**Video Meet - Enhanced Data Architecture & Models Documentation**

**1. Hybrid Database Architecture**

**1.1 Multi-Tier Data Strategy**

**Cloud Storage (MongoDB Atlas)**

* **Primary data store for user accounts and cloud meetings**
* **Cross-platform synchronization hub**
* **Enterprise features and analytics**

**Local Storage (SQLite + IndexedDB)**

* **Desktop application: SQLite for offline functionality**
* **Web application: IndexedDB for PWA capabilities**
* **Local network meeting data and device profiles**

**In-Memory Cache (Redis)**

* **Real-time session data and network topology**
* **WebRTC signaling state management**
* **Local network discovery cache**

**1.2 Technology Stack for Enhanced Data Layer**

**Cloud Data Layer**

* **MongoDB Atlas - Primary cloud database**
* **Mongoose - ODM with enhanced schemas**
* **Redis - Session and real-time data cache**

**Local Data Layer**

* **SQLite - Desktop application local database**
* **better-sqlite3 - High-performance Node.js SQLite driver**
* **IndexedDB - Browser-based local storage**
* **Dexie.js - IndexedDB wrapper for web applications**

**Synchronization Layer**

* **Custom sync engine - Bidirectional data synchronization**
* **Conflict resolution - Last-write-wins with timestamps**
* **Offline queue - Pending operations for when connectivity returns**

**2. Enhanced Core Data Entities**

**2.1 User Entity (Enhanced)**

**Purpose: Store user information across cloud and local contexts**

**Cloud Schema (MongoDB):**

**interface CloudUser {**

**\_id: ObjectId;**

**email: string; // unique, cloud identity**

**username: string; // unique, display name**

**firstName: string;**

**lastName: string;**

**password: string; // bcrypt hashed**

**avatar?: string; // cloud storage URL**

**// Enhanced fields**

**deviceIds: string[]; // registered desktop applications**

**networkPreferences: {**

**allowLocalDiscovery: boolean;**

**autoAcceptLocalInvites: boolean;**

**preferLocalConnections: boolean;**

**maxLocalParticipants: number;**

**};**

**// Synchronization**

**lastSyncAt: Date;**

**syncVersion: number;**

**// Metadata**

**isActive: boolean;**

**lastSeen: Date;**

**createdAt: Date;**

**updatedAt: Date;**

**}**

**Local Schema (SQLite/IndexedDB):**

**interface LocalUser {**

**id: string; // local device identifier**

**cloudUserId?: string; // link to cloud account**

**// Local identity (for offline mode)**

**displayName: string;**

**localAvatar?: string; // local file path**

**deviceName: string; // "John's MacBook Pro"**

**// Network configuration**

**networkInterfaces: NetworkInterface[];**

**discoveryEnabled: boolean;**

**lastDiscoveryAt: Date;**

**// Local preferences**

**autoStartApp: boolean;**

**systemTrayEnabled: boolean;**

**notificationsEnabled: boolean;**

**hotkeysEnabled: boolean;**

**// Sync state**

**lastCloudSync?: Date;**

**pendingSyncOperations: SyncOperation[];**

**createdAt: Date;**

**updatedAt: Date;**

**}**

**interface NetworkInterface {**

**name: string; // "Wi-Fi", "Ethernet"**

**ipAddress: string;**

**subnetMask: string;**

**isActive: boolean;**

**allowDiscovery: boolean;**

**}**

**2.2 Meeting Entity (Enhanced)**

**Cloud Schema (MongoDB):**

**interface CloudMeeting {**

**\_id: ObjectId;**

**roomId: string; // unique meeting identifier**

**hostId: ObjectId; // reference to User**

**// Basic meeting info**

**title: string;**

**description?: string;**

**password?: string; // bcrypt hashed**

**// Meeting type and scheduling**

**meetingType: 'cloud' | 'local' | 'hybrid';**

**isScheduled: boolean;**

**scheduledAt?: Date;**

**// Session tracking**

**status: 'waiting' | 'active' | 'ended' | 'cancelled';**

**startedAt?: Date;**

**endedAt?: Date;**

**duration?: number; // seconds**

**// Capacity and features**

**maxParticipants: number;**

**recordingEnabled: boolean;**

**recordingUrl?: string;**

**// Enhanced settings**

**settings: {**

**// Existing settings**

**allowGuests: boolean;**

**muteOnJoin: boolean;**

**videoOnJoin: boolean;**

**waitingRoom: boolean;**

**chat: boolean;**

**screenShare: boolean;**

**recording: boolean;**

**// New network settings**

**allowLocalParticipants: boolean;**

**preferLocalConnections: boolean;**

**allowFileSharing: boolean;**

**maxFileSize: number; // MB**

**networkQualityThreshold: number; // 0-100**

**};**

**// Network topology (for hybrid meetings)**

**networkTopology?: {**

**localNetworks: string[]; // subnet identifiers**

**bridgeParticipants: string[]; // participants acting as bridges**

**connectionMatrix: ConnectionInfo[][]; // who's connected to whom**

**};**

**// Metadata**

**createdAt: Date;**

**updatedAt: Date;**

**}**

**Local Schema (SQLite/IndexedDB):**

**interface LocalMeeting {**

**id: string; // local meeting identifier**

**cloudMeetingId?: string; // link to cloud meeting**

**// Local meeting info**

**title: string;**

**description?: string;**

**password?: string;**

**// Network-specific fields**

**networkScope: 'device' | 'subnet' | 'broadcast';**

**discoveryMethod: 'mdns' | 'broadcast' | 'manual';**

**localRoomId: string; // mDNS service name**

**// Host information**

**hostDeviceId: string;**

**hostIpAddress: string;**

**hostPort: number;**

**// Local participants**

**localParticipants: LocalParticipant[];**

**// File sharing**

**sharedFiles: SharedFile[];**

**// Connection state**

**isActive: boolean;**

**connectionQuality: NetworkQuality;**

**// Sync state**

**needsCloudSync: boolean;**

**lastSyncAttempt?: Date;**

**createdAt: Date;**

**updatedAt: Date;**

**}**

**interface NetworkQuality {**

**latency: number; // ms**

**bandwidth: number; // Mbps**

**packetLoss: number; // percentage**

**jitter: number; // ms**

**lastMeasured: Date;**

**}**

**2.3 Participant Entity (Enhanced)**

**Cloud Schema (MongoDB):**

**interface CloudParticipant {**

**\_id: ObjectId;**

**meetingId: ObjectId;**

**userId?: ObjectId; // null for guests**

**// Identity**

**displayName: string;**

**guestName?: string; // for guest users**

**avatar?: string;**

**// Permissions and role**

**role: 'host' | 'moderator' | 'participant' | 'guest';**

**permissions: {**

**canMuteOthers: boolean;**

**canRemoveParticipants: boolean;**

**canManageRecording: boolean;**

**canShareFiles: boolean;**

**};**

**// Session data**

**joinedAt: Date;**

**leftAt?: Date;**

**connectionType: 'cloud' | 'local' | 'hybrid';**

**// Media state**

**audioEnabled: boolean;**

**videoEnabled: boolean;**

**screenSharing: boolean;**

**handRaised: boolean;**

**// Connection information**

**socketId?: string; // WebSocket connection**

**peerId?: string; // WebRTC peer identifier**

**// Network information (for hybrid participants)**

**networkInfo?: {**

**ipAddress: string;**

**connectionPath: 'direct' | 'relayed' | 'hybrid';**

**bandwidth: number;**

**latency: number;**

**};**

**// Device information**

**deviceInfo: {**

**deviceId?: string; // for desktop app users**

**platform: 'web' | 'desktop' | 'mobile';**

**userAgent: string;**

**capabilities: {**

**supportsP2P: boolean;**

**supportsFileSharing: boolean;**

**supportsScreenShare: boolean;**

**};**

**};**

**createdAt: Date;**

**updatedAt: Date;**

**}**

**Local Schema (SQLite/IndexedDB):**

**interface LocalParticipant {**

**id: string;**

**localMeetingId: string;**

**// Identity**

**displayName: string;**

**deviceId: string;**

**deviceName: string;**

**// Network connection**

**ipAddress: string;**

**port: number;**

**macAddress?: string; // for device identification**

**// Connection state**

**connectionStatus: 'connecting' | 'connected' | 'disconnected' | 'reconnecting';**

**lastSeen: Date;**

**connectionQuality: NetworkQuality;**

**// Media state**

**audioEnabled: boolean;**

**videoEnabled: boolean;**

**screenSharing: boolean;**

**// P2P connection info**

**peerConnection?: {**

**peerId: string;**

**connectionState: RTCPeerConnectionState;**

**iceConnectionState: RTCIceConnectionState;**

**localDescription?: RTCSessionDescription;**

**remoteDescription?: RTCSessionDescription;**

**};**

**// File sharing**

**sharedFiles: string[]; // file IDs**

**joinedAt: Date;**

**leftAt?: Date;**

**}**

**2.4 Device Entity (New)**

**Purpose: Manage desktop application instances and local network devices**

**Local Schema (SQLite):**

**interface LocalDevice {**

**id: string; // unique device identifier**

**// Device identification**

**deviceName: string; // user-friendly name**

**hostname: string; // system hostname**

**platform: 'windows' | 'macos' | 'linux';**

**architecture: string; // x64, arm64, etc.**

**// Application info**

**appVersion: string;**

**electronVersion: string;**

**lastStartup: Date;**

**autoStartEnabled: boolean;**

**// Network configuration**

**networkInterfaces: NetworkInterface[];**

**preferredInterface?: string;**

**discoveryPort: number;**

**servicePort: number;**

**// Security**

**publicKey: string; // for device authentication**

**privateKey: string; // encrypted with user password**

**trustedDevices: string[]; // trusted device IDs**

**// User association**

**localUserId: string;**

**cloudUserId?: string;**

**// Status**

**isOnline: boolean;**

**lastOnline: Date;**

**createdAt: Date;**

**updatedAt: Date;**

**}**

**Discovery Cache (Redis):**

**interface DiscoveredDevice {**

**deviceId: string;**

**deviceName: string;**

**displayName: string; // user's name**

**ipAddress: string;**

**port: number;**

**// Service information**

**serviceType: string; // "\_videomeet.\_tcp"**

**serviceName: string; // "John's MacBook Pro"**

**// Capabilities**

**capabilities: {**

**maxParticipants: number;**

**supportsFileSharing: boolean;**

**supportsScreenShare: boolean;**

**supportedCodecs: string[];**

**};**

**// Discovery metadata**

**discoveredAt: Date;**

**lastSeen: Date;**

**ttl: number; // time to live in seconds**

**// Trust status**

**isTrusted: boolean;**

**trustLevel: 'unknown' | 'recognized' | 'trusted';**

**}**

**2.5 Message Entity (Enhanced)**

**Cloud Schema (MongoDB):**

**interface CloudMessage {**

**\_id: ObjectId;**

**meetingId: ObjectId;**

**senderId?: ObjectId; // null for system messages**

**// Content**

**content: string;**

**type: 'text' | 'system' | 'file' | 'emoji' | 'network\_event';**

**// Sender information**

**senderName: string;**

**senderRole: 'host' | 'moderator' | 'participant' | 'guest' | 'system';**

**// File attachment (if type is 'file')**

**fileInfo?: {**

**filename: string;**

**fileSize: number;**

**mimeType: string;**

**cloudStorageUrl?: string; // for cloud-stored files**

**localFileId?: string; // for locally shared files**

**checksum: string; // file integrity verification**

**};**

**// Network event data (if type is 'network\_event')**

**networkEvent?: {**

**eventType: 'device\_joined' | 'device\_left' | 'connection\_lost' | 'connection\_restored';**

**deviceInfo: {**

**deviceId: string;**

**deviceName: string;**

**ipAddress: string;**

**};**

**};**

**// Message metadata**

**timestamp: Date;**

**editedAt?: Date;**

**isEdited: boolean;**

**// Delivery tracking**

**deliveredTo: string[]; // participant IDs who received the message**

**readBy: { participantId: string; readAt: Date }[];**

**createdAt: Date;**

**updatedAt: Date;**

**}**

**Local Schema (SQLite/IndexedDB):**

**interface LocalMessage {**

**id: string;**

**localMeetingId: string;**

**senderId?: string; // local participant ID**

**// Content**

**content: string;**

**type: 'text' | 'system' | 'file' | 'emoji' | 'network\_event';**

**// Local file handling**

**localFile?: {**

**filename: string;**

**filepath: string; // local file system path**

**fileSize: number;**

**mimeType: string;**

**transferProgress: number; // 0-100 for ongoing transfers**

**transferStatus: 'pending' | 'transferring' | 'completed' | 'failed';**

**};**

**// Sync status**

**cloudMessageId?: string;**

**needsCloudSync: boolean;**

**syncStatus: 'pending' | 'syncing' | 'synced' | 'failed';**

**timestamp: Date;**

**localTimestamp: Date; // device local time**

**createdAt: Date;**

**updatedAt: Date;**

**}**

**2.6 File Transfer Entity (New)**

**Purpose: Manage file sharing in local network meetings**

**Local Schema (SQLite/IndexedDB):**

**interface FileTransfer {**

**id: string;**

**localMeetingId: string;**

**// File information**

**filename: string;**

**originalPath: string;**

**fileSize: number;**

**mimeType: string;**

**checksum: string; // SHA-256 hash for integrity**

**// Transfer details**

**senderId: string; // local participant ID**

**receiverIds: string[]; // target participants**

**transferMethod: 'webrtc' | 'http' | 'websocket';**

**// Progress tracking**

**totalChunks: number;**

**completedChunks: number;**

**transferredBytes: number;**

**transferSpeed: number; // bytes per second**

**// Status**

**status: 'pending' | 'transferring' | 'completed' | 'failed' | 'cancelled';**

**startedAt?: Date;**

**completedAt?: Date;**

**errorMessage?: string;**

**// Recipient status**

**recipientStatus: {**

**participantId: string;**

**status: 'pending' | 'downloading' | 'completed' | 'failed';**

**progress: number; // 0-100**

**localPath?: string; // where file was saved**

**}[];**

**createdAt: Date;**

**updatedAt: Date;**

**}**

**3. Data Synchronization Strategy**

**3.1 Bidirectional Sync Engine**

**Sync Operations:**

**interface SyncOperation {**

**id: string;**

**operationType: 'create' | 'update' | 'delete';**

**entityType: 'user' | 'meeting' | 'participant' | 'message';**

**entityId: string;**

**// Data payload**

**data: any;**

**cloudId?: string; // corresponding cloud entity ID**

**// Sync metadata**

**timestamp: Date;**

**syncAttempts: number;**

**lastSyncAttempt?: Date;**

**syncStatus: 'pending' | 'syncing' | 'completed' | 'failed';**

**errorMessage?: string;**

**// Conflict resolution**

**conflictResolution: 'local\_wins' | 'cloud\_wins' | 'merge' | 'manual';**

**createdAt: Date;**

**updatedAt: Date;**

**}**

**Conflict Resolution Rules:**

* **User profiles: Cloud wins (authoritative source)**
* **Meeting settings: Last write wins with timestamp comparison**
* **Messages: Merge (no conflicts, append-only)**
* **Participant status: Real-time wins (most recent state)**

**3.2 Offline-First Architecture**

**Local-First Principles:**

* **All operations work offline first**
* **Cloud sync happens in background**
* **Conflict resolution is automatic where possible**
* **Manual resolution for complex conflicts**

**Sync Triggers:**

* **Network connectivity restored**
* **User login/logout**
* **Periodic background sync (every 5 minutes)**
* **Before creating cloud meetings**
* **On app startup and shutdown**

**4. Network Discovery Data**

**4.1 mDNS Service Records**

**Service Registration:**

**interface MDNSService {**

**serviceName: string; // "John's MacBook Pro.\_videomeet.\_tcp.local"**

**serviceType: string; // "\_videomeet.\_tcp"**

**domain: string; // "local"**

**// Service data**

**port: number;**

**host: string; // device hostname**

**// TXT record data**

**txtRecord: {**

**version: string; // protocol version**

**user: string; // display name**

**device: string; // device identifier**

**capabilities: string; // comma-separated capabilities**

**status: string; // 'available' | 'busy' | 'away'**

**maxParticipants: string;**

**secureConnection: string; // 'true' | 'false'**

**};**

**// Discovery metadata**

**registeredAt: Date;**

**lastUpdate: Date;**

**ttl: number;**

**}**

**4.2 Network Topology Mapping**

**Purpose: Track connections between local network devices**

**Local Schema (SQLite):**

**interface NetworkTopology {**

**id: string;**

**networkId: string; // subnet identifier**

**// Network information**

**subnetCidr: string; // "192.168.1.0/24"**

**gatewayIp: string;**

**dnsServers: string[];**

**// Discovered devices**

**devices: DiscoveredDevice[];**

**// Connection matrix**

**connections: {**

**fromDeviceId: string;**

**toDeviceId: string;**

**connectionType: 'direct' | 'relayed';**

**latency: number;**

**bandwidth: number;**

**lastMeasured: Date;**

**}[];**

**// Topology metadata**

**lastScan: Date;**

**scanDuration: number; // milliseconds**

**createdAt: Date;**

**updatedAt: Date;**

**}**

**5. Performance and Indexing Strategy**

**5.1 Cloud Database Indexes (MongoDB)**

**User Collection:**

* **{ email: 1 } - unique, login lookup**
* **{ username: 1 } - unique, profile lookup**
* **{ deviceIds: 1 } - device association lookup**
* **{ "networkPreferences.allowLocalDiscovery": 1, isActive: 1 } - discovery filtering**

**Meeting Collection:**

* **{ roomId: 1 } - unique, meeting lookup**
* **{ hostId: 1, status: 1 } - user's meetings**
* **{ meetingType: 1, status: 1 } - meeting type filtering**
* **{ "settings.allowLocalParticipants": 1 } - hybrid meeting lookup**

**5.2 Local Database Indexes (SQLite)**

**LocalMeeting Table:**

* **CREATE INDEX idx\_local\_meeting\_host ON LocalMeeting(hostDeviceId)**
* **CREATE INDEX idx\_local\_meeting\_active ON LocalMeeting(isActive)**
* **CREATE INDEX idx\_local\_meeting\_network ON LocalMeeting(networkScope)**

**LocalParticipant Table:**

* **CREATE INDEX idx\_participant\_meeting ON LocalParticipant(localMeetingId)**
* **CREATE INDEX idx\_participant\_device ON LocalParticipant(deviceId)**
* **CREATE INDEX idx\_participant\_ip ON LocalParticipant(ipAddress)**

**5.3 Caching Strategy**

**Redis Cache Structure:**

**videomeet:discovery:{networkId} -> Set of active device IDs**

**videomeet:device:{deviceId} -> Device information JSON**

**videomeet:topology:{networkId} -> Network topology JSON**

**videomeet:session:{sessionId} -> WebRTC session state**

**Cache TTL Settings:**

* **Device discovery: 60 seconds**
* **Network topology: 300 seconds (5 minutes)**
* **WebRTC sessions: 3600 seconds (1 hour)**
* **User sessions: 86400 seconds (24 hours)**

**This enhanced data architecture provides comprehensive support for desktop applications, local network functionality, and hybrid cloud-local operations while maintaining performance and data integrity across all platforms.**