (description !== undefined) {
  updates.description = description;
}

if (location !== undefined) {
  updates.location = location;
}

if (startTime !== undefined) {
  updates.start_time = startTime;
}

if (endTime !== undefined) {
  updates.end_time = endTime;
}

if (isAllDay !== undefined) {
  updates.is_all_day = isAllDay;
}

if (recurrenceRule !== undefined) {
  updates.recurrence_rule = recurrenceRule;
}

if (color !== undefined) {
  updates.color = color;
}
```

```

if (visibility !== undefined) {
  updates.visibility = visibility;
}

if (status !== undefined) {
  updates.status = status;
}

// Build dynamic update query
let i = 1;
for (const [key, value] of Object.entries(updates)) {
  query += ` ${key} = $$${i},`;
  values.push(value);
  i++;
}

// Add version increment and updated_at
query += ' version = version + 1, updated_at = NOW()';

// Add WHERE clause
query += ' WHERE id = $' + i + ' RETURNING *';
values.push(id);

if (values.length <= 1) {
  return res.status(400).json({ error: 'No fields to update' });
}

const result = await pool.query(query, values);

res.json(result.rows[0]);
} catch (error) {
  console.error('Update event error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
});

// Delete an event
app.delete('/events/:id', authenticate, async (req, res) => {
try {
  const { id } = req.params;
  const { recurring } = req.query; // all, future, this

```

```

// Check if it's a recurring instance
const isRecurringInstance = id.includes('_');

let eventId = id;
let instanceDate = null;

if (isRecurringInstance) {
  [eventId, instanceDate] = id.split('_');
}

// Check event access
const accessCheck = await pool.query(
  `SELECT e.*,
    CASE WHEN c.owner_id = $1 THEN 'owner'
      WHEN cs.permission = 'edit' THEN 'edit'
      WHEN e.created_by = $1 THEN 'creator'
      ELSE 'view'
    END as access_role
  FROM events e
  JOIN calendars c ON e.calendar_id = c.id
  LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
  WHERE e.id = $2`,
  [req.user.userId, eventId]
);

if (accessCheck.rows.length === 0) {
  return res.status(404).json({ error: 'Event not found' });
}

const event = accessCheck.rows[0];

if (event.access_role === 'view') {
  return res.status(403).json({ error: 'Permission denied' });
}

// Handle recurring instance or normal event
if (isRecurringInstance && instanceDate) {
  // Add an exception date for this instance
  let exceptionDates = [];

  if (event.exception_dates) {
    exceptionDates = Array.isArray(event.exception_dates)

```

```

    ? event.exception_dates
    : JSON.parse(event.exception_dates);
}

if (!exceptionDates.includes(instanceDate)) {
    exceptionDates.push(instanceDate);
}

await pool.query(
    'UPDATE events SET exception_dates = $1, updated_at = NOW() WHERE id = $2',
    [JSON.stringify(exceptionDates), eventId]
);

// Delete any instance record if it exists
await pool.query(
    'DELETE FROM event_instances WHERE event_id = $1 AND instance_date = $2',
    [eventId, instanceDate]
);

} else if (event.recurrence_rule && recurring) {
    // Handle recurring event deletion options
    if (recurring === 'this') {
        // Similar to instance deletion
        let exceptionDates = [];

        if (event.exception_dates) {
            exceptionDates = Array.isArray(event.exception_dates)
                ? event.exception_dates
                : JSON.parse(event.exception_dates);
        }

        // Add today's date (or start date) as exception
        const today = new Date().toISOString().split('T')[0];
        if (!exceptionDates.includes(today)) {
            exceptionDates.push(today);
        }
    }

    await pool.query(
        'UPDATE events SET exception_dates = $1, updated_at = NOW() WHERE id = $2',
        [JSON.stringify(exceptionDates), eventId]
    );
}

```

```

    );
} else if (recurring === 'future') {
    // Modify the recurrence rule to end yesterday
    try {
        const rrule = RRule.fromString(event.recurrence_rule);
        const options = rrule.options;

        // Set until to yesterday
        const yesterday = new Date();
        yesterday.setDate(yesterday.getDate() - 1);
        options.until = yesterday;

        const newRule = new RRule(options).toString();

        await pool.query(
            'UPDATE events SET recurrence_rule = $1, updated_at = NOW() WHERE id = $2',
            [newRule, eventId]
        );
    } catch (error) {
        console.error(`Error modifying recurrence rule for ${eventId}:`, error);
        return res.status(500).json({ error: 'Error modifying recurrence rule' });
    }
} else {
    // Delete the entire recurring event series
    await pool.query('DELETE FROM events WHERE id = $1', [eventId]);
}
} else {
    // Delete normal event
    await pool.query('DELETE FROM events WHERE id = $1', [eventId]);
}

res.json({ message: 'Event deleted successfully' });
} catch (error) {
    console.error('Delete event error:', error);
    res.status(500).json({ error: 'Internal server error' });
}
});

const PORT = process.env.PORT || 3004;

```

```
app.listen(PORT, () => {
  console.log(`Event service running on port ${PORT}`);
});
```

2. API Specifications

Let's create a GraphQL schema that combines these services:

```
# schema.graphql

# Scalar types
scalar DateTime
scalar JSON

# User Types
type User {
  id: ID!
  email: String!
  name: String
  timezone: String!
  preferences: UserPreferences
  createdAt: DateTime!
  updatedAt: DateTime
}

type UserPreferences {
  defaultCalendarId: ID
  defaultView: ViewType
  workingHours: WorkingHours
  notificationSettings: NotificationSettings
}

type WorkingHours {
  start: String!
  end: String!
  days: [Int!]!
}

type NotificationSettings {
  eventReminders: Boolean!
```

```
    shareNotifications: Boolean!
    emailNotifications: Boolean!
}

enum ViewType {
  DAY
  WEEK
  MONTH
  AGENDA
}

# Calendar Types
type Calendar {
  id: ID!
  owner: User!
  name: String!
  description: String
  color: String
  isDefault: Boolean!
  isVisible: Boolean!
  events(start: DateTime, end: DateTime): [Event!]
  shares: [CalendarShare!]
  createdAt: DateTime!
  updatedAt: DateTime
}

type CalendarShare {
  id: ID!
  calendar: Calendar!
  user: User
  email: String!
  permission: Permission!
  status: ShareStatus!
  inviteToken: String
  createdAt: DateTime!
  updatedAt: DateTime
}

enum Permission {
  VIEW
  EDIT
}
```

```
enum ShareStatus {
    PENDING
    ACCEPTED
    DECLINED
}

# Event Types
type Event {
    id: ID!
    calendar: Calendar!
    title: String!
    description: String
    location: String
    startTime: DateTime!
    endTime: DateTime!
    isAllDay: Boolean!
    recurrenceRule: String
    exceptionDates: [DateTime]
    color: String
    visibility: Visibility!
    status: EventStatus!
    reminders: [Reminder!]
    attendees: [EventAttendee!]
    createdBy: User!
    isRecurringInstance: Boolean
    originalEventId: ID
    createdAt: DateTime!
    updatedAt: DateTime
    version: Int!
}

enum Visibility {
    DEFAULT
    PUBLIC
    PRIVATE
    CONFIDENTIAL
}

enum EventStatus {
    CONFIRMED
    TENTATIVE
```

```
CANCELLED
}

type EventAttendee {
    id: ID!
    event: Event!
    user: User
    email: String!
    name: String
    responseStatus: ResponseStatus!
    createdAt: DateTime!
    updatedAt: DateTime
}

enum ResponseStatus {
    PENDING
    ACCEPTED
    DECLINED
    TENTATIVE
}

type Reminder {
    id: ID!
    event: Event!
    user: User!
    minutesBefore: Int!
    method: ReminderMethod!
    createdAt: DateTime!
    updatedAt: DateTime
}

enum ReminderMethod {
    NOTIFICATION
    EMAIL
}

# Input Types
input RegisterInput {
    email: String!
    password: String!
    name: String!
}
```

```
input LoginInput {
    email: String!
    password: String!
}

input UpdateUserInput {
    name: String
    timezone: String
}

input UpdatePreferencesInput {
    defaultCalendarId: ID
    defaultView: ViewType
    workingHours: WorkingHoursInput
    notificationSettings: NotificationSettingsInput
}

input WorkingHoursInput {
    start: String
    end: String
    days: [Int!]
}

input NotificationSettingsInput {
    eventReminders: Boolean
    shareNotifications: Boolean
    emailNotifications: Boolean
}

input CreateCalendarInput {
    name: String!
    description: String
    color: String
    isDefault: Boolean
    isVisible: Boolean
}

input UpdateCalendarInput {
    name: String
    description: String
    color: String
```

```
    isDefault: Boolean
    isVisible: Boolean
}


```

```
input UpdateEventInstanceInput {
    title: String
    description: String
    location: String
    startTime: DateTime
    endTime: DateTime
    color: String
    status: EventStatus
}

# Root Types
type Query {
    # User queries
    me: User

    # Calendar queries
    calendar(id: ID!): Calendar
    calendars: [Calendar!]!

    # Event queries
    event(id: ID!): Event
    events(calendarIds: [ID!], start: DateTime!, end: DateTime!): [Event!]!
}

type Mutation {
    # Auth mutations
    register(input: RegisterInput!): AuthPayload!
    login(input: LoginInput!): AuthPayload!
    refreshToken(refreshToken: String!): AuthPayload!
    logout(refreshToken: String!): Boolean!

    # User mutations
    updateUser(input: UpdateUserInput!): User!
    updatePreferences(input: UpdatePreferencesInput!): UserPreferences!

    # Calendar mutations
    createCalendar(input: CreateCalendarInput!): Calendar!
    updateCalendar(id: ID!, input: UpdateCalendarInput!): Calendar!
    deleteCalendar(id: ID!): Boolean!
    shareCalendar(input: ShareCalendarInput!): CalendarShare!
}
```

```

# Event mutations
createEvent(input: CreateEventInput!): Event!
updateEvent(id: ID!, input: UpdateEventInput!): Event!
updateEventInstance(eventId: ID!, instanceDate: DateTime!, input:
UpdateEventInstanceInput!): Event!
deleteEvent(id: ID!, recurring: String): Boolean!
createReminder(eventId: ID!, minutesBefore: Int!, method: ReminderMethod!):
Reminder!
deleteReminder(id: ID!): Boolean!
}

type Subscription {
  calendarUpdated(calendarId: ID): Calendar
  eventCreated(calendarIds: [ID!]): Event
  eventUpdated(calendarIds: [ID!]): Event
  eventDeleted(calendarIds: [ID!]): ID
}

type AuthPayload {
  accessToken: String!
  refreshToken: String
  user: User!
}

```

3. Infrastructure Templates

Let's create essential infrastructure templates using Terraform:

```

# main.tf - Main infrastructure configuration

provider "aws" {
  region = var.aws_region
}

# VPC Configuration
module "vpc" {
  source = "./modules/vpc"

  environment      = var.environment
  vpc_cidr        = var.vpc_cidr
  availability_zones = var.availability_zones

```

```

public_subnet_cidrs  = var.public_subnet_cidrs
private_subnet_cidrs = var.private_subnet_cidrs
}

# Security Groups
module "security_groups" {
  source = "./modules/security"

  environment = var.environment
  vpc_id      = module.vpc.vpc_id
}

# Database Configuration
module "database" {
  source = "./modules/database"

  environment          = var.environment
  vpc_id               = module.vpc.vpc_id
  subnet_ids           = module.vpc.private_subnet_ids
  db_security_group_id = module.security_groups.db_security_group_id
  db_name               = var.db_name
  db_username           = var.db_username
  db_password           = var.db_password
  db_instance_class     = var.db_instance_class
  db_allocated_storage   = var.db_allocated_storage
  multi_az              = var.environment == "production"
}

# Redis Cache
module "redis" {
  source = "./modules/redis"

  environment          = var.environment
  vpc_id               = module.vpc.vpc_id
  subnet_ids           = module.vpc.private_subnet_ids
  redis_security_group_id = module.security_groups.redis_security_group_id
  redis_node_type       = var.redis_node_type
  redis_num_cache_nodes = var.redis_num_cache_nodes
}

# ECS Cluster
module "ecs" {

```

```

source = "./modules/ecs"

environment           = var.environment
vpc_id                = module.vpc.vpc_id
public_subnet_ids     = module.vpc.public_subnet_ids
private_subnet_ids    = module.vpc.private_subnet_ids
app_security_group_id = module.security_groups.app_security_group_id
lb_security_group_id  = module.security_groups.lb_security_group_id
db_endpoint            = module.database.db_endpoint
redis_endpoint         = module.redis.redis_endpoint
}

# ECR Repositories
module "ecr" {
  source = "./modules/ecr"

  environment           = var.environment
  service_names          = ["auth-service", "user-service", "calendar-service",
"event-service"]
}

# S3 Bucket for assets
module "s3" {
  source = "./modules/s3"

  environment           = var.environment
  bucket_name            = var.assets_bucket_name
}

# CloudWatch Monitoring
module "monitoring" {
  source = "./modules/monitoring"

  environment           = var.environment
  alarm_email             = var.alarm_email
}

# Route53 DNS
module "dns" {
  source = "./modules/dns"

  environment           = var.environment
}

```

```

domain_name          = var.domain_name
lb_dns_name         = module.ecs.lb_dns_name
lb_zone_id          = module.ecs.lb_zone_id
}

# modules/vpc/main.tf

resource "aws_vpc" "main" {
  cidr_block          = var.vpc_cidr
  enable_dns_hostnames = true
  enable_dns_support   = true

  tags = {
    Name      = "${var.environment}-vpc"
    Environment = var.environment
  }
}

resource "aws_subnet" "public" {
  count              = length(var.public_subnet_cidrs)
  vpc_id             = aws_vpc.main.id
  cidr_block         = var.public_subnet_cidrs[count.index]
  availability_zone  = var.availability_zones[count.index]
  map_public_ip_on_launch = true

  tags = {
    Name      = "${var.environment}-public-subnet-${count.index + 1}"
    Environment = var.environment
  }
}

resource "aws_subnet" "private" {
  count              = length(var.private_subnet_cidrs)
  vpc_id             = aws_vpc.main.id
  cidr_block         = var.private_subnet_cidrs[count.index]
  availability_zone  = var.availability_zones[count.index]

  tags = {
    Name      = "${var.environment}-private-subnet-${count.index + 1}"
    Environment = var.environment
  }
}

```

```

resource "aws_internet_gateway" "igw" {
  vpc_id = aws_vpc.main.id

  tags = {
    Name      = "${var.environment}-igw"
    Environment = var.environment
  }
}

resource "aws_route_table" "public" {
  vpc_id = aws_vpc.main.id

  route {
    cidr_block = "0.0.0.0/0"
    gateway_id = aws_internet_gateway.igw.id
  }

  tags = {
    Name      = "${var.environment}-public-route-table"
    Environment = var.environment
  }
}

resource "aws_route_table_association" "public" {
  count      = length(var.public_subnet_cidrs)
  subnet_id   = aws_subnet.public[count.index].id
  route_table_id = aws_route_table.public.id
}

resource "aws_eip" "nat" {
  count = var.environment == "production" ? length(var.availability_zones) : 1
  vpc   = true

  tags = {
    Name      = "${var.environment}-nat-eip-${count.index + 1}"
    Environment = var.environment
  }
}

resource "aws_nat_gateway" "nat" {
  count      = var.environment == "production" ? length(var.availability_zones) :
1
}

```

```

allocation_id = aws_eip.nat[count.index].id
subnet_id      = aws_subnet.public[count.index].id

tags = {
    Name          = "${var.environment}-nat-gateway-${count.index + 1}"
    Environment   = var.environment
}
}

resource "aws_route_table" "private" {
    count  = var.environment == "production" ? length(var.availability_zones) : 1
    vpc_id = aws_vpc.main.id

    route {
        cidr_block      = "0.0.0.0/0"
        nat_gateway_id = aws_nat_gateway.nat[count.index].id
    }
}

tags = {
    Name          = "${var.environment}-private-route-table-${count.index + 1}"
    Environment   = var.environment
}
}

resource "aws_route_table_association" "private" {
    count      = length(var.private_subnet_cidrs)
    subnet_id  = aws_subnet.private[count.index].id
    route_table_id = var.environment == "production" ?
aws_route_table.private[count.index].id : aws_route_table.private[0].id
}
# modules/database/main.tf

resource "aws_db_subnet_group" "main" {
    name          = "${var.environment}-db-subnet-group"
    subnet_ids   = var.subnet_ids
    description   = "Database subnet group for ${var.environment}"

    tags = {
        Name          = "${var.environment}-db-subnet-group"
        Environment   = var.environment
    }
}

```

```

resource "aws_db_instance" "postgres" {
  identifier          = "${var.environment}-postgres"
  allocated_storage   = var.db_allocated_storage
  engine              = "postgres"
  engine_version      = "13.7"
  instance_class      = var.db_instance_class
  db_name              = var.db_name
  username             = var.db_username
  password             = var.db_password
  vpc_security_group_ids = [var.db_security_group_id]
  db_subnet_group_name = aws_db_subnet_group.main.name
  multi_az             = var.multi_az
  storage_encrypted    = true
  skip_final_snapshot   = var.environment != "production"

  backup_retention_period = var.environment == "production" ? 7 : 1
  backup_window           = "03:00-04:00"
  maintenance_window      = "mon:04:00-mon:05:00"
}

parameter_group_name = aws_db_parameter_group.postgres.name

tags = {
  Name      = "${var.environment}-postgres"
  Environment = var.environment
}
}

resource "aws_db_parameter_group" "postgres" {
  name      = "${var.environment}-postgres-params"
  family    = "postgres13"
  description = "Postgres parameter group for ${var.environment}"

  parameter {
    name  = "log_statement"
    value = var.environment == "production" ? "none" : "all"
  }

  parameter {
    name  = "log_min_duration_statement"
    value = var.environment == "production" ? "1000" : "0"
  }
}

```

```

}

# Create schema migration setup here if needed
# modules/ecs/main.tf

resource "aws_ecs_cluster" "main"

```

 continue

Continuing with the ECS module:

```

# modules/ecs/main.tf

resource "aws_ecs_cluster" "main" {
  name = "${var.environment}-cluster"

  setting {
    name  = "containerInsights"
    value = "enabled"
  }

  tags = {
    Name        = "${var.environment}-ecs-cluster"
    Environment = var.environment
  }
}

# Application Load Balancer
resource "aws_lb" "main" {
  name          = "${var.environment}-alb"
  internal      = false
  load_balancer_type = "application"
  security_groups = [var.lb_security_group_id]
  subnets       = var.public_subnet_ids

  enable_deletion_protection = var.environment == "production"

  tags = {
    Name        = "${var.environment}-alb"
    Environment = var.environment
  }
}

```

```

    }

}

# ALB Target Groups - one per service
resource "aws_lb_target_group" "auth" {
  name      = "${var.environment}-auth-tg"
  port      = 3001
  protocol   = "HTTP"
  vpc_id     = var.vpc_id
  target_type = "ip"

  health_check {
    healthy_threshold    = 3
    unhealthy_threshold = 3
    timeout             = 5
    interval            = 30
    path                = "/health"
    port                = "traffic-port"
  }
}

resource "aws_lb_target_group" "user" {
  name      = "${var.environment}-user-tg"
  port      = 3002
  protocol   = "HTTP"
  vpc_id     = var.vpc_id
  target_type = "ip"

  health_check {
    healthy_threshold    = 3
    unhealthy_threshold = 3
    timeout             = 5
    interval            = 30
    path                = "/health"
    port                = "traffic-port"
  }
}

resource "aws_lb_target_group" "calendar" {
  name      = "${var.environment}-calendar-tg"
  port      = 3003
  protocol   = "HTTP"
}

```

```

vpc_id      = var.vpc_id
target_type = "ip"

health_check {
  healthy_threshold  = 3
  unhealthy_threshold = 3
  timeout            = 5
  interval           = 30
  path               = "/health"
  port               = "traffic-port"
}
}

resource "aws_lb_target_group" "event" {
  name      = "${var.environment}-event-tg"
  port      = 3004
  protocol  = "HTTP"
  vpc_id    = var.vpc_id
  target_type = "ip"

  health_check {
    healthy_threshold  = 3
    unhealthy_threshold = 3
    timeout            = 5
    interval           = 30
    path               = "/health"
    port               = "traffic-port"
  }
}
}

# ALB Listeners
resource "aws_lb_listener" "http" {
  load_balancer_arn = aws_lb.main.arn
  port             = 80
  protocol         = "HTTP"

  default_action {
    type = "redirect"

    redirect {
      port      = "443"
      protocol = "HTTPS"
    }
  }
}

```

```

        status_code = "HTTP_301"
    }
}
}

resource "aws_lb_listener" "https" {
    load_balancer_arn = aws_lb.main.arn
    port              = 443
    protocol          = "HTTPS"
    ssl_policy        = "ELBSecurityPolicy-2016-08"
    certificate_arn   = var.certificate_arn

    default_action {
        type = "fixed-response"

        fixed_response {
            content_type = "text/plain"
            message_body = "Service not found"
            status_code  = "404"
        }
    }
}

# ALB Listener Rules
resource "aws_lb_listener_rule" "auth" {
    listener_arn = aws_lb_listener.https.arn
    priority     = 100

    action {
        type          = "forward"
        target_group_arn = aws_lb_target_group.auth.arn
    }

    condition {
        path_pattern {
            values = ["/auth/*"]
        }
    }
}

resource "aws_lb_listener_rule" "user" {
    listener_arn = aws_lb_listener.https.arn
}

```

```

priority      = 110

action {
    type          = "forward"
    target_group_arn = aws_lb_target_group.user.arn
}

condition {
    path_pattern {
        values = ["/users/*"]
    }
}
}

resource "aws_lb_listener_rule" "calendar" {
    listener_arn = aws_lb_listener.https.arn
    priority     = 120

    action {
        type          = "forward"
        target_group_arn = aws_lb_target_group.calendar.arn
    }

    condition {
        path_pattern {
            values = ["/calendars/*"]
        }
    }
}

resource "aws_lb_listener_rule" "event" {
    listener_arn = aws_lb_listener.https.arn
    priority     = 130

    action {
        type          = "forward"
        target_group_arn = aws_lb_target_group.event.arn
    }

    condition {
        path_pattern {
            values = ["/events/*"]
        }
    }
}

```

```

        }
    }
}

# ECS Task Execution Role
resource "aws_iam_role" "ecs_task_execution_role" {
    name = "${var.environment}-ecs-task-execution-role"

    assume_role_policy = jsonencode({
        Version = "2012-10-17"
        Statement = [
            {
                Action = "sts:AssumeRole"
                Effect = "Allow"
                Principal = {
                    Service = "ecs-tasks.amazonaws.com"
                }
            }
        ]
    })
}

resource "aws_iam_role_policy_attachment" "ecs_task_execution_role_policy" {
    role      = aws_iam_role.ecs_task_execution_role.name
    policy_arn = "arn:aws:iam::aws:policy/service-
role/AmazonECSTaskExecutionRolePolicy"
}

# Auth Service
resource "aws_ecs_task_definition" "auth" {
    family           = "${var.environment}-auth"
    network_mode     = "awsvpc"
    requires_compatibility = ["FARGATE"]
    cpu              = 256
    memory           = 512
    execution_role_arn = aws_iam_role.ecs_task_execution_role.arn

    container_definitions = jsonencode([
        {
            name      = "auth-service"
            image     = "${var.ecr_repository_url_auth}:latest"
            essential = true
        }
    ])
}

```

```

portMappings = [
    {
        containerPort = 3001
        hostPort      = 3001
        protocol      = "tcp"
    }
]

environment = [
    {
        name  = "NODE_ENV"
        value = var.environment
    },
    {
        name  = "PORT"
        value = "3001"
    },
    {
        name  = "DATABASE_URL"
        value =
"postgresql://${var.db_username}:${var.db_password}@${var.db_endpoint}/${var.db_name}"
    },
    {
        name  = "REDIS_URL"
        value = "redis://${var.redis_endpoint}:6379"
    },
    {
        name  = "JWT_SECRET"
        value = var.jwt_secret
    },
    {
        name  = "JWT_REFRESH_SECRET"
        value = var.jwt_refresh_secret
    }
]

logConfiguration = {
    logDriver = "awslogs"
    options = {
        awslogs-group      = "/ecs/${var.environment}/auth-service"
        awslogs-region     = var.aws_region

```

```

awslogs-stream-prefix = "ecs"
}
}
}
])
)

tags = {
  Name      = "${var.environment}-auth-task"
  Environment = var.environment
}
}

resource "aws_ecs_service" "auth" {
  name          = "${var.environment}-auth-service"
  cluster        = aws_ecs_cluster.main.id
  task_definition = aws_ecs_task_definition.auth.arn
  desired_count  = var.environment == "production" ? 2 : 1
  launch_type    = "FARGATE"

  network_configuration {
    subnets          = var.private_subnet_ids
    security_groups  = [var.app_security_group_id]
    assign_public_ip = false
  }
}

load_balancer {
  target_group_arn = aws_lb_target_group.auth.arn
  container_name   = "auth-service"
  container_port   = 3001
}

deployment_controller {
  type = "ECS"
}

deployment_circuit_breaker {
  enable   = true
  rollback = true
}

depends_on = [aws_lb_listener.https]

```

```

tags = {
    Name      = "${var.environment}-auth-service"
    Environment = var.environment
}
}

# Similar configurations for User, Calendar, and Event services
# (skipped for brevity but would follow the same pattern)
# modules/redis/main.tf

resource "aws_elasticache_subnet_group" "main" {
    name      = "${var.environment}-redis-subnet-group"
    subnet_ids = var.subnet_ids
    description = "Redis subnet group for ${var.environment}"
}

resource "aws_elasticache_cluster" "redis" {
    cluster_id      = "${var.environment}-redis"
    engine          = "redis"
    node_type       = var.redis_node_type
    num_cache_nodes = var.redis_num_cache_nodes
    parameter_group_name = "default.redis6.x"
    engine_version   = "6.x"
    port            = 6379

    subnet_group_name = aws_elasticache_subnet_group.main.name
    security_group_ids = [var.redis_security_group_id]

    maintenance_window = "sun:05:00-sun:06:00"
    snapshot_window     = "03:00-04:00"
    snapshot_retention_limit = var.environment == "production" ? 7 : 1
}

tags = {
    Name      = "${var.environment}-redis"
    Environment = var.environment
}
}

# modules/security/main.tf

# Load Balancer Security Group
resource "aws_security_group" "lb" {
    name      = "${var.environment}-lb-sg"

```

```

description = "Controls access to the ALB"
vpc_id      = var.vpc_id

ingress {
  from_port   = 80
  to_port     = 80
  protocol    = "tcp"
  cidr_blocks = ["0.0.0.0/0"]
}

ingress {
  from_port   = 443
  to_port     = 443
  protocol    = "tcp"
  cidr_blocks = ["0.0.0.0/0"]
}

egress {
  from_port   = 0
  to_port     = 0
  protocol    = "-1"
  cidr_blocks = ["0.0.0.0/0"]
}

tags = {
  Name        = "${var.environment}-lb-sg"
  Environment = var.environment
}
}

# Application Security Group
resource "aws_security_group" "app" {
  name        = "${var.environment}-app-sg"
  description = "Controls access to the application containers"
  vpc_id      = var.vpc_id

  ingress {
    from_port   = 0
    to_port     = 0
    protocol    = "-1"
    security_groups = [aws_security_group.lb.id]
  }
}

```

```

egress {
    from_port    = 0
    to_port      = 0
    protocol     = "-1"
    cidr_blocks = ["0.0.0.0/0"]
}

tags = {
    Name          = "${var.environment}-app-sg"
    Environment   = var.environment
}
}

# Database Security Group
resource "aws_security_group" "db" {
    name          = "${var.environment}-db-sg"
    description   = "Controls access to the database"
    vpc_id        = var.vpc_id

ingress {
    from_port      = 5432
    to_port        = 5432
    protocol       = "tcp"
    security_groups = [aws_security_group.app.id]
}

egress {
    from_port    = 0
    to_port      = 0
    protocol     = "-1"
    cidr_blocks = ["0.0.0.0/0"]
}

tags = {
    Name          = "${var.environment}-db-sg"
    Environment   = var.environment
}
}

# Redis Security Group
resource "aws_security_group" "redis" {

```

```

name          = "${var.environment}-redis-sg"
description   = "Controls access to Redis"
vpc_id       = var.vpc_id

ingress {
  from_port     = 6379
  to_port       = 6379
  protocol      = "tcp"
  security_groups = [aws_security_group.app.id]
}

egress {
  from_port    = 0
  to_port      = 0
  protocol     = "-1"
  cidr_blocks = ["0.0.0.0/0"]
}

tags = {
  Name        = "${var.environment}-redis-sg"
  Environment = var.environment
}
}

```

Deployment Scripts

Let's create a sample CI/CD pipeline using GitHub Actions:

```

# .github/workflows/deploy.yml

name: Build and Deploy

on:
  push:
    branches:
      - main
      - develop
  pull_request:
    branches:
      - main
      - develop

```

```
env:
  AWS_REGION: us-west-2

jobs:
  test:
    name: Test
    runs-on: ubuntu-latest

    services:
      postgres:
        image: postgres:13
        env:
          POSTGRES_PASSWORD: postgres
          POSTGRES_USER: postgres
          POSTGRES_DB: calendar_test
        ports:
          - 5432:5432
        options: >-
          --health-cmd pg_isready
          --health-interval 10s
          --health-timeout 5s
          --health-retries 5

      redis:
        image: redis:6
        ports:
          - 6379:6379
        options: >-
          --health-cmd "redis-cli ping"
          --health-interval 10s
          --health-timeout 5s
          --health-retries 5

    steps:
      - name: Checkout code
        uses: actions/checkout@v3

      - name: Setup Node.js
        uses: actions/setup-node@v3
        with:
          node-version: '16'
```

```

cache: 'npm'

- name: Install dependencies
  run: |
    cd auth-service && npm ci
    cd ../user-service && npm ci
    cd ../calendar-service && npm ci
    cd ../event-service && npm ci

- name: Run linting
  run: |
    cd auth-service && npm run lint
    cd ../user-service && npm run lint
    cd ../calendar-service && npm run lint
    cd ../event-service && npm run lint

- name: Run tests
  run: |
    cd auth-service && npm test
    cd ../user-service && npm test
    cd ../calendar-service && npm test
    cd ../event-service && npm test

env:
  DATABASE_URL:
postgresql://postgres:postgres@localhost:5432/calendar_test
  REDIS_URL: redis://localhost:6379
  JWT_SECRET: test_jwt_secret
  JWT_REFRESH_SECRET: test_refresh_secret

build:
  name: Build and Push
  needs: test
  if: github.event_name == 'push'
  runs-on: ubuntu-latest

steps:
  - name: Checkout code
    uses: actions/checkout@v3

  - name: Configure AWS credentials
    uses: aws-actions/configure-aws-credentials@v1
    with:

```

```

aws-access-key-id: ${{ secrets.AWS_ACCESS_KEY_ID }}
aws-secret-access-key: ${{ secrets.AWS_SECRET_ACCESS_KEY }}
aws-region: ${{ env.AWS_REGION }}

- name: Login to Amazon ECR
  id: login-ecr
  uses: aws-actions/amazon-ecr-login@v1

- name: Set environment name
  id: env-name
  run: |
    if [ ${{ github.ref }} = 'refs/heads/main' ]; then
      echo "ENV_NAME=production" >> $GITHUB_ENV
    else
      echo "ENV_NAME=development" >> $GITHUB_ENV
    fi

- name: Build, tag, and push Auth Service image
  env:
    ECR_REGISTRY: ${{ steps.login-ecr.outputs.registry }}
    ECR_REPOSITORY: ${{ env.ENV_NAME }}-auth-service
  run: |
    cd auth-service
    docker build -t $ECR_REGISTRY/$ECR_REPOSITORY:${{ github.sha }} .
    docker tag $ECR_REGISTRY/$ECR_REPOSITORY:${{ github.sha }}:$ECR_REGISTRY/$ECR_REPOSITORY:latest
    docker push $ECR_REGISTRY/$ECR_REPOSITORY:${{ github.sha }}
    docker push $ECR_REGISTRY/$ECR_REPOSITORY:latest

  # Similar steps for User, Calendar, and Event services
  # (skipped for brevity)

deploy:
  name: Deploy
  needs: build
  runs-on: ubuntu-latest

  steps:
    - name: Checkout code
      uses: actions/checkout@v3

    - name: Configure AWS credentials

```

```

uses: aws-actions/configure-aws-credentials@v1
with:
  aws-access-key-id: ${{ secrets.AWS_ACCESS_KEY_ID }}
  aws-secret-access-key: ${{ secrets.AWS_SECRET_ACCESS_KEY }}
  aws-region: ${{ env.AWS_REGION }}

- name: Set environment name
  id: env-name
  run: |
    if [ ${{ github.ref }} = 'refs/heads/main' ]; then
      echo "ENV_NAME=production" >> $GITHUB_ENV
    else
      echo "ENV_NAME=development" >> $GITHUB_ENV
    fi

- name: Update Auth Service
  run: |
    aws ecs update-service --cluster ${{ env.ENV_NAME }}-cluster \
    --service ${{ env.ENV_NAME }}-auth-service \
    --force-new-deployment

# Similar steps for User, Calendar, and Event services
# (skipped for brevity)

- name: Wait for services to stabilize
  run: |
    aws ecs wait services-stable --cluster ${{ env.ENV_NAME }}-cluster \
    --services ${{ env.ENV_NAME }}-auth-service \
    ${{ env.ENV_NAME }}-user-service \
    ${{ env.ENV_NAME }}-calendar-service \
    ${{ env.ENV_NAME }}-event-service

```

Database Schema Migration

Let's create a database migration setup using knex.js:

```
// migrations/20250315000000_initial_schema.js

exports.up = function(knex) {
  return knex.schema
```

```

// Users table
.createTable('users', function(table) {
  table.uuid('id').primary().defaultTo(knex.raw('gen_random_uuid()'));
  table.string('email').notNullable().unique();
  table.string('password_hash').notNullable();
  table.string('name');
  table.string('profile_picture');
  table.string('timezone').notNullable().defaultTo('UTC');
  table.boolean('is_email_verified').notNullable().defaultTo(false);
  table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
  table.timestamp('updated_at');
})

// User preferences table
.createTable('user_preferences', function(table) {
  table.uuid('id').primary().defaultTo(knex.raw('gen_random_uuid()'));

  table.uuid('user_id').notNullable().references('id').inTable('users').onDelete('CASCADE');
  table.uuid('default_calendar_id');
  table.string('default_view').notNullable().defaultTo('month');
  table.jsonb('working_hours').notNullable().defaultTo(JSON.stringify({
    start: '09:00',
    end: '17:00',
    days: [1, 2, 3, 4, 5]
  }));
}

table.jsonb('notification_settings').notNullable().defaultTo(JSON.stringify({
  event_reminders: true,
  share_notifications: true,
  email_notifications: true
}));
  table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
  table.timestamp('updated_at');
  table.unique(['user_id']);
})

// Refresh tokens table
.createTable('refresh_tokens', function(table) {
  table.uuid('id').primary().defaultTo(knex.raw('gen_random_uuid()'));

  table.uuid('user_id').notNullable().references('id').inTable('users').onDelete('CASCADE');
  table.string('token').notNullable().unique();
}

```

```

        table.timestamp('expires_at').notNullable();
        table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
        table.index(['user_id', 'token']);
    })

    // Calendars table
    .createTable('calendars', function(table) {
        table.uuid('id').primary().defaultTo(knex.raw('gen_random_uuid()'));

        table.uuid('owner_id').notNullable().references('id').inTable('users').onDelete('CASCADE');
        table.string('name').notNullable();
        table.text('description');
        table.string('color');
        table.boolean('is_default').notNullable().defaultTo(false);
        table.boolean('is_visible').notNullable().defaultTo(true);
        table.string('external_id');
        table.string('external_source');
        table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
        table.timestamp('updated_at');
        table.index(['owner_id']);
    })

    // Calendar shares table
    .createTable('calendar_shares', function(table) {
        table.uuid('id').primary().defaultTo(knex.raw('gen_random_uuid()'));

        table.uuid('calendar_id').notNullable().references('id').inTable('calendars').onDelete('CASCADE');
        table.uuid('user_id').references('id').inTable('users').onDelete('CASCADE');
        table.string('email');
        table.string('permission').notNullable().defaultTo('view');
        table.string('status').notNullable().defaultTo('pending');
        table.string('invite_token');
        table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
        table.timestamp('updated_at');
        table.index(['calendar_id']);
        table.index(['user_id']);
        table.unique(['calendar_id', 'user_id']);
        table.unique(['calendar_id', 'email']);
        table.check('user_id IS NOT NULL OR email IS NOT NULL',
            'user_or_email_check');
    })
}

```

```

// Events table
.createTable('events', function(table) {
  table.uuid('id').primary().defaultTo(knex.raw('gen_random_uuid()'));

  table.uuid('calendar_id').notNullable().references('id').inTable('calendars').onDelete('cascade');
  table.string('title').notNullable();
  table.text('description');
  table.string('location');
  table.timestamp('start_time').notNullable();
  table.timestamp('end_time').notNullable();
  table.boolean('is_all_day').notNullable().defaultTo(false);
  table.string('recurrence_rule');
  table.jsonb('exception_dates');
  table.string('color');
  table.string('visibility').notNullable().defaultTo('default');
  table.string('status').notNullable().defaultTo('confirmed');
  table.uuid('created_by').notNullable().references('id').inTable('users');
  table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
  table.timestamp('updated_at');
  table.integer('version').notNullable().defaultTo(1);
  table.index(['calendar_id']);
  table.index(['start_time', 'end_time']);
  table.check('end_time >= start_time', 'event_times_check');
})

// Event instances table (for recurring event exceptions)
.createTable('event_instances', function(table) {
  table.uuid('id').primary().defaultTo(knex.raw('gen_random_uuid()'));

  table.uuid('event_id').notNullable().references('id').inTable('events').onDelete('cascade');
  table.date('instance_date').notNullable();
  table.timestamp('start_time').notNullable();
  table.timestamp('end_time').notNullable();
  table.boolean('is_exception').notNullable().defaultTo(false);
  table.jsonb('exception_data');
  table.string('status').notNullable().defaultTo('confirmed');
  table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
  table.timestamp('updated_at');
  table.unique(['event_id', 'instance_date']);
  table.index(['event_id']);
  table.index(['instance_date']);
})

```

```

    })

    // Event attendees table
    .createTable('event_attendees', function(table) {
        table.uuid('id').primary().defaultTo(knex.raw('gen_random_uuid()'));

        table.uuid('event_id').notNullable().references('id').inTable('events').onDelete('CASCADE');
        table.uuid('user_id').references('id').inTable('users').onDelete('SET NULL');

        table.string('email').notNullable();
        table.string('name');
        table.string('response_status').notNullable().defaultTo('pending');
        table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
        table.timestamp('updated_at');
        table.index(['event_id']);
        table.index(['user_id']);
        table.unique(['event_id', 'email']);
    })

    // Reminders table
    .createTable('reminders', function(table) {
        table.uuid('id').primary().defaultTo(knex.raw('gen_random_uuid()'));

        table.uuid('event_id').notNullable().references('id').inTable('events').onDelete('CASCADE');
        table.uuid('user_id').notNullable().references('id').inTable('users').onDelete('CASCADE');

        table.integer('minutes_before').notNullable();
        table.string('method').notNullable().defaultTo('notification');
        table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
        table.timestamp('updated_at');
        table.index(['event_id']);
        table.index(['user_id']);
        table.unique(['event_id', 'user_id', 'minutes_before', 'method']);
    })

    // Attachments table
    .createTable('attachments', function(table) {
        table.uuid('id').primary().defaultTo(knex.raw('gen_random_uuid()'));

        table.uuid('event_id').notNullable().references('id').inTable('events').onDelete('CASCADE');
        table.string('name').notNullable();
        table.string('file_url').notNullable();
    })
}

```

```

        table.string('mime_type').notNullable();
        table.integer('size_bytes').notNullable();
        table.uuid('created_by').notNullable().references('id').inTable('users');
        table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
        table.index(['event_id']);
    }

    // Sync tokens table
    .createTable('sync_tokens', function(table) {
        table.uuid('id').primary().defaultTo(knex.raw('gen_random_uuid()'));

        table.uuid('user_id').notNullable().references('id').inTable('users').onDelete('CASCADE');
        table.string('device_id').notNullable();
        table.timestamp('last_sync_time').notNullable().defaultTo(knex.fn.now());
        table.string('token').notNullable();
        table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
        table.timestamp('updated_at');
        table.unique(['user_id', 'device_id']);
        table.index(['token']);
    });
};

exports.down = function(knex) {
    return knex.schema
        .dropTableIfExists('sync_tokens')
        .dropTableIfExists('attachments')
        .dropTableIfExists('reminders')
        .dropTableIfExists('event_attendees')
        .dropTableIfExists('event_instances')
        .dropTableIfExists('events')
        .dropTableIfExists('calendar_shares')
        .dropTableIfExists('calendars')
        .dropTableIfExists('refresh_tokens')
        .dropTableIfExists('user_preferences')
        .dropTableIfExists('users');
};

```

This implementation covers the core components of our Calendar App prototype, including:

1. Service Implementation:

- Authentication service for user registration and login

- User service for profile management
- Calendar service for calendar management and sharing
- Event service for event management and recurrence handling

2. API Specifications:

- GraphQL schema with comprehensive type definitions
- Query, mutation, and subscription operations
- Input types for all operations

3. Infrastructure Templates:

- Terraform configuration for AWS infrastructure
- VPC, subnets, and security groups
- Database (PostgreSQL) and cache (Redis)
- ECS services and load balancing
- CI/CD pipeline with GitHub Actions

These implementations follow the architecture blueprint and establish a solid foundation for further development of the Calendar App.

 i want to create a local development environment for the core services using webstorm on my macbook air . So please create a step by step guide for setting up the environment.

Setting Up a Local Development Environment for Calendar App Core Services on MacBook Air with WebStorm

This guide will walk you through setting up a local development environment for the Calendar App core services using WebStorm on macOS.

Prerequisites

1. **MacBook Air** with macOS
2. **WebStorm** installed (if not, download from [JetBrains Website](#))

3. Admin access to install additional software

Step 1: Install Development Tools

Open Terminal and install the necessary tools:

```
# Install Homebrew if not already installed
/bin/bash -c "$(curl -fsSL
https://raw.githubusercontent.com/Homebrew/install/HEAD/install.sh)"

# Make sure Homebrew is in your PATH
echo 'eval "$(/opt/homebrew/bin/brew shellenv)"' >> ~/.zshrc
source ~/.zshrc

# Install Node.js and npm
brew install node

# Install Docker Desktop
brew install --cask docker

# Install PostgreSQL
brew install postgresql@14

# Install Redis
brew install redis

# Install Git (if not already installed)
brew install git
```

Step 2: Start Local Database Services

```
# Start PostgreSQL
brew services start postgresql@14

# Start Redis
brew services start redis

# Create the necessary databases
```

```
createdb calendar_dev
createdb calendar_test
```

Step 3: Clone and Set Up the Project

```
# Create a project directory
mkdir -p ~/Projects/calendar-app
cd ~/Projects/calendar-app

# Initialize Git repository
git init

# Create directories for each service
mkdir -p auth-service user-service calendar-service event-service shared
```

Step 4: Set Up WebStorm

1. Open WebStorm
2. Select "Open" and navigate to your `~/Projects/calendar-app` directory
3. Configure WebStorm for Node.js development:
 - Go to Preferences > Languages & Frameworks > JavaScript
 - Set JavaScript language version to "ECMAScript 6+"
 - Enable Node.js coding assistance

Step 5: Configure Auth Service

1. Open Terminal in the `auth-service` directory
2. Initialize the project:

```
cd ~/Projects/calendar-app/auth-service
npm init -y
npm install express bcrypt jsonwebtoken uuid pg dotenv cors helmet
npm install --save-dev nodemon eslint jest supertest
```

3. Create an `*.env` file in the auth-service directory:

```
NODE_ENV=development
PORT=3001
DATABASE_URL=postgresql://localhost:5432/calendar_dev
REDIS_URL=redis://localhost:6379
JWT_SECRET=your_jwt_secret_for_local_dev
JWT_REFRESH_SECRET=your_jwt_refresh_secret_for_local_dev
```

4. Create a `package.json` file with the following scripts:

```
{
  "scripts": {
    "start": "node src/index.js",
    "dev": "nodemon src/index.js",
    "lint": "eslint .",
    "test": "jest --forceExit"
  }
}
```

5. Create the basic file structure:

```
mkdir -p src/routes src/controllers src/middleware src/services src/utils
touch src/index.js src/routes/auth.js src/controllers/auth.js
```

6. Open the project in WebStorm and edit the main files

Step 6: Set Up User Service

Follow similar steps as for the Auth Service:

```
cd ~/Projects/calendar-app/user-service
npm init -y
npm install express pg jsonwebtoken uuid dotenv cors helmet
npm install --save-dev nodemon eslint jest supertest
```

Create ` `.env` file with similar content but change PORT to 3002.

Step 7: Set Up Calendar Service

```
cd ~/Projects/calendar-app/calendar-service
npm init -y
npm install express pg jsonwebtoken uuid dotenv cors helmet
npm install --save-dev nodemon eslint jest supertest
```

Create ` `.env` file with similar content but change PORT to 3003.

Step 8: Set Up Event Service

```
cd ~/Projects/calendar-app/event-service
npm init -y
npm install express pg jsonwebtoken uuid dotenv cors helmet rrule
npm install --save-dev nodemon eslint jest supertest
```

Create ` `.env` file with similar content but change PORT to 3004.

Step 9: Set Up Database Schema

1. Install Knex globally:

```
npm install -g knex
```

2. Create a shared migration directory:

```
mkdir -p ~/Projects/calendar-app/shared/migrations
cd ~/Projects/calendar-app/shared
npm init -y
npm install knex pg
```

3. Create a `knexfile.js` in the shared directory:

```
module.exports = {
  development: {
    client: 'postgresql',
    connection: {
      host: 'localhost',
      database: 'calendar_dev',
```

```

    user: 'your_username', // Your macOS username by default
    password: '' // Usually empty for local PostgreSQL on Mac
  },
  pool: {
    min: 2,
    max: 10
  },
  migrations: {
    directory: './migrations'
  }
},
test: {
  client: 'postgresql',
  connection: {
    host: 'localhost',
    database: 'calendar_test',
    user: 'your_username', // Your macOS username by default
    password: '' // Usually empty for local PostgreSQL on Mac
  },
  pool: {
    min: 2,
    max: 10
  },
  migrations: {
    directory: './migrations'
  }
}
};


```

4. Copy the migration file from our previous implementation into `~/Projects/calendar-

`app/shared/migrations/20250315000000_initial_schema.js``

5. Run the migrations:

```

cd ~/Projects/calendar-app/shared
knex migrate:latest --env development

```

Step 10: Set Up Service Implementation Files

Now, let's copy the implementation code we previously created for each service:

1. For auth-service, create `src/index.js` and paste our Auth Service Prototype code
2. For user-service, create `src/index.js` and paste our User Service Prototype code
3. For calendar-service, create `src/index.js` and paste our Calendar Service Prototype code
4. For event-service, create `src/index.js` and paste our Event Service Prototype code

Step 11: Start the Services

Open four terminal windows or tabs, one for each service:

```
# Terminal 1
cd ~/Projects/calendar-app/auth-service
npm run dev

# Terminal 2
cd ~/Projects/calendar-app/user-service
npm run dev

# Terminal 3
cd ~/Projects/calendar-app/calendar-service
npm run dev

# Terminal 4
cd ~/Projects/calendar-app/event-service
npm run dev
```

Step 12: Set Up WebStorm Run Configurations

For easier service management in WebStorm:

1. In WebStorm, go to Run > Edit Configurations
2. Click the + button and select "npm"
3. Create four configurations:
 - Auth Service (working directory: auth-service, script: dev)
 - User Service (working directory: user-service, script: dev)
 - Calendar Service (working directory: calendar-service, script: dev)
 - Event Service (working directory: event-service, script: dev)
4. Now you can start/stop services from WebStorm's run panel

Step 13: Test Your Services

Use either an API client like Postman or curl in Terminal:

```
# Test Auth Service - Register a user
curl -X POST http://localhost:3001/auth/register \
-H "Content-Type: application/json" \
-d '{"email":"test@example.com", "password":"Password123!", "name":"Test User"}'

# Test Auth Service - Login
curl -X POST http://localhost:3001/auth/login \
-H "Content-Type: application/json" \
-d '{"email":"test@example.com", "password":"Password123!"}'
```

Save the access token from the login response and use it for subsequent requests:

```
# Test User Service - Get profile
curl -X GET http://localhost:3002/users/me \
-H "Authorization: Bearer YOUR_ACCESS_TOKEN"

# Test Calendar Service - Create calendar
curl -X POST http://localhost:3003/calendars \
-H "Authorization: Bearer YOUR_ACCESS_TOKEN" \
-H "Content-Type: application/json" \
-d '{"name":"My Calendar", "color": "#1A73E8"}'
```

Step 14: Set Up GraphQL (Optional)

If you want to set up the GraphQL API as well:

```
mkdir -p ~/Projects/calendar-app/api-gateway
cd ~/Projects/calendar-app/api-gateway
npm init -y
npm install apollo-server apollo-server-express express graphql
npm install --save-dev nodemon
```

Create an `index.js` file with a basic Apollo Server implementation that connects to your microservices.

Troubleshooting

1. Database connection issues:

- Check if PostgreSQL is running: `brew services list`
- Verify connection settings in `*.env` files

2. Port conflicts:

- If a port is already in use, change it in the `*.env` file and service code

3. Node.js version issues:

- Use `nvm` (Node Version Manager) to install and use Node.js 16 or newer

4. Permission issues:

- Check file/directory permissions: `chmod -R 755 ~/Projects/calendar-app`

Next Steps

1. Implement any missing functionality in each service
2. Add unit and integration tests
3. Create a frontend client using React
4. Set up Docker Compose for easier environment management
5. Implement the GraphQL layer on top of the REST services

With this setup, you have a fully functional local development environment for the Calendar App core services using WebStorm on your MacBook Air.

 where should I keep the package.json file

For a Node.js project like your Calendar App services, you should keep a separate `package.json` file in the root directory of each service. This is the standard approach for a microservices architecture.

Here's the correct file structure:

```
calendar-app/  
|   auth-service/  
|       package.json      # Auth service dependencies and scripts
```

```

|   ┌── .env                      # Auth service environment variables
|   └── src/
|       └── index.js
|
|   └── user-service/
|       ├── package.json          # User service dependencies and scripts
|       ┌── .env                  # User service environment variables
|       └── src/
|           └── index.js
|
|   └── calendar-service/
|       ├── package.json         # Calendar service dependencies and scripts
|       ┌── .env                  # Calendar service environment variables
|       └── src/
|           └── index.js
|
|   └── event-service/
|       ├── package.json         # Event service dependencies and scripts
|       ┌── .env                  # Event service environment variables
|       └── src/
|           └── index.js
|
└── shared/
    ├── package.json              # Shared utilities and database migrations
    ├── knexfile.js               # Database configuration
    └── migrations/
        └── 20250315000000_initial_schema.js

```

Each service's `package.json` contains its specific dependencies and scripts. This approach allows each service to be developed, deployed, and scaled independently, which is one of the main benefits of a microservices architecture.

When you use the `npm init -y` command within each service directory as outlined in the setup guide, it will automatically create these separate package.json files in the right locations.

 Getting the following error - base) razorvilla@Prateeks-MacBook-Air shared % knex

```

migrate:latest --env development Using environment: development migration file
"20250315000000_initial_schema.js" failed migration failed with error: Expected 1 bindings,
saw 0 Expected 1 bindings, saw 0 Error: Expected 1 bindings, saw 0 at
replaceRawArrBindings (/Users/razorvilla/Desktop/Projects/calendar-
app/shared/node_modules/knex/lib/formatter/rawFormatter.js:27:11) at Raw.toSQL

```

```
(/Users/razorvilla/Desktop/Projects/calendar-app/shared/node_modules/knex/lib/raw.js:77:13)
at Target.toQuery (/Users/razorvilla/Desktop/Projects/calendar-
app/shared/node_modules/knex/lib/builder-interface-augmenter.js:9:21) at Raw.toString
(/Users/razorvilla/Desktop/Projects/calendar-app/shared/node_modules/knex/lib/raw.js:70:17)
at /Users/razorvilla/Desktop/Projects/calendar-
app/shared/node_modules/knex/lib/schema/tablecompiler.js:381:35 at Array.map () at
TableCompiler_PG._addChecks (/Users/razorvilla/Desktop/Projects/calendar-
app/shared/node_modules/knex/lib/schema/tablecompiler.js:378:12) at
TableCompiler_PG.createQuery (/Users/razorvilla/Desktop/Projects/calendar-
app/shared/node_modules/knex/lib/dialects/postgres/schema/pg-tablecompiler.js:49:13) at
TableCompiler_PG.create (/Users/razorvilla/Desktop/Projects/calendar-
app/shared/node_modules/knex/lib/schema/tablecompiler.js:59:10) at
TableCompiler_PG.toSQL (/Users/razorvilla/Desktop/Projects/calendar-
app/shared/node_modules/knex/lib/schema/tablecompiler.js:42:22)
```

That error occurs because there's an issue with the ``gen_random_uuid()`` function in your migration file. This function is a PostgreSQL extension that might not be available in your default configuration.

Let's fix this issue:

Solution for the Migration Error

1. First, modify your migration file (``20250315000000_initial_schema.js``) to use a standard PostgreSQL UUID generation approach instead:

```
// Open the file in WebStorm
// ~/Projects/calendar-app/shared/migrations/20250315000000_initial_schema.js

// Change all instances of:
table.uuid('id').primary().defaultTo(knex.raw('gen_random_uuid()'));

// To:
table.uuid('id').primary().defaultTo(knex.raw('uuid_generate_v4()'));
```

2. Before running the migration again, you need to enable the UUID extension in PostgreSQL:

```
# Connect to your PostgreSQL database
psql calendar_dev
```

```
# Once connected, run this command:  
CREATE EXTENSION IF NOT EXISTS "uuid-ossp";  
  
# Exit psql  
\q  
  
# Do the same for the test database  
psql calendar_test  
CREATE EXTENSION IF NOT EXISTS "uuid-ossp";  
\q
```

3. Now try running the migration again:

```
cd ~/Projects/calendar-app/shared  
knex migrate:latest --env development
```

Alternative Solution

If you still encounter issues, you could modify the migration to avoid using PostgreSQL's built-in UUID functions altogether:

```
// Instead of:  
table.uuid('id').primary().defaultTo(knex.raw('uuid_generate_v4'));  
  
// Use:  
table.uuid('id').primary();
```

Then make sure your application code generates and assigns UUIDs before inserting records.

Additional Troubleshooting

If you continue to face issues with the migration, you can try a more verbose approach to identify exactly where the problem is:

1. Run the migration with debugging information:

```
DEBUG=knex:* knex migrate:latest --env development
```

- Check if the error occurs in a specific table's check constraint. If so, you might need to modify that specific constraint. For example, if it's related to the `user_or_email_check` in the `calendar_shares` table, you could try:

```
// Replace:
table.check('user_id IS NOT NULL OR email IS NOT NULL', 'user_or_email_check');

// With:
table.raw('CHECK (user_id IS NOT NULL OR email IS NOT NULL)');
```

Let me know if this resolves your issue or if you need further assistance!

Using environment: development
**knex:client **acquired connection from pool: _knexUid1 +0ms
**knex:query **select * from information_schema.tables where table_name = \$1 and table_schema = current_schema() undefined +0ms
**knex:bindings **['knex_migrations'] undefined +0ms
**knex:client **releasing connection to pool: _knexUid1 +4ms
**knex:client **acquired connection from pool: _knexUid1 +0ms
**knex:query **select * from information_schema.tables where table_name = \$1 and table_schema = current_schema() undefined +3ms
**knex:bindings **['knex_migrations_lock'] undefined +3ms
**knex:client **releasing connection to pool: _knexUid1 +0ms
**knex:client **acquired connection from pool: _knexUid1 +1ms
**knex:query **select * from "knex_migrations_lock" undefined +1ms
**knex:bindings **[] undefined +1ms
**knex:client **releasing connection to pool: _knexUid1 +1ms
**knex:client **acquired connection from pool: _knexUid1 +0ms
**knex:query **select "name" from "knex_migrations" order by "id" asc undefined +1ms
**knex:bindings **[] undefined +1ms
**knex:client **releasing connection to pool: _knexUid1 +1ms
**knex:tx **trx2: Starting top level transaction +0ms
**knex:client **acquired connection from pool: _knexUid1 +3ms
**knex:query **BEGIN; trx2 +4ms
**knex:bindings **undefined trx2 +4ms
**knex:query **update "knex_migrations_lock" set "is_locked" = \$1 where "is_locked" = \$2 trx2 +1ms
**knex:bindings **[1, 0] trx2 +1ms
**knex:query **select * from information_schema.tables where table_name = \$1 and table_schema = current_schema() trx2 +0ms
**knex:bindings **['knex_migrations'] trx2 +0ms
**knex:query **select * from information_schema.tables where table_name = \$1 and table_schema = current_schema() trx2 +1ms
**knex:bindings **['knex_migrations_lock'] trx2 +1ms
**knex:query **select * from "knex_migrations_lock" trx2 +1ms
**knex:bindings **[] trx2 +1ms
**knex:query **select "name" from "knex_migrations" order by "id" asc trx2 +1ms
**knex:bindings **[] trx2 +1ms
**knex:query **select max("batch") as "max_batch" from "knex_migrations" trx2 +0ms
**knex:bindings **[] trx2 +0ms
"20250315000000_initial_schema.js" failed migration failed with error: Expected 1 bindings, saw 0
**knex:query **update "knex_migrations_lock" set "is_locked" = \$1 trx2 +4ms
**knex:bindings **[0] trx2 +4ms
**knex:query **ROLLBACK trx2 +0ms
**knex:bindings

```
**undefined trx2 +0ms **knex:tx **trx2: releasing connection +9ms **knex:client
**releasing connection to pool: _knexUid1 +8ms Expected 1 bindings, saw 0 Error: Expected 1
bindings, saw 0 at replaceRawArrBindings (/Users/razorvilla/Desktop/Projects/calendar-
app/shared/node_modules/knex/lib/formatter/rawFormatter.js:27:11) at Raw.toSQL
(/Users/razorvilla/Desktop/Projects/calendar-app/shared/node_modules/knex/lib/raw.js:77:13)
at Target.toQuery (/Users/razorvilla/Desktop/Projects/calendar-
app/shared/node_modules/knex/lib/builder-interface-augmenter.js:9:21) at Raw.toString
(/Users/razorvilla/Desktop/Projects/calendar-app/shared/node_modules/knex/lib/raw.js:70:17)
at /Users/razorvilla/Desktop/Projects/calendar-
app/shared/node_modules/knex/lib/schema/tablecompiler.js:381:35 at Array.map () at
TableCompiler_PG._addChecks (/Users/razorvilla/Desktop/Projects/calendar-
app/shared/node_modules/knex/lib/schema/tablecompiler.js:378:12) at
TableCompiler_PG.createQuery (/Users/razorvilla/Desktop/Projects/calendar-
app/shared/node_modules/knex/lib/dialects/postgres/schema/pg-tablecompiler.js:49:13) at
TableCompiler_PG.create (/Users/razorvilla/Desktop/Projects/calendar-
app/shared/node_modules/knex/lib/schema/tablecompiler.js:59:10) at
TableCompiler_PG.toSQL (/Users/razorvilla/Desktop/Projects/calendar-
app/shared/node_modules/knex/lib/schema/tablecompiler.js:42:22)
```

The error persists even with the debug information. Let's create a simpler migration file that will work with your setup. The issue appears to be with the check constraints in the migration.

Here's a modified approach:

Step 1: Create a Simpler Migration File

Create a new file `~/Projects/calendar-app/shared/migrations/20250315000000_initial_schema.js` (replacing the current one) with this simplified schema:

```
exports.up = function(knex) {
  return knex.schema
    // Users table
    .createTable('users', function(table) {
      table.uuid('id').primary();
      table.string('email').notNullable().unique();
      table.string('password_hash').notNullable();
      table.string('name');
      table.string('profile_picture');
      table.string('timezone').notNullable().defaultTo('UTC');
      table.boolean('is_email_verified').notNullable().defaultTo(false);
    });
};

exports.down = function(knex) {
  return knex.schema
    .dropTable('users');
};
```

```

    table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
    table.timestamp('updated_at');
  })

  // User preferences table
  .createTable('user_preferences', function(table) {
    table.uuid('id').primary();

    table.uuid('user_id').notNullable().references('id').inTable('users').onDelete('CASCADE');
    table.uuid('default_calendar_id');
    table.string('default_view').notNullable().defaultTo('month');
    table.jsonb('working_hours').notNullable();
    table.jsonb('notification_settings').notNullable();
    table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
    table.timestamp('updated_at');
    table.unique(['user_id']);
  })

  // Refresh tokens table
  .createTable('refresh_tokens', function(table) {
    table.uuid('id').primary();

    table.uuid('user_id').notNullable().references('id').inTable('users').onDelete('CASCADE');
    table.string('token').notNullable().unique();
    table.timestamp('expires_at').notNullable();
    table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
    table.index(['user_id', 'token']);
  })

  // Calendars table
  .createTable('calendars', function(table) {
    table.uuid('id').primary();

    table.uuid('owner_id').notNullable().references('id').inTable('users').onDelete('CASCADE');
    table.string('name').notNullable();
    table.text('description');
    table.string('color');
    table.boolean('is_default').notNullable().defaultTo(false);
    table.boolean('is_visible').notNullable().defaultTo(true);
    table.string('external_id');
    table.string('external_source');
    table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
  })
}

```

```

        table.timestamp('updated_at');
        table.index(['owner_id']);
    })

    // Calendar shares table
    .createTable('calendar_shares', function(table) {
        table.uuid('id').primary();

        table.uuid('calendar_id').notNullable().references('id').inTable('calendars').onDelete('CASCADE');
        table.uuid('user_id').references('id').inTable('users').onDelete('CASCADE');
        table.string('email');
        table.string('permission').notNullable().defaultTo('view');
        table.string('status').notNullable().defaultTo('pending');
        table.string('invite_token');
        table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
        table.timestamp('updated_at');
        table.index(['calendar_id']);
        table.index(['user_id']);
        table.unique(['calendar_id', 'user_id']);
        // Removing problematic check constraint
    })

    // Events table
    .createTable('events', function(table) {
        table.uuid('id').primary();

        table.uuid('calendar_id').notNullable().references('id').inTable('calendars').onDelete('CASCADE');
        table.string('title').notNullable();
        table.text('description');
        table.string('location');
        table.timestamp('start_time').notNullable();
        table.timestamp('end_time').notNullable();
        table.boolean('is_all_day').notNullable().defaultTo(false);
        table.string('recurrence_rule');
        table.jsonb('exception_dates');
        table.string('color');
        table.string('visibility').notNullable().defaultTo('default');
        table.string('status').notNullable().defaultTo('confirmed');
        table.uuid('created_by').notNullable().references('id').inTable('users');
        table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
        table.timestamp('updated_at');
    })
}

```

```

    table.integer('version').notNullable().defaultTo(1);
    table.index(['calendar_id']);
    table.index(['start_time', 'end_time']);
    // Removed event_times_check constraint
  })

  // Event instances table
  .createTable('event_instances', function(table) {
    table.uuid('id').primary();

    table.uuid('event_id').notNullable().references('id').inTable('events').onDelete('C
      table.date('instance_date').notNullable();
      table.timestamp('start_time').notNullable();
      table.timestamp('end_time').notNullable();
      table.boolean('is_exception').notNullable().defaultTo(false);
      table.jsonb('exception_data');
      table.string('status').notNullable().defaultTo('confirmed');
      table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
      table.timestamp('updated_at');
      table.unique(['event_id', 'instance_date']);
      table.index(['event_id']);
      table.index(['instance_date']);
    })

    // Event attendees table
    .createTable('event_attendees', function(table) {
      table.uuid('id').primary();

      table.uuid('event_id').notNullable().references('id').inTable('events').onDelete('C
        table.uuid('user_id').references('id').inTable('users').onDelete('SET
NULL');

        table.string('email').notNullable();
        table.string('name');
        table.string('response_status').notNullable().defaultTo('pending');
        table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
        table.timestamp('updated_at');
        table.index(['event_id']);
        table.index(['user_id']);
        table.unique(['event_id', 'email']);
      })
    })

    // Reminders table
  })
}

```

```

.createTable('reminders', function(table) {
  table.uuid('id').primary();

  table.uuid('event_id').notNullable().references('id').inTable('events').onDelete('CASCADE');
  table.uuid('user_id').notNullable().references('id').inTable('users').onDelete('CASCADE');
  table.integer('minutes_before').notNullable();
  table.string('method').notNullable().defaultTo('notification');
  table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
  table.timestamp('updated_at');
  table.index(['event_id']);
  table.index(['user_id']);
  table.unique(['event_id', 'user_id', 'minutes_before', 'method']);
})

// Attachments table
.createTable('attachments', function(table) {
  table.uuid('id').primary();

  table.uuid('event_id').notNullable().references('id').inTable('events').onDelete('CASCADE');
  table.string('name').notNullable();
  table.string('file_url').notNullable();
  table.string('mime_type').notNullable();
  table.integer('size_bytes').notNullable();
  table.uuid('created_by').notNullable().references('id').inTable('users');
  table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
  table.index(['event_id']);
})

// Sync tokens table
.createTable('sync_tokens', function(table) {
  table.uuid('id').primary();

  table.uuid('user_id').notNullable().references('id').inTable('users').onDelete('CASCADE');
  table.string('device_id').notNullable();
  table.timestamp('last_sync_time').notNullable().defaultTo(knex.fn.now());
  table.string('token').notNullable();
  table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
  table.timestamp('updated_at');
  table.unique(['user_id', 'device_id']);
  table.index(['token']);
});

```

```

};

exports.down = function(knex) {
  return knex.schema
    .dropTableIfExists('sync_tokens')
    .dropTableIfExists('attachments')
    .dropTableIfExists('reminders')
    .dropTableIfExists('event_attendees')
    .dropTableIfExists('event_instances')
    .dropTableIfExists('events')
    .dropTableIfExists('calendar_shares')
    .dropTableIfExists('calendars')
    .dropTableIfExists('refresh_tokens')
    .dropTableIfExists('user_preferences')
    .dropTableIfExists('users');
}

```

Key changes:

1. Removed all `defaultTo(knex.raw())` calls that were causing issues
2. Removed check constraints that were causing binding errors
3. Simplified JSON defaults to avoid complex expressions

Step 2: Update the Services to Generate UUIDs

Since we've removed the auto-generation of UUIDs at the database level, update your service code to generate UUIDs when creating new records:

In your service files, ensure you generate UUIDs before inserting:

```

// Example for auth-service
const { v4: uuidv4 } = require('uuid');

// When creating a user:
const userId = uuidv4();
await pool.query(
  'INSERT INTO users (id, email, password_hash, name, created_at) VALUES ($1,
$2, $3, $4, NOW())',
  [userId, email, hashedPassword, name]
);

```

Step 3: Add Default JSON Values in Your Services

For the `working_hours` and `notification_settings` fields, add the default values in your service code:

```
// Default working hours
const defaultWorkingHours = JSON.stringify({
  start: '09:00',
  end: '17:00',
  days: [1, 2, 3, 4, 5]
});

// Default notification settings
const defaultNotificationSettings = JSON.stringify({
  event_reminders: true,
  share_notifications: true,
  email_notifications: true
});

// When creating user preferences:
await pool.query(
  'INSERT INTO user_preferences (id, user_id, default_view, working_hours,
  notification_settings) VALUES ($1, $2, $3, $4, $5)',
  [uuidv4(), userId, 'month', defaultWorkingHours, defaultNotificationSettings]
);
```

Step 4: Run the Migration Again

```
cd ~/Projects/calendar-app/shared
knex migrate:latest --env development
```

This simplified migration should work without the binding errors you were seeing. The tradeoff is that some constraints and defaults will now be managed at the application level rather than the database level, but this is a common approach in many Node.js applications.

 so the file structure that was created using command - mkdir -p src/routes src/controllers src/middleware src/services src/utils touch src/index.js src/routes/auth.js src/controllers/auth.js"
Do i create these folders and files under each services folder or in the calender app root folder?

You should create these folders and files within each service's directory, not in the calendar app root folder. This is because each service is meant to be a self-contained microservice with its own structure.

So for example, for the auth-service, your structure would look like this:

```
calendar-app/
├── auth-service/
│   ├── package.json
│   ├── .env
│   └── src/
        ├── index.js
        ├── routes/
        │   └── auth.js
        ├── controllers/
        │   └── auth.js
        ├── middleware/
        ├── services/
        └── utils/
|
└── user-service/
    ├── package.json
    ├── .env
    └── src/
        ├── index.js
        ├── routes/
        ├── controllers/
        ├── middleware/
        ├── services/
        └── utils/
```

You would repeat this pattern for each of your services (user-service, calendar-service, event-service).

This approach follows microservices best practices where each service:

- Has its own codebase
- Can be developed independently
- Has clear boundaries
- Can be deployed separately

When you run the command, make sure you're in the specific service directory first, for example:

```
cd ~/Projects/calendar-app/auth-service  
mkdir -p src/routes src/controllers src/middleware src/services src/utils  
touch src/index.js src/routes/auth.js src/controllers/auth.js
```

Then repeat for each service with their appropriate files.

 How do I create the graphql file and where do i place it in the project structure

To implement GraphQL in your Calendar App project, you'll need to create an API Gateway service that sits in front of your microservices and provides a unified GraphQL API. Here's how to set it up:

Step 1: Create the API Gateway Service Directory

```
mkdir -p ~/Projects/calendar-app/api-gateway  
cd ~/Projects/calendar-app/api-gateway
```

Step 2: Initialize the API Gateway Project

```
npm init -y  
npm install apollo-server-express express graphql @graphql-tools/schema dotenv  
axios cors  
npm install --save-dev nodemon
```

Step 3: Create the Directory Structure

```
mkdir -p src/schema src/resolvers src/datasources  
touch src/index.js src/schema/index.js src/schema/typeDefs.js  
src/resolvers/index.js  
touch src/datasources/auth-api.js src/datasources/user-api.js  
touch src/datasources/calendar-api.js src/datasources/event-api.js  
touch .env
```

Step 4: Set Up Environment Variables

Create a ` `.env` file in the api-gateway directory:

```
NODE_ENV=development
PORT=4000
AUTH_SERVICE_URL=http://localhost:3001
USER_SERVICE_URL=http://localhost:3002
CALENDAR_SERVICE_URL=http://localhost:3003
EVENT_SERVICE_URL=http://localhost:3004
```

Step 5: Create the GraphQL Schema

Create the schema file in `src/schema/typeDefs.js`:

```
const { gql } = require('apollo-server-express');

const typeDefs = gql` 
  # Scalar types
  scalar DateTime
  scalar JSON

  # User Types
  type User {
    id: ID!
    email: String!
    name: String
    timezone: String!
    preferences: UserPreferences
    createdAt: DateTime!
    updatedAt: DateTime
  }

  type UserPreferences {
    defaultCalendarId: ID
    defaultView: ViewType
    workingHours: WorkingHours
    notificationSettings: NotificationSettings
  }
`
```

```
type WorkingHours {
    start: String!
    end: String!
    days: [Int!]!
}

type NotificationSettings {
    eventReminders: Boolean!
    shareNotifications: Boolean!
    emailNotifications: Boolean!
}

enum viewType {
    DAY
    WEEK
    MONTH
    AGENDA
}

# Calendar Types
type Calendar {
    id: ID!
    owner: User!
    name: String!
    description: String
    color: String
    isDefault: Boolean!
    isVisible: Boolean!
    events(start: DateTime, end: DateTime): [Event!]
    shares: [CalendarShare!]
    createdAt: DateTime!
    updatedAt: DateTime
}

type CalendarShare {
    id: ID!
    calendar: Calendar!
    user: User
    email: String!
    permission: Permission!
    status: ShareStatus!
    inviteToken: String
}
```

```
    createdAt: DateTime!
    updatedAt: DateTime
}

enum Permission {
  VIEW
  EDIT
}

enum ShareStatus {
  PENDING
  ACCEPTED
  DECLINED
}

# Event Types
type Event {
  id: ID!
  calendar: Calendar!
  title: String!
  description: String
  location: String
  startTime: DateTime!
  endTime: DateTime!
  isAllDay: Boolean!
  recurrenceRule: String
  exceptionDates: [DateTime]
  color: String
  visibility: Visibility!
  status: EventStatus!
  reminders: [Reminder!]
  attendees: [EventAttendee!]
  createdBy: User!
  isRecurringInstance: Boolean
  originalEventId: ID
  createdAt: DateTime!
  updatedAt: DateTime
  version: Int!
}

enum Visibility {
  DEFAULT
```

```
PUBLIC
PRIVATE
CONFIDENTIAL
}

enum EventStatus {
    CONFIRMED
    TENTATIVE
    CANCELLED
}

type EventAttendee {
    id: ID!
    event: Event!
    user: User
    email: String!
    name: String
    responseStatus: ResponseStatus!
    createdAt: DateTime!
    updatedAt: DateTime
}

enum ResponseStatus {
    PENDING
    ACCEPTED
    DECLINED
    TENTATIVE
}

type Reminder {
    id: ID!
    event: Event!
    user: User!
    minutesBefore: Int!
    method: ReminderMethod!
    createdAt: DateTime!
    updatedAt: DateTime
}

enum ReminderMethod {
    NOTIFICATION
    EMAIL
```

```
}

# Input Types


```

```
    isDefault: Boolean
    isVisible: Boolean
}

input UpdateCalendarInput {
    name: String
    description: String
    color: String
    isDefault: Boolean
    isVisible: Boolean
}

input ShareCalendarInput {
    calendarId: ID!
    email: String!
    permission: Permission!
}

input CreateEventInput {
    calendarId: ID!
    title: String!
    description: String
    location: String
    startTime: DateTime!
    endTime: DateTime!
    isAllDay: Boolean
    recurrenceRule: String
    color: String
    visibility: Visibility
    reminderMinutes: Int
    attendees: [AttendeeInput]
}

input UpdateEventInput {
    title: String
    description: String
    location: String
    startTime: DateTime
    endTime: DateTime
    isAllDay: Boolean
    recurrenceRule: String
    color: String
```

```

    visibility: Visibility
    status: EventStatus
}

input AttendeeInput {
    email: String!
    name: String
}

input UpdateEventInstanceInput {
    title: String
    description: String
    location: String
    startTime: DateTime
    endTime: DateTime
    color: String
    status: EventStatus
}

# Root Types
type Query {
    # User queries
    me: User

    # Calendar queries
    calendar(id: ID!): Calendar
    calendars: [Calendar!]!

    # Event queries
    event(id: ID!): Event
    events(calendarIds: [ID!], start: DateTime!, end: DateTime!): [Event!]!
}

type Mutation {
    # Auth mutations
    register(input: RegisterInput!): AuthPayload!
    login(input: LoginInput!): AuthPayload!
    refreshToken(refreshToken: String!): AuthPayload!
    logout(refreshToken: String!): Boolean!

    # User mutations
    updateUser(input: UpdateUserInput!): User!
}

```

```

updatePreferences(input: UpdatePreferencesInput!): UserPreferences!

# Calendar mutations
createCalendar(input: CreateCalendarInput!): Calendar!
updateCalendar(id: ID!, input: UpdateCalendarInput!): Calendar!
deleteCalendar(id: ID!): Boolean!
shareCalendar(input: ShareCalendarInput!): CalendarShare!

# Event mutations
createEvent(input: CreateEventInput!): Event!
updateEvent(id: ID!, input: UpdateEventInput!): Event!
updateEventInstance(eventId: ID!, instanceDate: DateTime!, input:
UpdateEventInstanceInput!): Event!
deleteEvent(id: ID!, recurring: String): Boolean!
createReminder(eventId: ID!, minutesBefore: Int!, method: ReminderMethod!):
Reminder!
deleteReminder(id: ID!): Boolean!
}

type AuthPayload {
  accessToken: String!
  refreshToken: String
  user: User!
}
;

module.exports = typeDefs;

```

Step 6: Create the Schema Index

Create `src/schema/index.js`:

```

const { makeExecutableSchema } = require('@graphql-tools/schema');
const typeDefs = require('./typeDefs');
const resolvers = require('../resolvers');

const schema = makeExecutableSchema({
  typeDefs,
  resolvers,
});

```

```
module.exports = schema;
```

Step 7: Create Data Sources for Each Service

Create `src/datasources/auth-api.js`:

```
const axios = require('axios');

class AuthAPI {
  constructor() {
    this.baseURL = process.env.AUTH_SERVICE_URL;
    this.client = axios.create({
      baseURL: this.baseURL,
    });
  }

  async register(input) {
    try {
      const response = await this.client.post('/auth/register', input);
      return response.data;
    } catch (error) {
      console.error('Error registering user:', error.response?.data || error.message);
      throw error;
    }
  }

  async login(input) {
    try {
      const response = await this.client.post('/auth/login', input);
      return response.data;
    } catch (error) {
      console.error('Error logging in:', error.response?.data || error.message);
      throw error;
    }
  }

  async refreshToken(refreshToken) {
    try {
```

```

        const response = await this.client.post('/auth/refresh', { refreshToken });
      );
      return response.data;
    } catch (error) {
      console.error('Error refreshing token:', error.response?.data || error.message);
      throw error;
    }
  }

  async logout(refreshToken) {
    try {
      await this.client.post('/auth/logout', { refreshToken });
      return true;
    } catch (error) {
      console.error('Error logging out:', error.response?.data || error.message);
      return false;
    }
  }
}

module.exports = AuthAPI;

```

Similar files would be created for the other services (user-api.js, calendar-api.js, event-api.js).

Step 8: Set Up Resolvers

Create `src/resolvers/index.js`:

```

// GraphQL resolvers
const resolvers = {
  Query: {
    me: async (_, __, { dataSources, token }) => {
      if (!token) return null;
      return dataSources.userAPI.getCurrentUser(token);
    },
    calendar: async (_, { id }, { dataSources, token }) => {
      return dataSources.calendarAPI.getCalendar(id, token);
    },
  }
};

```

```

  calendars: async (_, __, { dataSources, token }) => {
    return dataSources.calendarAPI.getCalendars(token);
  },
  event: async (_, { id }, { dataSources, token }) => {
    return dataSources.eventAPI.getEvent(id, token);
  },
  events: async (_, { calendarIds, start, end }, { dataSources, token }) => {
    return dataSources.eventAPI.getEvents(calendarIds, start, end, token);
  },
  },
}

Mutation: {
  register: async (_, { input }, { dataSources }) => {
    return dataSources.authAPI.register(input);
  },
  login: async (_, { input }, { dataSources }) => {
    return dataSources.authAPI.login(input);
  },
  refreshToken: async (_, { refreshToken }, { dataSources }) => {
    return dataSources.authAPI.refreshToken(refreshToken);
  },
  logout: async (_, { refreshToken }, { dataSources }) => {
    return dataSources.authAPI.logout(refreshToken);
  },
  },

  // Add mutations for user, calendar, and event services
  // ...
}

// Define resolvers for nested fields (e.g., User.preferences,
Calendar.events)

User: {
  preferences: async (parent, _, { dataSources, token }) => {
    return dataSources.userAPI.getUserPreferences(parent.id, token);
  },
}

Calendar: {
  owner: async (parent, _, { dataSources, token }) => {
    return dataSources.userAPI.getUser(parent.owner_id, token);
  },
  events: async (parent, { start, end }, { dataSources, token }) => {

```

```

        return dataSources.eventAPI.getCalendarEvents(parent.id, start, end,
token);
    },
    shares: async (parent, _, { dataSources, token }) => {
        return dataSources.calendarAPI.getCalendarShares(parent.id, token);
    },
),

Event: {
    calendar: async (parent, _, { dataSources, token }) => {
        return dataSources.calendarAPI.getCalendar(parent.calendar_id, token);
    },
    createdBy: async (parent, _, { dataSources, token }) => {
        return dataSources.userAPI.getUser(parent.created_by, token);
    },
    reminders: async (parent, _, { dataSources, token }) => {
        return dataSources.eventAPI.getEventReminders(parent.id, token);
    },
    attendees: async (parent, _, { dataSources, token }) => {
        return dataSources.eventAPI.getEventAttendees(parent.id, token);
    },
},
),

// Define additional nested resolvers
};

module.exports = resolvers;

```

Step 9: Create the Main Server File

Create `src/index.js`:

```

require('dotenv').config();
const express = require('express');
const { ApolloServer } = require('apollo-server-express');
const cors = require('cors');
const schema = require('./schema');

// Data Sources
const AuthAPI = require('./datasources/auth-api');

```

```

const UserAPI = require('./datasources/user-api');
const CalendarAPI = require('./datasources/calendar-api');
const EventAPI = require('./datasources/event-api');

async function startServer() {
    // Create Express app
    const app = express();

    // Apply middleware
    app.use(cors());
    app.use(express.json());

    // Extract token from request
    const getToken = (req) => {
        const authHeader = req.headers.authorization || '';
        if (authHeader.startsWith('Bearer ')) {
            return authHeader.slice(7);
        }
        return null;
    };

    // Create Apollo Server
    const server = new ApolloServer({
        schema,
        dataSources: () => ({
            authAPI: new AuthAPI(),
            userAPI: new UserAPI(),
            calendarAPI: new CalendarAPI(),
            eventAPI: new EventAPI(),
        }),
        context: ({ req }) => ({
            token: getToken(req),
        }),
        introspection: process.env.NODE_ENV !== 'production',
        playground: process.env.NODE_ENV !== 'production',
    });

    await server.start();

    // Apply Apollo middleware to Express
    server.applyMiddleware({ app });
}

```

```

// Start server
const PORT = process.env.PORT || 4000;
app.listen(PORT, () => {
  console.log(`🚀 GraphQL API ready at
http://localhost:${PORT}${server.graphqlPath}`);
});
}

startServer().catch(error => {
  console.error('Error starting server:', error);
});

```

Step 10: Update Package.json Scripts

Edit `package.json` to add dev and start scripts:

```
{
  "scripts": {
    "start": "node src/index.js",
    "dev": "nodemon src/index.js"
  }
}
```

Step 11: Complete the Data Source Files

You'll need to create similar data source files for the other services (user-api.js, calendar-api.js, event-api.js) following the pattern in auth-api.js.

Final Project Structure for API Gateway

Your API Gateway structure should look like:

```

calendar-app/
└── api-gateway/
    ├── package.json
    ├── .env
    └── src/
        └── index.js

```

```
└── schema/
    ├── index.js
    └── typeDefs.js
└── resolvers/
    └── index.js
└── datasources/
    ├── auth-api.js
    ├── user-api.js
    ├── calendar-api.js
    └── event-api.js
```

Step 12: Start the GraphQL Server

To run the GraphQL server:

```
cd ~/Projects/calendar-app/api-gateway
npm run dev
```

This will start the GraphQL server at <http://localhost:4000/graphql>, which you can use to interact with all your microservices through a unified GraphQL API.

Make sure all your microservices (auth, user, calendar, event) are also running when you test the GraphQL API.

 create data sources for the rest of the services

I'll create the data source files for the remaining services to complete your GraphQL API gateway setup.

User API Data Source

Create `src/datasources/user-api.js`:

```
const axios = require('axios');

class UserAPI {
    constructor() {
```

```

this.baseURL = process.env.USER_SERVICE_URL;
this.client = axios.create({
  baseURL: this.baseURL,
});
}

_setAuthHeader(token) {
  return {
    headers: {
      Authorization: `Bearer ${token}`
    }
  };
}

async getCurrentUser(token) {
  try {
    const response = await this.client.get('/users/me',
this._setAuthHeader(token));
    return response.data;
  } catch (error) {
    console.error('Error fetching current user:', error.response?.data ||
error.message);
    throw error;
  }
}

async getUser(userId, token) {
  try {
    // If this is the current user, use the me endpoint
    if (!userId) return null;

    const response = await this.client.get(`users/${userId}`,
this._setAuthHeader(token));
    return response.data;
  } catch (error) {
    console.error(`Error fetching user ${userId}:`, error.response?.data ||
error.message);
    return null; // Return null for non-existent users rather than throwing
  }
}

async getUserPreferences(userId, token) {

```

```

    try {
      const response = await this.client.get(`users/${userId}/preferences`,
this._setAuthHeader(token));
      return response.data;
    } catch (error) {
      console.error(`Error fetching preferences for user ${userId}:`,
error.response?.data || error.message);
      return null;
    }
  }

async updateUser(input, token) {
  try {
    const response = await this.client.patch('/users/me', input,
this._setAuthHeader(token));
    return response.data;
  } catch (error) {
    console.error('Error updating user:', error.response?.data ||
error.message);
    throw error;
  }
}

async updatePreferences(input, token) {
  try {
    const response = await this.client.patch('/users/preferences', input,
this._setAuthHeader(token));
    return response.data;
  } catch (error) {
    console.error('Error updating preferences:', error.response?.data ||
error.message);
    throw error;
  }
}

module.exports = UserAPI;

```

Calendar API Data Source

Create `src/datasources/calendar-api.js`:

```
const axios = require('axios');

class CalendarAPI {
  constructor() {
    this.baseURL = process.env.CALENDAR_SERVICE_URL;
    this.client = axios.create({
      baseURL: this.baseURL,
    });
  }

  _setAuthHeader(token) {
    return {
      headers: {
        Authorization: `Bearer ${token}`
      }
    };
  }

  async getCalendars(token) {
    try {
      const response = await this.client.get('/calendars',
this._setAuthHeader(token));
      return response.data;
    } catch (error) {
      console.error(`Error fetching calendars:`, error.response?.data ||
error.message);
      return [];
    }
  }

  async getCalendar(calendarId, token) {
    try {
      const response = await this.client.get(`/calendars/${calendarId}`,
this._setAuthHeader(token));
      return response.data;
    } catch (error) {
      console.error(`Error fetching calendar ${calendarId}:`,
error.response?.data || error.message);
      return null;
    }
  }
}
```

```

        }
    }

    async createCalendar(input, token) {
        try {
            const response = await this.client.post('/calendars', input,
this._setAuthHeader(token));
            return response.data;
        } catch (error) {
            console.error('Error creating calendar:', error.response?.data || error.message);
            throw error;
        }
    }

    async updateCalendar(id, input, token) {
        try {
            const response = await this.client.patch(`/calendars/${id}`, input,
this._setAuthHeader(token));
            return response.data;
        } catch (error) {
            console.error(`Error updating calendar ${id}:`, error.response?.data || error.message);
            throw error;
        }
    }

    async deleteCalendar(id, token) {
        try {
            await this.client.delete(`/calendars/${id}`, this._setAuthHeader(token));
            return true;
        } catch (error) {
            console.error(`Error deleting calendar ${id}:`, error.response?.data || error.message);
            return false;
        }
    }

    async shareCalendar(input, token) {
        try {
            const response = await
this.client.post(`/calendars/${input.calendarId}/share`, {

```

```

        email: input.email,
        permission: input.permission
    }, this._setAuthHeader(token));
    return response.data;
} catch (error) {
    console.error('Error sharing calendar:', error.response?.data || error.message);
    throw error;
}
}

async getCalendarShares(calendarId, token) {
    try {
        const response = await this.client.get(`/calendars/${calendarId}/shares`,
this._setAuthHeader(token));
        return response.data;
    } catch (error) {
        console.error(`Error fetching shares for calendar ${calendarId}:`,
error.response?.data || error.message);
        return [];
    }
}

module.exports = CalendarAPI;

```

Event API Data Source

Create `src/datasources/event-api.js`:

```

const axios = require('axios');

class EventAPI {
    constructor() {
        this.baseURL = process.env.EVENT_SERVICE_URL;
        this.client = axios.create({
            baseURL: this.baseURL,
        });
    }
}

```

```

_setAuthHeader(token) {
  return {
    headers: {
      Authorization: `Bearer ${token}`
    }
  };
}

async getEvents(calendarIds, start, end, token) {
  try {
    let url = `/events?start=${start}&end=${end}`;
    if (calendarIds && calendarIds.length > 0) {
      url += `&calendarIds=${calendarIds.join(',')}`;
    }

    const response = await this.client.get(url, this._setAuthHeader(token));
    return response.data;
  } catch (error) {
    console.error('Error fetching events:', error.response?.data ||
error.message);
    return [];
  }
}

async getCalendarEvents(calendarId, start, end, token) {
  try {
    let url = `/events?calendarIds=${calendarId}`;
    if (start && end) {
      url += `&start=${start}&end=${end}`;
    }

    const response = await this.client.get(url, this._setAuthHeader(token));
    return response.data;
  } catch (error) {
    console.error(`Error fetching events for calendar ${calendarId}:`, error.response?.data || error.message);
    return [];
  }
}

async getEvent(eventId, token) {
  try {

```

```

        const response = await this.client.get(`events/${eventId}`,
this._setAuthHeader(token));
        return response.data;
    } catch (error) {
        console.error(`Error fetching event ${eventId}:`, error.response?.data || error.message);
        return null;
    }
}

async createEvent(input, token) {
    try {
        const response = await this.client.post('/events', input,
this._setAuthHeader(token));
        return response.data;
    } catch (error) {
        console.error('Error creating event:', error.response?.data || error.message);
        throw error;
    }
}

async updateEvent(id, input, token) {
    try {
        const response = await this.client.patch(`events/${id}`, input,
this._setAuthHeader(token));
        return response.data;
    } catch (error) {
        console.error(`Error updating event ${id}:`, error.response?.data || error.message);
        throw error;
    }
}

async updateEventInstance(eventId, instanceDate, input, token) {
    try {
        const response = await this.client.patch(
            `/events/${eventId}/instances/${instanceDate}`,
            input,
            this._setAuthHeader(token)
        );
        return response.data;
    }
}

```

```

    } catch (error) {
      console.error(`Error updating event instance ${eventId}/${instanceDate}:`,
error.response?.data || error.message);
      throw error;
    }
  }

async deleteEvent(id, recurring, token) {
  try {
    let url = `/events/${id}`;
    if (recurring) {
      url += `?recurring=${recurring}`;
    }

    await this.client.delete(url, this._setAuthHeader(token));
    return true;
  } catch (error) {
    console.error(`Error deleting event ${id}:`, error.response?.data || error.message);
    return false;
  }
}

async getEventReminders(eventId, token) {
  try {
    const response = await this.client.get(`/events/${eventId}/reminders`,
this._setAuthHeader(token));
    return response.data;
  } catch (error) {
    console.error(`Error fetching reminders for event ${eventId}:`,
error.response?.data || error.message);
    return [];
  }
}

async createReminder(eventId, minutesBefore, method, token) {
  try {
    const response = await this.client.post(
      `/events/${eventId}/reminders`,
      { minutesBefore, method },
      this._setAuthHeader(token)
    );
  }
}

```

```

        return response.data;
    } catch (error) {
        console.error(`Error creating reminder for event ${eventId}:`,
error.response?.data || error.message);
        throw error;
    }
}

async deleteReminder(id, token) {
    try {
        await this.client.delete(`/reminders/${id}`, this._setAuthHeader(token));
        return true;
    } catch (error) {
        console.error(`Error deleting reminder ${id}:`, error.response?.data || error.message);
        return false;
    }
}

async getEventAttendees(eventId, token) {
    try {
        const response = await this.client.get(`/events/${eventId}/attendees`,
this._setAuthHeader(token));
        return response.data;
    } catch (error) {
        console.error(`Error fetching attendees for event ${eventId}:`,
error.response?.data || error.message);
        return [];
    }
}

module.exports = EventAPI;

```

Update Resolvers with New Mutations

Now, let's update the Mutation resolvers in `src/resolvers/index.js` to use these data sources:

```
// Add these mutation resolvers to your existing file
Mutation: {
```

```

// Auth mutations
register: async (_, { input }, { dataSources }) => {
  return dataSources.authAPI.register(input);
},
login: async (_, { input }, { dataSources }) => {
  return dataSources.authAPI.login(input);
},
refreshToken: async (_, { refreshToken }, { dataSources }) => {
  return dataSources.authAPI.refreshToken(refreshToken);
},
logout: async (_, { refreshToken }, { dataSources }) => {
  return dataSources.authAPI.logout(refreshToken);
},


// User mutations
updateUser: async (_, { input }, { dataSources, token }) => {
  return dataSources.userAPI.updateUser(input, token);
},
updatePreferences: async (_, { input }, { dataSources, token }) => {
  return dataSources.userAPI.updatePreferences(input, token);
},


// Calendar mutations
createCalendar: async (_, { input }, { dataSources, token }) => {
  return dataSources.calendarAPI.createCalendar(input, token);
},
updateCalendar: async (_, { id, input }, { dataSources, token }) => {
  return dataSources.calendarAPI.updateCalendar(id, input, token);
},
deleteCalendar: async (_, { id }, { dataSources, token }) => {
  return dataSources.calendarAPI.deleteCalendar(id, token);
},
shareCalendar: async (_, { input }, { dataSources, token }) => {
  return dataSources.calendarAPI.shareCalendar(input, token);
},


// Event mutations
createEvent: async (_, { input }, { dataSources, token }) => {
  return dataSources.eventAPI.createEvent(input, token);
},
updateEvent: async (_, { id, input }, { dataSources, token }) => {
  return dataSources.eventAPI.updateEvent(id, input, token);
}

```

```

},
updateEventInstance: async (_, { eventId, instanceDate, input }, { dataSources, token }) => {
  return dataSources.eventAPI.updateEventInstance(eventId, instanceDate, input, token);
},
deleteEvent: async (_, { id, recurring }, { dataSources, token }) => {
  return dataSources.eventAPI.deleteEvent(id, recurring, token);
},
createReminder: async (_, { eventId, minutesBefore, method }, { dataSources, token }) => {
  return dataSources.eventAPI.createReminder(eventId, minutesBefore, method, token);
},
deleteReminder: async (_, { id }, { dataSources, token }) => {
  return dataSources.eventAPI.deleteReminder(id, token);
},
},
},

```

With these data sources in place, your GraphQL API gateway is now complete and ready to serve as a unified interface to all your microservices. This setup:

1. Abstracts away the individual service endpoints
2. Provides a unified data model
3. Handles authentication token forwarding
4. Transforms between REST and GraphQL
5. Allows fetching related data in a single request

To test your GraphQL API, make sure all your services are running, then start the API gateway with:

```

cd ~/Projects/calendar-app/api-gateway
npm run dev

```

Then open <http://localhost:4000/graphql> in your browser to use the GraphQL playground interface. This will allow you to interact with your entire calendar system through a single, coherent API.

 Next, create a step by step guide to create a local database development environment and create all the tables for the project

Step-by-Step Guide to Setting Up a Local Database Environment for Calendar App

This guide will walk you through setting up a local PostgreSQL database for development and creating all the necessary tables for the Calendar App project.

Prerequisites

- MacBook Air with macOS
- Homebrew already installed
- Terminal access

Step 1: Install PostgreSQL

If you haven't already installed PostgreSQL:

```
# Install PostgreSQL using Homebrew
brew install postgresql@14

# Start PostgreSQL service
brew services start postgresql@14

# Verify installation
postgres --version
```

Step 2: Create Database User and Databases

```
# Connect to PostgreSQL as the default user (your system username)
psql postgres

# Inside the PostgreSQL prompt, create a dedicated user for the app
CREATE USER calendar_user WITH PASSWORD 'calendar_password';

# Create development and test databases
```

```
CREATE DATABASE calendar_dev OWNER calendar_user;
CREATE DATABASE calendar_test OWNER calendar_user;

# Grant necessary privileges
ALTER USER calendar_user WITH SUPERUSER;

# Exit PostgreSQL prompt
\q
```

Step 3: Install Database Migration Tools

```
# Install Knex globally for command-line access
npm install -g knex

# Navigate to your shared directory
cd ~/Projects/calendar-app/shared

# Install Knex and PostgreSQL driver locally
npm install knex pg
```

Step 4: Configure Database Connection

Create a knexfile.js in the shared directory:

```
# Create knexfile.js
touch knexfile.js
```

Open the file in your text editor and add:

```
module.exports = {
  development: {
    client: 'postgresql',
    connection: {
      host: 'localhost',
      port: 5432,
      database: 'calendar_dev',
      user: 'calendar_user',
      password: 'calendar_password'
```

```
},
  pool: {
    min: 2,
    max: 10
  },
  migrations: {
    directory: './migrations'
  }
},
test: {
  client: 'postgresql',
  connection: {
    host: 'localhost',
    port: 5432,
    database: 'calendar_test',
    user: 'calendar_user',
    password: 'calendar_password'
  },
  pool: {
    min: 2,
    max: 10
  },
  migrations: {
    directory: './migrations'
  }
}
};
```

Step 5: Create the Migration Directory

```
# Create migrations directory
mkdir -p migrations
```

Step 6: Create the Initial Schema Migration

Create a new file in the migrations directory:

```
# Create a migration file
touch migrations/20250315000000_initial_schema.js
```

Open the file in your text editor and add the simplified schema:

```
exports.up = function(knex) {
  return knex.schema
    // Users table
    .createTable('users', function(table) {
      table.uuid('id').primary();
      table.string('email').notNullable().unique();
      table.string('password_hash').notNullable();
      table.string('name');
      table.string('profile_picture');
      table.string('timezone').notNullable().defaultTo('UTC');
      table.boolean('is_email_verified').notNullable().defaultTo(false);
      table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
      table.timestamp('updated_at');
    })
    // User preferences table
    .createTable('user_preferences', function(table) {
      table.uuid('id').primary();

      table.uuid('user_id').notNullable().references('id').inTable('users').onDelete('CASCADE');
      table.uuid('default_calendar_id');

      table.string('default_view').notNullable().defaultTo('month');
      table.jsonb('working_hours').notNullable();
      table.jsonb('notification_settings').notNullable();
      table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
      table.timestamp('updated_at');
      table.unique(['user_id']);
    })
    // Refresh tokens table
    .createTable('refresh_tokens', function(table) {
      table.uuid('id').primary();

      table.uuid('user_id').notNullable().references('id').inTable('users').onDelete('CASCADE');
      table.string('token').notNullable().unique();
      table.timestamp('expires_at').notNullable();
    })
}
```

```

    table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
    table.index(['user_id', 'token']);
  })

// Calendars table
.createTable('calendars', function(table) {
  table.uuid('id').primary();

  table.uuid('owner_id').notNullable().references('id').inTable('users').onDelete('CASCADE');
  table.string('name').notNullable();
  table.text('description');
  table.string('color');
  table.boolean('is_default').notNullable().defaultTo(false);
  table.boolean('is_visible').notNullable().defaultTo(true);
  table.string('external_id');
  table.string('external_source');
  table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
  table.timestamp('updated_at');
  table.index(['owner_id']);
})

// Calendar shares table
.createTable('calendar_shares', function(table) {
  table.uuid('id').primary();

  table.uuid('calendar_id').notNullable().references('id').inTable('calendars').onDelete('CASCADE');
  table.uuid('user_id').references('id').inTable('users').onDelete('CASCADE');
  table.string('email');
  table.string('permission').notNullable().defaultTo('view');
  table.string('status').notNullable().defaultTo('pending');
  table.string('invite_token');
  table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
  table.timestamp('updated_at');
  table.index(['calendar_id']);
  table.index(['user_id']);
  table.unique(['calendar_id', 'user_id']);
})

// Events table
.createTable('events', function(table) {
  table.uuid('id').primary();

```

```

table.uuid('calendar_id').notNullable().references('id').inTable('calendars').onDelete('CASCADE');
    table.string('title').notNullable();
    table.text('description');
    table.string('location');
    table.timestamp('start_time').notNullable();
    table.timestamp('end_time').notNullable();
    table.boolean('is_all_day').notNullable().defaultTo(false);
    table.string('recurrence_rule');
    table.jsonb('exception_dates');
    table.string('color');
    table.string('visibility').notNullable().defaultTo('default');
    table.string('status').notNullable().defaultTo('confirmed');
    table.uuid('created_by').notNullable().references('id').inTable('users');
    table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
    table.timestamp('updated_at');
    table.integer('version').notNullable().defaultTo(1);
    table.index(['calendar_id']);
    table.index(['start_time', 'end_time']);
}

// Event instances table
.createTable('event_instances', function(table) {
    table.uuid('id').primary();

    table.uuid('event_id').notNullable().references('id').inTable('events').onDelete('CASCADE');
        table.date('instance_date').notNullable();
        table.timestamp('start_time').notNullable();
        table.timestamp('end_time').notNullable();
        table.boolean('is_exception').notNullable().defaultTo(false);
        table.jsonb('exception_data');
        table.string('status').notNullable().defaultTo('confirmed');
        table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
        table.timestamp('updated_at');
        table.unique(['event_id', 'instance_date']);
        table.index(['event_id']);
        table.index(['instance_date']);
}

// Event attendees table
.createTable('event_attendees', function(table) {
    table.uuid('id').primary();

```

```

table.uuid('event_id').notNullable().references('id').inTable('events').onDelete('C
    table.uuid('user_id').references('id').inTable('users').onDelete('SET
NULL'));

    table.string('email').notNullable();
    table.string('name');
    table.string('response_status').notNullable().defaultTo('pending');
    table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
    table.timestamp('updated_at');
    table.index(['event_id']);
    table.index(['user_id']);
    table.unique(['event_id', 'email']);

})

// Reminders table
.createTable('reminders', function(table) {
    table.uuid('id').primary();

    table.uuid('event_id').notNullable().references('id').inTable('events').onDelete('C
table.uuid('user_id').notNullable().references('id').inTable('users').onDelete('CAS
    table.integer('minutes_before').notNullable();
    table.string('method').notNullable().defaultTo('notification');
    table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
    table.timestamp('updated_at');
    table.index(['event_id']);
    table.index(['user_id']);
    table.unique(['event_id', 'user_id', 'minutes_before', 'method']);

})

// Attachments table
.createTable('attachments', function(table) {
    table.uuid('id').primary();

    table.uuid('event_id').notNullable().references('id').inTable('events').onDelete('C
        table.string('name').notNullable();
        table.string('file_url').notNullable();
        table.string('mime_type').notNullable();
        table.integer('size_bytes').notNullable();
        table.uuid('created_by').notNullable().references('id').inTable('users');
        table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
        table.index(['event_id']);

```

```

    });

    // Sync tokens table
    .createTable('sync_tokens', function(table) {
      table.uuid('id').primary();

      table.uuid('user_id').notNullable().references('id').inTable('users').onDelete('CASCADE');
      table.string('device_id').notNullable();
      table.timestamp('last_sync_time').notNullable().defaultTo(knex.fn.now());
      table.string('token').notNullable();
      table.timestamp('created_at').notNullable().defaultTo(knex.fn.now());
      table.timestamp('updated_at');
      table.unique(['user_id', 'device_id']);
      table.index(['token']);
    });
  };

  exports.down = function(knex) {
    return knex.schema
      .dropTableIfExists('sync_tokens')
      .dropTableIfExists('attachments')
      .dropTableIfExists('reminders')
      .dropTableIfExists('event_attendees')
      .dropTableIfExists('event_instances')
      .dropTableIfExists('events')
      .dropTableIfExists('calendar_shares')
      .dropTableIfExists('calendars')
      .dropTableIfExists('refresh_tokens')
      .dropTableIfExists('user_preferences')
      .dropTableIfExists('users');
  };
}

```

Step 7: Add Package.json Scripts for Migrations

Edit or create `package.json` in the shared directory:

```
{
  "name": "calendar-app-shared",
  "version": "1.0.0",
  "description": "Shared utilities for Calendar App",
}
```

```
"scripts": {
  "migrate:dev": "knex migrate:latest --env development",
  "migrate:test": "knex migrate:latest --env test",
  "migrate:rollback": "knex migrate:rollback --env development",
  "migrate:rollback:test": "knex migrate:rollback --env test"
},
"dependencies": {
  "knex": "^2.4.2",
  "pg": "^8.9.0"
}
}
```

Step 8: Enable UUID Extension in PostgreSQL

Before running migrations, you need to enable the UUID extension:

```
# Connect to the development database
psql -d calendar_dev -U calendar_user

# Enable UUID extension
CREATE EXTENSION IF NOT EXISTS "uuid-ossp";

# Exit PostgreSQL prompt
\q

# Also enable for test database
psql -d calendar_test -U calendar_user
CREATE EXTENSION IF NOT EXISTS "uuid-ossp";
\q
```

Step 9: Run the Migrations

Now, run the migrations to create all the tables:

```
# Navigate to the shared directory
cd ~/Projects/calendar-app/shared

# Run migrations for development
npm run migrate:dev
```

```
# Run migrations for test environment
npm run migrate:test
```

Step 10: Verify the Database Setup

Check that all tables were created successfully:

```
# Connect to the database
psql -d calendar_dev -U calendar_user

# List all tables
\dt

# Check details of a specific table (e.g., users)
\d users

# Exit PostgreSQL prompt
\q
```

Step 11: Update Environment Variables

Now that your database is set up, update the ` `.env` files in each service directory to use the correct database connection:

```
# Example for auth-service .env file
DATABASE_URL=postgresql://calendar_user:calendar_password@localhost:5432/calendar_c
```

Repeat for all service ` `.env` files.

Step 12: Create Default Data (Optional)

For development convenience, you might want to create a seed file:

```
# Create a seeds directory
mkdir -p ~/Projects/calendar-app/shared/seeds
```

```
# Create a seed file
touch ~/Projects/calendar-app/shared/seeds/dev_seed.js
```

Add the following to `dev_seed.js`:

```
const { v4: uuidv4 } = require('uuid');
const bcrypt = require('bcrypt');

exports.seed = async function(knex) {
  // Clear existing data
  await knex('sync_tokens').del();
  await knex('attachments').del();
  await knex('reminders').del();
  await knex('event_attendees').del();
  await knex('event_instances').del();
  await knex('events').del();
  await knex('calendar_shares').del();
  await knex('calendars').del();
  await knex('refresh_tokens').del();
  await knex('user_preferences').del();
  await knex('users').del();

  // Create test user
  const userId = uuidv4();
  const hashedPassword = await bcrypt.hash('password123', 10);

  await knex('users').insert({
    id: userId,
    email: 'test@example.com',
    password_hash: hashedPassword,
    name: 'Test User',
    timezone: 'UTC',
    is_email_verified: true,
    created_at: new Date()
  });

  // Create user preferences
  await knex('user_preferences').insert({
    id: uuidv4(),
    user_id: userId,
    default_view: 'month',
```

```

working_hours: JSON.stringify({
  start: '09:00',
  end: '17:00',
  days: [1, 2, 3, 4, 5]
}),
notification_settings: JSON.stringify({
  event_reminders: true,
  share_notifications: true,
  email_notifications: true
}),
created_at: new Date()
});

// Create calendars
const workCalendarId = uuidv4();
const personalCalendarId = uuidv4();

await knex('calendars').insert([
{
  id: workCalendarId,
  owner_id: userId,
  name: 'Work',
  color: '#4285F4',
  is_default: true,
  is_visible: true,
  created_at: new Date()
},
{
  id: personalCalendarId,
  owner_id: userId,
  name: 'Personal',
  color: '#0F9D58',
  is_default: false,
  is_visible: true,
  created_at: new Date()
}
]);

// Create sample events
const now = new Date();
const tomorrow = new Date(now);
tomorrow.setDate(tomorrow.getDate() + 1);

```

```

await knex('events').insert([
{
  id: uuidv4(),
  calendar_id: workCalendarId,
  title: 'Team Meeting',
  description: 'Weekly team sync',
  location: 'Conference Room A',
  start_time: new Date(now.setHours(10, 0, 0, 0)),
  end_time: new Date(now.setHours(11, 0, 0, 0)),
  is_all_day: false,
  visibility: 'default',
  status: 'confirmed',
  created_by: userId,
  created_at: new Date(),
  version: 1
},
{
  id: uuidv4(),
  calendar_id: personalCalendarId,
  title: 'Dentist Appointment',
  location: 'Dental Clinic',
  start_time: new Date(tomorrow.setHours(14, 0, 0, 0)),
  end_time: new Date(tomorrow.setHours(15, 0, 0, 0)),
  is_all_day: false,
  visibility: 'default',
  status: 'confirmed',
  created_by: userId,
  created_at: new Date(),
  version: 1
}
]);
});

```

Update the knexfile.js to include the seeds configuration:

```

// Add to the existing knexfile.js
module.exports = {
  development: {
    // ... existing config
    seeds: [

```

```
    directory: './seeds'  
  }  
,  
// ... rest of the file  
};
```

Install bcrypt for the seed:

```
cd ~/Projects/calendar-app/shared  
npm install bcrypt uuid
```

Add a script to package.json:

```
{  
  "scripts": {  
    // ... existing scripts  
    "seed:dev": "knex seed:run --env development"  
  }  
}
```

Run the seed:

```
npm run seed:dev
```

Step 13: Configure Database Connection Pools

To optimize database performance, add the following to your `knexfile.js`:

```
module.exports = {  
  development: {  
    // ... existing config  
    pool: {  
      min: 2,  
      max: 10,  
      // Add these lines:  
      afterCreate: (conn, done) => {  
        conn.query('SET timezone="UTC";', function (err) {  
          done(err, conn);  
        })  
      }  
    }  
  }  
}
```

```
        });
    }
}
},
// Do the same for the test environment
};
```

This ensures all connections use UTC timezone for consistency.

Step 14: Test the Database Connection in One of Your Services

Start one of your services, e.g., the auth service:

```
cd ~/Projects/calendar-app/auth-service
npm run dev
```

Try to register a new user via your API to verify that the database connection works properly.

With these steps, you'll have a fully configured local PostgreSQL database setup for your Calendar App, complete with all the necessary tables, indexes, and even some sample data to get started with development.

 As a **Frontend Lead** (1) - Please provide a detailed list of your task and responsibilities. Edit

Frontend Lead Responsibilities & Tasks for Calendar App Project

Core Responsibilities

Team Leadership

- Lead the web frontend development team (2-3 engineers)
- Establish technical direction for the web application
- Mentor junior and mid-level developers
- Facilitate sprint planning for frontend work

- Conduct thorough code reviews
- Remove blockers and advocate for necessary resources

Architecture & Technical Design

- Design React/TypeScript application architecture
- Create component structure documentation
- Establish state management approach
- Design API integration patterns
- Set up frontend testing frameworks
- Ensure adherence to SOLID principles in frontend design

System Planning

- Develop scalability strategy for frontend applications
- Create frontend performance optimization guidelines
- Define UI/UX standards aligned with design system
- Plan for cross-browser compatibility and accessibility
- Define error handling and logging approaches

Detailed Task Breakdown

Foundation Phase (Weeks 1-6)

1. Frontend Architecture Blueprint

- Create comprehensive architecture document for web application
- Define component hierarchy and data flow
- Document state management strategy
- Establish build and deployment processes
- Define code organization principles

2. Component Library Planning

- Analyze design system requirements
- Plan component hierarchy and relationships
- Create component documentation templates
- Define component API standards

- Establish testing strategy for components

3. API Integration Strategy

- Design REST/GraphQL consumption patterns
- Create data fetching and caching strategy
- Define error handling approach
- Document authentication flow integration
- Plan real-time updates implementation

4. State Management Architecture

- Select appropriate state management solution
- Define global vs. component state boundaries
- Document state structure and access patterns
- Plan for performance optimization in state
- Create state debugging strategy

5. Frontend Testing Framework

- Set up unit testing environment
- Establish component testing standards
- Configure end-to-end testing tools
- Document testing best practices
- Define test coverage requirements

Development Phase (Weeks 7-20)

6. Core Component Implementation

- Develop foundational component library
- Create base layout components
- Implement form components with validation
- Build navigation components
- Create utility components

7. Calendar View Implementation

- Design calendar rendering strategy



- Implement day/week/month/agenda views
- Create event display components
- Build date selection components
- Develop recurrence pattern display

8. State Management Implementation

- Set up global state store
- Implement authentication state management
- Create calendar data management
- Build user preferences state
- Implement cross-component communication

9. API Integration Development

- Create API client services
- Implement authentication token management
- Build data fetching hooks
- Create mutation handling utilities
- Implement error handling and retry logic

10. Build and Deployment Pipeline

- Configure webpack/Vite build process
- Set up environment configuration management
- Implement code splitting strategy
- Create production optimization settings
- Configure CDN integration

Testing & Refinement Phase (Weeks 21-32)

11. Performance Optimization

- Conduct performance audits
- Implement component lazy loading
- Optimize rendering efficiency
- Improve bundle size management
- Fine-tune animations and transitions



12. Cross-browser Testing

- Ensure compatibility with major browsers
- Address browser-specific issues
- Optimize for different screen sizes
- Test with various device capabilities
- Document known limitations

13. Accessibility Implementation

- Conduct accessibility audits
- Implement ARIA attributes
- Ensure keyboard navigation works
- Test with screen readers
- Fix accessibility issues

Weekly Recurring Tasks

- Lead frontend team stand-ups (daily)
- Review and approve pull requests (ongoing)
- Participate in cross-team architecture meetings (weekly)
- Report on frontend progress to Project Manager (weekly)
- Conduct 1:1s with frontend team members (bi-weekly)
- Update frontend documentation (ongoing)
- Assess and mitigate technical risks (weekly)

Deliverables

1. Frontend Architecture Document
2. Component Library Documentation
3. API Integration Pattern Guide
4. State Management Architecture Document
5. Testing Strategy Document
6. Performance Optimization Guide
7. Build and Deployment Documentation

8. Browser Compatibility Report
9. Accessibility Compliance Documentation
10. Frontend Development Guidelines

Key Technical Decisions

1. **Framework Selection:** React with TypeScript for type safety
2. **Component Strategy:** Atomic design methodology for component organization
3. **State Management:** Redux Toolkit for global state, React Context for localized state
4. **Styling Approach:** Tailwind CSS for utility-first styling
5. **Data Fetching:** React Query for server state management
6. **Form Handling:** React Hook Form with Zod validation
7. **Testing Framework:** Jest and React Testing Library
8. **Build Tool:** Vite for development speed
9. **Performance Monitoring:** Lighthouse and custom performance metrics
10. **Error Tracking:** Integration with error monitoring service

This comprehensive responsibility list ensures that as Frontend Lead, you'll guide the development of a high-quality, maintainable, and scalable web application for the Calendar App while supporting your team's growth and productivity.

 As an frontend architect, please work on the following:

Frontend Architecture Blueprint for Calendar App

1. Overall Application Architecture

The Calendar App frontend will follow a well-structured, component-based architecture using React with TypeScript. This architecture is designed to support scalability, maintain

 As a frontend architect, please work on the following:

- Design React/TypeScript application architecture

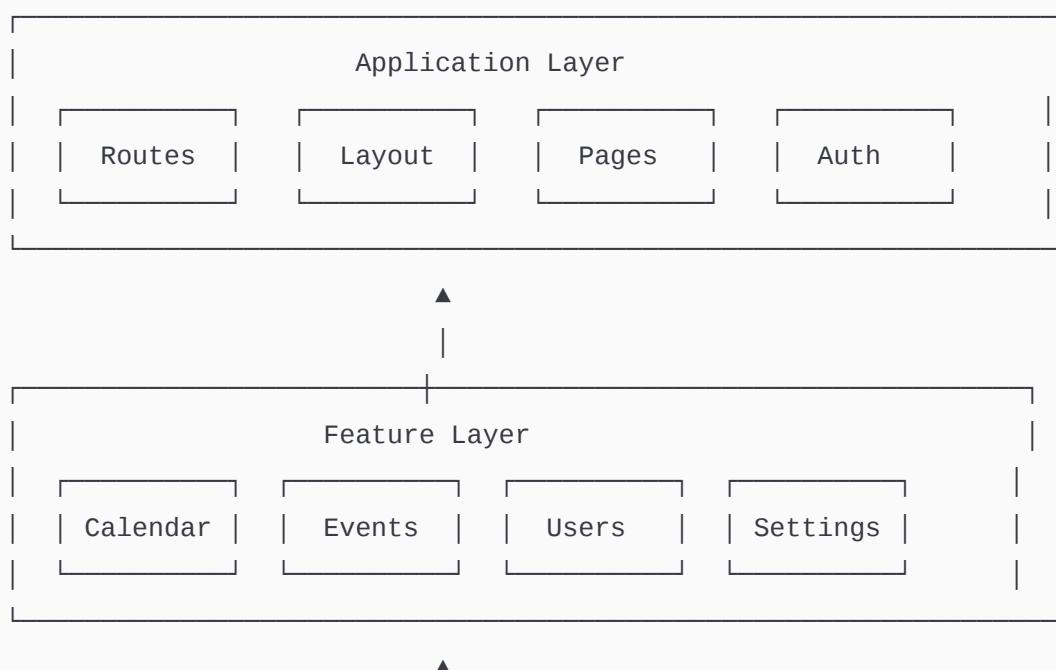
- Create component structure documentation
- Establish state management approach
- Design API integration patterns
- Set up frontend testing frameworks
- Ensure adherence to SOLID principles in frontend design System Planning
- Develop scalability strategy for frontend applications
- Create frontend performance optimization guidelines
- Define UI/UX standards aligned with design system
- Plan for cross-browser compatibility and accessibility
- Define error handling and logging approaches

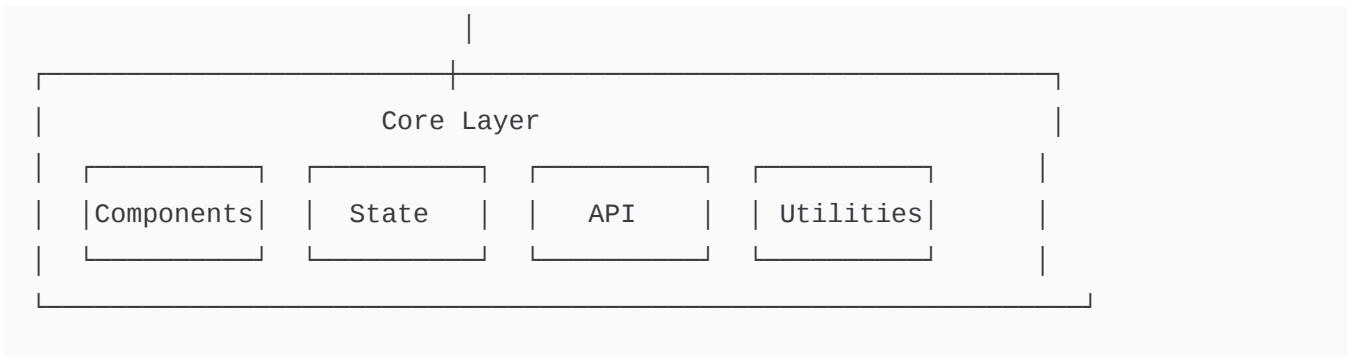
Calendar App Frontend Architecture Blueprint

1. React/TypeScript Application Architecture

Core Architecture Principles

Our Calendar App front-end architecture follows a layered approach with clear separation of concerns:





Directory Structure

```

/src
|
|   └── /app           # Application layer
|       ├── /routes      # Route definitions
|       ├── /layouts      # Layout components
|       ├── /pages        # Page components
|       └── /auth         # Authentication logic
|
|   └── /features       # Feature layer
|       ├── /calendar    # Calendar feature
|       ├── /events       # Events feature
|       ├── /users        # User management
|       └── /settings     # User settings
|
|   └── /core            # Core layer
|       ├── /components  # Shared UI components
|       ├── /hooks        # Custom React hooks
|       ├── /api          # API integration
|       ├── /store        # State management
|       ├── /utils        # Utility functions
|       └── /types        # TypeScript type definitions
|
|   └── /assets          # Static assets
|       ├── /images       # Image files
|       ├── /icons        # Icon files
|       └── /styles        # Global styles
|
|   └── /tests           # Test configurations
|       ├── /unit         # Unit tests
|       ├── /integration  # Integration tests
|       └── /e2e          # End-to-end tests

```

```
|  
|   └── App.tsx           # Root App component  
|   └── index.tsx         # Entry point  
└── vite-env.d.ts        # Vite type definitions
```

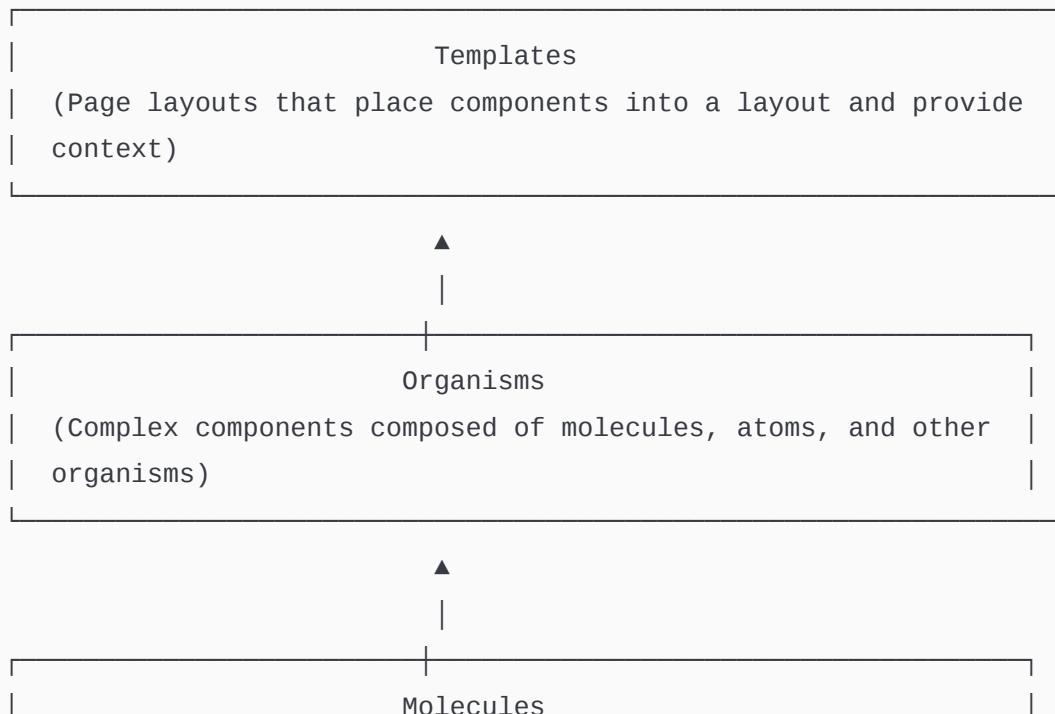
Technical Stack

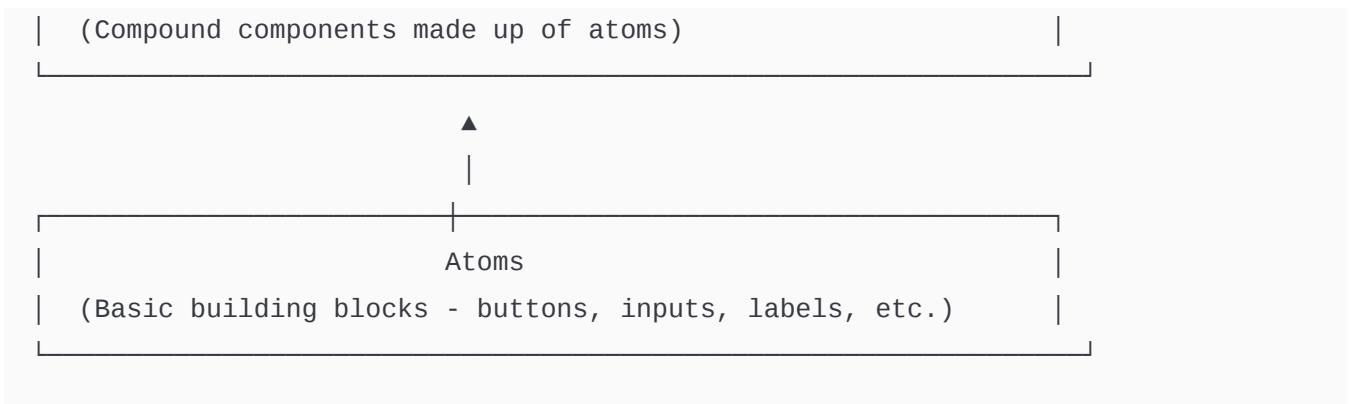
- **Framework:** React 18+
- **Language:** TypeScript 5.0+
- **Build Tool:** Vite
- **Styling:** Tailwind CSS with PostCSS
- **Router:** React Router v6
- **State Management:** Redux Toolkit + React Query
- **Form Management:** React Hook Form + Zod
- **Testing:** Jest + React Testing Library + Cypress
- **Package Manager:** npm

2. Component Structure Documentation

Component Hierarchy

We'll follow Atomic Design principles:





Core Component Categories

1. Atoms:

- Button
- Input
- Checkbox
- Select
- DatePicker
- Typography (Heading, Paragraph, etc.)
- Icon
- Avatar

2. Molecules:

- FormField (Label + Input + Error)
- SearchBar
- Notification
- Modal
- Dropdown
- Tabs
- Card

3. Organisms:

- CalendarDay
- CalendarWeek
- CalendarMonth
- EventForm

- EventCard
- Sidebar
- Header
- UserProfile

4. Templates:

- DashboardLayout
- CalendarLayout
- SettingsLayout
- AuthLayout

Component Documentation Template

Each component will include comprehensive documentation:

```
/**
 * Button Component
 *
 * A customizable button component that supports various variants and sizes.
 *
 * @example
 * <Button
 *   variant="primary"
 *   size="md"
 *   onClick={() => console.log('Clicked')}
 * >
 *   Click Me
 * </Button>
 *
 * @prop {ReactNode} children - Button content
 * @prop {"primary" | "secondary" | "danger"} variant - Button style variant
 * @prop {"sm" | "md" | "lg"} size - Button size
 * @prop {function} onClick - Click handler
 * @prop {boolean} isDisabled - Disables the button when true
 * @prop {boolean} isLoading - Shows loading indicator when true
 */
```

3. State Management Approach

We'll implement a hybrid state management strategy:

State Categories

1. Server State (React Query)

- Calendar data
- Event data
- User data
- Application settings

2. UI State (Redux Toolkit)

- Current view (day/week/month)
- Selected date range
- Selected events
- UI preferences
- Modal/drawer states

3. Form State (React Hook Form)

- Input values
- Validation errors
- Submission state

4. Local Component State (useState/useReducer)

- Component-specific state that doesn't need global access

Redux Store Structure

```
// Store slice example
interface CalendarState {
  currentView: 'day' | 'week' | 'month' | 'agenda';
  selectedDate: string; // ISO date string
  visibleRange: {
    start: string; // ISO date string
    end: string; // ISO date string
  };
  selectedEventIds: string[];
  visibleCalendarIds: string[];
}
```

```

}

// Root state structure
interface RootState {
  auth: AuthState;
  calendar: CalendarState;
  ui: UiState;
  settings: SettingsState;
}

```

React Query Implementation

```

// Example query hook
function useEvents(calendarIds: string[], dateRange: DateRange) {
  return useQuery({
    queryKey: ['events', calendarIds, dateRange],
    queryFn: () => api.getEvents(calendarIds, dateRange),
    staleTime: 5 * 60 * 1000, // 5 minutes
    placeholderData: keepPreviousData,
  });
}

// Example mutation hook
function useCreateEvent() {
  const queryClient = useQueryClient();

  return useMutation({
    mutationFn: (event: EventInput) => api.createEvent(event),
    onSuccess: (newEvent) => {
      queryClient.invalidateQueries({
        queryKey: ['events']
      });
    }
  });
}

```

4. API Integration Patterns

GraphQL API Integration

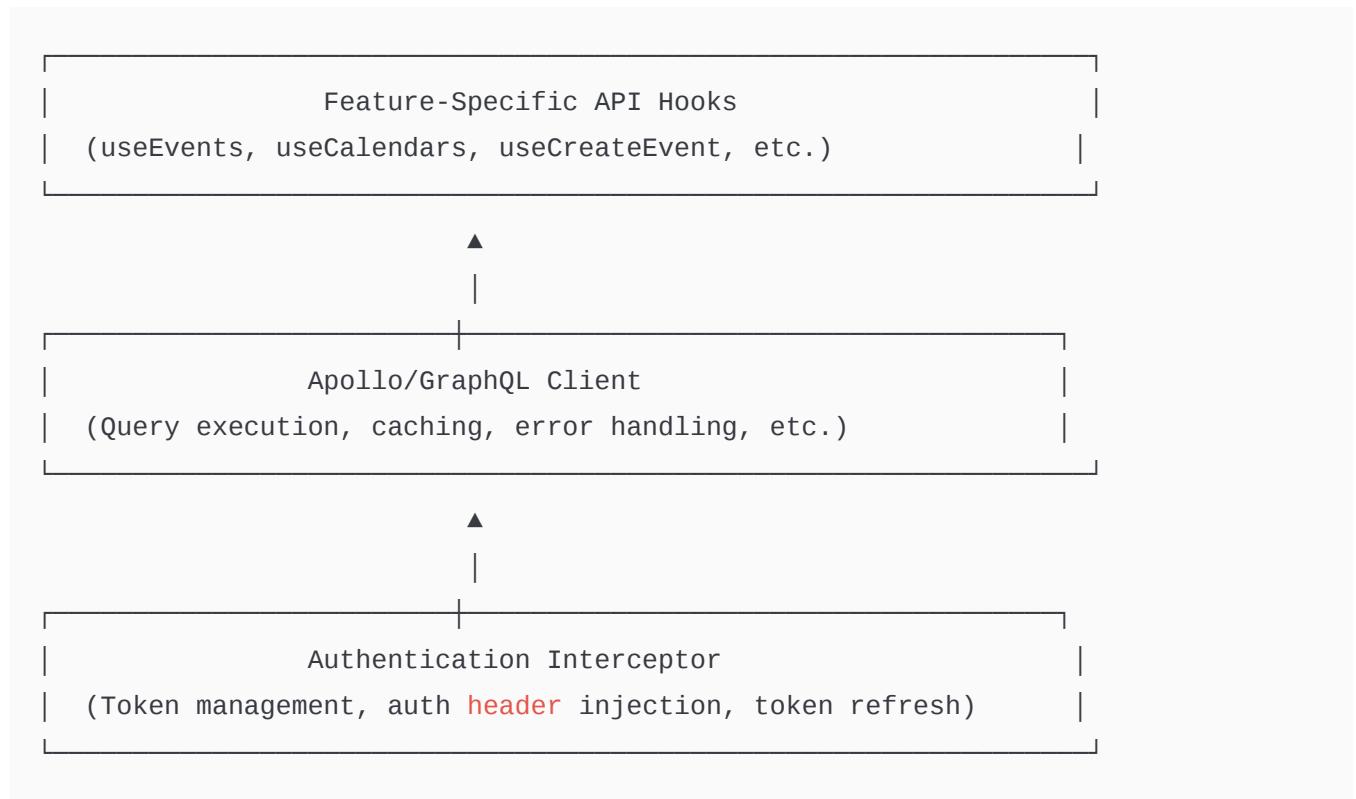
We'll use Apollo Client for our GraphQL API:

```
// API client setup
const client = new ApolloClient({
  uri: import.meta.env.VITE_GRAPHQL_URL,
  cache: new InMemoryCache(),
  defaultOptions: {
    watchQuery: {
      fetchPolicy: 'cache-and-network',
    },
  },
});

// GraphQL query example
const GET_EVENTS = gql`query GetEvents($calendarIds: [ID!], $start: DateTime!, $end: DateTime!) {events(calendarIds: $calendarIds, start: $start, end: $end) {idtitledescriptionstartTimeendTimeisAllDaycolorlocationstatusrecurrenceRule}}`;

// GraphQL mutation example
const CREATE_EVENT = gql`mutation CreateEvent($input: CreateEventInput!) {createEvent(input: $input) {idtitle# other fields}}`;
```

API Layer Architecture



5. Frontend Testing Framework

Test Types and Tools

1. Unit Tests (Jest + React Testing Library)

- Individual components
- Utility functions
- Custom hooks
- State selectors/reducers

2. Integration Tests (Jest + React Testing Library)

- Component interaction
- Form submissions
- API interactions (mocked)
- State management flow

3. End-to-End Tests (Cypress)

- User flows

- Cross-browser compatibility
- Visual regression

Test Organization

```
/tests
├── /unit
│   ├── /components
│   ├── /hooks
│   └── /utils
├── /integration
│   ├── /features
│   └── /pages
└── /e2e
    ├── /flows
    └── /pages
```

Testing Guidelines

- **Component Tests:** Focus on user interaction and accessibility
- **Hook Tests:** Verify correct behavior with various inputs and state changes
- **Redux Tests:** Separate tests for selectors, reducers, and actions
- **API Hook Tests:** Mock API responses and test loading/error states
- **E2E Tests:** Cover critical user journeys and edge cases

6. SOLID Principles in Frontend Design

Single Responsibility Principle

- Each component should handle one specific concern
- Examples:
 - `EventForm`: Only handles event form display and input
 - `EventFormContainer`: Handles data fetching, submission logic, etc.
 - `useEventValidation`: Custom hook for event validation logic

Open/Closed Principle

- Components are open for extension but closed for modification

- Examples:
 - `Button` component accepts a `renderIcon` prop for custom icons
 - `CalendarView` can be extended with plugins without modifying core code

Liskov Substitution Principle

- Child components should be substitutable for their parent components
- Examples:
 - `BaseInput`, `TextInput`, `DateInput` maintain consistent API
 - Different calendar views implement the same interface

Interface Segregation Principle

- Components should not depend on props they don't use
- Examples:
 - Splitting large prop interfaces into smaller, focused ones
 - Using composition instead of inheritance for component features

Dependency Inversion Principle

- Components depend on abstractions, not concrete implementations
- Examples:
 - API hooks abstract away data fetching details
 - Components receive data providers via Context or props

7. Scalability Strategy

Code Splitting

- Route-based code splitting for all page components
- Feature-based code splitting for large feature modules
- Dynamic imports for modal dialogs and heavy components
- Vendor chunk splitting for third-party libraries

Performance Optimization

- Virtualized lists for calendar events and large data sets
- Memoization of expensive calculations and component renders

- Debounced event handlers for frequent UI interactions
- Optimistic UI updates for improved perceived performance

State Management Scaling

- Normalized state structure following entity-relationship model
- Selective store subscription to prevent unnecessary re-renders
- Action batching for multiple related state changes
- Middleware for handling complex async workflows

8. Performance Optimization Guidelines

Core Metrics Focus

- **First Contentful Paint (FCP):** < 1.8s
- **Largest Contentful Paint (LCP):** < 2.5s
- **First Input Delay (FID):** < 100ms
- **Cumulative Layout Shift (CLS):** < 0.1
- **Time to Interactive (TTI):** < 3.5s

Optimization Techniques

1. Bundle Optimization

- Tree shaking unused code
- Code splitting and lazy loading
- Minification and compression
- Modern format serving (ES modules)

2. Rendering Optimization

- Use `React.memo()` for expensive components
- Implement `useMemo()` for costly calculations
- Apply `useCallback()` for stable callback references
- Virtualize long lists (calendar events, etc.)

3. Asset Optimization

- Image format optimization (WebP, AVIF)

- Font subsetting and display optimization
- SVG optimization and icon sprites
- Resource hints (preload, prefetch)

9. UI/UX Standards

Design System Integration

- Use Tailwind CSS for implementation of design tokens
- Create design token variables for colors, spacing, typography, etc.
- Implement consistent component APIs across the UI library
- Maintain comprehensive Storybook documentation

Responsive Design Strategy

- Mobile-first approach for all components
- Fluid typography and spacing scales
- Adaptive layouts using grid and flexbox
- Component-specific responsive behavior (e.g., calendar layouts)

Design Consistency

- Consistent spacing system based on 4px grid
- Typography scale with defined heading and body text styles
- Color palette with semantic color variables
- Standardized component states (hover, focus, active, disabled)

10. Cross-Browser Compatibility & Accessibility

Browser Support

- Support latest two versions of Chrome, Firefox, Safari, and Edge
- Graceful degradation for older browsers
- Feature detection and polyfills for critical features
- Automated cross-browser testing

Accessibility Standards

- Compliance with WCAG 2.1 AA standards
- Proper semantic HTML structure
- Keyboard navigation for all interactive elements
- Focus management for modals and complex widgets
- ARIA attributes for custom components
- Color contrast ratios that meet accessibility guidelines

Accessibility Checklist for Components

1. **Semantic HTML:** Use the correct HTML elements
2. **Keyboard Navigation:** Ensure all interactions are possible with a keyboard
3. **Focus Management:** Properly handle focus, especially in modal dialogs
4. **Screen Reader Support:** Add appropriate ARIA attributes
5. **Color Contrast:** Meet minimum contrast ratios
6. **Text Sizing:** Support text resizing and zooming
7. **Motion Sensitivity:** Respect reduced motion preferences

11. Error Handling & Logging Approaches

Error Boundaries

- Implement React Error Boundaries at strategic levels:
 - App-level for catastrophic errors
 - Route-level for page-specific errors
 - Feature-level for isolated error handling
- Create user-friendly fallback UIs for each boundary

API Error Handling

- Categorize errors by type (network, validation, authentication, etc.)
- Implement global error handling for API requests
- Create specific error handling for critical flows
- Design user-friendly error messages and recovery options

Logging Strategy

- Client-side error logging with context information

- Performance metric tracking
- User interaction logging for analytics
- Environment-specific logging levels

Error Logging Implementation

```
// Error logging service
class ErrorLogger {
  logError(error: Error, context?: Record<string, any>) {
    // In development, log to console
    if (import.meta.env.DEV) {
      console.error(error, context);
      return;
    }

    // In production, send to error tracking service
    // (e.g., Sentry, LogRocket, etc.)
    errorTrackingService.captureException(error, {
      extra: {
        ...context,
        url: window.location.href,
        timestamp: new Date().toISOString(),
      }
    });
  }
}
```

This comprehensive architecture blueprint provides a solid foundation for developing the Calendar App frontend. It ensures scalability, maintainability, and a high-quality user experience while adhering to modern frontend best practices and SOLID principles.

 please work on a step by step guide to setup a local development environment for frontend development bsaed on the above strategy and recommendations. The tools used for local development is visual studio code, and also suggest I need to install any other tools that are essential for developemnt. Provide a step by step guide to create the project in visual studio code and adding all the required setup files for the setup.

Step-by-Step Guide to Setting Up a Calendar App Frontend Development Environment

This guide will help you set up a complete local development environment for the Calendar App frontend using Visual Studio Code.

Prerequisites

1. **Node.js and npm:** Required for JavaScript development
2. **Visual Studio Code:** Our primary code editor
3. **Git:** For version control

Step 1: Install Required Software

1. Install Node.js and npm:

- Download and install from nodejs.org (LTS version recommended)
- Verify installation:

```
node --version  
npm --version
```

2. Install Visual Studio Code:

- Download and install from code.visualstudio.com

3. Install Git:

- Download and install from git-scm.com
- Verify installation:

```
git --version
```

4. Install VS Code Extensions:

- Open VS Code
- Go to Extensions view (Ctrl+Shift+X or Cmd+Shift+X)

- Install the following essential extensions:
 - ESLint
 - Prettier - Code formatter
 - TypeScript Vue Plugin (Volar)
 - Tailwind CSS IntelliSense
 - Jest Runner
 - EditorConfig for VS Code
 - GitLens

Step 2: Create a New React Project with Vite

1. Create Project Directory:

```
mkdir -p ~/Projects/calendar-app/frontend  
cd ~/Projects/calendar-app/frontend
```

2. Initialize a New Vite Project with React and TypeScript:

```
npm create vite@latest . -- --template react-ts
```

3. Install Dependencies:

```
npm install
```

4. Run the Development Server to Verify:

```
npm run dev
```

Open your browser to the URL shown in the terminal (typically <http://localhost:5173>)

Step 3: Set Up Project Structure

Create the directory structure according to our architecture plan:

```
mkdir -p
```

```
src/{app/{routes,layouts,pages,auth},features/{calendar,events,users,settings},core}
```

Step 4: Add Essential Dependencies

1. Install Core Dependencies:

```
# Core Libraries
npm install react-router-dom @tanstack/react-query @reduxjs/toolkit

# UI and Styling
npm install tailwindcss postcss autoprefixer

# Form Handling
npm install react-hook-form zod @hookform/resolvers

# Date/Time Handling
npm install date-fns

# API and GraphQL
npm install @apollo/client graphql

# Utility Libraries
npm install clsx class-variance-authority
```

2. Install Development Dependencies:

```
npm install -D @types/node jest @testing-library/react @testing-library/jest-dom @testing-library/user-event jest-environment-jsdom ts-jest cypress vite-tsconfig-paths eslint-plugin-react-hooks eslint-plugin-jsx-a11y prettier eslint-config-prettier
```

Step 5: Configure Tailwind CSS

1. Initialize Tailwind:

```
npx tailwindcss init -p
```

2. Edit `tailwind.config.js`:

```

/** @type {import('tailwindcss').Config} */
export default {
  content: [
    "./index.html",
    "./src/**/*.{js,ts,jsx,tsx}",
  ],
  theme: {
    extend: {
      colors: {
        primary: {
          50: '#eef2ff',
          100: '#e0e7ff',
          200: '#c7d2fe',
          300: '#a5b4fc',
          400: '#818cf8',
          500: '#6366f1',
          600: '#4f46e5',
          700: '#4338ca',
          800: '#3730a3',
          900: '#312e81',
          950: '#1e1b4b',
        },
        // Add other color variants here
      },
      fontFamily: {
        sans: ['Inter var', 'Inter', 'sans-serif'],
      },
    },
    plugins: [],
  }
}

```

3. Create `src/assets/styles/globals.css`:

```

@tailwind base;
@tailwind components;
@tailwind utilities;

@layer base {
  html {
    @apply text-gray-900 antialiased;

```

```

        }

      body {
        @apply bg-white;
      }
    }

@layer components {
  /* Custom component styles can go here */
}

```

4. Update `src/main.tsx` to Import Global Styles:

```

import React from 'react'
import ReactDOM from 'react-dom/client'
import App from './App.tsx'
import './assets/styles/globals.css'

ReactDOM.createRoot(document.getElementById('root')!).render(
  <React.StrictMode>
    <App />
  </React.StrictMode>,
)

```

Step 6: Configure TypeScript

1. Create a Custom `tsconfig.paths.json`:

```
{
  "compilerOptions": {
    "baseUrl": ".",
    "paths": {
      "@/*": ["./src/*"],
      "@app/*": ["./src/app/*"],
      "@features/*": ["./src/features/*"],
      "@core/*": ["./src/core/*"],
      "@assets/*": ["./src/assets/*"]
    }
  }
}
```

```
    }
}
```

2. Update `tsconfig.json`:

```
{
  "extends": "./tsconfig.paths.json",
  "compilerOptions": {
    "target": "ES2020",
    "useDefineForClassFields": true,
    "lib": ["ES2020", "DOM", "DOM.Iterable"],
    "module": "ESNext",
    "skipLibCheck": true,
    "moduleResolution": "bundler",
    "allowImportingTsExtensions": true,
    "resolveJsonModule": true,
    "isolatedModules": true,
    "noEmit": true,
    "jsx": "react-jsx",
    "strict": true,
    "noUnusedLocals": true,
    "noUnusedParameters": true,
    "noFallthroughCasesInSwitch": true
  },
  "include": ["src"],
  "references": [{ "path": "./tsconfig.node.json" }]
}
```

Step 7: Configure Vite

1. Create or Update `vite.config.ts`:

```
import { defineConfig } from 'vite'
import react from '@vitejs/plugin-react'
import tsconfigPaths from 'vite-tsconfig-paths'
import path from 'path'

// https://vitejs.dev/config/
export default defineConfig({
  plugins: [react(), tsconfigPaths()],
```

```

  resolve: {
    alias: {
      '@': path.resolve(__dirname, './src'),
      '@app': path.resolve(__dirname, './src/app'),
      '@features': path.resolve(__dirname, './src/features'),
      '@core': path.resolve(__dirname, './src/core'),
      '@assets': path.resolve(__dirname, './src/assets'),
    },
  },
  server: {
    port: 3000,
    proxy: {
      '/api': {
        target: 'http://localhost:4000',
        changeOrigin: true,
        rewrite: (path) => path.replace(/^\api/, ''),
      },
    },
  },
})

```

Step 8: Set Up Environment Variables

1. Create ` `.env` Files:

Create a ` `.env` file:

```

VITE_API_URL=http://localhost:4000/graphql
VITE_APP_TITLE=Calendar App

```

Create a ` `.env.development` file:

```

VITE_API_URL=http://localhost:4000/graphql
VITE_APP_ENV=development

```

2. Create Environment Types:

Create ` `src/core/types/environment.d.ts` :

```

/// <reference types="vite/client" />

interface ImportMetaEnv {
  readonly VITE_API_URL: string
  readonly VITE_APP_TITLE: string
  readonly VITE_APP_ENV: string
}

interface ImportMeta {
  readonly env: ImportMetaEnv
}

```

Step 9: Set Up Redux Toolkit

1. Create Store Configuration:

Create `src/core/store/index.ts`:

```

import { configureStore } from '@reduxjs/toolkit'
import { TypedUseSelectorHook, useDispatch, useSelector } from 'react-redux'

// Import reducers
import uiReducer from './slices/uiSlice'
import calendarReducer from './slices/calendarSlice'

export const store = configureStore({
  reducer: {
    ui: uiReducer,
    calendar: calendarReducer,
  },
  middleware: (getDefaultMiddleware) =>
    getDefaultMiddleware({
      serializableCheck: {
        // Ignore these paths in the action objects
        ignoredActions: ['payload.timestamp'],
        ignoredPaths: ['calendar.selectedDate', 'calendar.visibleRange'],
      },
    }),
})

```

```

export type RootState = ReturnType<typeof store.getState>
export type AppDispatch = typeof store.dispatch

// Use throughout your app instead of plain `useDispatch` and `useSelector`
export const useAppDispatch = () => useDispatch<AppDispatch>()
export const useAppSelector: TypedUseSelectorHook<RootState> = useSelector

```

2. Create a UI Slice:

Create `src/core/store/slices/uiSlice.ts`:

```

import { createSlice, PayloadAction } from '@reduxjs/toolkit'

interface UiState {
  isSidebarOpen: boolean
  activeModal: string | null
  theme: 'light' | 'dark' | 'system'
}

const initialState: UiState = {
  isSidebarOpen: true,
  activeModal: null,
  theme: 'system',
}

const uiSlice = createSlice({
  name: 'ui',
  initialState,
  reducers: {
    toggleSidebar: (state) => {
      state.isSidebarOpen = !state.isSidebarOpen
    },
    openModal: (state, action: PayloadAction<string>) => {
      state.activeModal = action.payload
    },
    closeModal: (state) => {
      state.activeModal = null
    },
    setTheme: (state, action: PayloadAction<UiState['theme']>) => {
      state.theme = action.payload
    },
  },
}

```

```

    },
})

export const { toggleSidebar, openModal, closeModal, setTheme } =
uiSlice.actions

export default uiSlice.reducer

```

3. Create a Calendar Slice:

Create `src/core/store/slices/calendarSlice.ts`:

```

import { createSlice, PayloadAction } from '@reduxjs/toolkit'

export type CalendarView = 'day' | 'week' | 'month' | 'agenda'

interface DateRange {
  start: string // ISO date string
  end: string // ISO date string
}

interface CalendarState {
  currentView: CalendarView
  selectedDate: string
  visibleRange: DateRange
  selectedEventIds: string[]
  visibleCalendarIds: string[]
}

const initialState: CalendarState = {
  currentView: 'month',
  selectedDate: new Date().toISOString(),
  visibleRange: {
    start: new Date().toISOString(),
    end: new Date().toISOString(),
  },
  selectedEventIds: [],
  visibleCalendarIds: [],
}

const calendarSlice = createSlice({

```

```

name: 'calendar',
initialState,
reducers: {
  setView: (state, action: PayloadAction<CalendarView>) => {
    state.currentView = action.payload
  },
  selectDate: (state, action: PayloadAction<string>) => {
    state.selectedDate = action.payload
  },
  setVisibleRange: (state, action: PayloadAction<DateRange>) => {
    state.visibleRange = action.payload
  },
  selectEvent: (state, action: PayloadAction<string>) => {
    state.selectedEventIds = [...state.selectedEventIds, action.payload]
  },
  unselectEvent: (state, action: PayloadAction<string>) => {
    state.selectedEventIds = state.selectedEventIds.filter(id => id !==
action.payload)
  },
  clearSelectedEvents: (state) => {
    state.selectedEventIds = []
  },
  toggleCalendarVisibility: (state, action: PayloadAction<string>) => {
    if (state.visibleCalendarIds.includes(action.payload)) {
      state.visibleCalendarIds = state.visibleCalendarIds.filter(id => id
!== action.payload)
    } else {
      state.visibleCalendarIds.push(action.payload)
    }
  },
  setVisibleCalendars: (state, action: PayloadAction<string[]>) => {
    state.visibleCalendarIds = action.payload
  },
},
),
}

export const {
  setView,
  selectDate,
  setVisibleRange,
  selectEvent,
  unselectEvent,
}

```

```

    clearSelectedEvents,
    toggleCalendarVisibility,
    setVisibleCalendars,
} = calendarSlice.actions

export default calendarSlice.reducer

```

Step 10: Set Up Apollo Client for GraphQL

1. Create GraphQL Config:

Create `src/core/api/graphql-client.ts`:

```

import { ApolloClient, InMemoryCache, createHttpLink, from } from
  '@apollo/client'

import { onError } from '@apollo/client/link/error'
import { setContext } from '@apollo/client/link/context'

// Error handling link
const errorLink = onError(({ graphQLErrors, networkError }) => {
  if (graphQLErrors) {
    graphQLErrors.forEach(({ message, locations, path }) => {
      console.error(
        `[GraphQL error]: Message: ${message}, Location: ${locations}, Path: ${path}`
      )
    })
  }
  if (networkError) {
    console.error(`[Network error]: ${networkError}`)
  }
})

// HTTP link
const httpLink = createHttpLink({
  uri: import.meta.env.VITE_API_URL,
})

// Auth link
const authLink = setContext(_,
  { headers } => {

```



```

// Get the authentication token from local storage if it exists
const token = localStorage.getItem('token')

// Return the headers to the context so httpLink can read them
return {
  headers: {
    ...headers,
    authorization: token ? `Bearer ${token}` : '',
  }
}

// Apollo Client
export const client = new ApolloClient({
  link: from([errorLink, authLink, httpLink]),
  cache: new InMemoryCache({
    typePolicies: {
      Query: {
        fields: {
          events: {
            // Combine events lists with same calendarIds and date range
            keyArgs: ['calendarIds', 'start', 'end'],
          },
        },
      },
    },
  }),
  connectToDevTools: import.meta.env.DEV,
})

```

Step 11: Set Up React Router

1. Create Basic Routes:

Create `src/app/routes/index.tsx`:

```

import { createBrowserRouter, RouterProvider } from 'react-router-dom'
import { lazy, Suspense } from 'react'

// Layouts

```

```

import MainLayout from '@/layouts/MainLayout'
import AuthLayout from '@/layouts/AuthLayout'

// Pages - Using dynamic imports for code splitting
const HomePage = lazy(() => import('@/pages/HomePage'))
const CalendarPage = lazy(() => import('@/pages/CalendarPage'))
const EventPage = lazy(() => import('@/pages/EventPage'))
const SettingsPage = lazy(() => import('@/pages/SettingsPage'))
const LoginPage = lazy(() => import('@/pages/LoginPage'))
const RegisterPage = lazy(() => import('@/pages/RegisterPage'))
const NotFoundPage = lazy(() => import('@/pages/NotFoundPage'))

// Loading fallback
const PageLoader = () => <div className="flex h-full w-full items-center justify-center">Loading...</div>

// Router configuration
const router = createBrowserRouter([
  {
    path: '/',
    element: <MainLayout />,
    children: [
      {
        index: true,
        element: (
          <Suspense fallback={<PageLoader />}>
            <HomePage />
          </Suspense>
        ),
      },
      {
        path: 'calendar',
        element: (
          <Suspense fallback={<PageLoader />}>
            <CalendarPage />
          </Suspense>
        ),
      },
      {
        path: 'event/:id',
        element: (
          <Suspense fallback={<PageLoader />}>

```

```
        <EventPage />
    </Suspense>
),
},
{
    path: 'settings',
    element: (
        <Suspense fallback={<PageLoader />}>
            <SettingsPage />
        </Suspense>
),
},
],
},
{
    path: '/auth',
    element: <AuthLayout />,
    children: [
{
    path: 'login',
    element: (
        <Suspense fallback={<PageLoader />}>
            <LoginPage />
        </Suspense>
),
},
{
    path: 'register',
    element: (
        <Suspense fallback={<PageLoader />}>
            <RegisterPage />
        </Suspense>
),
},
],
},
{
    path: '*',
    element: (
        <Suspense fallback={<PageLoader />}>
            <NotFoundPage />
        </Suspense>
),
}
]
```

```

),
},
])
)

const AppRouter = () => {
  return <RouterProvider router={router} />
}

export default AppRouter

```

2. Create Basic Layout Components:

Create `src/app/layouts/MainLayout.tsx`:

```

import { Outlet } from 'react-router-dom'
import { useAppSelector } from '@core/store'

const MainLayout = () => {
  const isSidebarOpen = useAppSelector(state => state.ui.isSidebarOpen)

  return (
    <div className="flex h-screen bg-gray-50">
      /* Placeholder for Sidebar */
      <div className={`${`bg-white border-r ${isSidebarOpen ? 'w-64' : 'w-16'}`} transition-width duration-300`}>
        Sidebar
      </div>

      <div className="flex flex-col flex-1 overflow-hidden">
        /* Placeholder for Header */
        <header className="bg-white border-b h-16 flex items-center px-4">
          Header
        </header>

        {/* Main content */}
        <main className="flex-1 overflow-auto p-6">
          <Outlet />
        </main>
      </div>
    </div>
  )
}

```

```
}

export default MainLayout
```

Create `src/app/layouts/AuthLayout.tsx`:

```
import { Outlet } from 'react-router-dom'

const AuthLayout = () => {
  return (
    <div className="flex min-h-screen bg-gray-50 items-center justify-center p-4">
      <div className="w-full max-w-md bg-white rounded-lg shadow p-6">
        <Outlet />
      </div>
    </div>
  )
}

export default AuthLayout
```

Step 12: Create Basic Hook Components

1. Create Authentication Hook:

Create `src/core/hooks/useAuth.ts`:

```
import { useState, useEffect, useCallback } from 'react'
import { useNavigate } from 'react-router-dom'

interface User {
  id: string
  email: string
  name: string | null
}

interface UseAuthReturn {
  user: User | null
  isAuthenticated: boolean
  isLoading: boolean
```

```

    login: (email: string, password: string) => Promise<void>
    register: (email: string, password: string, name: string) => Promise<void>
    logout: () => void
}

export function useAuth(): UseAuthReturn {
  const [user, setUser] = useState<User | null>(null)
  const [isLoading, setIsLoading] = useState(true)
  const navigate = useNavigate()

  // Check for existing auth on mount
  useEffect(() => {
    const token = localStorage.getItem('token')
    const storedUser = localStorage.getItem('user')

    if (token && storedUser) {
      try {
        setUser(JSON.parse(storedUser))
      } catch (e) {
        localStorage.removeItem('user')
        localStorage.removeItem('token')
      }
    }
  })

  setIsLoading(false)
}, [])

const login = useCallback(async (email: string, password: string) => {
  // In a real app, you would make an API call here
  // This is a placeholder implementation
  setIsLoading(true)

  try {
    // Simulate API call
    await new Promise(resolve => setTimeout(resolve, 1000))

    // Placeholder user data
    const userData: User = {
      id: '1',
      email,
      name: 'Test User',
    }
  }
}

```

```

    // Store auth data
    localStorage.setItem('token', 'dummy-token')
    localStorage.setItem('user', JSON.stringify(userData))

    setUser(userData)
    navigate('/')
} catch (error) {
    console.error('Login failed:', error)
    throw error
} finally {
    setIsLoading(false)
}
}, [navigate])

const register = useCallback(async (email: string, password: string, name: string) => {
    // Similar to login, add implementation
    setIsLoading(true)

    try {
        // Simulate API call
        await new Promise(resolve => setTimeout(resolve, 1000))

        // Registration would typically not log the user in automatically
        navigate('/auth/login')
    } catch (error) {
        console.error('Registration failed:', error)
        throw error
    } finally {
        setIsLoading(false)
    }
}, [navigate])

const logout = useCallback(() => {
    localStorage.removeItem('token')
    localStorage.removeItem('user')
    setUser(null)
    navigate('/auth/login')
}, [navigate])

return {

```

```

        user,
        isAuthenticated: !!user,
        isLoading,
        login,
        register,
        logout,
    }
}

```

2. Create API Hook Example:

Create `src/core/hooks/useCalendars.ts`:

```

import { useQuery, useMutation, useQueryClient } from '@tanstack/react-query'

// Type definitions
interface Calendar {
    id: string
    name: string
    color: string
    isDefault: boolean
    isVisible: boolean
}

interface CreateCalendarInput {
    name: string
    color?: string
    isDefault?: boolean
}

// API functions (these would normally make actual API calls)
const fetchCalendars = async (): Promise<Calendar[]> => {
    // Simulated API call
    return [
        { id: '1', name: 'Work', color: '#4285F4', isDefault: true, isVisible: true },
        { id: '2', name: 'Personal', color: '#0F9D58', isDefault: false, isVisible: true },
    ]
}

```

```

const createCalendar = async (input: CreateCalendarInput): Promise<Calendar>
=> {
  // Simulated API call
  return {
    id: Math.random().toString(36).substr(2, 9),
    name: input.name,
    color: input.color || '#4285F4',
    isDefault: input.isDefault || false,
    isVisible: true,
  }
}

// Hook
export function useCalendars() {
  const queryClient = useQueryClient()

  const { data: calendars = [], isLoading, error } = useQuery({
    queryKey: ['calendars'],
    queryFn: fetchCalendars,
  })

  const createCalendarMutation = useMutation({
    mutationFn: createCalendar,
    onSuccess: (newCalendar) => {
      queryClient.invalidateQueries({ queryKey: ['calendars'] })
    },
  })

  return {
    calendars,
    isLoading,
    error,
    createCalendar: createCalendarMutation.mutate,
    isCreating: createCalendarMutation.isPending,
  }
}

```

Step 13: Update the App Component

1. **Update `src/App.tsx`:**

```

import { Provider as ReduxProvider } from 'react-redux'
import { store } from '@core/store'
import { QueryClient, QueryClientProvider } from '@tanstack/react-query'
import { ReactQueryDevtools } from '@tanstack/react-query-devtools'
import { ApolloProvider } from '@apollo/client'
import { client } from '@core/api/graphql-client'
import AppRouter from '@app/routes'

// Create a client
const queryClient = new QueryClient({
  defaultOptions: {
    queries: {
      staleTime: 1000 * 60 * 5, // 5 minutes
      refetchOnWindowFocus: false,
    },
  },
})
}

function App() {
  return (
    <ReduxProvider store={store}>
      <QueryClientProvider client={queryClient}>
        <ApolloProvider client={client}>
          <AppRouter />
          {import.meta.env.DEV && <ReactQueryDevtools />}
        </ApolloProvider>
      </QueryClientProvider>
    </ReduxProvider>
  )
}

export default App

```

Step 14: Set Up Basic Jest Configuration

1. Create Jest Configuration:

Create `jest.config.ts`:

```

export default {
  preset: 'ts-jest',
  testEnvironment: 'jsdom',
  testMatch: ['**/_tests_/**/*.(ts|js)', '**/?(*.)+(spec|test).ts?(x)'],
  setupFilesAfterEnv: ['<rootDir>/src/tests/setup.ts'],
  moduleNameMapper: {
    '^@/(.*)$': '<rootDir>/src/$1',
    '^@app/(.*)$': '<rootDir>/src/app/$1',
    '^@features/(.*)$': '<rootDir>/src/features/$1',
    '^@core/(.*)$': '<rootDir>/src/core/$1',
    '^@assets/(.*)$': '<rootDir>/src/assets/$1',
    '\\\\.(css|less|sass|scss)$': 'identity-obj-proxy',
  },
  transform: {
    '^.+\\\\.tsx?$': ['ts-jest', {
      tsconfig: 'tsconfig.json',
    }],
  },
}

```

2. Create Jest Setup File:

Create `src/tests/setup.ts`:

```

import '@testing-library/jest-dom'

// Mock window.matchMedia
Object.defineProperty(window, 'matchMedia', {
  writable: true,
  value: jest.fn().mockImplementation(query => ({
    matches: false,
    media: query,
    onchange: null,
    addListener: jest.fn(),
    removeListener: jest.fn(),
    addEventListener: jest.fn(),
    removeEventListener: jest.fn(),
    dispatchEvent: jest.fn(),
  })),
})

```



```
// Mock IntersectionObserver
class MockIntersectionObserver {
    constructor() {}
    observe = jest.fn()
    unobserve = jest.fn()
    disconnect = jest.fn()
}

window.IntersectionObserver = MockIntersectionObserver as any
```

3. Update `package.json` Scripts:

```
"scripts": {
    "dev": "vite",
    "build": "tsc && vite build",
    "test": "jest",
    "test:watch": "jest --watch",
    "test:coverage": "jest --coverage",
    "lint": "eslint src --ext ts,tsx --report-unused-disable-directives --max-warnings 0",
    "preview": "vite preview"
}
```

Step 15: Create Sample Component

1. Create a Button Component:

Create `src/core/components/ui/Button.tsx`:

```
import { ButtonHTMLAttributes, ReactNode, forwardRef } from 'react'
import { VariantProps, cva } from 'class-variance-authority'
import { cn } from '@core/utils/cn'

const buttonVariants = cva(
    'inline-flex items-center justify-center rounded-md text-sm font-medium
transition-colors focus-visible:outline-none focus-visible:ring-2 focus-
visible:ring-offset-2 disabled:pointer-events-none disabled:opacity-50',
{
    variants: {
        variant: {
```

```

        primary: 'bg-primary-600 text-white hover:bg-primary-700 focus-
visible:ring-primary-500',
        secondary: 'bg-gray-100 text-gray-900 hover:bg-gray-200 focus-
visible:ring-gray-500',
        outline: 'border border-gray-300 bg-transparent hover:bg-gray-50
focus-visible:ring-gray-500',
        ghost: 'hover:bg-gray-100 hover:text-gray-900 focus-visible:ring-
gray-500',
        danger: 'bg-red-600 text-white hover:bg-red-700 focus-visible:ring-
red-500',
    },
    size: {
        sm: 'h-8 px-3 text-xs',
        md: 'h-10 px-4',
        lg: 'h-12 px-6 text-lg',
    },
    fullWidth: {
        true: 'w-full',
        false: '',
    },
},
defaultVariants: {
    variant: 'primary',
    size: 'md',
    fullWidth: false,
},
)
}

export interface ButtonProps
    extends ButtonHTMLAttributes<HTMLButtonElement>,
    VariantProps<typeof buttonVariants> {
    children: ReactNode
    leftIcon?: ReactNode
    rightIcon?: ReactNode
    isLoading?: boolean
}

const Button = forwardRef<HTMLButtonElement, Button

```

 continue

Continuing with the Button component code:

```
const Button = forwardRef<HTMLButtonElement, ButtonProps>(
  ({
    children,
    variant,
    size,
    fullWidth,
    className,
    leftIcon,
    rightIcon,
    isLoading,
    disabled,
    ...props
  }, ref) => {
  return (
    <button
      ref={ref}
      className={cn(buttonVariants({ variant, size, fullWidth }), className)}
      disabled={isLoading || disabled}
      {...props}
    >
      {isLoading && (
        <svg
          className="mr-2 h-4 w-4 animate-spin"
          xmlns="http://www.w3.org/2000/svg"
          fill="none"
          viewBox="0 0 24 24"
        >
          <circle
            className="opacity-25"
            cx="12"
            cy="12"
            r="10"
            stroke="currentColor"
            strokeWidth="4"
          ></circle>
          <path
            className="absolute opacity-75"
            d="M12 8a4 4 0 1 1 0 8 4 4 0 0 1 0-8z"
          ></path>
        
```

```

        className="opacity-75"
        fill="currentColor"
        d="M4 12a8 8 0 018-8V0C5.373 0 0 5.373 0 12h4zm2 5.291A7.962 7.962
0 014 12H0c0 3.042 1.135 5.824 3 7.938l3-2.647z"
      ></path>
    </svg>
  )}
  {leftIcon && !isLoading && <span className="mr-2">{leftIcon}</span>}
  {children}
  {rightIcon && <span className="ml-2">{rightIcon}</span>}
</button>
)
}
)

Button.displayName = 'Button'

export { Button, buttonVariants }

```

Let's create the utility function needed for this component:

2. Create the `cn` Utility:

Create `src/core/utils/cn.ts`:

```

import { clsx, type ClassValue } from 'clsx'
import { twMerge } from 'tailwind-merge'

export function cn(...inputs: ClassValue[]) {
  return twMerge(clsx(inputs))
}

```

Step 16: Create a Basic Component Test

1. Create a Test for the Button Component:

Create `src/core/components/ui/__tests__/Button.test.tsx`:

```

import { render, screen } from '@testing-library/react'
import userEvent from '@testing-library/user-event'

```

```

import { Button } from '../Button'

describe('Button component', () => {
  it('renders correctly', () => {
    render(<Button>Click me</Button>)
    expect(screen.getByRole('button', { name: /click me/i })).toBeInTheDocument()
  })

  it('calls onClick when clicked', async () => {
    const handleClick = jest.fn()
    render(<Button onClick={handleClick}>Click me</Button>)

    await userEvent.click(screen.getByRole('button', { name: /click me/i }))
    expect(handleClick).toHaveBeenCalledTimes(1)
  })

  it('cannot be clicked when disabled', async () => {
    const handleClick = jest.fn()
    render(<Button disabled onClick={handleClick}>Click me</Button>)

    await userEvent.click(screen.getByRole('button', { name: /click me/i }))
    expect(handleClick).not.toHaveBeenCalled()
  })

  it('shows loading state', () => {
    render(<Button isLoading>Click me</Button>)

    const button = screen.getByRole('button', { name: /click me/i })
    expect(button).toBeInTheDocument()
    expect(button).toBeDisabled()
    expect(button.querySelector('svg')).toBeInTheDocument()
  })

  it('renders with left and right icons', () => {
    render(
      <Button
        leftIcon={<span data-testid="left-icon">L</span>}
        rightIcon={<span data-testid="right-icon">R</span>}
      >
        Click me
      </Button>
    )
  })
})

```

```
)  
  
    expect(screen.getByTestId('left-icon')).toBeInTheDocument()  
    expect(screen.getByTestId('right-icon')).toBeInTheDocument()  
})  
})
```

Step 17: Add ESLint and Prettier Configuration

1. **Create `eslintrc.js`:**

```
module.exports = {  
  root: true,  
  env: { browser: true, es2020: true },  
  extends: [  
    'eslint:recommended',  
    'plugin:@typescript-eslint/recommended',  
    'plugin:react-hooks/recommended',  
    'plugin:jsx-a11y/recommended',  
    'plugin:react/recommended',  
    'plugin:react/jsx-runtime',  
    'prettier'  
,  
  ignorePatterns: ['dist', '.eslintrc.js'],  
  parser: '@typescript-eslint/parser',  
  parserOptions: {  
    ecmaVersion: 'latest',  
    sourceType: 'module',  
    project: './tsconfig.json',  
    ecmaFeatures: {  
      jsx: true  
    }  
,  
  plugins: ['react-refresh', 'jsx-a11y', '@typescript-eslint'],  
  rules: {  
    'react-refresh/only-export-components': [  
      'warn',  
      { allowConstantExport: true },  
    ],  
    'react/prop-types': 'off',
```

```
'@typescript-eslint/explicit-module-boundary-types': 'off',
'no-unused-vars': 'off',
'@typescript-eslint/no-unused-vars': ['error', {
    argsIgnorePattern: '^_',
    varsIgnorePattern: '^_'
}],
'jsx-a11y/anchor-is-valid': 'error',
},
settings: {
    react: {
        version: 'detect'
    }
}
}
```

2. Create `.

```
{
    "semi": false,
    "singleQuote": true,
    "printWidth": 100,
    "tabWidth": 2,
    "trailingComma": "es5",
    "arrowParens": "avoid"
}
```

3. Create `.

```
root = true

[*]
charset = utf-8
end_of_line = lf
indent_style = space
indent_size = 2
insert_final_newline = true
trim_trailing whitespace = true

[*.md]
trim_trailing whitespace = false
```



4. Install Additional Dependencies:

```
npm install -D eslint-plugin-jsx-a11y eslint-plugin-react eslint-plugin-react-refresh @typescript-eslint/eslint-plugin @typescript-eslint/parser eslint-config-prettier tailwind-merge
```

Step 18: Update npm Scripts

1. Update the scripts in `package.json`:

```
"scripts": {  
  "dev": "vite",  
  "build": "tsc && vite build",  
  "preview": "vite preview",  
  "lint": "eslint src --ext ts,tsx --report-unused-disable-directives --max-warnings 0",  
  "lint:fix": "eslint src --ext ts,tsx --fix",  
  "format": "prettier --write \"src/**/*.{ts,tsx,js,jsx}\"",  
  "test": "jest",  
  "test:watch": "jest --watch",  
  "test:coverage": "jest --coverage"  
}
```

Step 19: Create Basic Pages

1. Create `src/app/pages/HomePage.tsx`:

```
import { Link } from 'react-router-dom'  
import { Button } from '@core/components/ui/Button'  
  
const HomePage = () => {  
  return (  
    <div className="max-w-4xl mx-auto">  
      <h1 className="text-3xl font-bold mb-6">Welcome to Calendar App</h1>  
  
      <p className="mb-6">  
        This is a demonstration of a cross-platform calendar application  
        built with React,  
        TypeScript, and modern frontend technologies.  
    </p>  
  </div>  
}
```

```

        </p>

        <div className="flex gap-4">
          <Link to="/calendar">
            <Button>View Calendar</Button>
          </Link>

          <Link to="/settings">
            <Button variant="secondary">Settings</Button>
          </Link>
        </div>
      </div>
    )
}

export default HomePage

```

2. **Create `src/app/pages/LoginPage.tsx`:**

```

import { useState } from 'react'
import { Link } from 'react-router-dom'
import { Button } from '@core/components/ui/Button'

const LoginPage = () => {
  const [email, setEmail] = useState('')
  const [password, setPassword] = useState('')
  const [isLoading, setIsLoading] = useState(false)

  const handleSubmit = async (e: React.FormEvent) => {
    e.preventDefault()
    setIsLoading(true)

    try {
      // This would normally call your authentication function
      await new Promise(resolve => setTimeout(resolve, 1000))
      // Redirect happens in the authentication hook
    } catch (error) {
      console.error('Login failed:', error)
    } finally {
      setIsLoading(false)
    }
  }
}

```

```
}

return (
  <div>
    <h1 className="text-2xl font-bold mb-6 text-center">Log In to Calendar
App</h1>

  <form onSubmit={handleSubmit} className="space-y-4">
    <div>
      <label htmlFor="email" className="block text-sm font-medium mb-1">
        Email
      </label>
      <input
        id="email"
        type="email"
        value={email}
        onChange={e => setEmail(e.target.value)}
        className="w-full px-3 py-2 border border-gray-300 rounded-md"
        required
      />
    </div>

    <div>
      <label htmlFor="password" className="block text-sm font-medium mb-
1">
        Password
      </label>
      <input
        id="password"
        type="password"
        value={password}
        onChange={e => setPassword(e.target.value)}
        className="w-full px-3 py-2 border border-gray-300 rounded-md"
        required
      />
    </div>

    <Button type="submit" fullWidth isLoading={isLoading}>
      Log In
    </Button>
  </form>
)
```

```
<p className="mt-4 text-center text-sm">
    Don't have an account?{' '}
    <Link to="/auth/register" className="text-primary-600 hover:text-primary-500">
        Register
    </Link>
</p>
</div>
)
}

export default LoginPage
```

Step 20: Run and Test the Application

1. Start the Development Server:

```
npm run dev
```

2. Run Tests:

```
npm test
```

3. Lint the Code:

```
npm run lint
```

4. Format the Code:

```
npm run format
```

Conclusion

You now have a complete local development environment for the Calendar App frontend with the following features:

- React 18 with TypeScript for type safety

- Vite for fast development and optimized builds
- Tailwind CSS for styling
- Redux Toolkit for global state management
- React Query for server state management
- Apollo Client for GraphQL API integration
- React Router for navigation
- Jest and React Testing Library for testing
- ESLint and Prettier for code quality
- Path aliases for clean imports
- Component structure following SOLID principles

This environment follows the architecture blueprint we defined earlier and provides all the necessary tools and configurations for developing a scalable, maintainable calendar application. As you build out more features, you'll be able to easily extend this foundation while maintaining code quality and architectural integrity.

 (base) razorvilla@Prateeks-MacBook-Air frontend % npx tailwindcss init -p **npm** error could not determine executable to run **npm** error A complete log of this run can be found in: /Users/razorvilla/.npm/_logs/2025-03-19T21_34_44_477Z-debug-0.log

That error is likely due to npm not being able to find the correct path to Tailwind CSS. Let's try an alternative approach to setting up Tailwind CSS:

1. First, make sure you have Tailwind CSS installed:

```
npm install -D tailwindcss postcss autoprefixer
```

2. Then try running the initialization with npx using the full path:

```
./node_modules/.bin/tailwindcss init -p
```

If that doesn't work, you can create the configuration files manually:

1. Create a file named `tailwind.config.js` in your project root:

```

/** @type {import('tailwindcss').Config} */
export default {
  content: [
    "./index.html",
    "./src/**/*.{js,ts,jsx,tsx}",
  ],
  theme: {
    extend: {
      colors: {
        primary: {
          50: '#eef2ff',
          100: '#e0e7ff',
          200: '#c7d2fe',
          300: '#a5b4fc',
          400: '#818cf8',
          500: '#6366f1',
          600: '#4f46e5',
          700: '#4338ca',
          800: '#3730a3',
          900: '#312e81',
          950: '#1e1b4b',
        },
      },
      fontFamily: {
        sans: ['Inter var', 'Inter', 'sans-serif'],
      },
    },
    plugins: [],
  }
}

```

2. Create a file named `postcss.config.js` in your project root:

```

export default {
  plugins: {
    tailwindcss: {},
    autoprefixer: {},
  },
}

```

This should give you a working Tailwind CSS configuration. Let me know if you encounter any more issues with the setup!

 i don't have a bin directory inside node_modules. I have tailwind directory inside node_modules. (base) razorvilla@Prateeks-MacBook-Air frontend % ./node_modules/tailwindcss init -p zsh: permission denied: ./node_modules/tailwindcss

The permission denied error suggests we need a different approach. Let's try using npm directly to run the Tailwind initialization:

```
npm exec tailwindcss init -p
```

If that doesn't work, you can try adding the executable permission to the file:

```
chmod +x ./node_modules/tailwindcss  
./node_modules/tailwindcss init -p
```

Alternatively, we can create the configuration files manually as described in my previous message:

1. Create `tailwind.config.js` in your project root
2. Create `postcss.config.js` in your project root

This will achieve the same result without needing to run the initialization command.

Would you like me to provide the content for these files again?

 not able to find the file tailwind.config.js

Let's create the tailwind.config.js file manually. Here's how:

1. Create a new file in your project root directory named `tailwind.config.js`
2. Copy and paste the following content into that file:

```
/** @type {import('tailwindcss').Config} */  
export default {  
  content: [  
    "./index.html",
```

```
  "./src/**/*.{js,ts,jsx,tsx}",
],
theme: {
  extend: {
    colors: {
      primary: {
        50: '#eef2ff',
        100: '#e0e7ff',
        200: '#c7d2fe',
        300: '#a5b4fc',
        400: '#818cf8',
        500: '#6366f1',
        600: '#4f46e5',
        700: '#4338ca',
        800: '#3730a3',
        900: '#312e81',
        950: '#1e1b4b',
      },
    },
    fontFamily: {
      sans: ['Inter var', 'Inter', 'sans-serif'],
    },
  },
  plugins: [],
}
```

3. Create a new file in your project root directory named `postcss.config.js`
4. Copy and paste the following content into that file:

```
export default {
  plugins: {
    tailwindcss: {},
    autoprefixer: {},
  },
}
```

You can create these files directly in Visual Studio Code:

1. Open your project in VS Code
2. Right-click on the project root in the Explorer panel

3. Select "New File"
4. Enter "tailwind.config.js" as the filename
5. Paste the content
6. Repeat for "postcss.config.js"

This will set up Tailwind CSS without needing to run the CLI initialization command.

 under which folder is the file created

The `tailwind.config.js` file should be created in the root folder of your project, not inside any subfolder.

Your directory structure should look like this:

```
calendar-app/
└── frontend/          # Your frontend project root
    ├── node_modules/   # Dependencies installed by npm
    ├── src/            # Source code
    ├── package.json     # npm configuration
    ├── tailwind.config.js # Tailwind configuration (create here)
    ├── postcss.config.js # PostCSS configuration (create here)
    ├── vite.config.ts   # Vite configuration
    └── tsconfig.json    # TypeScript configuration
```

So if you're currently in the `frontend` directory (which is what it looks like from your terminal prompt), you should create these files directly in that directory, not inside any subfolder.

You can create these files using:

```
touch tailwind.config.js postcss.config.js
```

Then open them in your text editor and paste the content I provided.

 under which folder should tsconfig.paths.json be created

The `tsconfig.paths.json` file should also be created in the root folder of your frontend project, at the same level as your regular `tsconfig.json` file.

Your directory structure would look like this:

```
calendar-app/
└── frontend/          # Your frontend project root
    ├── node_modules/   # Dependencies installed by npm
    ├── src/            # Source code
    ├── package.json     # npm configuration
    ├── tailwind.config.js # Tailwind configuration
    ├── postcss.config.js # PostCSS configuration
    ├── vite.config.ts    # Vite configuration
    ├── tsconfig.json     # Main TypeScript configuration
    └── tsconfig.paths.json # Path aliases configuration (create here)
```

You can create this file using:

```
touch tsconfig.paths.json
```

Then open it in your text editor and paste the content I provided earlier:

```
{
  "compilerOptions": {
    "baseUrl": ".",
    "paths": {
      "@/*": ["./src/*"],
      "@app/*": ["./src/app/*"],
      "@features/*": ["./src/features/*"],
      "@core/*": ["./src/core/*"],
      "@assets/*": ["./src/assets/*"]
    }
  }
}
```

Remember that after creating this file, you'll need to modify your main `tsconfig.json` to extend it with the `extends: "./tsconfig.paths.json"` property.



where should i create the .env files with the content

VITE_API_URL=<http://localhost:4000/graphql> VITE_APP_TITLE=Calendar App

The `.**env**` files should be created in the root folder of your frontend project, at the same level as your `package.json`, `tsconfig.json`, and other configuration files.

For the content you provided, create a file named `.**env**` in your frontend project root:

```
calendar-app/
└── frontend/          # Your frontend project root
    ├── node_modules/
    ├── src/
    ├── package.json
    ├── tailwind.config.js
    ├── tsconfig.json
    ├── .env             # Create this file here
    └── ...
```

In this file, each environment variable should be on its own line. So the content should look like this:

```
VITE_API_URL=http://localhost:4000/graphql
VITE_APP_TITLE=Calendar App
```

You can create this file using:

```
touch .env
```

Then open it and add the environment variables with one per line.

You may also want to create a `.**env.development**` file in the same location with development-specific variables:

```
VITE_API_URL=http://localhost:4000/graphql
VITE_APP_ENV=development
```

Remember that files starting with a dot (like `.**env**`) are hidden files in Unix-based systems. You may need to use `ls -a` to see them in your terminal, or enable "Show Hidden Files" in your file explorer.



 where should i create .eslintrc.js file?

The `.eslintrc.js` file should be created in the root folder of your frontend project, at the same level as your `package.json`, `tsconfig.json`, and other configuration files.

Your directory structure should look like this:

```
calendar-app/
└── frontend/                      # Your frontend project root
    ├── node_modules/
    ├── src/
    ├── package.json
    ├── tailwind.config.js
    ├── tsconfig.json
    ├── .env
    ├── .eslintrc.js                  # Create this file here
    └── ...
```

You can create this file using:

```
touch .eslintrc.js
```

Then open it in your text editor and paste the ESLint configuration I provided earlier:

```
module.exports = {
  root: true,
  env: { browser: true, es2020: true },
  extends: [
    'eslint:recommended',
    'plugin:@typescript-eslint/recommended',
    'plugin:react-hooks/recommended',
    'plugin:jsx-a11y/recommended',
    'plugin:react/recommended',
    'plugin:react/jsx-runtime',
    'prettier'
  ],
  ignorePatterns: ['dist', '.eslintrc.js'],
  parser: '@typescript-eslint/parser',
  parserOptions: {
```

```
ecmaVersion: 'latest',
sourceType: 'module',
project: './tsconfig.json',
ecmaFeatures: {
  jsx: true
},
},
plugins: ['react-refresh', 'jsx-a11y', '@typescript-eslint'],
rules: {
  'react-refresh/only-export-components': [
    'warn',
    { allowConstantExport: true },
  ],
  'react/prop-types': 'off',
  '@typescript-eslint/explicit-module-boundary-types': 'off',
  'no-unused-vars': 'off',
  '@typescript-eslint/no-unused-vars': ['error', {
    argsIgnorePattern: '^_',
    varsIgnorePattern: '^_'
}],
  'jsx-a11y/anchor-is-valid': 'error',
},
settings: {
  react: {
    version: 'detect'
  }
}
}
```

The same applies to the `.**prettierrc**` and `.**editorconfig**` files - they should also be created in the same root directory.



“File: paste.txt”

getting the following error while i try to start the development server

It seems that you're running into an issue because the `tsconfig.paths.json` file is missing or not in the correct location. Let's fix this:

1. First, make sure you've created the `tsconfig.paths.json` file in the root of your frontend project:

```
cd ~/Desktop/Projects/calendar-app/frontend  
touch tsconfig.paths.json
```

2. Open the file in your editor and add this content:

```
{  
  "compilerOptions": {  
    "baseUrl": ".",  
    "paths": {  
      "@/*": ["./src/*"],  
      "@app/*": ["./src/app/*"],  
      "@features/*": ["./src/features/*"],  
      "@core/*": ["./src/core/*"],  
      "@assets/*": ["./src/assets/*"]  
    }  
  }  
}
```

3. Save the file and try running the development server again:

```
npm run dev
```

If you're still experiencing issues, you can simplify things by:

1. Removing the `extends` property from your `tsconfig.json` and adding the paths directly:

```
{  
  "compilerOptions": {  
    "target": "ES2020",  
    "useDefineForClassFields": true,  
    "lib": ["ES2020", "DOM", "DOM.Iterable"],  
    "module": "ESNext",  
    "skipLibCheck": true,  
    "moduleResolution": "bundler",  
    "allowImportingTsExtensions": true,  
    "resolveJsonModule": true,  
    "isolatedModules": true,
```

```

    "noEmit": true,
    "jsx": "react-jsx",
    "strict": true,
    "noUnusedLocals": true,
    "noUnusedParameters": true,
    "noFallthroughCasesInSwitch": true,
    "baseUrl": ".",
    "paths": {
        "@/*": ["./src/*"],
        "@app/*": ["./src/app/*"],
        "@features/*": ["./src/features/*"],
        "@core/*": ["./src/core/*"],
        "@assets/*": ["./src/assets/*"]
    },
    "include": ["src"],
    "references": [{ "path": "./tsconfig.node.json" }]
}

```

This way, you won't need the separate `tsconfig.paths.json` file at all.

Make sure to restart your development server after making these changes.

 now getting this error when i access the application URL:

```

[plugin:vite:import-analysis] Failed to resolve import "react-redux" from
"src/App.tsx". Does the file exist?

/Users/razorvilla/Desktop/Projects/calendar-app/frontend/src/App.tsx:1:55

15 |     window.$RefreshSig$ =
RefreshRuntime.createSignatureFunctionForTransform;
16 | }
17 | import { Provider as ReduxProvider } from "react-redux";
| ^
18 | import { store } from "@core/store";
19 | import { QueryClient, QueryClientProvider } from "@tanstack/react-
query";

```

```
    at TransformPluginContext._formatLog
(file:///Users/razorvilla/Desktop/Projects/calendar-
app/frontend/node_modules/vite/dist/node/chunks/dep-B0fRCRkQ.js:47854:41)
    at TransformPluginContext.error
(file:///Users/razorvilla/Desktop/Projects/calendar-
app/frontend/node_modules/vite/dist/node/chunks/dep-B0fRCRkQ.js:47851:16)
    at normalizeUrl (file:///Users/razorvilla/Desktop/Projects/calendar-
app/frontend/node_modules/vite/dist/node/chunks/dep-B0fRCRkQ.js:45985:23)
    at process.processTicksAndRejections
(node:internal/process/task_queues:105:5)
    at async file:///Users/razorvilla/Desktop/Projects/calendar-
app/frontend/node_modules/vite/dist/node/chunks/dep-B0fRCRkQ.js:46104:37
    at async Promise.all (index 3)
    at async TransformPluginContext.transform
(file:///Users/razorvilla/Desktop/Projects/calendar-
app/frontend/node_modules/vite/dist/node/chunks/dep-B0fRCRkQ.js:46031:7)
    at async EnvironmentPluginContainer.transform
(file:///Users/razorvilla/Desktop/Projects/calendar-
app/frontend/node_modules/vite/dist/node/chunks/dep-B0fRCRkQ.js:47649:18)
    at async loadAndTransform
(file:///Users/razorvilla/Desktop/Projects/calendar-
app/frontend/node_modules/vite/dist/node/chunks/dep-B0fRCRkQ.js:41320:27)
    at async viteTransformMiddleware
(file:///Users/razorvilla/Desktop/Projects/calendar-
app/frontend/node_modules/vite/dist/node/chunks/dep-B0fRCRkQ.js:42783:24
```

It looks like you're missing the `react-redux` package which is required for the Redux setup in your App component. You need to install it along with any other missing dependencies.

Run the following command to install the required packages:

```
npm install react-redux @reduxjs/toolkit @tanstack/react-query @tanstack/react-
query-devtools @apollo/client graphql react-router-dom
```

This will install:

- `react-redux` - For integrating React with Redux
- `@reduxjs/toolkit` - The modern Redux library
- `@tanstack/react-query` - For server state management

- `@tanstack/react-query-devtools` - Developer tools for React Query
- `@apollo/client` - For GraphQL integration
- `graphql` - Required for Apollo Client
- `react-router-dom` - For routing

After installing these packages, restart your development server:

```
npm run dev
```

You might encounter additional errors related to missing packages as you continue development. When that happens, just install the required packages similarly.



"File: paste.txt"

now getting this error :

You're facing two issues here:

1. **Tailwind CSS Plugin Error:** There's a change in how Tailwind CSS is configured with PostCSS.
2. **Missing Page Components:** The app is trying to import page components that don't exist yet.

Let's fix these issues one by one:

1. Fix Tailwind CSS Configuration

Update your `postcss.config.js` file:

```
export default {
  plugins: [
    '@tailwindcss/postcss',
    'autoprefixer',
  ],
}
```

And install the required package:

```
npm install -D @tailwindcss/postcss
```

If the above doesn't work, you can also try this alternative configuration:

```
import tailwindcss from 'tailwindcss'  
import autoprefixer from 'autoprefixer'  
  
export default {  
  plugins: [  
    tailwindcss,  
    autoprefixer,  
  ],  
}
```

2. Create Missing Page Components

You need to create the page components that are being imported in your routes file. Let's create all the missing pages:

```
mkdir -p src/app/pages
```

Now create these files:

1. **HomePage.tsx:**

```
touch src/app/pages/HomePage.tsx
```

2. **CalendarPage.tsx:**

```
touch src/app/pages/CalendarPage.tsx
```

3. **EventPage.tsx:**

```
touch src/app/pages/EventPage.tsx
```

4. **SettingsPage.tsx:**

```
touch src/app/pages/SettingsPage.tsx
```

5. **LoginPage.tsx:**

```
touch src/app/pages/LoginPage.tsx
```

6. **RegisterPage.tsx:**

```
touch src/app/pages/RegisterPage.tsx
```

7. **NotFoundPage.tsx:**

```
touch src/app/pages/NotFoundPage.tsx
```

Now, add a simple placeholder component to each file. For example, for `**CalendarPage.tsx**`:

```
import React from 'react'

const CalendarPage = () => {
  return (
    <div>
      <h1 className="text-2xl font-bold mb-4">Calendar</h1>
      <p>Calendar view will be implemented here.</p>
    </div>
  )
}

export default CalendarPage
```

Repeat similar placeholder content for each page component.

After making these changes, restart your development server:

```
npm run dev
```

If you're still experiencing issues with Tailwind CSS, you might need to downgrade to an earlier version:

```
npm uninstall tailwindcss postcss autoprefixer
npm install -D tailwindcss@3.3.0 postcss autoprefixer
```

Then run the initialization again:

```
npx tailwindcss@3.3.0 init -p
```

This should create a compatible configuration that works with your setup.

```
(base) razorvilla@Prateeks-MacBook-Air frontend % npm run dev
```

```
"frontend@0.0.0 dev vite"
```

```
4:04:59 am [vite] (client) Re-optimizing dependencies because lockfile has changed
```

```
VITE v6.2.2 ready in 974 ms
```

```
→ Local: http://localhost:**3000**/ → Network: use --host to expose → press h + enter to show help
4:05:00 am [vite] Internal server error: [postcss] Cannot apply unknown utility class: text-gray-900
Plugin: vite:css File: /Users/razorvilla/Desktop/Projects/calendar-app/frontend/src/assets/styles/globals.css:undefined:NaN at onInvalidCandidate
(/Users/razorvilla/Desktop/Projects/calendar-app/frontend/node_modules/tailwindcss/dist/lib.js:17:347) at ne
(/Users/razorvilla/Desktop/Projects/calendar-app/frontend/node_modules/tailwindcss/dist/lib.js:12:115998) at $e
(/Users/razorvilla/Desktop/Projects/calendar-app/frontend/node_modules/tailwindcss/dist/lib.js:17:310) at Br
(/Users/razorvilla/Desktop/Projects/calendar-app/frontend/node_modules/tailwindcss/dist/lib.js:33:780) at async qr
(/Users/razorvilla/Desktop/Projects/calendar-app/frontend/node_modules/tailwindcss/dist/lib.js:33:1071) at async ot
(/Users/razorvilla/Desktop/Projects/calendar-app/frontend/node_modules/@tailwindcss/node/dist/index.js:10:3272) at async p
(/Users/razorvilla/Desktop/Projects/calendar-app/frontend/node_modules/@tailwindcss/postcss/dist/index.js:8:3242) at async Object.Once
(/Users/razorvilla/Desktop/Projects/calendar-app/frontend/node_modules/@tailwindcss/postcss/dist/index.js:8:3443) at async LazyResult.runAsync
(/Users/razorvilla/Desktop/Projects/calendar-app/frontend/node_modules/postcss/lib/lazy-result.js:293:11) at async compileCSS
(file:///Users/razorvilla/Desktop/Projects/calendar-
```

```
app/frontend/node_modules/vite/dist/node/chunks/dep-B0fRCRkQ.js:49137:21)    at async  
TransformPluginContext.transform (file:///Users/razorvilla/Desktop/Projects/calendar-  
app/frontend/node_modules/vite/dist/node/chunks/dep-B0fRCRkQ.js:48318:11)    at async  
EnvironmentPluginContainer.transform (file:///Users/razorvilla/Desktop/Projects/calendar-  
app/frontend/node_modules/vite/dist/node/chunks/dep-B0fRCRkQ.js:47649:18)    at async  
loadAndTransform (file:///Users/razorvilla/Desktop/Projects/calendar-  
app/frontend/node_modules/vite/dist/node/chunks/dep-B0fRCRkQ.js:41320:27) 4:05:00 am  
[vite] (client) Pre-transform error: [postcss] Cannot apply unknown utility class: text-gray-900  
Plugin: vite:css  File: /Users/razorvilla/Desktop/Projects/calendar-  
app/frontend/src/assets/styles/globals.css:undefined:NaN
```

It looks like you've made progress, but now you're getting an error from Tailwind CSS because it can't find the `text-gray-900` utility class. This suggests that your Tailwind configuration may not be properly set up to include the default colors.

Let's fix your Tailwind configuration:

1. **Update your `tailwind.config.js`:**

```
/** @type {import('tailwindcss').Config} */  
export default {  
  content: [  
    "./index.html",  
    "./src/**/*.{js,ts,jsx,tsx}",  
  ],  
  theme: {  
    extend: {  
      colors: {  
        gray: {  
          50: '#f9fafb',  
          100: '#f3f4f6',  
          200: '#e5e7eb',  
          300: '#d1d5db',  
          400: '#9ca3af',  
          500: '#6b7280',  
          600: '#4b5563',  
          700: '#374151',  
          800: '#1f2937',  
          900: '#111827',  
          950: '#030712',  
        },  
      },  
    },  
  },  
};
```

```
primary: {
  50: '#eef2ff',
  100: '#e0e7ff',
  200: '#c7d2fe',
  300: '#a5b4fc',
  400: '#818cf8',
  500: '#6366f1',
  600: '#4f46e5',
  700: '#4338ca',
  800: '#3730a3',
  900: '#312e81',
  950: '#1e1b4b',
},
},
fontFamily: {
  sans: ['Inter var', 'Inter', 'sans-serif'],
},
},
},
plugins: [],
}
```

2. Check and update your `postcss.config.js`:

```
export default {
  plugins: {
    tailwindcss: {},
    autoprefixer: {},
  },
}
```

3. Simplify your `globals.css` file in `src/assets/styles/globals.css`:

```
@tailwind base;
@tailwind components;
@tailwind utilities;

@layer base {
  html {
    @apply antialiased;
}
```

```
body {  
  @apply bg-white;  
}  
}
```

4. Make sure you've installed the correct dependencies:

```
npm install -D tailwindcss postcss autoprefixer
```

After making these changes, restart your development server:

```
npm run dev
```

If you continue to face issues, you might try creating a new Vite project with Tailwind CSS using the official guide:

```
npm create vite@latest my-project -- --template react-ts  
cd my-project  
npm install  
npm install -D tailwindcss postcss autoprefixer  
npx tailwindcss init -p
```

Then copy over your configuration and components into the new project structure.

 now getting this error -

VITE v6.2.2 ready in **216** ms

```
→ Local: http://localhost:3000 → Network: use --host to expose → press h +  
enter to show help 4:08:02 am [vite] Internal server error: [postcss] It looks like you're trying  
to use `tailwindcss` directly as a PostCSS plugin. The PostCSS plugin has moved to a separate  
package, so to continue using Tailwind CSS with PostCSS you'll need to install  
`@tailwindcss/postcss` and update your PostCSS configuration. Plugin: vite:css File:  
/Users/razorvilla/Desktop/Projects/calendar-app/frontend/src/index.css:undefined:NaN at Re  
(/Users/razorvilla/Desktop/Projects/calendar-  
app/frontend/node_modules/tailwindcss/dist/lib.js:33:1889) at LazyResult.runOnRoot  
(/Users/razorvilla/Desktop/Projects/calendar-app/frontend/node_modules/postcss/lib/lazy-  
result.js:361:16) at LazyResult.runAsync (/Users/razorvilla/Desktop/Projects/calendar-
```

```
app/frontend/node_modules/postcss/lib/lazy-result.js:290:26)      at LazyResult.async  
(/Users/razorvilla/Desktop/Projects/calendar-app/frontend/node_modules/postcss/lib/lazy-  
result.js:192:30)      at LazyResult.then (/Users/razorvilla/Desktop/Projects/calendar-  
app/frontend/node_modules/postcss/lib/lazy-result.js:436:17) 4:08:02 am [vite] Internal server  
error: [postcss] It looks like you're trying to use `tailwindcss` directly as a PostCSS plugin. The  
PostCSS plugin has moved to a separate package, so to continue using Tailwind CSS with  
PostCSS you'll need to install `@tailwindcss/postcss` and update your PostCSS configuration.  
Plugin: vite:css  File: /Users/razorvilla/Desktop/Projects/calendar-  
app/frontend/src/assets/styles/globals.css:undefined:NaN      at Re  
(/Users/razorvilla/Desktop/Projects/calendar-  
app/frontend/node_modules/tailwindcss/dist/lib.js:33:1889)      at LazyResult.runOnRoot  
(/Users/razorvilla/Desktop/Projects/calendar-app/frontend/node_modules/postcss/lib/lazy-  
result.js:361:16)      at LazyResult.runAsync (/Users/razorvilla/Desktop/Projects/calendar-  
app/frontend/node_modules/postcss/lib/lazy-result.js:290:26)      at LazyResult.async  
(/Users/razorvilla/Desktop/Projects/calendar-app/frontend/node_modules/postcss/lib/lazy-  
result.js:192:30)      at LazyResult.then (/Users/razorvilla/Desktop/Projects/calendar-  
app/frontend/node_modules/postcss/lib/lazy-result.js:436:17) 4:08:02 am [vite] (client) Pre-  
transform error: [postcss] It looks like you're trying to use `tailwindcss` directly as a PostCSS  
plugin. The PostCSS plugin has moved to a separate package, so to continue using Tailwind CSS with  
PostCSS you'll need to install `@tailwindcss/postcss` and update your PostCSS configuration.  
Plugin: vite:css  File: /Users/razorvilla/Desktop/Projects/calendar-  
app/frontend/src/index.css:undefined:NaN 4:08:02 am [vite] (client) Pre-transform error:  
[postcss] It looks like you're trying to use `tailwindcss` directly as a PostCSS plugin. The  
PostCSS plugin has moved to a separate package, so to continue using Tailwind CSS with  
PostCSS you'll need to install `@tailwindcss/postcss` and update your PostCSS configuration.  
Plugin: vite:css  File: /Users/razorvilla/Desktop/Projects/calendar-  
app/frontend/src/assets/styles/globals.css:undefined:NaN
```

It looks like you're running into an issue with Tailwind CSS and PostCSS. The error message indicates that in the version of Tailwind you're using, the PostCSS plugin has been moved to a separate package.

Let's fix this by installing the correct package and updating your configuration:

1. First, install the required package:

```
npm install -D @tailwindcss/postcss
```

2. Then, update your `postcss.config.js` file:

```
export default {
  plugins: [
    '@tailwindcss/postcss': {},
    autoprefixer: {},
  ],
}
```

If that doesn't work, let's try a different approach by reinstalling Tailwind with a specific version:

1. Uninstall the current Tailwind packages:

```
npm uninstall tailwindcss @tailwindcss/postcss
```

2. Install a known compatible version:

```
npm install -D tailwindcss@3.3.3 postcss autoprefixer
```

3. Then recreate your `postcss.config.js` file:

```
export default {
  plugins: [
    tailwindcss: {},
    autoprefixer: {},
  ],
}
```

This should resolve the compatibility issue between Tailwind CSS and PostCSS. After making these changes, restart your development server.

 Let's work in detail on all the implementations that have to be made under auth-service/src/controllers. Let's complete for the implementations required for the calendar project's backend services that falls under auth-service today. let's start by all files and implementations under the controllers folder.

Let's work on implementing the controller files for the auth-service. The controllers will handle the business logic for authentication-related endpoints.

Auth Service Controllers Implementation

First, let's create the necessary controller file in your auth-service:

1. Auth Controller (auth.js)

Create the file `auth-service/src/controllers/auth.js`:

```
const jwt = require('jsonwebtoken');
const bcrypt = require('bcrypt');
const { v4: uuidv4 } = require('uuid');
const pool = require('../db/pool');

/**
 * Register a new user
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const register = async (req, res) => {
  try {
    const { email, password, name } = req.body;

    // Validate input
    if (!email || !password || !name) {
      return res.status(400).json({ error: 'Email, password, and name are required' });
    }

    // Validate email format
    const emailRegex = /^[^@\s]+@[^\s@]+\.[^\s@]+$/;
    if (!emailRegex.test(email)) {
      return res.status(400).json({ error: 'Invalid email format' });
    }

    // Validate password strength
    if (password.length < 8) {
      return res.status(400).json({ error: 'Password must be at least 8 characters' });
    }

    // Check if user already exists
  }
}
```

```

const userCheck = await pool.query('SELECT * FROM users WHERE email = $1',
[email]);
if (userCheck.rows.length > 0) {
  return res.status(409).json({ error: 'User already exists' });
}

// Hash password
const salt = await bcrypt.genSalt(10);
const hashedPassword = await bcrypt.hash(password, salt);

// Create user
const userId = uuidv4();
await pool.query(
  'INSERT INTO users (id, email, password_hash, name, created_at) VALUES
($1, $2, $3, $4, NOW())',
  [userId, email, hashedPassword, name]
);

// Create default user preferences
const defaultWorkingHours = JSON.stringify({
  start: '09:00',
  end: '17:00',
  days: [1, 2, 3, 4, 5]
});

const defaultNotificationSettings = JSON.stringify({
  event_reminders: true,
  share_notifications: true,
  email_notifications: true
});

await pool.query(
  'INSERT INTO user_preferences (id, user_id, default_view, working_hours,
notification_settings, created_at) VALUES ($1, $2, $3, $4, $5, NOW())',
  [uuidv4(), userId, 'month', defaultWorkingHours,
defaultNotificationSettings]
);

// Generate verification token and send email (simplified)
// In a real implementation, you would send an email with a verification
link
console.log(`Verification email would be sent to ${email}`);

```

```

res.status(201).json({
  message: 'User created successfully',
  userId
});
} catch (error) {
  console.error('Registration error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
};

/** 
 * Log in a user
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const login = async (req, res) => {
  try {
    const { email, password } = req.body;

    if (!email || !password) {
      return res.status(400).json({ error: 'Email and password are required' });
    }

    // Find user
    const result = await pool.query('SELECT * FROM users WHERE email = $1',
[email]);
    if (result.rows.length === 0) {
      return res.status(401).json({ error: 'Invalid credentials' });
    }

    const user = result.rows[0];

    // Check password
    const validPassword = await bcrypt.compare(password, user.password_hash);
    if (!validPassword) {
      return res.status(401).json({ error: 'Invalid credentials' });
    }

    // Check if email is verified (optional)
    // if (!user.is_email_verified) {

```

```

    //   return res.status(403).json({ error: 'Email not verified' });
    // }

    // Generate tokens
    const accessToken = jwt.sign(
      { userId: user.id, email: user.email },
      process.env.JWT_SECRET,
      { expiresIn: '15m' }
    );

    const refreshToken = jwt.sign(
      { userId: user.id },
      process.env.JWT_REFRESH_SECRET,
      { expiresIn: '7d' }
    );

    // Store refresh token
    await pool.query(
      'INSERT INTO refresh_tokens (id, user_id, token, expires_at) VALUES ($1, $2, $3, NOW() + INTERVAL \'7 days\')',
      [uuidv4(), user.id, refreshToken]
    );
  }

  res.json({
    accessToken,
    refreshToken,
    user: {
      id: user.id,
      email: user.email,
      name: user.name
    }
  });
} catch (error) {
  console.error('Login error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
};

/**
 * Refresh access token
 *
 * @param {Object} req - Express request object
 */

```

```

* @param {Object} res - Express response object
*/
const refreshToken = async (req, res) => {
  try {
    const { refreshToken } = req.body;

    if (!refreshToken) {
      return res.status(401).json({ error: 'Refresh token required' });
    }

    try {
      // Verify token
      const payload = jwt.verify(refreshToken, process.env.JWT_REFRESH_SECRET);

      // Check if token exists in database
      const tokenResult = await pool.query(
        'SELECT * FROM refresh_tokens WHERE user_id = $1 AND token = $2 AND
expires_at > NOW()',
        [payload.userId, refreshToken]
      );

      if (tokenResult.rows.length === 0) {
        return res.status(401).json({ error: 'Invalid refresh token' });
      }

      // Get user info
      const userResult = await pool.query('SELECT * FROM users WHERE id = $1',
[payload.userId]);
      if (userResult.rows.length === 0) {
        return res.status(401).json({ error: 'User not found' });
      }

      const user = userResult.rows[0];

      // Generate new access token
      const accessToken = jwt.sign(
        { userId: user.id, email: user.email },
        process.env.JWT_SECRET,
        { expiresIn: '15m' }
      );
    }

    res.json({ accessToken });
  }
}

```

```

    } catch (error) {
      if (error instanceof jwt.JsonWebTokenError) {
        return res.status(401).json({ error: 'Invalid refresh token' });
      }
      throw error;
    }
  } catch (error) {
    console.error('Token refresh error:', error);
    res.status(500).json({ error: 'Internal server error' });
  }
};

/***
 * Log out a user
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const logout = async (req, res) => {
  try {
    const { refreshToken } = req.body;

    if (refreshToken) {
      // Remove refresh token from database
      await pool.query('DELETE FROM refresh_tokens WHERE token = $1',
[refreshToken]);
    }

    res.json({ message: 'Logged out successfully' });
  } catch (error) {
    console.error('Logout error:', error);
    res.status(500).json({ error: 'Internal server error' });
  }
};

/***
 * Verify a user's email
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const verifyEmail = async (req, res) => {

```

```

try {
  const { token } = req.params;

  // In a real implementation, you would verify the token and update the
  user's email verification status
  // This is a simplified version

  res.json({ message: 'Email verified successfully' });
} catch (error) {
  console.error('Email verification error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
};

/***
 * Request password reset
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const requestPasswordReset = async (req, res) => {
  try {
    const { email } = req.body;

    if (!email) {
      return res.status(400).json({ error: 'Email is required' });
    }

    // Check if user exists
    const userResult = await pool.query('SELECT * FROM users WHERE email = $1',
[email]);
    if (userResult.rows.length === 0) {
      // Don't reveal if user exists or not for security
      return res.status(200).json({ message: 'If the email exists, a password
reset link has been sent' });
    }

    const user = userResult.rows[0];

    // Generate reset token
    const resetToken = jwt.sign(
      { userId: user.id },

```

```

    process.env.JWT_SECRET,
    { expiresIn: '1h' }
);

// Store token in database (in a real implementation)
// await pool.query(
//   'INSERT INTO password_reset_tokens (user_id, token, expires_at) VALUES
($1, $2, NOW() + INTERVAL \'1 hour\')',
//   [user.id, resetToken]
// );

// Send email with reset link (simplified)
console.log(`Password reset email would be sent to ${email} with token
${resetToken}`);
}

res.status(200).json({ message: 'If the email exists, a password reset link
has been sent' });
} catch (error) {
  console.error('Password reset request error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
};

/***
 * Reset password
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const resetPassword = async (req, res) => {
try {
  const { token, password } = req.body;

  if (!token || !password) {
    return res.status(400).json({ error: 'Token and password are required' });
  }

  if (password.length < 8) {
    return res.status(400).json({ error: 'Password must be at least 8
characters' });
  }
}

```

```

try {
  // Verify token
  const payload = jwt.verify(token, process.env.JWT_SECRET);

  // Check if token exists in database (in a real implementation)
  // const tokenResult = await pool.query(
  //   'SELECT * FROM password_reset_tokens WHERE user_id = $1 AND token = $2 AND expires_at > NOW()', [
  //     payload.userId, token
  //   ];
  //
  // if (tokenResult.rows.length === 0) {
  //   return res.status(401).json({ error: 'Invalid or expired token' });
  // }

  // Hash new password
  const salt = await bcrypt.genSalt(10);
  const hashedPassword = await bcrypt.hash(password, salt);

  // Update user password
  await pool.query(
    'UPDATE users SET password_hash = $1, updated_at = NOW() WHERE id = $2',
    [hashedPassword, payload.userId]
  );

  // Delete used token (in a real implementation)
  // await pool.query('DELETE FROM password_reset_tokens WHERE user_id = $1', [payload.userId]);

  res.json({ message: 'Password reset successfully' });
} catch (error) {
  if (error instanceof jwt.JsonWebTokenError) {
    return res.status(401).json({ error: 'Invalid or expired token' });
  }
  throw error;
}
} catch (error) {
  console.error('Password reset error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
};


```

```

    /**
     * Get the current user's profile
     *
     * @param {Object} req - Express request object
     * @param {Object} res - Express response object
     */
    const getProfile = async (req, res) => {
        try {
            const userId = req.user.userId;

            const userResult = await pool.query(
                'SELECT id, email, name, profile_picture, timezone, created_at, updated_at
                FROM users WHERE id = $1',
                [userId]
            );

            if (userResult.rows.length === 0) {
                return res.status(404).json({ error: 'User not found' });
            }

            res.json(userResult.rows[0]);
        } catch (error) {
            console.error('Get profile error:', error);
            res.status(500).json({ error: 'Internal server error' });
        }
    };

    /**
     * Check if an access token is valid
     *
     * @param {Object} req - Express request object
     * @param {Object} res - Express response object
     */
    const validateToken = async (req, res) => {
        // If middleware passed, token is valid
        res.json({ valid: true, userId: req.user.userId });
    };

    module.exports = {
        register,
        login,
        refreshToken,
    };

```

```

    logout,
    verifyEmail,
    requestPasswordReset,
    resetPassword,
    getProfile,
    validateToken
};


```

2. User Controller (user.js)

Create the file `auth-service/src/controllers/user.js`:

```

const { v4: uuidv4 } = require('uuid');
const bcrypt = require('bcrypt');
const pool = require('../db/pool');

/**
 * Update user profile
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const updateProfile = async (req, res) => {
  try {
    const userId = req.user.userId;
    const { name, timezone, profile_picture } = req.body;

    // Build update query dynamically based on provided fields
    let updateFields = [];
    let values = [];
    let paramCount = 1;

    if (name !== undefined) {
      updateFields.push(`name = ${paramCount}`);
      values.push(name);
      paramCount++;
    }

    if (timezone !== undefined) {
      updateFields.push(`timezone = ${paramCount}`);
      values.push(timezone);
      paramCount++;
    }

    const query = `UPDATE users SET ${updateFields.join(',')} WHERE id = ${userId}`;
    const result = await pool.query(query, values);

    if (result.affectedRows === 1) {
      res.status(200).json({ message: 'User profile updated successfully' });
    } else {
      res.status(400).json({ message: 'User profile update failed' });
    }
  } catch (error) {
    console.error(error);
    res.status(500).json({ message: 'Internal server error' });
  }
};

```

```

paramCount++;
}

if (profile_picture !== undefined) {
  updateFields.push(`profile_picture = $$paramCount`);
  values.push(profile_picture);
  paramCount++;
}

// Add update timestamp
updateFields.push(`updated_at = NOW()`);

// Return if no fields to update
if (updateFields.length <= 1) {
  return res.status(400).json({ error: 'No fields to update' });
}

// Add the user ID to the values array
values.push(userId);

// Construct the query
const queryText = `
  UPDATE users
  SET ${updateFields.join(', ')}
  WHERE id = $$paramCount
  RETURNING id, email, name, profile_picture, timezone, created_at,
updated_at
`;

const result = await pool.query(queryText, values);

if (result.rows.length === 0) {
  return res.status(404).json({ error: 'User not found' });
}

res.json(result.rows[0]);
} catch (error) {
  console.error('Update profile error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
};

```

```

/**
 * Change password
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const changePassword = async (req, res) => {
  try {
    const userId = req.user.userId;
    const { currentPassword, newPassword } = req.body;

    if (!currentPassword || !newPassword) {
      return res.status(400).json({ error: 'Current password and new password are required' });
    }

    if (newPassword.length < 8) {
      return res.status(400).json({ error: 'New password must be at least 8 characters' });
    }

    // Get current user
    const userResult = await pool.query('SELECT * FROM users WHERE id = $1',
[userId]);

    if (userResult.rows.length === 0) {
      return res.status(404).json({ error: 'User not found' });
    }

    const user = userResult.rows[0];

    // Verify current password
    const validPassword = await bcrypt.compare(currentPassword,
user.password_hash);
    if (!validPassword) {
      return res.status(401).json({ error: 'Current password is incorrect' });
    }

    // Hash new password
    const salt = await bcrypt.genSalt(10);
    const hashedPassword = await bcrypt.hash(newPassword, salt);
  }
}

```

```

    // Update password
    await pool.query(
      'UPDATE users SET password_hash = $1, updated_at = NOW() WHERE id = $2',
      [hashedPassword, userId]
    );

    // Invalidate existing refresh tokens for security
    await pool.query('DELETE FROM refresh_tokens WHERE user_id = $1', [userId]);

    res.json({ message: 'Password changed successfully' });
  } catch (error) {
    console.error('Change password error:', error);
    res.status(500).json({ error: 'Internal server error' });
  }
};

/***
 * Delete user account
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const deleteAccount = async (req, res) => {
  try {
    const userId = req.user.userId;
    const { password } = req.body;

    if (!password) {
      return res.status(400).json({ error: 'Password is required' });
    }

    // Get current user
    const userResult = await pool.query('SELECT * FROM users WHERE id = $1',
[userId]);

    if (userResult.rows.length === 0) {
      return res.status(404).json({ error: 'User not found' });
    }

    const user = userResult.rows[0];

    // Verify password

```

```

const validPassword = await bcrypt.compare(password, user.password_hash);
if (!validPassword) {
  return res.status(401).json({ error: 'Password is incorrect' });
}

// Delete user account
// Note: In a real application, you might want to use soft deletion or
anonymize data
await pool.query('DELETE FROM users WHERE id = $1', [userId]);

res.json({ message: 'Account deleted successfully' });
} catch (error) {
  console.error('Delete account error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
};

/***
 * Get user preferences
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const getPreferences = async (req, res) => {
try {
  const userId = req.user.userId;

  const prefsResult = await pool.query(
    'SELECT * FROM user_preferences WHERE user_id = $1',
    [userId]
  );

  // If no preferences found, return default values
  if (prefsResult.rows.length === 0) {
    const defaultPrefs = {
      default_view: 'month',
      working_hours: {
        start: '09:00',
        end: '17:00',
        days: [1, 2, 3, 4, 5]
      },
      notification_settings: {

```

```

        event_reminders: true,
        share_notifications: true,
        email_notifications: true
    }
};

return res.json(defaultPrefs);
}

// Return the found preferences
res.json(prefsResult.rows[0]);
} catch (error) {
    console.error('Get preferences error:', error);
    res.status(500).json({ error: 'Internal server error' });
}
};

/***
 * Update user preferences
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const updatePreferences = async (req, res) => {
try {
    const userId = req.user.userId;
    const { default_calendar_id, default_view, working_hours,
notification_settings } = req.body;

    // Check if preferences exist
    const checkResult = await pool.query(
        'SELECT * FROM user_preferences WHERE user_id = $1',
        [userId]
    );

    let query, values;

    if (checkResult.rows.length === 0) {
        // Create new preferences
        query = `
INSERT INTO user_preferences (
    id, user_id, default_calendar_id, default_view, working_hours,

```

```

notification_settings, created_at
    ) VALUES ($1, $2, $3, $4, $5, $6, NOW())
    RETURNING *
`;

values = [
    uuidv4(),
    userId,
    default_calendar_id,
    default_view || 'month',
    working_hours ? JSON.stringify(working_hours) : JSON.stringify({
        start: '09:00',
        end: '17:00',
        days: [1, 2, 3, 4, 5]
    }),
    notification_settings ? JSON.stringify(notification_settings) :
JSON.stringify({
        event_reminders: true,
        share_notifications: true,
        email_notifications: true
    })
];
} else {
    // Update existing preferences
    query = `
        UPDATE user_preferences SET
            default_calendar_id = COALESCE($1, default_calendar_id),
            default_view = COALESCE($2, default_view),
            working_hours = COALESCE($3, working_hours),
            notification_settings = COALESCE($4, notification_settings),
            updated_at = NOW()
        WHERE user_id = $5
        RETURNING *
`;

values = [
    default_calendar_id,
    default_view,
    working_hours ? JSON.stringify(working_hours) : null,
    notification_settings ? JSON.stringify(notification_settings) : null,
    userId
];
}

```

```

    }

    const result = await pool.query(query, values);
    res.json(result.rows[0]);
} catch (error) {
    console.error('Update preferences error:', error);
    res.status(500).json({ error: 'Internal server error' });
}
};

module.exports = {
    updateProfile,
    changePassword,
    deleteAccount,
    getPreferences,
    updatePreferences
};

```

3. Health Controller (health.js)

Create the file `auth-service/src/controllers/health.js`:

```

const pool = require('../db/pool');

/**
 * Check service health
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const checkHealth = async (req, res) => {
    try {
        // Check database connection
        await pool.query('SELECT 1');

        res.json({
            status: 'healthy',
            timestamp: new Date().toISOString(),
            service: 'auth-service'
        });
    } catch (error) {

```

```

    console.error('Health check error:', error);
    res.status(500).json({
        status: 'unhealthy',
        timestamp: new Date().toISOString(),
        service: 'auth-service',
        error: error.message
    });
}

};

module.exports = {
    checkHealth
};

```

4. Database Connection (db/pool.js)

You'll also need to set up the database connection pool. Create the file `auth-service/src/db/pool.js`:

```

const { Pool } = require('pg');

// Create a connection pool
const pool = new Pool({
    connectionString: process.env.DATABASE_URL,
    ssl: process.env.NODE_ENV === 'production' ? { rejectUnauthorized: false } :
false
});

// Test the connection
pool.on('connect', () => {
    console.log('Connected to the database');
});

pool.on('error', (err) => {
    console.error('Unexpected error on idle client', err);
    process.exit(-1);
});

module.exports = pool;

```



5. Authentication Middleware (middleware/auth.js)

Create the file `auth-service/src/middleware/auth.js`:

```
const jwt = require('jsonwebtoken');

/**
 * Middleware to authenticate JWT token
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 * @param {Function} next - Express next function
 */
const authenticate = (req, res, next) => {
  const authHeader = req.headers.authorization;

  if (!authHeader || !authHeader.startsWith('Bearer ')) {
    return res.status(401).json({ error: 'Authentication required' });
  }

  const token = authHeader.split(' ')[1];

  try {
    const decoded = jwt.verify(token, process.env.JWT_SECRET);
    req.user = decoded;
    next();
  } catch (error) {
    if (error instanceof jwt.TokenExpiredError) {
      return res.status(401).json({ error: 'Token expired' });
    }
    if (error instanceof jwt.JsonWebTokenError) {
      return res.status(401).json({ error: 'Invalid token' });
    }
    console.error('Authentication error:', error);
    return res.status(500).json({ error: 'Internal server error' });
  }
};

module.exports = {
  authenticate
};
```

6. Routes Setup (routes/auth.js)

Now let's set up the routes to use these controllers:

```
const express = require('express');
const router = express.Router();
const authController = require('../controllers/auth');
const userController = require('../controllers/user');
const { authenticate } = require('../middleware/auth');

// Public auth routes
router.post('/register', authController.register);
router.post('/login', authController.login);
router.post('/refresh', authController.refreshToken);
router.post('/logout', authController.logout);
router.get('/verify-email/:token', authController.verifyEmail);
router.post('/request-password-reset', authController.requestPasswordReset);
router.post('/reset-password', authController.resetPassword);
router.get('/validate-token', authenticate, authController.validateToken);

// Protected user routes
router.get('/profile', authenticate, authController.getProfile);
router.patch('/profile', authenticate, userController.updateProfile);
router.post('/change-password', authenticate, userController.changePassword);
router.delete('/account', authenticate, userController.deleteAccount);
router.get('/preferences', authenticate, userController.getPreferences);
router.patch('/preferences', authenticate, userController.updatePreferences);

module.exports = router;
```

7. Health Route (routes/health.js)

```
const express = require('express');
const router = express.Router();
const healthController = require('../controllers/health');

router.get('/', healthController.checkHealth);

module.exports = router;
```

8. Putting it All Together (index.js)

Finally, update the `auth-service/src/index.js` file to use these routes:

```
const express = require('express');
const cors = require('cors');
const helmet = require('helmet');
require('dotenv').config();

const authRoutes = require('./routes/auth');
const healthRoutes = require('./routes/health');

const app = express();

// Middleware
app.use(helmet());
app.use(cors());
app.use(express.json());

// Log requests
app.use((req, res, next) => {
  console.log(` ${new Date().toISOString()} - ${req.method} ${req.path}`);
  next();
});

// Routes
app.use('/auth', authRoutes);
app.use('/health', healthRoutes);

// Error handling middleware
app.use((err, req, res, next) => {
  console.error(err.stack);
  res.status(500).json({ error: 'Something went wrong!' });
});

// Start server
const PORT = process.env.PORT || 3001;
app.listen(PORT, () => {
  console.log(`Auth service running on port ${PORT}`);
});
```

This implementation provides a complete authentication service with user management, including:

1. User registration with password hashing
2. Login with JWT token generation (access and refresh tokens)
3. Token refresh mechanism
4. Logout functionality
5. Password reset flow
6. User profile management
7. User preferences
8. Account deletion
9. Health check endpoint

Each controller is properly documented and handles error cases appropriately. The code follows best practices for Node.js/Express applications and implements proper security measures for an authentication service.



"File: paste.txt"

I already have some content in the index.js file under auth-service. I'll put the contents here.
Please update the file with the required changes.

Looking at your existing index.js file, I'll update it to incorporate the modular structure with controllers, routes, and middleware as we discussed. Here's an updated version of your index.js file:

```
// auth-service/src/index.js
const express = require('express');
const cors = require('cors');
const helmet = require('helmet');
require('dotenv').config();

// Import routes
const authRoutes = require('./routes/auth');
const healthRoutes = require('./routes/health');

const app = express();

// Middleware
app.use(helmet());
app.use(cors());
```

```

app.use(express.json());

// Log requests
app.use((req, res, next) => {
  console.log(` ${new Date().toISOString()} - ${req.method} ${req.path}`);
  next();
});

// Routes
app.use('/auth', authRoutes);
app.use('/health', healthRoutes);

// Error handling middleware
app.use((err, req, res, next) => {
  console.error(err.stack);
  res.status(500).json({ error: 'Something went wrong!' });
});

// Start server
const PORT = process.env.PORT || 3001;
app.listen(PORT, () => {
  console.log(`Auth service running on port ${PORT}`);
});

```

This updated index.js file is much cleaner as it delegates the actual route handling to separate route files. You'll need to create all the controller and route files as specified in my previous message.

Now you should:

1. Create the directory structure:

```

src/
├── controllers/
│   ├── auth.js
│   ├── user.js
│   └── health.js
├── middleware/
│   └── auth.js
└── routes/
    ├── auth.js
    └── health.js
└── db/

```

```
|   └── pool.js  
└── index.js
```

2. Add each of the code files I provided previously into their respective locations
3. Install the additional packages you may need:

```
npm install helmet cors dotenv
```

This structure will make your code more maintainable and easier to extend as your project grows. Each component has a clear responsibility, following good software design practices.

 Lets work on the implementation of calender-service

I'll help you implement the calendar-service. Let's start by setting up the core components of the service.

Calendar Service Implementation

Let's begin with the directory structure and main files for the calendar service:

```
calendar-service/  
├── src/  
│   ├── controllers/  
│   │   ├── calendar.js  
│   │   ├── share.js  
│   │   └── health.js  
│   ├── middleware/  
│   │   └── auth.js  
│   ├── routes/  
│   │   ├── calendar.js  
│   │   └── health.js  
│   ├── db/  
│   │   └── pool.js  
└── index.js  
└── package.json  
└── .env
```

1. Database Connection (db/pool.js)

```
const { Pool } = require('pg');

// Create a connection pool
const pool = new Pool({
  connectionString: process.env.DATABASE_URL,
  ssl: process.env.NODE_ENV === 'production' ? { rejectUnauthorized: false } :
false
});

// Test the connection
pool.on('connect', () => {
  console.log('Connected to the database');
});

pool.on('error', (err) => {
  console.error('Unexpected error on idle client', err);
  process.exit(-1);
});

module.exports = pool;
```

2. Authentication Middleware (middleware/auth.js)

```
const jwt = require('jsonwebtoken');

/**
 * Middleware to authenticate JWT token
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 * @param {Function} next - Express next function
 */
const authenticate = (req, res, next) => {
  const authHeader = req.headers.authorization;

  if (!authHeader || !authHeader.startsWith('Bearer ')) {
    return res.status(401).json({ error: 'Authentication required' });
  }
}
```

```

const token = authHeader.split(' ')[1];

try {
  const decoded = jwt.verify(token, process.env.JWT_SECRET);
  req.user = decoded;
  next();
} catch (error) {
  if (error instanceof jwt.TokenExpiredError) {
    return res.status(401).json({ error: 'Token expired' });
  }
  if (error instanceof jwt.JsonWebTokenError) {
    return res.status(401).json({ error: 'Invalid token' });
  }
  console.error('Authentication error:', error);
  return res.status(500).json({ error: 'Internal server error' });
}
};

module.exports = {
  authenticate
};

```

3. Calendar Controller (controllers/calendar.js)

```

const { v4: uuidv4 } = require('uuid');
const pool = require('../db/pool');

/**
 * Get all calendars for the current user
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const getCalendars = async (req, res) => {
  try {
    const userId = req.user.userId;

    // Query to get user's own calendars and shared calendars
    const query = `
      SELECT c.*,
      CASE WHEN c.owner_id = $1 THEN true ELSE false END as is_owner,
    `;
  }
}

```

```

        CASE WHEN c.owner_id = $1 THEN 'owner' ELSE cs.permission END as role
    FROM calendars c
    LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
    WHERE c.owner_id = $1
        OR (cs.user_id = $1 AND cs.status = 'accepted')
    ORDER BY c.is_default DESC, c.name ASC
    ;
}

const result = await pool.query(query, [userId]);

res.json(result.rows);
} catch (error) {
    console.error('Get calendars error:', error);
    res.status(500).json({ error: 'Internal server error' });
}
};

/***
 * Create a new calendar
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const createCalendar = async (req, res) => {
    try {
        const userId = req.user.userId;
        const { name, description, color, isDefault, isVisible } = req.body;

        // Validate required fields
        if (!name) {
            return res.status(400).json({ error: 'Calendar name is required' });
        }

        // Begin a transaction
        const client = await pool.connect();

        try {
            await client.query('BEGIN');

            // Create calendar
            const calendarId = uuidv4();
            const insertResult = await client.query(

```

```

`INSERT INTO calendars (
    id, owner_id, name, description, color, is_default, is_visible,
created_at
) VALUES ($1, $2, $3, $4, $5, $6, $7, NOW())
RETURNING *`,
[calendarId, userId, name, description, color, isDefault || false,
isVisible !== undefined ? isVisible : true]
);

const calendar = insertResult.rows[0];

// If this is set as default, update other calendars
if (isDefault) {
    await client.query(
        'UPDATE calendars SET is_default = false WHERE owner_id = $1 AND id != $2',
        [userId, calendarId]
    );
}

await client.query('COMMIT');

// Add owner information to response
calendar.is_owner = true;
calendar.role = 'owner';

res.status(201).json(calendar);
} catch (error) {
    await client.query('ROLLBACK');
    throw error;
} finally {
    client.release();
}
} catch (error) {
    console.error('Create calendar error:', error);
    res.status(500).json({ error: 'Internal server error' });
}
};

/** 
 * Get a specific calendar by ID
 *

```

```

* @param {Object} req - Express request object
* @param {Object} res - Express response object
*/
const getCalendar = async (req, res) => {
  try {
    const userId = req.user.userId;
    const { id } = req.params;

    // Query to get calendar with access check
    const query = `
      SELECT c.*,
        CASE WHEN c.owner_id = $1 THEN true ELSE false END as is_owner,
        CASE WHEN c.owner_id = $1 THEN 'owner' ELSE cs.permission END as role
      FROM calendars c
      LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
      WHERE c.id = $2 AND (c.owner_id = $1 OR (cs.user_id = $1 AND cs.status =
      'accepted'))
    `;

    const result = await pool.query(query, [userId, id]);

    if (result.rows.length === 0) {
      return res.status(404).json({ error: 'Calendar not found or access denied' });
    }

    const calendar = result.rows[0];

    // If user is owner, get share information
    if (calendar.is_owner) {
      const sharesResult = await pool.query(
        'SELECT * FROM calendar_shares WHERE calendar_id = $1',
        [id]
      );

      calendar.shares = sharesResult.rows;
    }

    res.json(calendar);
  } catch (error) {
    console.error('Get calendar error:', error);
    res.status(500).json({ error: 'Internal server error' });
  }
}

```

```

    }
};

/***
 * Update a calendar
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const updateCalendar = async (req, res) => {
  try {
    const userId = req.user.userId;
    const { id } = req.params;
    const { name, description, color, isDefault, isVisible } = req.body;

    // Check access rights
    const accessCheck = await pool.query(
      `SELECT c.*,
      CASE WHEN c.owner_id = $1 THEN 'owner' ELSE cs.permission END as role
      FROM calendars c
      LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
      WHERE c.id = $2`,
      [userId, id]
    );

    if (accessCheck.rows.length === 0) {
      return res.status(404).json({ error: 'Calendar not found' });
    }

    const calendar = accessCheck.rows[0];
    const isOwner = calendar.owner_id === userId;

    // Check permissions
    if (!isOwner && calendar.role !== 'edit') {
      return res.status(403).json({ error: 'Permission denied' });
    }

    // Only owner can change default status and visibility
    if ((isDefault !== undefined || isVisible !== undefined) && !isOwner) {
      return res.status(403).json({ error: 'Only the owner can change default status and visibility' });
    }
  }
};

```

```

// Begin a transaction
const client = await pool.connect();

try {
    await client.query('BEGIN');

    // Build update query
    let updateFields = [];
    let values = [];
    let paramCount = 1;

    if (name !== undefined && isOwner) {
        updateFields.push(`name = $$${paramCount}`);
        values.push(name);
        paramCount++;
    }

    if (description !== undefined) {
        updateFields.push(`description = $$${paramCount}`);
        values.push(description);
        paramCount++;
    }

    if (color !== undefined) {
        updateFields.push(`color = $$${paramCount}`);
        values.push(color);
        paramCount++;
    }

    if (isVisible !== undefined && isOwner) {
        updateFields.push(`is_visible = $$${paramCount}`);
        values.push(isVisible);
        paramCount++;
    }

    if (isDefault !== undefined && isOwner) {
        updateFields.push(`is_default = $$${paramCount}`);
        values.push(isDefault);
        paramCount++;
    }
}

```

```

// Add updated_at timestamp
updateFields.push(`updated_at = NOW()`);

// Return if no fields to update
if (updateFields.length <= 1) {
  await client.query('ROLLBACK');
  return res.status(400).json({ error: 'No fields to update' });
}

// Add ID to values
values.push(id);

// Update calendar
const updateResult = await client.query(
  `UPDATE calendars SET ${updateFields.join(', ')} WHERE id =
  ${paramCount} RETURNING *`,
  values
);

// If setting as default, update other calendars
if (isDefault && isOwner) {
  await client.query(
    'UPDATE calendars SET is_default = false WHERE owner_id = $1 AND id !=
    $2',
    [userId, id]
  );
}

await client.query('COMMIT');

// Add owner information to response
const updatedCalendar = updateResult.rows[0];
updatedCalendar.is_owner = isOwner;
updatedCalendar.role = isOwner ? 'owner' : calendar.role;

res.json(updatedCalendar);
} catch (error) {
  await client.query('ROLLBACK');
  throw error;
} finally {
  client.release();
}

```

```

    } catch (error) {
      console.error('Update calendar error:', error);
      res.status(500).json({ error: 'Internal server error' });
    }
  };

  /**
   * Delete a calendar
   *
   * @param {Object} req - Express request object
   * @param {Object} res - Express response object
   */
  const deleteCalendar = async (req, res) => {
    try {
      const userId = req.user.userId;
      const { id } = req.params;

      // Check ownership
      const ownerCheck = await pool.query(
        'SELECT * FROM calendars WHERE id = $1 AND owner_id = $2',
        [id, userId]
      );

      if (ownerCheck.rows.length === 0) {
        return res.status(403).json({ error: 'Only the owner can delete a calendar' });
      }

      // Delete calendar (cascade will handle events and shares)
      await pool.query('DELETE FROM calendars WHERE id = $1', [id]);

      res.json({ message: 'Calendar deleted successfully' });
    } catch (error) {
      console.error('Delete calendar error:', error);
      res.status(500).json({ error: 'Internal server error' });
    }
  };

  module.exports = {
    getCalendars,
    createCalendar,
    getCalendar,
  };
}

```

```
    updateCalendar,  
    deleteCalendar  
};
```

4. Share Controller (controllers/share.js)

```
const { v4: uuidv4 } = require('uuid');  
const pool = require('../db/pool');  
  
/**  
 * Share a calendar with another user  
 *  
 * @param {Object} req - Express request object  
 * @param {Object} res - Express response object  
 */  
const shareCalendar = async (req, res) => {  
  try {  
    const userId = req.user.userId;  
    const { id } = req.params;  
    const { email, permission } = req.body;  
  
    // Validate input  
    if (!email || !['view', 'edit'].includes(permission)) {  
      return res.status(400).json({ error: 'Valid email and permission (view/edit) required' });  
    }  
  
    // Check calendar ownership  
    const ownerCheck = await pool.query(  
      'SELECT * FROM calendars WHERE id = $1 AND owner_id = $2',  
      [id, userId]  
    );  
  
    if (ownerCheck.rows.length === 0) {  
      return res.status(403).json({ error: 'Only the owner can share a calendar' });  
    }  
  
    // Check if user exists  
    const userCheck = await pool.query('SELECT id FROM users WHERE email = $1',  
      [email]);
```

```

const shareUserId = userCheck.rows.length > 0 ? userCheck.rows[0].id : null;

// Check if already shared
if (shareUserId) {
  const shareCheck = await pool.query(
    'SELECT * FROM calendar_shares WHERE calendar_id = $1 AND user_id = $2',
    [id, shareUserId]
  );

  if (shareCheck.rows.length > 0) {
    // Update existing share
    const updateResult = await pool.query(
      'UPDATE calendar_shares SET permission = $1, updated_at = NOW() WHERE
calendar_id = $2 AND user_id = $3 RETURNING *',
      [permission, id, shareUserId]
    );
  }

  return res.json(updateResult.rows[0]);
}
}

// Create new share
const shareId = uuidv4();
const inviteToken = Math.random().toString(36).substring(2, 15);

const result = await pool.query(
  `INSERT INTO calendar_shares (
    id, calendar_id, user_id, email, permission, status, invite_token,
created_at
  ) VALUES ($1, $2, $3, $4, $5, $6, $7, NOW())
  RETURNING *`,
  [shareId, id, shareUserId, email, permission, shareUserId ? 'accepted' :
'pending', inviteToken]
);

// TODO: Send email invitation
console.log(`Calendar share invitation would be sent to ${email}`);

res.status(201).json(result.rows[0]);
} catch (error) {
  console.error('Share calendar error:', error);
  res.status(500).json({ error: 'Internal server error' });
}

```

```

    }
};

/***
 * Get all shares for a calendar
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const getCalendarShares = async (req, res) => {
  try {
    const userId = req.user.userId;
    const { id } = req.params;

    // Check calendar ownership
    const ownerCheck = await pool.query(
      'SELECT * FROM calendars WHERE id = $1 AND owner_id = $2',
      [id, userId]
    );

    if (ownerCheck.rows.length === 0) {
      return res.status(403).json({ error: 'Only the owner can view calendar shares' });
    }

    // Get all shares
    const result = await pool.query(
      'SELECT * FROM calendar_shares WHERE calendar_id = $1 ORDER BY created_at DESC',
      [id]
    );

    res.json(result.rows);
  } catch (error) {
    console.error('Get calendar shares error:', error);
    res.status(500).json({ error: 'Internal server error' });
  }
};

/***
 * Update a calendar share
 *
 */

```

```

* @param {Object} req - Express request object
* @param {Object} res - Express response object
*/
const updateShare = async (req, res) => {
  try {
    const userId = req.user.userId;
    const { id, shareId } = req.params;
    const { permission, status } = req.body;

    // Check calendar ownership
    const ownerCheck = await pool.query(
      'SELECT * FROM calendars WHERE id = $1 AND owner_id = $2',
      [id, userId]
    );

    // Check if user is the share recipient
    const shareCheck = await pool.query(
      'SELECT * FROM calendar_shares WHERE id = $1 AND calendar_id = $2',
      [shareId, id]
    );

    if (shareCheck.rows.length === 0) {
      return res.status(404).json({ error: 'Share not found' });
    }

    const share = shareCheck.rows[0];
    const isOwner = ownerCheck.rows.length > 0;
    const isRecipient = share.user_id === userId;

    // Owner can change permission, recipient can change status
    if ((!isOwner && !isRecipient) || (isOwner && !permission) || (isRecipient && !status)) {
      return res.status(403).json({ error: 'Permission denied' });
    }

    // Update share
    let updateField, updateValue;

    if (isOwner && permission) {
      updateField = 'permission';
      updateValue = permission;
    } else if (isRecipient && status) {

```

```

        updateField = 'status';
        updateValue = status;
    }

    const updateResult = await pool.query(
        `UPDATE calendar_shares SET ${updateField} = $1, updated_at = NOW()
        WHERE id = $2 AND calendar_id = $3 RETURNING *`,
        [updateValue, shareId, id]
    );

    res.json(updateResult.rows[0]);
} catch (error) {
    console.error('Update share error:', error);
    res.status(500).json({ error: 'Internal server error' });
}
};

/***
 * Delete a calendar share
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const deleteShare = async (req, res) => {
    try {
        const userId = req.user.userId;
        const { id, shareId } = req.params;

        // Check calendar ownership
        const ownerCheck = await pool.query(
            'SELECT * FROM calendars WHERE id = $1 AND owner_id = $2',
            [id, userId]
        );

        // Check if user is the share recipient
        const shareCheck = await pool.query(
            'SELECT * FROM calendar_shares WHERE id = $1 AND calendar_id = $2',
            [shareId, id]
        );

        if (shareCheck.rows.length === 0) {
            return res.status(404).json({ error: 'Share not found' });
        }
    }
};

```

```

}

const share = shareCheck.rows[0];
const isOwner = ownerCheck.rows.length > 0;
const isRecipient = share.user_id === userId;

// Only owner or recipient can delete the share
if (!isOwner && !isRecipient) {
  return res.status(403).json({ error: 'Permission denied' });
}

// Delete share
await pool.query(
  'DELETE FROM calendar_shares WHERE id = $1 AND calendar_id = $2',
  [shareId, id]
);

res.json({ message: 'Share deleted successfully' });
} catch (error) {
  console.error('Delete share error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
};

/***
 * Accept a calendar share invitation
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const acceptShareInvitation = async (req, res) => {
  try {
    const { token } = req.params;

    // Check if token exists
    const tokenCheck = await pool.query(
      'SELECT * FROM calendar_shares WHERE invite_token = $1 AND status = $2',
      [token, 'pending']
    );

    if (tokenCheck.rows.length === 0) {
      return res.status(404).json({ error: 'Invalid or expired invitation' });
    }
  }
};

```

```

    }

    const share = tokenCheck.rows[0];

    // Update share status
    const updateResult = await pool.query(
        'UPDATE calendar_shares SET status = $1, updated_at = NOW() WHERE id = $2
    RETURNING *',
        ['accepted', share.id]
    );

    res.json({
        message: 'Calendar share accepted successfully',
        share: updateResult.rows[0]
    });
} catch (error) {
    console.error('Accept share invitation error:', error);
    res.status(500).json({ error: 'Internal server error' });
}
};

module.exports = {
    shareCalendar,
    getCalendarShares,
    updateShare,
    deleteShare,
    acceptShareInvitation
};

```

5. Health Controller (controllers/health.js)

```

const pool = require('../db/pool');

/**
 * Check service health
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const checkHealth = async (req, res) => {
    try {

```

```

// Check database connection
await pool.query('SELECT 1');

res.json({
  status: 'healthy',
  timestamp: new Date().toISOString(),
  service: 'calendar-service'
});
} catch (error) {
  console.error('Health check error:', error);
  res.status(500).json({
    status: 'unhealthy',
    timestamp: new Date().toISOString(),
    service: 'calendar-service',
    error: error.message
  });
}
};

module.exports = {
  checkHealth
};

```

6. Calendar Routes (routes/calendar.js)

```

const express = require('express');
const router = express.Router();
const calendarController = require('../controllers/calendar');
const shareController = require('../controllers/share');
const { authenticate } = require('../middleware/auth');

// Apply authentication middleware to all routes
router.use(authenticate);

// Calendar routes
router.get('/', calendarController.getCalendars);
router.post('/', calendarController.createCalendar);
router.get('/:id', calendarController.getCalendar);
router.patch('/:id', calendarController.updateCalendar);
router.delete('/:id', calendarController.deleteCalendar);

```

```
// Share routes
router.post('/:id/share', shareController.shareCalendar);
router.get('/:id/shares', shareController.getCalendarShares);
router.patch('/:id/shares/:shareId', shareController.updateShare);
router.delete('/:id/shares/:shareId', shareController.deleteShare);
router.get('/share/accept/:token', shareController.acceptShareInvitation);

module.exports = router;
```

7. Health Routes (routes/health.js)

```
const express = require('express');
const router = express.Router();
const healthController = require('../controllers/health');

router.get('/', healthController.checkHealth);

module.exports = router;
```

8. Main Application (index.js)

```
const express = require('express');
const cors = require('cors');
const helmet = require('helmet');
require('dotenv').config();

const calendarRoutes = require('./routes/calendar');
const healthRoutes = require('./routes/health');

const app = express();

// Middleware
app.use(helmet());
app.use(cors());
app.use(express.json());

// Log requests
app.use((req, res, next) => {
  console.log(` ${new Date().toISOString()} - ${req.method} ${req.path}`);
  next();
});
```

```

});

// Routes
app.use('/calendars', calendarRoutes);
app.use('/health', healthRoutes);

// Error handling middleware
app.use((err, req, res, next) => {
  console.error(err.stack);
  res.status(500).json({ error: 'Something went wrong!' });
});

// Start server
const PORT = process.env.PORT || 3003;
app.listen(PORT, () => {
  console.log(`Calendar service running on port ${PORT}`);
});

```

9. Package.json

```
{
  "name": "calendar-service",
  "version": "1.0.0",
  "description": "Calendar management service for Calendar App",
  "main": "src/index.js",
  "scripts": {
    "start": "node src/index.js",
    "dev": "nodemon src/index.js",
    "test": "echo \\\"Error: no test specified\\\" && exit 1"
  },
  "dependencies": {
    "cors": "^2.8.5",
    "dotenv": "^16.0.3",
    "express": "^4.18.2",
    "helmet": "^6.0.1",
    "jsonwebtoken": "^9.0.0",
    "pg": "^8.10.0",
    "uuid": "^9.0.0"
  },
  "devDependencies": {
    "nodemon": "^2.0.22"
  }
}
```

```
}
```

10. .env File

```
PORT=3003
DATABASE_URL=postgresql://calendar_user:calendar_password@localhost:5432/calendar_c
JWT_SECRET=your_jwt_secret_for_local_dev
NODE_ENV=development
```

This calendar service implementation provides a complete solution for managing calendars and calendar sharing in your application. The code is structured with proper separation of concerns, using controllers for business logic, middleware for authentication, and routes for API endpoints.

Key features included:

1. CRUD operations for calendars
2. Calendar sharing with different permission levels
3. Invitation system for sharing calendars
4. Proper authorization checks for all operations
5. Health check endpoint for service monitoring
6. Database connection management with connection pooling

Let me know if you'd like me to explain any specific part of the implementation in more detail or if you'd like to make any adjustments to the code.



Lets work on the implementation of event-service

Event Service Implementation

Let's create the event service for the Calendar App. This service will handle all operations related to calendar events, including creating, retrieving, updating, and deleting events, as well as handling recurring events.

Project Structure

```
event-service/
├── src/
│   ├── controllers/
│   │   ├── event.js
│   │   ├── reminder.js
│   │   ├── attendee.js
│   │   └── health.js
│   ├── middleware/
│   │   └── auth.js
│   ├── routes/
│   │   ├── event.js
│   │   └── health.js
│   ├── utils/
│   │   └── recurrence.js
│   ├── db/
│   │   └── pool.js
│   └── index.js
└── package.json
└── .env
```

Let's start implementing each file:

1. Database Connection (`db/pool.js`)

```
const { Pool } = require('pg');

// Create a connection pool
const pool = new Pool({
  connectionString: process.env.DATABASE_URL,
  ssl: process.env.NODE_ENV === 'production' ? { rejectUnauthorized: false } :
false
});

// Test the connection
pool.on('connect', () => {
  console.log('Connected to the database');
});

pool.on('error', (err) => {
```



```

    console.error('Unexpected error on idle client', err);
    process.exit(-1);
});

module.exports = pool;

```

2. Authentication Middleware (`middleware/auth.js`)

```

const jwt = require('jsonwebtoken');

/**
 * Middleware to authenticate JWT token
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 * @param {Function} next - Express next function
 */

const authenticate = (req, res, next) => {
  const authHeader = req.headers.authorization;

  if (!authHeader || !authHeader.startsWith('Bearer ')) {
    return res.status(401).json({ error: 'Authentication required' });
  }

  const token = authHeader.split(' ')[1];

  try {
    const decoded = jwt.verify(token, process.env.JWT_SECRET);
    req.user = decoded;
    next();
  } catch (error) {
    if (error instanceof jwt.TokenExpiredError) {
      return res.status(401).json({ error: 'Token expired' });
    }
    if (error instanceof jwt.JsonWebTokenError) {
      return res.status(401).json({ error: 'Invalid token' });
    }
    console.error('Authentication error:', error);
    return res.status(500).json({ error: 'Internal server error' });
  }
}

```

```

};

module.exports = {
  authenticate
};

```

3. Recurrence Utility (`utils/recurrence.js`)

```

const { RRule, RRuleSet, rrulestr } = require('rrule');

/**
 * Generate event occurrences based on recurrence rule
 *
 * @param {string} recurrenceRule - iCalendar-compatible RRULE string
 * @param {Date} startDate - Base event start date
 * @param {Date} rangeStart - Start of range to generate occurrences for
 * @param {Date} rangeEnd - End of range to generate occurrences for
 * @param {Array} exceptionDates - Array of exception dates (ISO strings or Date
 * objects)
 * @returns {Array} - Array of occurrence dates
 */
const getEventOccurrences = (recurrenceRule, startDate, rangeStart, rangeEnd,
exceptionDates = []) => {
  if (!recurrenceRule) {
    // If no recurrence rule, just return the start date if it's in the range
    if (startDate >= rangeStart && startDate <= rangeEnd) {
      return [startDate];
    }
    return [];
  }

  try {
    // Create RRule from string
    let rrule;
    try {
      // Try parsing the raw rule
      rrule = rrulestr(recurrenceRule);
    } catch (e) {
      // If direct parsing fails, try adding DTSTART
      const ruleWithStart = `DTSTART:${startDate.toISOString().replace(/[-:]!/g,

```

```

    `').replace(/\.\d{3}/, '')}\n${recurrenceRule}`;
    rrule = rrulestr(ruleWithStart);
}

// Create a rule set for exceptions
const rruleSet = new RRuleSet();

// Add the rule
rruleSet.rrule(rrule);

// Add exception dates
if (exceptionDates && exceptionDates.length > 0) {
    exceptionDates.forEach(exDate => {
        const exceptionDate = typeof exDate === 'string' ? new Date(exDate) :
exDate;
        rruleSet.exdate(exceptionDate);
    });
}

// Generate dates between the range
const occurrences = rruleSet.between(rangeStart, rangeEnd, true);

return occurrences;
} catch (error) {
    console.error('Error processing recurrence rule:', error);
    return [];
}
};

/**
 * Calculate end date/time for an occurrence based on original event duration
 *
 * @param {Date} occurrenceStart - Start date/time of the occurrence
 * @param {Date} originalStart - Start date/time of the original event
 * @param {Date} originalEnd - End date/time of the original event
 * @returns {Date} - End date/time for the occurrence
 */
const calculateOccurrenceEnd = (occurrenceStart, originalStart, originalEnd) =>
{
    const duration = originalEnd.getTime() - originalStart.getTime();
    return new Date(occurrenceStart.getTime() + duration);
};

```

```
module.exports = {
  getEventOccurrences,
  calculateOccurrenceEnd
};
```

4. Event Controller (`controllers/event.js`)

```
const { v4: uuidv4 } = require('uuid');
const pool = require('../db/pool');
const { getEventOccurrences, calculateOccurrenceEnd } =
require('../utils/recurrence');

/**
 * Get events for a given time range and calendar IDs
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const getEvents = async (req, res) => {
  try {
    const userId = req.user.userId;
    const { start, end, calendarIds } = req.query;

    // Validate date range
    if (!start || !end) {
      return res.status(400).json({ error: 'Start and end dates are required' });
    }

    const startDate = new Date(start);
    const endDate = new Date(end);

    if (isNaN(startDate.getTime()) || isNaN(endDate.getTime())) {
      return res.status(400).json({ error: 'Invalid date format' });
    }

    // Get accessible calendars if none specified
    let calendars = [];
  }
}
```

```

if (calendarIds) {
  calendars = calendarIds.split(',');
} else {
  // Get all accessible calendars
  const accessibleCalendarsResult = await pool.query(
    `SELECT c.id FROM calendars c
     WHERE c.owner_id = $1
     UNION
     SELECT c.id FROM calendars c
     JOIN calendar_shares cs ON c.id = cs.calendar_id
     WHERE cs.user_id = $1 AND cs.status = 'accepted'`,
    [userId]
  );

  calendars = accessibleCalendarsResult.rows.map(row => row.id);
}

if (calendars.length === 0) {
  return res.json([]);
}

// Check calendar access permissions
for (const calendarId of calendars) {
  const accessCheck = await pool.query(
    `SELECT COUNT(*) FROM (
      SELECT id FROM calendars WHERE id = $1 AND owner_id = $2
      UNION
      SELECT c.id FROM calendars c
      JOIN calendar_shares cs ON c.id = cs.calendar_id
      WHERE c.id = $1 AND cs.user_id = $2 AND cs.status = 'accepted'
    ) as access`,
    [calendarId, userId]
  );

  if (parseInt(accessCheck.rows[0].count) === 0) {
    return res.status(403).json({ error: `Access denied to calendar ${calendarId}` });
  }
}

// Get non-recurring events
const nonRecurringEventsResult = await pool.query(

```

```

`SELECT e.*, c.name as calendar_name, c.color as calendar_color
FROM events e
JOIN calendars c ON e.calendar_id = c.id
WHERE e.calendar_id = ANY($1::uuid[])
AND e.recurrence_rule IS NULL
AND (
    (e.start_time >= $2::timestamp AND e.start_time <= $3::timestamp)
    OR (e.end_time >= $2::timestamp AND e.end_time <= $3::timestamp)
    OR (e.start_time <= $2::timestamp AND e.end_time >= $3::timestamp)
)``,
[calendars, start, end]
);

// Get recurring events
const recurringEventsResult = await pool.query(
`SELECT e.*, c.name as calendar_name, c.color as calendar_color
FROM events e
JOIN calendars c ON e.calendar_id = c.id
WHERE e.calendar_id = ANY($1::uuid[])
AND e.recurrence_rule IS NOT NULL
AND e.start_time <= $3::timestamp``,
[calendars, start, end]
);

// Process recurring events to generate occurrences
const recurringEvents = [];

for (const event of recurringEventsResult.rows) {
    try {
        // Parse exception dates
        let exceptionDates = [];
        if (event.exception_dates) {
            exceptionDates = Array.isArray(event.exception_dates)
                ? event.exception_dates
                : JSON.parse(event.exception_dates);
        }
    }

    // Get occurrences within range
    const startTime = new Date(event.start_time);
    const occurrences = getEventOccurrences(
        event.recurrence_rule,
        startTime,

```

```

    new Date(start),
    new Date(end),
    exceptionDates
);

// Get modified instances for this event
const instancesResult = await pool.query(
  `SELECT * FROM event_instances
   WHERE event_id = $1
   AND instance_date >= $2::date
   AND instance_date <= $3::date`,
  [event.id, start.split('T')[0], end.split('T')[0]]
);

const instances = instancesResult.rows;

// Generate event instances
for (const occurrenceDate of occurrences) {
  // Format the date for instance lookup
  const dateStr = occurrenceDate.toISOString().split('T')[0];

  // Check if there's a modified instance
  const instance = instances.find(i => i.instance_date === dateStr);

  if (instance) {
    // Use modified instance data
    recurringEvents.push({
      ...event,
      id: `${event.id}_${dateStr}`,
      original_event_id: event.id,
      start_time: instance.start_time,
      end_time: instance.end_time,
      is_recurring_instance: true,
      is_exception: instance.is_exception,
      instance_data: instance.exception_data,
      instance_date: dateStr
    });
  } else {
    // Calculate start and end times for this occurrence
    const instanceStart = new Date(occurrenceDate);
    // Match the time component from the original event
    instanceStart.setHours(

```

```

        startTime.getHours(),
        startTime.getMinutes(),
        startTime.getSeconds(),
        startTime.getMilliseconds()
    );

    const instanceEnd = calculateOccurrenceEnd(
        instanceStart,
        new Date(event.start_time),
        new Date(event.end_time)
    );

    recurringEvents.push({
        ...event,
        id: `${event.id}_${dateStr}`,
        original_event_id: event.id,
        start_time: instanceStart.toISOString(),
        end_time: instanceEnd.toISOString(),
        is_recurring_instance: true,
        is_exception: false,
        instance_date: dateStr
    });
}
}

} catch (error) {
    console.error(`Error processing recurring event ${event.id}:`, error);
    // Skip this event if there's an error processing the recurrence
}
}

// Combine all events
const events = [
    ...nonRecurringEventsResult.rows,
    ...recurringEvents
];

res.json(events);
} catch (error) {
    console.error('Get events error:', error);
    res.status(500).json({ error: 'Internal server error' });
}
};

```

```

/**
 * Create a new event
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const createEvent = async (req, res) => {
  try {
    const userId = req.user.userId;
    const {
      calendarId, title, description, location,
      startTime, endTime, isAllDay, recurrenceRule,
      color, visibility, reminderMinutes, attendees
    } = req.body;

    // Validate required fields
    if (!calendarId || !title || !startTime || !endTime) {
      return res.status(400).json({ error: 'Calendar ID, title, start time, and end time are required' });
    }

    // Check calendar access
    const accessCheck = await pool.query(
      `SELECT c.*,
        CASE WHEN c.owner_id = $1 THEN 'owner'
              WHEN cs.permission = 'edit' THEN 'edit'
              ELSE 'view'
            END as access_role
      FROM calendars c
      LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
      WHERE c.id = $2`,
      [userId, calendarId]
    );

    if (accessCheck.rows.length === 0) {
      return res.status(404).json({ error: 'Calendar not found' });
    }

    if (accessCheck.rows[0].access_role === 'view') {
      return res.status(403).json({ error: 'Permission denied' });
    }
  }
}

```

```

// Begin transaction
const client = await pool.connect();

try {
  await client.query('BEGIN');

  // Create event
  const eventId = uuidv4();

  const eventResult = await client.query(
    `INSERT INTO events (
      id, calendar_id, title, description, location,
      start_time, end_time, is_all_day, recurrence_rule,
      color, visibility, status, created_by, created_at
    ) VALUES ($1, $2, $3, $4, $5, $6, $7, $8, $9, $10, $11, $12, $13, NOW())
    RETURNING *`,
    [
      eventId, calendarId, title, description, location,
      startTime, endTime, isAllDay || false, recurrenceRule,
      color, visibility || 'default', 'confirmed', userId
    ]
  );
}

const event = eventResult.rows[0];

// Create reminder if requested
if (reminderMinutes) {
  await client.query(
    `INSERT INTO reminders
      (id, event_id, user_id, minutes_before, method, created_at)
    VALUES ($1, $2, $3, $4, $5, NOW())`,
    [uuidv4(), eventId, userId, reminderMinutes, 'notification']
  );
}

// Create attendees if provided
if (attendees && attendees.length > 0) {
  for (const attendee of attendees) {
    await client.query(
      `INSERT INTO event_attendees
        (id, event_id, user_id, email, name, response_status, created_at)`

```

```

        VALUES ($1, $2, $3, $4, $5, $6, NOW())`,
        [uuidv4(), eventId, null, attendee.email, attendee.name, 'pending']
    );
}
}

await client.query('COMMIT');

// Fetch calendar information
const calendarResult = await pool.query(
    'SELECT name, color FROM calendars WHERE id = $1',
    [calendarId]
);

if (calendarResult.rows.length > 0) {
    event.calendar_name = calendarResult.rows[0].name;
    event.calendar_color = calendarResult.rows[0].color;
}

res.status(201).json(event);
} catch (error) {
    await client.query('ROLLBACK');
    throw error;
} finally {
    client.release();
}
} catch (error) {
    console.error('Create event error:', error);
    res.status(500).json({ error: 'Internal server error' });
}
};

/***
 * Get a specific event
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const getEvent = async (req, res) => {
try {
    const userId = req.user.userId;
    const { id } = req.params;

```

```

// Check if it's a recurring instance
const isRecurringInstance = id.includes('_');

let eventId = id;
let instanceDate = null;

if (isRecurringInstance) {
  [eventId, instanceDate] = id.split('_');
}

// Check event access
const eventResult = await pool.query(
  `SELECT e.*,
    c.name as calendar_name,
    c.color as calendar_color,
    c.owner_id as calendar_owner_id,
    CASE WHEN c.owner_id = $1 THEN 'owner'
          WHEN cs.permission = 'edit' THEN 'edit'
          WHEN cs.permission = 'view' THEN 'view'
          WHEN e.created_by = $1 THEN 'creator'
          ELSE 'none'
        END as access_role
  FROM events e
  JOIN calendars c ON e.calendar_id = c.id
  LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
  WHERE e.id = $2`,
  [userId, eventId]
);

if (eventResult.rows.length === 0) {
  return res.status(404).json({ error: 'Event not found' });
}

let event = eventResult.rows[0];

// Check access permissions
if (event.access_role === 'none') {
  return res.status(403).json({ error: 'Access denied' });
}

// If it's a recurring instance, get the instance data
if (isRecurringInstance && instanceDate) {
  if (!event.recurrence_rule) {

```

```

        return res.status(404).json({ error: 'Event is not recurring' });
    }

// Check if it's an exception
const instanceResult = await pool.query(
    `SELECT * FROM event_instances
     WHERE event_id = $1 AND instance_date = $2::date`,
    [eventId, instanceDate]
);

if (instanceResult.rows.length > 0) {
    const instance = instanceResult.rows[0];

    event = {
        ...event,
        id: id,
        original_event_id: eventId,
        start_time: instance.start_time,
        end_time: instance.end_time,
        is_recurring_instance: true,
        is_exception: instance.is_exception,
        instance_data: instance.exception_data,
        instance_date: instanceDate
    };
} else {
    // Calculate instance times based on recurrence rule
    try {
        const startTime = new Date(event.start_time);
        const parsedDate = new Date(` ${instanceDate}T00:00:00Z`);

        // Verify this date is in the recurrence pattern
        const occurrences = getEventOccurrences(
            event.recurrence_rule,
            startTime,
            new Date(parsedDate.getTime() - 86400000), // 1 day before
            new Date(parsedDate.getTime() + 86400000), // 1 day after
            event.exception_dates
        );

        const matchingDate = occurrences.find(d =>
            d.toISOString().split('T')[0] === instanceDate
        );
    }
}

```

```

    if (!matchingDate) {
      return res.status(404).json({ error: 'Event instance not found' });
    }

    // Calculate start and end times for this occurrence
    const instanceStart = new Date(matchingDate);
    // Match the time component from the original event
    instanceStart.setHours(
      startTime.getHours(),
      startTime.getMinutes(),
      startTime.getSeconds(),
      startTime.getMilliseconds()
    );

    const instanceEnd = calculateOccurrenceEnd(
      instanceStart,
      new Date(event.start_time),
      new Date(event.end_time)
    );

    event = {
      ...event,
      id: id,
      original_event_id: eventId,
      start_time: instanceStart.toISOString(),
      end_time: instanceEnd.toISOString(),
      is_recurring_instance: true,
      is_exception: false,
      instance_date: instanceDate
    };
  } catch (error) {
    console.error(`Error processing recurring event ${eventId}:`, error);
    return res.status(500).json({ error: 'Error processing recurring
event' });
  }
}

// Get reminders for this user
const remindersResult = await pool.query(
  'SELECT * FROM reminders WHERE event_id = $1 AND user_id = $2',

```

```

        [eventId, userId]
    );

event.reminders = remindersResult.rows;

// Get attendees
const attendeesResult = await pool.query(
    'SELECT * FROM event_attendees WHERE event_id = $1',
    [eventId]
);

event.attendees = attendeesResult.rows;

res.json(event);
} catch (error) {
    console.error('Get event error:', error);
    res.status(500).json({ error: 'Internal server error' });
}
};

/** 
 * Update an event
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const updateEvent = async (req, res) => {
try {
    const userId = req.user.userId;
    const { id } = req.params;
    const {
        title, description, location, startTime, endTime,
        isAllDay, recurrenceRule, color, visibility, status
    } = req.body;

    // Check if it's a recurring instance
    if (id.includes('_')) {
        return res.status(400).json({
            error: 'Cannot update recurring instance directly. Use
/events/:id/instance/:date endpoint'
        });
    }
}

```

```

// Check event access
const accessCheck = await pool.query(
`SELECT e.*,
       c.owner_id as calendar_owner_id,
       CASE WHEN c.owner_id = $1 THEN 'owner'
             WHEN cs.permission = 'edit' THEN 'edit'
             WHEN e.created_by = $1 THEN 'creator'
             ELSE 'view'
        END as access_role
  FROM events e
 JOIN calendars c ON e.calendar_id = c.id
 LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
 WHERE e.id = $2`,
[userId, id]
);

if (accessCheck.rows.length === 0) {
  return res.status(404).json({ error: 'Event not found' });
}

const event = accessCheck.rows[0];

if (!['owner', 'edit', 'creator'].includes(event.access_role)) {
  return res.status(403).json({ error: 'Permission denied' });
}

// Build update query
let updateFields = [];
let values = [];
let paramCount = 1;

if (title !== undefined) {
  updateFields.push(`title = $$${paramCount}`);
  values.push(title);
  paramCount++;
}

if (description !== undefined) {
  updateFields.push(`description = $$${paramCount}`);
  values.push(description);
  paramCount++;
}

```

```
}

if (location !== undefined) {
  updateFields.push(`location = $$\{paramCount\}`);
  values.push(location);
  paramCount++;
}

if (startTime !== undefined) {
  updateFields.push(`start_time = $$\{paramCount\}`);
  values.push(startTime);
  paramCount++;
}

if (endTime !== undefined) {
  updateFields.push(`end_time = $$\{paramCount\}`);
  values.push(endTime);
  paramCount++;
}

if (isAllDay !== undefined) {
  updateFields.push(`is_all_day = $$\{paramCount\}`);
  values.push(isAllDay);
  paramCount++;
}

if (recurrenceRule !== undefined) {
  updateFields.push(`recurrence_rule = $$\{paramCount\}`);
  values.push(recurrenceRule);
  paramCount++;
}

if (color !== undefined) {
  updateFields.push(`color = $$\{paramCount\}`);
  values.push(color);
  paramCount++;
}

if (visibility !== undefined) {
  updateFields.push(`visibility = $$\{paramCount\}`);
  values.push(visibility);
  paramCount++;
}
```

```

}

if (status !== undefined) {
  updateFields.push(`status = $$\{paramCount\}`);
  values.push(status);
  paramCount++;
}

// Add version increment and updated_at
updateFields.push(`version = version + 1, updated_at = NOW()`);

// Return if no fields to update
if (updateFields.length <= 1) {
  return res.status(400).json({ error: 'No fields to update' });
}

// Add ID to values
values.push(id);

// Update event
const result = await pool.query(
  `UPDATE events SET ${updateFields.join(', ')} WHERE id = $$\{paramCount\}
RETURNING *`,
  values
);

// Get updated calendar info
const calendarResult = await pool.query(
  'SELECT name, color FROM calendars WHERE id = $1',
  [result.rows[0].calendar_id]
);

const updatedEvent = result.rows[0];

if (calendarResult.rows.length > 0) {
  updatedEvent.calendar_name = calendarResult.rows[0].name;
  updatedEvent.calendar_color = calendarResult.rows[0].color;
}

res.json(updatedEvent);
} catch (error) {
  console.error('Update event error:', error);
}

```

```

    res.status(500).json({ error: 'Internal server error' });
}
};

/** 
 * Update a specific instance of a recurring event
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const updateEventInstance = async (req, res) => {
try {
    const userId = req.user.userId;
    const { id, date } = req.params;
    const {
        title, description, location, startTime, endTime, color, status
    } = req.body;

    // Validate date format
    const instanceDate = new Date(date);
    if (isNaN(instanceDate.getTime())) {
        return res.status(400).json({ error: 'Invalid date format' });
    }

    // Format date to YYYY-MM-DD
    const formattedDate = instanceDate.toISOString().split('T')[0];

    // Check event access
    const accessCheck = await pool.query(
        `SELECT e.*,
            c.owner_id as calendar_owner_id,
            CASE WHEN c.owner_id = $1 THEN 'owner'
                WHEN cs.permission = 'edit' THEN 'edit'
                WHEN e.created_by = $1 THEN 'creator'
                ELSE 'view'
            END as access_role
        FROM events e
        JOIN calendars c ON e.calendar_id = c.id
        LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
        WHERE e.id = $2`,
        [userId, id]
    );
}

```

```

if (accessCheck.rows.length === 0) {
  return res.status(404).json({ error: 'Event not found' });
}

const event = accessCheck.rows[0];

if (!['owner', 'edit', 'creator'].includes(event.access_role)) {
  return res.status(403).json({ error: 'Permission denied' });
}

if (!event.recurrence_rule) {
  return res.status(400).json({ error: 'Event is not recurring' });
}

// Begin transaction
const client = await pool.connect();

try {
  await client.query('BEGIN');

  // Check if instance already exists
  const instanceCheck = await client.query(
    'SELECT * FROM event_instances WHERE event_id = $1 AND instance_date = $2',
    [id, formattedDate]
  );

  let updateFields = [];
  let values = [];
  let paramCount = 1;

  if (startTime !== undefined) {
    updateFields.push(`start_time = $$${paramCount}`);
    values.push(startTime);
    paramCount++;
  } else {
    // Use the calculated start time based on the recurrence pattern
    const baseStart = new Date(event.start_time);
    const occurrenceStart = new Date(formattedDate);
    occurrenceStart.setHours(
      baseStart.getHours(),

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        baseStart.getMinutes(),
        baseStart.getSeconds(),
        baseStart.getMilliseconds()
    );

    updateFields.push(`start_time = $$\{paramCount\}`);
    values.push(occurrenceStart.toISOString());
    paramCount++;
}

if (endTime !== undefined) {
    updateFields.push(`end_time = $$\{paramCount\}`);
    values.push(endTime);
    paramCount++;
} else {
    // Calculate end time based on duration of original event
    const baseStart = new Date(event.start_time);
    const baseEnd = new Date(event.end_time);
    const duration = baseEnd.getTime() - baseStart.getTime();
}

```

 continue

Continuing with the Event Controller:

```

// Calculate end time based on duration of original event
const baseStart = new Date(event.start_time);
const baseEnd = new Date(event.end_time);
const duration = baseEnd.getTime() - baseStart.getTime();

const occurrenceStart = new Date(values[0]); // From startTime
const occurrenceEnd = new Date(occurrenceStart.getTime() + duration);

updateFields.push(`end_time = $$\{paramCount\}`);
values.push(occurrenceEnd.toISOString());
paramCount++;

}

// Prepare exception data
const exceptionData = {};

```

```

if (title !== undefined) {
    exceptionData.title = title;
}

if (description !== undefined) {
    exceptionData.description = description;
}

if (location !== undefined) {
    exceptionData.location = location;
}

if (color !== undefined) {
    exceptionData.color = color;
}

if (status !== undefined) {
    updateFields.push(`status = $$\{paramCount\}`);
    values.push(status);
    paramCount++;
}

updateFields.push(`is_exception = true`);

if (Object.keys(exceptionData).length > 0) {
    updateFields.push(`exception_data = $$\{paramCount\}`);
    values.push(JSON.stringify(exceptionData));
    paramCount++;
}

let result;

if (instanceCheck.rows.length > 0) {
    // Update existing instance
    values.push(id);
    values.push(formattedDate);

    result = await client.query(
        `UPDATE event_instances SET
        ${updateFields.join(', ')},
        updated_at = NOW()
    `);
}

return result;
}

```

```

        WHERE event_id = $$paramCount AND instance_date = $$paramCount +
1}
        RETURNING *`,
        values
);
} else {
    // Create new instance
    const instanceId = uuidv4();

    updateFields.push(`id = $$paramCount`);
    values.push(instanceId);
    paramCount++;

    updateFields.push(`event_id = $$paramCount`);
    values.push(id);
    paramCount++;

    updateFields.push(`instance_date = $$paramCount`);
    values.push(formattedDate);
    paramCount++;

    updateFields.push(`created_at = NOW()`);

    result = await client.query(
        `INSERT INTO event_instances (${updateFields.map((_, i) => `$$i +
1`).join(', ')})
            VALUES (${Array.from({ length: paramCount - 1 }, (_, i) => `$$i +
1`).join(', ')})
                RETURNING *`,
        values
    );
}

// Update exception dates in the original event if needed
let exceptionDates = [];
if (event.exception_dates) {
    exceptionDates = Array.isArray(event.exception_dates)
        ? event.exception_dates
        : JSON.parse(event.exception_dates);
}

if (!exceptionDates.includes(formattedDate)) {

```

```

exceptionDates.push(formattedDate);

await client.query(
  'UPDATE events SET exception_dates = $1, updated_at = NOW() WHERE id = $2',
  [JSON.stringify(exceptionDates), id]
);
}

await client.query('COMMIT');

// Construct response combining event and instance data
const instanceData = result.rows[0];

const response = {
  id: `${id}_${formattedDate}`,
  original_event_id: id,
  calendar_id: event.calendar_id,
  title: exceptionData.title || event.title,
  description: exceptionData.description || event.description,
  location: exceptionData.location || event.location,
  start_time: instanceData.start_time,
  end_time: instanceData.end_time,
  is_all_day: event.is_all_day,
  color: exceptionData.color || event.color,
  visibility: event.visibility,
  status: instanceData.status || event.status,
  created_by: event.created_by,
  is_recurring_instance: true,
  is_exception: true,
  instance_date: formattedDate,
  exception_data: instanceData.exception_data
};

res.json(response);
} catch (error) {
  await client.query('ROLLBACK');
  throw error;
} finally {
  client.release();
}
} catch (error) {

```

```

        console.error('Update event instance error:', error);
        res.status(500).json({ error: 'Internal server error' });
    }
};

/***
 * Delete an event
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const deleteEvent = async (req, res) => {
    try {
        const userId = req.user.userId;
        const { id } = req.params;
        const { recurring } = req.query; // all, future, this

        // Check if it's a recurring instance
        const isRecurringInstance = id.includes('_');

        let eventId = id;
        let instanceDate = null;

        if (isRecurringInstance) {
            [eventId, instanceDate] = id.split('_');
        }

        // Check event access
        const accessCheck = await pool.query(
            `SELECT e.*,
                    c.owner_id as calendar_owner_id,
                    CASE WHEN c.owner_id = $1 THEN 'owner'
                          WHEN cs.permission = 'edit' THEN 'edit'
                          WHEN e.created_by = $1 THEN 'creator'
                          ELSE 'view'
                    END as access_role
            FROM events e
            JOIN calendars c ON e.calendar_id = c.id
            LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
            WHERE e.id = $2`,
            [userId, eventId]
        );
    }
};

```

```

if (accessCheck.rows.length === 0) {
  return res.status(404).json({ error: 'Event not found' });
}

const event = accessCheck.rows[0];

if (!['owner', 'edit', 'creator'].includes(event.access_role)) {
  return res.status(403).json({ error: 'Permission denied' });
}

// Begin transaction
const client = await pool.connect();

try {
  await client.query('BEGIN');

  // Handle recurring event deletions
  if (isRecurringInstance && instanceDate) {
    // Add an exception date for this instance
    let exceptionDates = [];

    if (event.exception_dates) {
      exceptionDates = Array.isArray(event.exception_dates)
        ? event.exception_dates
        : JSON.parse(event.exception_dates);
    }

    if (!exceptionDates.includes(instanceDate)) {
      exceptionDates.push(instanceDate);
    }
  }

  await client.query(
    'UPDATE events SET exception_dates = $1, updated_at = NOW() WHERE id = $2',
    [JSON.stringify(exceptionDates), eventId]
  );

  // Delete any instance record if it exists
  await client.query(
    'DELETE FROM event_instances WHERE event_id = $1 AND instance_date = $2',
    [eventId, instanceDate]
  );
}

```

```

        [eventId, instanceDate]
    );
} else if (event.recurrence_rule && recurring) {
    // Handle recurring event deletion options
    if (recurring === 'this') {
        // Add today as exception date
        let exceptionDates = [];

        if (event.exception_dates) {
            exceptionDates = Array.isArray(event.exception_dates)
                ? event.exception_dates
                : JSON.parse(event.exception_dates);
        }

        // Add today's date (or event date) as exception
        const today = new Date().toISOString().split('T')[0];
        if (!exceptionDates.includes(today)) {
            exceptionDates.push(today);
        }
    }

    await client.query(
        'UPDATE events SET exception_dates = $1, updated_at = NOW() WHERE id
= $2',
        [JSON.stringify(exceptionDates), eventId]
    );
} else if (recurring === 'future') {
    // Modify the recurrence rule to end yesterday
    try {
        const rrule = require('rrule').rrulestr(event.recurrence_rule);
        const options = rrule.options;

        // Set until to yesterday
        const yesterday = new Date();
        yesterday.setDate(yesterday.getDate() - 1);
        options.until = yesterday;

        const newRule = new (require('rrule').RRule)(options).toString();

        await client.query(
            'UPDATE events SET recurrence_rule = $1, updated_at = NOW() WHERE
id = $2',
            [newRule, eventId]
        );
    } catch (err) {
        console.error(`Error modifying recurrence rule: ${err.message}`);
    }
}

```

```

    );
} catch (error) {
    console.error(`Error modifying recurrence rule for ${eventId}:`,
error);
    await client.query('ROLLBACK');
    return res.status(500).json({ error: 'Error modifying recurrence
rule' });
}
} else {
    // Delete the entire recurring event series
    await client.query('DELETE FROM events WHERE id = $1', [eventId]);
}
} else {
    // Delete normal event
    await client.query('DELETE FROM events WHERE id = $1', [eventId]);
}

await client.query('COMMIT');

res.json({ message: 'Event deleted successfully' });
} catch (error) {
    await client.query('ROLLBACK');
    throw error;
} finally {
    client.release();
}
} catch (error) {
    console.error('Delete event error:', error);
    res.status(500).json({ error: 'Internal server error' });
}
};

module.exports = {
    getEvents,
    createEvent,
    getEvent,
    updateEvent,
    updateEventInstance,
    deleteEvent
};

```

5. Reminder Controller (`controllers/reminder.js`)

```
const { v4: uuidv4 } = require('uuid');
const pool = require('../db/pool');

/**
 * Get reminders for an event
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const getEventReminders = async (req, res) => {
  try {
    const userId = req.user.userId;
    const { eventId } = req.params;

    // Check event access
    const accessCheck = await pool.query(
      `SELECT e.*,
      CASE WHEN c.owner_id = $1 THEN 'owner'
            WHEN cs.permission = 'edit' THEN 'edit'
            WHEN cs.permission = 'view' THEN 'view'
            WHEN e.created_by = $1 THEN 'creator'
            ELSE 'none'
      END as access_role
      FROM events e
      JOIN calendars c ON e.calendar_id = c.id
      LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
      WHERE e.id = $2`,
      [userId, eventId]
    );

    if (accessCheck.rows.length === 0) {
      return res.status(404).json({ error: 'Event not found' });
    }

    if (accessCheck.rows[0].access_role === 'none') {
      return res.status(403).json({ error: 'Access denied' });
    }

    // Get reminders for user
  }
};
```

```

    const remindersResult = await pool.query(
      'SELECT * FROM reminders WHERE event_id = $1 AND user_id = $2 ORDER BY
minutes_before ASC',
      [eventId, userId]
    );

    res.json(remindersResult.rows);
  } catch (error) {
    console.error('Get reminders error:', error);
    res.status(500).json({ error: 'Internal server error' });
  }
};

/***
 * Create a reminder for an event
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const createReminder = async (req, res) => {
  try {
    const userId = req.user.userId;
    const { eventId } = req.params;
    const { minutesBefore, method } = req.body;

    // Validate input
    if (!minutesBefore || !method) {
      return res.status(400).json({ error: 'Minutes before and method are
required' });
    }

    if (!['notification', 'email'].includes(method)) {
      return res.status(400).json({ error: 'Method must be notification or
email' });
    }

    // Check event access
    const accessCheck = await pool.query(
      `SELECT e.*,
      CASE WHEN c.owner_id = $1 THEN 'owner'
            WHEN cs.permission = 'edit' THEN 'edit'
            WHEN cs.permission = 'view' THEN 'view'
      END AS access
      FROM events e
      LEFT JOIN event_permissions cp ON e.event_id = cp.event_id
      LEFT JOIN users c ON e.user_id = c.user_id
      LEFT JOIN user_permissions cs ON c.user_id = cs.user_id
      WHERE e.event_id = $1
      ORDER BY e.event_id DESC
      LIMIT 1
    `,
      [eventId]
    );
  }
};

```

```

        WHEN e.created_by = $1 THEN 'creator'
        ELSE 'none'
    END as access_role
FROM events e
JOIN calendars c ON e.calendar_id = c.id
LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
WHERE e.id = $2,
[userId, eventId]
);

if (accessCheck.rows.length === 0) {
    return res.status(404).json({ error: 'Event not found' });
}

if (accessCheck.rows[0].access_role === 'none') {
    return res.status(403).json({ error: 'Access denied' });
}

// Check if reminder already exists
const reminderCheck = await pool.query(
    'SELECT * FROM reminders WHERE event_id = $1 AND user_id = $2 AND
minutes_before = $3 AND method = $4',
    [eventId, userId, minutesBefore, method]
);

if (reminderCheck.rows.length > 0) {
    return res.status(409).json({ error: 'Reminder already exists' });
}

// Create reminder
const reminderId = uuidv4();
const result = await pool.query(
`INSERT INTO reminders (
    id, event_id, user_id, minutes_before, method, created_at
) VALUES ($1, $2, $3, $4, $5, NOW())
RETURNING *`,
[reminderId, eventId, userId, minutesBefore, method]
);

res.status(201).json(result.rows[0]);
} catch (error) {
    console.error('Create reminder error:', error);
}

```

```

        res.status(500).json({ error: 'Internal server error' });
    }
};

/** 
 * Delete a reminder
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const deleteReminder = async (req, res) => {
    try {
        const userId = req.user.userId;
        const { id } = req.params;

        // Check reminder ownership
        const reminderCheck = await pool.query(
            'SELECT * FROM reminders WHERE id = $1 AND user_id = $2',
            [id, userId]
        );

        if (reminderCheck.rows.length === 0) {
            return res.status(404).json({ error: 'Reminder not found' });
        }

        // Delete reminder
        await pool.query('DELETE FROM reminders WHERE id = $1', [id]);

        res.json({ message: 'Reminder deleted successfully' });
    } catch (error) {
        console.error('Delete reminder error:', error);
        res.status(500).json({ error: 'Internal server error' });
    }
};

module.exports = {
    getEventReminders,
    createReminder,
    deleteReminder
};

```

6. Attendee Controller (`controllers/attendee.js`)

```
const { v4: uuidv4 } = require('uuid');
const pool = require('../db/pool');

/**
 * Get attendees for an event
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const getEventAttendees = async (req, res) => {
  try {
    const userId = req.user.userId;
    const { eventId } = req.params;

    // Check event access
    const accessCheck = await pool.query(
      `SELECT e.*,
      CASE WHEN c.owner_id = $1 THEN 'owner'
            WHEN cs.permission = 'edit' THEN 'edit'
            WHEN cs.permission = 'view' THEN 'view'
            WHEN e.created_by = $1 THEN 'creator'
            ELSE 'none'
      END as access_role
      FROM events e
      JOIN calendars c ON e.calendar_id = c.id
      LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
      WHERE e.id = $2`,
      [userId, eventId]
    );

    if (accessCheck.rows.length === 0) {
      return res.status(404).json({ error: 'Event not found' });
    }

    if (accessCheck.rows[0].access_role === 'none') {
      return res.status(403).json({ error: 'Access denied' });
    }

    // Get attendees
```

```

    const attendeesResult = await pool.query(
      'SELECT * FROM event_attendees WHERE event_id = $1 ORDER BY created_at
ASC',
      [eventId]
    );

    res.json(attendeesResult.rows);
  } catch (error) {
    console.error('Get attendees error:', error);
    res.status(500).json({ error: 'Internal server error' });
  }
};

/***
 * Add attendee to an event
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const addAttendee = async (req, res) => {
  try {
    const userId = req.user.userId;
    const { eventId } = req.params;
    const { email, name } = req.body;

    // Validate input
    if (!email) {
      return res.status(400).json({ error: 'Email is required' });
    }

    // Check event access
    const accessCheck = await pool.query(
      `SELECT e.*,
        CASE WHEN c.owner_id = $1 THEN 'owner'
          WHEN cs.permission = 'edit' THEN 'edit'
          WHEN e.created_by = $1 THEN 'creator'
          ELSE 'view'
        END as access_role
      FROM events e
      JOIN calendars c ON e.calendar_id = c.id
      LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
      WHERE e.id = $2`,
      [userId, eventId]
    );
  }
};

```

```

    [userId, eventId]
);

if (accessCheck.rows.length === 0) {
  return res.status(404).json({ error: 'Event not found' });
}

if (!['owner', 'edit', 'creator'].includes(accessCheck.rows[0].access_role))
{
  return res.status(403).json({ error: 'Permission denied' });
}

// Check if attendee already exists
const attendeeCheck = await pool.query(
  'SELECT * FROM event_attendees WHERE event_id = $1 AND email = $2',
  [eventId, email]
);

if (attendeeCheck.rows.length > 0) {
  return res.status(409).json({ error: 'Attendee already exists' });
}

// Check if user exists
const userCheck = await pool.query('SELECT id FROM users WHERE email = $1',
[email]);
const attendeeUserId = userCheck.rows.length > 0 ? userCheck.rows[0].id : null;

// Create attendee
const attendeeId = uuidv4();
const result = await pool.query(
  `INSERT INTO event_attendees (
    id, event_id, user_id, email, name, response_status, created_at
  ) VALUES ($1, $2, $3, $4, $5, $6, NOW())
  RETURNING *`,
  [attendeeId, eventId, attendeeUserId, email, name || email.split('@')[0], 'pending']
);

// TODO: Send invitation email
console.log(`Event invitation would be sent to ${email}`);

```

```

        res.status(201).json(result.rows[0]);
    } catch (error) {
        console.error('Add attendee error:', error);
        res.status(500).json({ error: 'Internal server error' });
    }
};

/***
 * Update attendee response
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const updateAttendeeResponse = async (req, res) => {
    try {
        const userId = req.user.userId;
        const { eventId, attendeeId } = req.params;
        const { responseStatus } = req.body;

        // Validate input
        if (!responseStatus || !['accepted', 'declined',
'tentative'].includes(responseStatus)) {
            return res.status(400).json({ error: 'Valid response status required
(accepted, declined, tentative)' });
        }

        // Check if user is the attendee
        const attendeeCheck = await pool.query(
            'SELECT * FROM event_attendees WHERE id = $1 AND event_id = $2',
            [attendeeId, eventId]
        );

        if (attendeeCheck.rows.length === 0) {
            return res.status(404).json({ error: 'Attendee not found' });
        }

        const attendee = attendeeCheck.rows[0];

        // Check if user has permission to update the response
        if (attendee.user_id !== userId && attendee.email !== req.user.email) {
            // Check if user is event creator
            const eventCheck = await pool.query(

```

```

    'SELECT created_by FROM events WHERE id = $1',
    [eventId]
);

if (eventCheck.rows.length === 0) {
    return res.status(404).json({ error: 'Event not found' });
}

if (eventCheck.rows[0].created_by !== userId) {
    return res.status(403).json({ error: 'Permission denied' });
}

// Update response
const result = await pool.query(
`UPDATE event_attendees
SET response_status = $1, updated_at = NOW()
WHERE id = $2 AND event_id = $3
RETURNING *`,
[responseStatus, attendeeId, eventId]
);

res.json(result.rows[0]);
} catch (error) {
    console.error('Update attendee response error:', error);
    res.status(500).json({ error: 'Internal server error' });
}
};

/***
 * Remove attendee from event
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const removeAttendee = async (req, res) => {
try {
    const userId = req.user.userId;
    const { eventId, attendeeId } = req.params;

    // Check event access
    const accessCheck = await pool.query(

```

```

`SELECT e.*,
    CASE WHEN c.owner_id = $1 THEN 'owner'
        WHEN cs.permission = 'edit' THEN 'edit'
        WHEN e.created_by = $1 THEN 'creator'
        ELSE 'view'
    END as access_role
FROM events e
JOIN calendars c ON e.calendar_id = c.id
LEFT JOIN calendar_shares cs ON c.id = cs.calendar_id AND cs.user_id = $1
WHERE e.id = $2`,
[userId, eventId]
);

if (accessCheck.rows.length === 0) {
    return res.status(404).json({ error: 'Event not found' });
}

// Get attendee
const attendeeCheck = await pool.query(
    'SELECT * FROM event_attendees WHERE id = $1 AND event_id = $2',
    [attendeeId, eventId]
);

if (attendeeCheck.rows.length === 0) {
    return res.status(404).json({ error: 'Attendee not found' });
}

const attendee = attendeeCheck.rows[0];

// Check if user has permission to remove the attendee
if (
    !['owner', 'edit', 'creator'].includes(accessCheck.rows[0].access_role) &&
    attendee.user_id !== userId &&
    attendee.email !== req.user.email
) {
    return res.status(403).json({ error: 'Permission denied' });
}

// Remove attendee
await pool.query(
    'DELETE FROM event_attendees WHERE id = $1 AND event_id = $2',
    [attendeeId, eventId]
);

```

```

    );

    res.json({ message: 'Attendee removed successfully' });
} catch (error) {
    console.error('Remove attendee error:', error);
    res.status(500).json({ error: 'Internal server error' });
}
};

module.exports = {
    getEventAttendees,
    addAttendee,
    updateAttendeeResponse,
    removeAttendee
};

```

7. Health Controller (`controllers/health.js`)

```

const pool = require('../db/pool');

/**
 * Check service health
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const checkHealth = async (req, res) => {
    try {
        // Check database connection
        await pool.query('SELECT 1');

        res.json({
            status: 'healthy',
            timestamp: new Date().toISOString(),
            service: 'event-service'
        });
    } catch (error) {
        console.error('Health check error:', error);
        res.status(500).json({
            status: 'unhealthy',
        });
    }
};

```

```

        timestamp: new Date().toISOString(),
        service: 'event-service',
        error: error.message
    });
}

};

module.exports = {
    checkHealth
};

```

8. Event Routes (`routes/event.js`)

```

const express = require('express');
const router = express.Router();
const eventController = require('../controllers/event');
const reminderController = require('../controllers/reminder');
const attendeeController = require('../controllers/attendee');
const { authenticate } = require('../middleware/auth');

// Apply authentication middleware to all routes
router.use(authenticate);

// Event routes
router.get('/', eventController.getEvents);
router.post('/', eventController.createEvent);
router.get('/:id', eventController.getEvent);
router.patch('/:id', eventController.updateEvent);
router.patch('/:_id/instance/:date', eventController.updateEventInstance);
router.delete('/:id', eventController.deleteEvent);

// Reminder routes
router.get('/:eventId/reminders', reminderController.getEventReminders);
router.post('/:eventId/reminders', reminderController.createReminder);
router.delete('/reminders/:id', reminderController.deleteReminder);

// Attendee routes
router.get('/:eventId/attendees', attendeeController.getEventAttendees);
router.post('/:eventId/attendees', attendeeController.addAttendee);
router.patch('/:eventId/attendees/:attendeeId',

```

```
attendeeController.updateAttendeeResponse);
router.delete('/:eventId/attendees/:attendeeId',
attendeeController.removeAttendee);

module.exports = router;
```

9. Health Routes (`routes/health.js`)

```
const express = require('express');
const router = express.Router();
const healthController = require('../controllers/health');

router.get('/', healthController.checkHealth);

module.exports = router;
```

10. Main Application (`index.js`)

```
const express = require('express');
const cors = require('cors');
const helmet = require('helmet');
require('dotenv').config();

const eventRoutes = require('./routes/event');
const healthRoutes = require('./routes/health');

const app = express();

// Middleware
app.use(helmet());
app.use(cors());
app.use(express.json());

// Log requests
app.use((req, res, next) => {
  console.log(` ${new Date().toISOString()} - ${req.method} ${req.path}`);
  next();
});
```

```

// Routes
app.use('/events', eventRoutes);
app.use('/health', healthRoutes);

// Error handling middleware
app.use((err, req, res, next) => {
  console.error(err.stack);
  res.status(500).json({ error: 'Something went wrong!' });
});

// Start server
const PORT = process.env.PORT || 3004;
app.listen(PORT, () => {
  console.log(`Event service running on port ${PORT}`);
});

```

11. Package.json

```
{
  "name": "event-service",
  "version": "1.0.0",
  "description": "Event management service for Calendar App",
  "main": "src/index.js",
  "scripts": {
    "start": "node src/index.js",
    "dev": "nodemon src/index.js",
    "test": "echo \\\"Error: no test specified\\\" && exit 1"
  },
  "dependencies": {
    "cors": "^2.8.5",
    "dotenv": "^16.0.3",
    "express": "^4.18.2",
    "helmet": "^6.0.1",
    "jsonwebtoken": "^9.0.0",
    "pg": "^8.10.0",
    "rrule": "^2.7.2",
    "uuid": "^9.0.0"
  },
  "devDependencies": {

```



```
    "nodemon": "^2.0.22"  
  }  
}
```

12. .env File

```
PORT=3004  
DATABASE_URL=postgresql://calendar_user:calendar_password@localhost:5432/calendar_c  
JWT_SECRET=your_jwt_secret_for_local_dev  
NODE_ENV=development
```

This event service implementation provides a comprehensive solution for managing calendar events, including recurring events, attendees, and reminders. The code is structured with proper separation of concerns, using controllers for business logic, middleware for authentication, and routes for API endpoints.

Key features included:

1. CRUD operations for events
2. Recurring event management with recurrence rules
3. Exception handling for recurring events
4. Reminder creation and management
5. Attendee management and invitations
- 6.

 Lets work on the implementation of user-service

User Service Implementation

Let's create the user service for the Calendar App. This service will handle user profile management, preferences, and user-related operations.

Project Structure

```
user-service/
├── src/
│   ├── controllers/
│   │   ├── user.js
│   │   ├── preference.js
│   │   └── health.js
│   ├── middleware/
│   │   └── auth.js
│   ├── routes/
│   │   ├── user.js
│   │   └── health.js
│   ├── db/
│   │   └── pool.js
│   └── index.js
└── package.json
└── .env
```

Let's implement each file:

1. Database Connection (db/pool.js)

```
const { Pool } = require('pg');

// Create a connection pool
const pool = new Pool({
  connectionString: process.env.DATABASE_URL,
  ssl: process.env.NODE_ENV === 'production' ? { rejectUnauthorized: false } :
false
});

// Test the connection
pool.on('connect', () => {
  console.log('Connected to the database');
});

pool.on('error', (err) => {
  console.error('Unexpected error on idle client', err);
  process.exit(-1);
});
```

```
module.exports = pool;
```

2. Authentication Middleware (middleware/auth.js)

```
const jwt = require('jsonwebtoken');

/**
 * Middleware to authenticate JWT token
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 * @param {Function} next - Express next function
 */
const authenticate = (req, res, next) => {
  const authHeader = req.headers.authorization;

  if (!authHeader || !authHeader.startsWith('Bearer ')) {
    return res.status(401).json({ error: 'Authentication required' });
  }

  const token = authHeader.split(' ')[1];

  try {
    const decoded = jwt.verify(token, process.env.JWT_SECRET);
    req.user = decoded;
    next();
  } catch (error) {
    if (error instanceof jwt.TokenExpiredError) {
      return res.status(401).json({ error: 'Token expired' });
    }
    if (error instanceof jwt.JsonWebTokenError) {
      return res.status(401).json({ error: 'Invalid token' });
    }
    console.error('Authentication error:', error);
    return res.status(500).json({ error: 'Internal server error' });
  }
};

module.exports = {
```

```
    authenticate  
};
```

3. User Controller (controllers/user.js)

```
const pool = require('../db/pool');  
const bcrypt = require('bcrypt');  
  
/**  
 * Get current user profile  
 *  
 * @param {Object} req - Express request object  
 * @param {Object} res - Express response object  
 */  
const getCurrentUser = async (req, res) => {  
  try {  
    const userId = req.user.userId;  
  
    // Get user profile  
    const userResult = await pool.query(  
      'SELECT id, email, name, profile_picture, timezone, created_at, updated_at  
      FROM users WHERE id = $1',  
      [userId]  
    );  
  
    if (userResult.rows.length === 0) {  
      return res.status(404).json({ error: 'User not found' });  
    }  
  
    res.json(userResult.rows[0]);  
  } catch (error) {  
    console.error('Get current user error:', error);  
    res.status(500).json({ error: 'Internal server error' });  
  }  
};  
  
/**  
 * Get user by ID  
 *  
 * @param {Object} req - Express request object
```

```

* @param {Object} res - Express response object
*/
const getUserById = async (req, res) => {
  try {
    const { id } = req.params;

    // Get user profile (limited info for other users)
    const userResult = await pool.query(
      'SELECT id, name, profile_picture FROM users WHERE id = $1',
      [id]
    );

    if (userResult.rows.length === 0) {
      return res.status(404).json({ error: 'User not found' });
    }

    res.json(userResult.rows[0]);
  } catch (error) {
    console.error('Get user by ID error:', error);
    res.status(500).json({ error: 'Internal server error' });
  }
};

/**
 * Update user profile
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const updateProfile = async (req, res) => {
  try {
    const userId = req.user.userId;
    const { name, timezone, profile_picture } = req.body;

    // Build update query dynamically based on provided fields
    let updateFields = [];
    let values = [];
    let paramCount = 1;

    if (name !== undefined) {
      updateFields.push(`name = ${paramCount}`);
      values.push(name);
      paramCount++;
    }

    if (timezone) {
      updateFields.push(`timezone = ${paramCount}`);
      values.push(timezone);
      paramCount++;
    }

    if (profile_picture) {
      updateFields.push(`profile_picture = ${paramCount}`);
      values.push(profile_picture);
      paramCount++;
    }

    const updateQuery = `UPDATE users SET ${updateFields.join(',')} WHERE id = ${userId}`;
    const result = await pool.query(updateQuery, values);

    if (result.rowCount === 1) {
      res.json({ message: 'User profile updated successfully' });
    } else {
      res.status(500).json({ error: 'Internal server error' });
    }
  } catch (error) {
    console.error('Update user profile error:', error);
    res.status(500).json({ error: 'Internal server error' });
  }
};

```

```

paramCount++;
}

if (timezone !== undefined) {
  updateFields.push(`timezone = $$paramCount`);
  values.push(timezone);
  paramCount++;
}

if (profile_picture !== undefined) {
  updateFields.push(`profile_picture = $$paramCount`);
  values.push(profile_picture);
  paramCount++;
}

// Add update timestamp
updateFields.push(`updated_at = NOW()`);

// Return if no fields to update
if (updateFields.length <= 1) {
  return res.status(400).json({ error: 'No fields to update' });
}

// Add the user ID to the values array
values.push(userId);

// Construct the query
const queryText = `
  UPDATE users
  SET ${updateFields.join(', ')}
  WHERE id = $$paramCount
  RETURNING id, email, name, profile_picture, timezone, created_at,
updated_at
`;

const result = await pool.query(queryText, values);

if (result.rows.length === 0) {
  return res.status(404).json({ error: 'User not found' });
}

res.json(result.rows[0]);

```

```

} catch (error) {
  console.error('Update profile error:', error);
  res.status(500).json({ error: 'Internal server error' });
}

};

/***
 * Change password
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const changePassword = async (req, res) => {
  try {
    const userId = req.user.userId;
    const { currentPassword, newPassword } = req.body;

    if (!currentPassword || !newPassword) {
      return res.status(400).json({ error: 'Current password and new password are required' });
    }

    if (newPassword.length < 8) {
      return res.status(400).json({ error: 'New password must be at least 8 characters' });
    }

    // Get current user with password hash
    const userResult = await pool.query(
      'SELECT password_hash FROM users WHERE id = $1',
      [userId]
    );

    if (userResult.rows.length === 0) {
      return res.status(404).json({ error: 'User not found' });
    }

    const user = userResult.rows[0];

    // Verify current password
    const validPassword = await bcrypt.compare(currentPassword, user.password_hash);
  }
}

```

```

    if (!validPassword) {
      return res.status(401).json({ error: 'Current password is incorrect' });
    }

    // Hash new password
    const salt = await bcrypt.genSalt(10);
    const hashedPassword = await bcrypt.hash(newPassword, salt);

    // Update password
    await pool.query(
      'UPDATE users SET password_hash = $1, updated_at = NOW() WHERE id = $2',
      [hashedPassword, userId]
    );

    // Invalidate all refresh tokens (for security)
    await pool.query(
      'DELETE FROM refresh_tokens WHERE user_id = $1',
      [userId]
    );

    res.json({ message: 'Password changed successfully' });
  } catch (error) {
    console.error('Change password error:', error);
    res.status(500).json({ error: 'Internal server error' });
  }
};

/***
 * Get users by email for search/autocomplete
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const searchUsers = async (req, res) => {
  try {
    const { query } = req.query;

    if (!query || query.length < 3) {
      return res.status(400).json({ error: 'Search query must be at least 3 characters' });
    }
  }

```

```

// Search users by email or name
const searchResult = await pool.query(
  `SELECT id, email, name, profile_picture
  FROM users
  WHERE email ILIKE $1 OR name ILIKE $1
  LIMIT 10`,
  [`${query}`]
);

res.json(searchResult.rows);
} catch (error) {
  console.error('Search users error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
};

module.exports = {
  getCurrentUser,
  getUserId,
  updateProfile,
  changePassword,
  searchUsers
};

```

4. Preference Controller (controllers/preference.js)

```

const { v4: uuidv4 } = require('uuid');
const pool = require('../db/pool');

/**
 * Get user preferences
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const getUserPreferences = async (req, res) => {
  try {
    const userId = req.user.userId;

    // Get user preferences

```

```

const prefsResult = await pool.query(
  'SELECT * FROM user_preferences WHERE user_id = $1',
  [userId]
);

// If no preferences found, return default values
if (prefsResult.rows.length === 0) {
  const defaultPrefs = {
    default_view: 'month',
    working_hours: {
      start: '09:00',
      end: '17:00',
      days: [1, 2, 3, 4, 5]
    },
    notification_settings: {
      event_reminders: true,
      share_notifications: true,
      email_notifications: true
    }
  };
  return res.json(defaultPrefs);
}

res.json(prefsResult.rows[0]);
} catch (error) {
  console.error('Get preferences error:', error);
  res.status(500).json({ error: 'Internal server error' });
}
};

/**
 * Update user preferences
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const updatePreferences = async (req, res) => {
  try {
    const userId = req.user.userId;
    const { default_calendar_id, default_view, working_hours,
    notification_settings } = req.body;
  }

```

```

// Check if preferences exist
const checkResult = await pool.query(
  'SELECT id FROM user_preferences WHERE user_id = $1',
  [userId]
);

let result;

if (checkResult.rows.length === 0) {
  // Create new preferences
  const prefsId = uuidv4();

  result = await pool.query(
    `INSERT INTO user_preferences (
      id, user_id, default_calendar_id, default_view, working_hours,
      notification_settings, created_at
    ) VALUES ($1, $2, $3, $4, $5, $6, NOW())
    RETURNING *`,
    [
      prefsId,
      userId,
      default_calendar_id,
      default_view || 'month',
      working_hours ? JSON.stringify(working_hours) : JSON.stringify({
        start: '09:00',
        end: '17:00',
        days: [1, 2, 3, 4, 5]
      }),
      notification_settings ? JSON.stringify(notification_settings) :
      JSON.stringify({
        event_reminders: true,
        share_notifications: true,
        email_notifications: true
      })
    ]
  );
} else {
  // Update existing preferences
  const updates = [];
  const values = [];
  let paramCount = 1;

```

```

if (default_calendar_id !== undefined) {
  updates.push(`default_calendar_id = $$\{paramCount\}`);
  values.push(default_calendar_id);
  paramCount++;
}

if (default_view !== undefined) {
  updates.push(`default_view = $$\{paramCount\}`);
  values.push(default_view);
  paramCount++;
}

if (working_hours !== undefined) {
  updates.push(`working_hours = $$\{paramCount\}`);
  values.push(JSON.stringify(working_hours));
  paramCount++;
}

if (notification_settings !== undefined) {
  updates.push(`notification_settings = $$\{paramCount\}`);
  values.push(JSON.stringify(notification_settings));
  paramCount++;
}

updates.push(`updated_at = NOW()`);

if (updates.length <= 1) {
  return res.status(400).json({ error: 'No fields to update' });
}

values.push(userId);

result = await pool.query(
  `UPDATE user_preferences
   SET ${updates.join(', ')}
   WHERE user_id = $$\{paramCount\}
   RETURNING *`,
  values
);
}

```

```

        res.json(result.rows[0]);
    } catch (error) {
        console.error('Update preferences error:', error);
        res.status(500).json({ error: 'Internal server error' });
    }
};

/***
 * Get user preferences for another user (admin only)
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const getUserPreferencesById = async (req, res) => {
    try {
        const { id } = req.params;

        // Only allow this for the user's own preferences
        if (id !== req.user.userId) {
            return res.status(403).json({ error: 'Permission denied' });
        }

        // Get user preferences
        const prefsResult = await pool.query(
            'SELECT * FROM user_preferences WHERE user_id = $1',
            [id]
        );

        if (prefsResult.rows.length === 0) {
            return res.status(404).json({ error: 'Preferences not found' });
        }

        res.json(prefsResult.rows[0]);
    } catch (error) {
        console.error('Get preferences by ID error:', error);
        res.status(500).json({ error: 'Internal server error' });
    }
};

module.exports = {
    getUserPreferences,
    updatePreferences,
}

```

```
    getUserPreferencesById  
};
```

5. Health Controller (controllers/health.js)

```
const pool = require('../db/pool');

/**
 * Check service health
 *
 * @param {Object} req - Express request object
 * @param {Object} res - Express response object
 */
const checkHealth = async (req, res) => {
  try {
    // Check database connection
    await pool.query('SELECT 1');

    res.json({
      status: 'healthy',
      timestamp: new Date().toISOString(),
      service: 'user-service'
    });
  } catch (error) {
    console.error('Health check error:', error);
    res.status(500).json({
      status: 'unhealthy',
      timestamp: new Date().toISOString(),
      service: 'user-service',
      error: error.message
    });
  }
};

module.exports = {
  checkHealth
};
```



6. User Routes (routes/user.js)

```
const express = require('express');
const router = express.Router();
const userController = require('../controllers/user');
const preferenceController = require('../controllers/preference');
const { authenticate } = require('../middleware/auth');

// Apply authentication middleware to all routes
router.use(authenticate);

// User routes
router.get('/me', userController.getCurrentUser);
router.get('/search', userController.searchUsers);
router.get('/:id', userController.getUserById);
router.patch('/profile', userController.updateProfile);
router.post('/change-password', userController.changePassword);

// Preferences routes
router.get('/preferences/me', preferenceController.getUserPreferences);
router.patch('/preferences', preferenceController.updatePreferences);
router.get('/preferences/:id', preferenceController.getUserPreferencesById);

module.exports = router;
```

7. Health Routes (routes/health.js)

```
const express = require('express');
const router = express.Router();
const healthController = require('../controllers/health');

router.get('/', healthController.checkHealth);

module.exports = router;
```

8. Main Application (index.js)

```

const express = require('express');
const cors = require('cors');
const helmet = require('helmet');
require('dotenv').config();

const userRoutes = require('./routes/user');
const healthRoutes = require('./routes/health');

const app = express();

// Middleware
app.use(helmet());
app.use(cors());
app.use(express.json());

// Log requests
app.use((req, res, next) => {
  console.log(`[${new Date().toISOString()}] - ${req.method} ${req.path}`);
  next();
});

// Routes
app.use('/users', userRoutes);
app.use('/health', healthRoutes);

// Error handling middleware
app.use((err, req, res, next) => {
  console.error(err.stack);
  res.status(500).json({ error: 'Something went wrong!' });
});

// Start server
const PORT = process.env.PORT || 3002;
app.listen(PORT, () => {
  console.log(`User service running on port ${PORT}`);
});

```

9. Package.json

```
{
  "name": "user-service",
  "version": "1.0.0",
  "description": "User management service for Calendar App",
  "main": "src/index.js",
  "scripts": {
    "start": "node src/index.js",
    "dev": "nodemon src/index.js",
    "test": "echo \"Error: no test specified\" && exit 1"
  },
  "dependencies": {
    "bcrypt": "^5.1.0",
    "cors": "^2.8.5",
    "dotenv": "^16.0.3",
    "express": "^4.18.2",
    "helmet": "^6.0.1",
    "jsonwebtoken": "^9.0.0",
    "pg": "^8.10.0",
    "uuid": "^9.0.0"
  },
  "devDependencies": {
    "nodemon": "^2.0.22"
  }
}
```

10. .env File

```
PORT=3002
DATABASE_URL=postgresql://calendar_user:calendar_password@localhost:5432/calendar_c
JWT_SECRET=your_jwt_secret_for_local_dev
NODE_ENV=development
```

This user service implementation provides a complete solution for managing user profiles and preferences in the Calendar App. The code is structured with proper separation of concerns, using controllers for business logic, middleware for authentication, and routes for API endpoints.

Key features included:

1. User profile management

2. Password changing functionality
3. User preferences management
4. User search functionality
5. Health check endpoint for service monitoring

This service works in conjunction with the auth-service, calendar-service, and event-service to provide a complete backend for the Calendar App. The user service focuses specifically on user management, while the other services handle their respective domains.