XYZ Health Solutions

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CASE STUDY

Modernization of a Legacy Patient Management System

This document presents a systems analysis of XYZ Health Solutions' Patient Management System, including current-state process evaluation, data flow modelling, and identification of architectural constraints. A future-state design is proposed to enable incremental modernization through service-based extensions while maintaining compliance and operational continuity.

Executive Summary

XYZ Health Solutions operates as a mid-sized outpatient healthcare network, consisting of three clinic locations and maintaining a total of 75,000 active patient records. The organization relies on a Patient Management System (PMS) that has become outdated relative to its current workload and operational needs. Initially developed eight to nine years ago, the system offers only basic functionalities such as patient registration, appointment scheduling, and note-taking, with limited voice capabilities.

Due to these limitations, a significant portion of appointment-related tasks is handled manually by the front desk staff, which has contributed to inconsistent billing accuracy and frequent manual updates. The PMS currently in use lacks integration with external systems and requires substantial improvement in error handling and reporting processes.

Patient feedback indicated many had difficulties or errors when interacting with the system. Additionally, physicians have reported a high incidence of patient no-shows, attributed to inaccuracies in appointment scheduling and record keeping.

My Role:
I served as the Systems Analyst for this project. I was responsible for evaluating the limitations of the existing Patient Management System and defining this modernized approach. My work included documenting workflows, identifying integration points, creating data flow and sequence diagrams, and translating business needs into functional and non-functional requirements that support a modern modular, API-driven architecture.

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Problem Statement

Key stakeholders must perform tasks manually creating data inconsistencies.

XYZ Health Solutions' current Patient Management System is outdated for the growing workload and operational demands. Developed 8-9 years ago, the system only supports basic patient registration, scheduling, note-taking, and offers limited voice functionality. As a result, front desk staff and physicians (both key stakeholders who rely on the system daily) must perform most appointment tasks manually, leading to inconsistent billing accuracy and frequent manual changes.

System Integrations

The system also lacks integration with external systems, falls short on robust error handling and reporting, and does not comply with current operational standards: system uptime averages just 90%, below industry benchmarks for healthcare IT.

HIPPA Regulations

Additionally, all changes and enhancements must ensure strict adherence to HIPPA regulations regarding patient data privacy and security. Recent patient surveys show over 25% of patients have experienced difficulties or errors using the system, while physicians report high patient no-show rates due to inaccurate appointment keeping.

Constraints and Assumptions

Constraints

- Budgetary and licensing limitations prevent a full replacement of the existing PMS. The modernization effort must retain the core system and introduce new capabilities as modular extensions.
- HIPAA compliance requirements must be strictly maintained. All patient data must be encrypted in transit and at rest, and access to protected health information is restricted to authorized staff roles.
- The solution must integrate with the current technical environment without requiring major infrastructure changes.

Assumptions

- Existing PMS infrastructure can support the additional modular services introduced through this modernization.
- Stakeholders will be available to provide timely input during requirements validation and review discussions.
- Required third-party APIs (for notifications, payment, or eligibility checks) are available, stable, and properly documented.
- Patient and appointment data stored in the current system is sufficiently complete and accurate for workflow modernization without large-scale data cleansing.

Current State Process Overview (Legacy PMS)

XYZ Health Solutions currently relies on a legacy Patient Management System (PMS) that serves as the central system for patient scheduling, record management, and billing coordination. The system functions as a single, monolithic application with limited automation and heavy reliance on manual staff intervention.

Patients initiate the process by submitting appointment requests, either online or through direct communication with front desk staff. These requests are received by the Legacy PMS, which is responsible for validating availability, recording appointment details, and generating appointment confirmations. Patients receive confirmation once the request is processed, but the system provides limited real-time feedback or automated notifications.

Front desk staff play a critical operational role in the current process. Staff members manually manage appointment changes, update patient information, and handle scheduling adjustments directly within the PMS

All patient, appointment, and billing data is stored in a centralized legacy database. Billing information is captured and stored, but billing workflows are largely manual, with minimal automation and limited validation at the system level.

Pain Point 1

High patient no-show rates.

Lack of automatic notifications and inconsistent data recording has led to an abundance of preventable patient no-shows.

Pain Point 2

Manual system creating a bottleneck.

Reminders/confirmations performed by front desk staff by phone and email. Billing can be inconsistent due to manual application of charges that are only reconciled at the end of the day. Insurance also requires manual check-in to an external portal which has been causing duplicate entries and delays.

Pain Point 3

Lack of system monitoring systems and poor coordination between clinics.

Legacy PMS lacks integration with external systems and inter-clinic workflows and does not provide adequate error handling or monitoring for audit and compliance purposes. As a result, inconsistent communication between clinics has led to coordination and operational inefficiencies.

Pain Point 4

Inability to scale processes.

As patient volume increases the system lacks a robust and scalable cloud-based architecture for future proofing XYZ's projected expansion.

Monitoring

Key Monitoring Metrics

1. Appointment booking success rate
2. Appointment cancellation success rate
3. Payment authorization success rate
4. Average response time for appointment availability lookup
5. Notification delivery success rate

Monitoring Thresholds

6. Appointment booking success rate drops below acceptable levels
7. Payment authorization failures exceed expected baseline
8. Average response time exceeds acceptable user experience limits
9. Notification delivery failures exceed tolerance levels

Logging and Audit Considerations

10. Appointment creation, modification, and cancellation events
11. Payment authorization attempts and outcomes
12. Eligibility verification results
13. User actions associated with patient record updates

Proposed Solution Architecture

Legacy Patient Management System Diagram

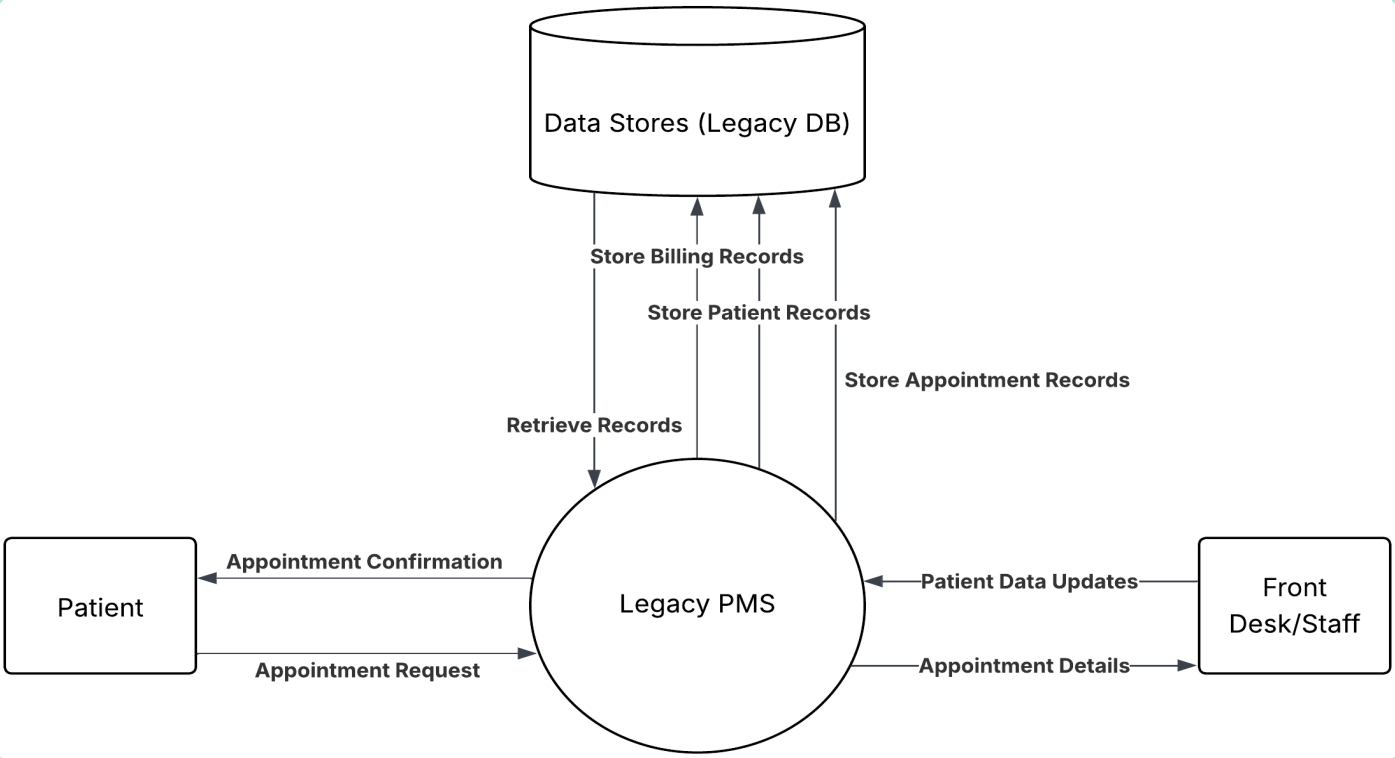

Diagram Explanation - Legacy

This level 0 data flow diagram shows how patients interact with the system by submitting appointment requests. These requests are received by the Legacy PMS which processes the request and returns an appointment confirmation to the patient once scheduling is complete. Front desk staff serve as a secondary “external” actor and need to manage appointments and maintain patient information. The Legacy PMS communicates directly with the data store that contains records for patients, appointments, and billing. The data store updates when changes occur. All data is managed internally by the PMS with no external systems accessing the store directly. This diagram demonstrates that XYZ’s current Legacy PMS functions as a “monolithic” system limiting scalability and automation.

Proposed Patient Management System Diagram

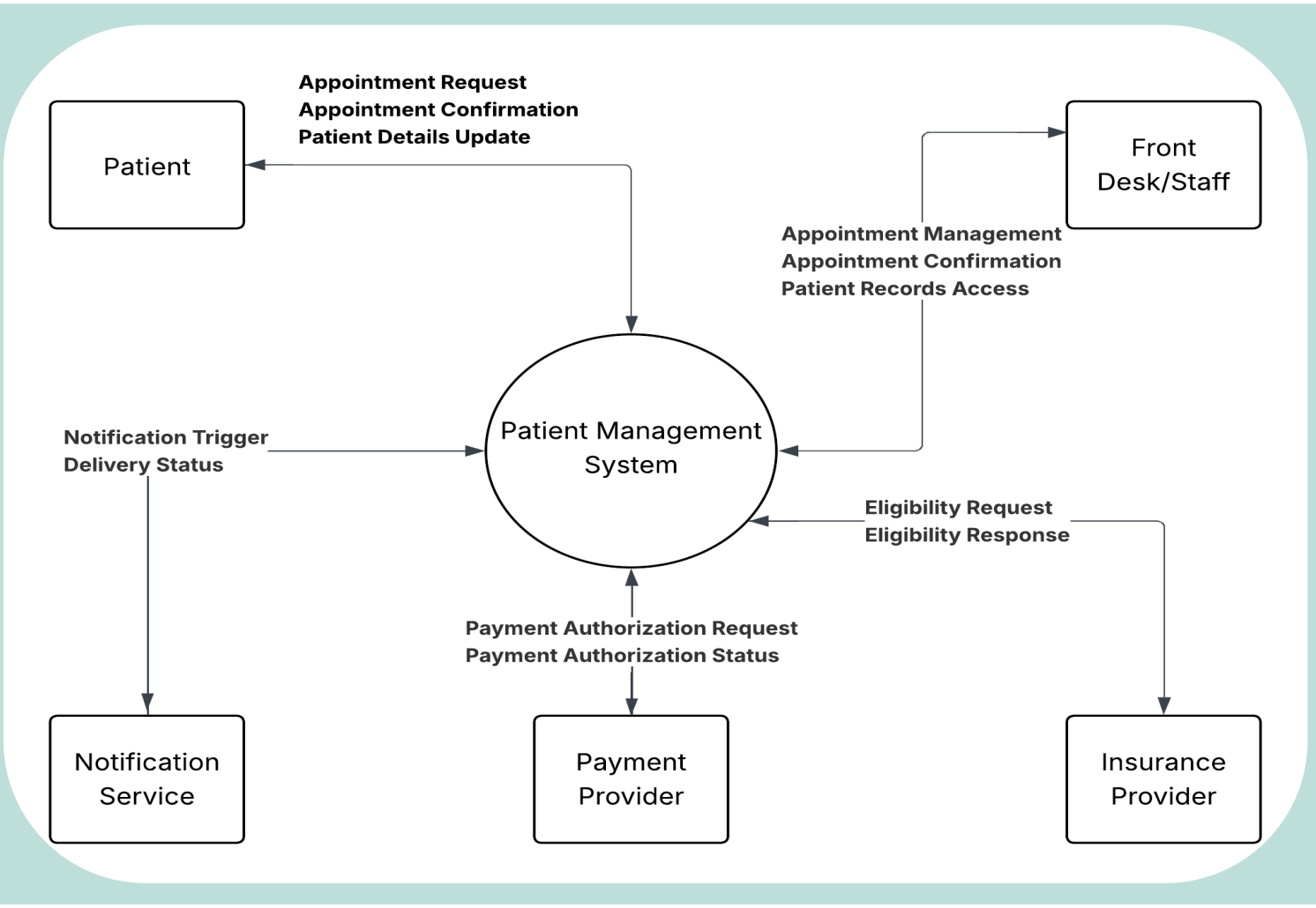

Diagram Explanation - Proposed

The proposed Level 0 Data Flow Diagram illustrates a modernized Patient Management System that introduces improved automation and data handling while maintaining existing system boundaries. In this future state, patients submit appointment requests and receive confirmations through streamlined system interactions, reducing reliance on manual front desk processes. Front desk staff continue to manage appointments and patient data but benefit from more structured system outputs and reporting. The Patient Management System centrally coordinates all interactions and persists patient, appointment, and billing information within the legacy data store, ensuring continuity with existing infrastructure. This design establishes a foundation for future modular enhancements while improving data consistency, operational efficiency, and scalability compared to the legacy system.

System Models

Level 1 Data Flow Diagram

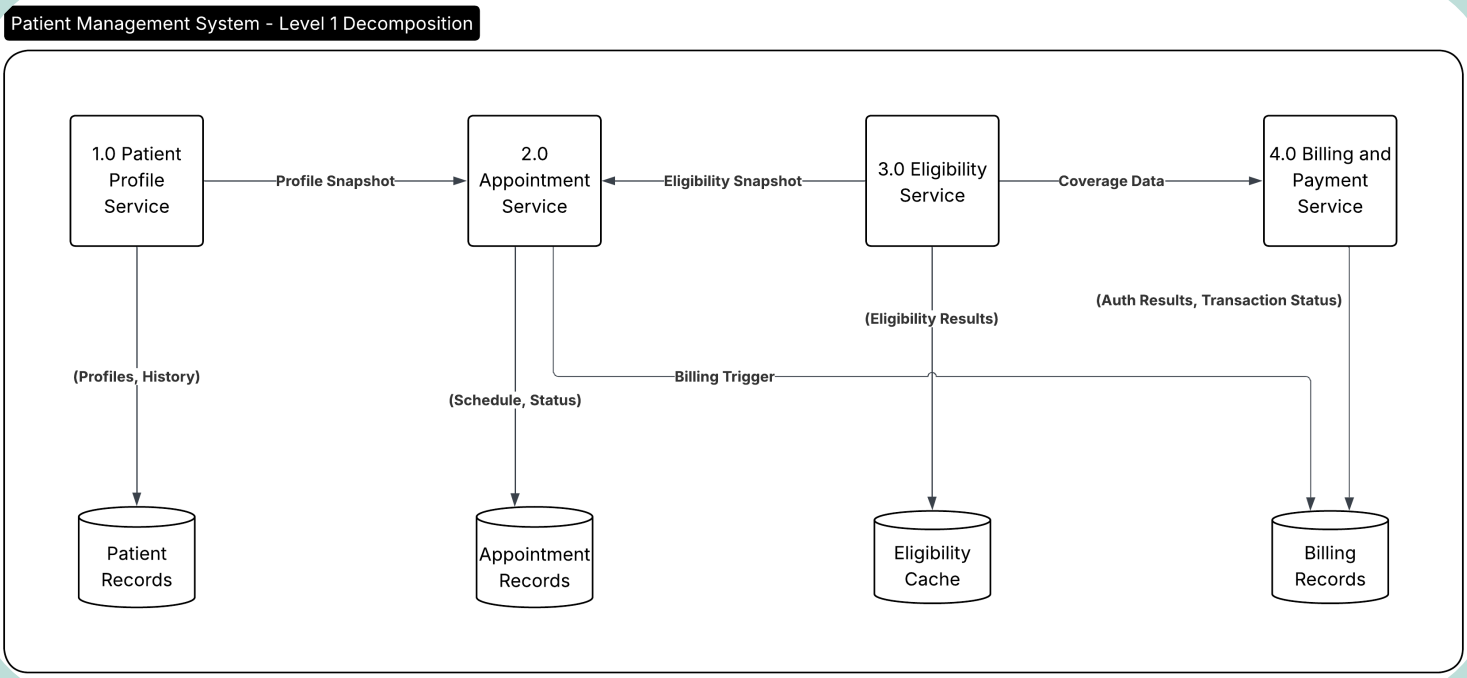

Diagram Explanation - Legacy

This Level 1 Data Flow Diagram illustrates how XYZ Health Solutions' Patient Management System is broken into into core functions to address limitations in the current legacy PMS.
Patient profile management, appointment scheduling, insurance eligibility verification, and billing are shown as distinct processes to reflect how responsibilities are separated in the modernized system. This structure directly supports XYZ's goal of reducing manual front desk work, improving billing accuracy, and enabling real-time eligibility checks. By clearly defining data ownership across patient, appointment, eligibility, and billing records, the diagram demonstrates how the proposed system improves data consistency and prepares XYZ Health Solutions for future growth and integration.

Sequence Diagram – Appointment Cancellation

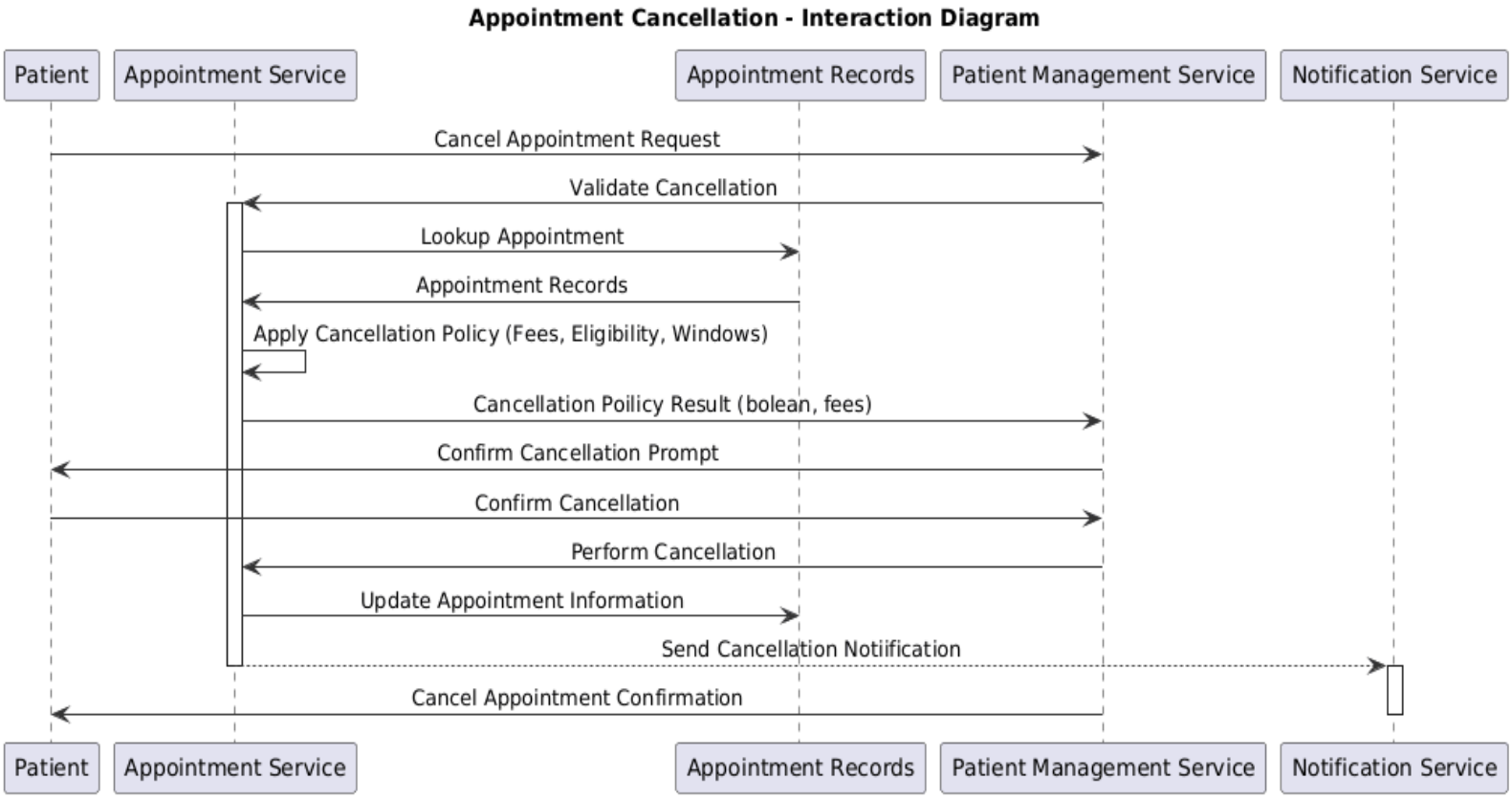

Diagram Explanation - Proposed

This sequence diagram illustrates how an appointment cancellation request will be processed within XYZ Health Solutions' Patient Management System with the new system. It highlights validation, policy enforcement, user confirmation, and record updates as distinct steps to reduce errors and ensure compliance with cancellation rules. Notifications are handled asynchronously to avoid delaying the user experience.

Sequence Diagram – Appointment Booking

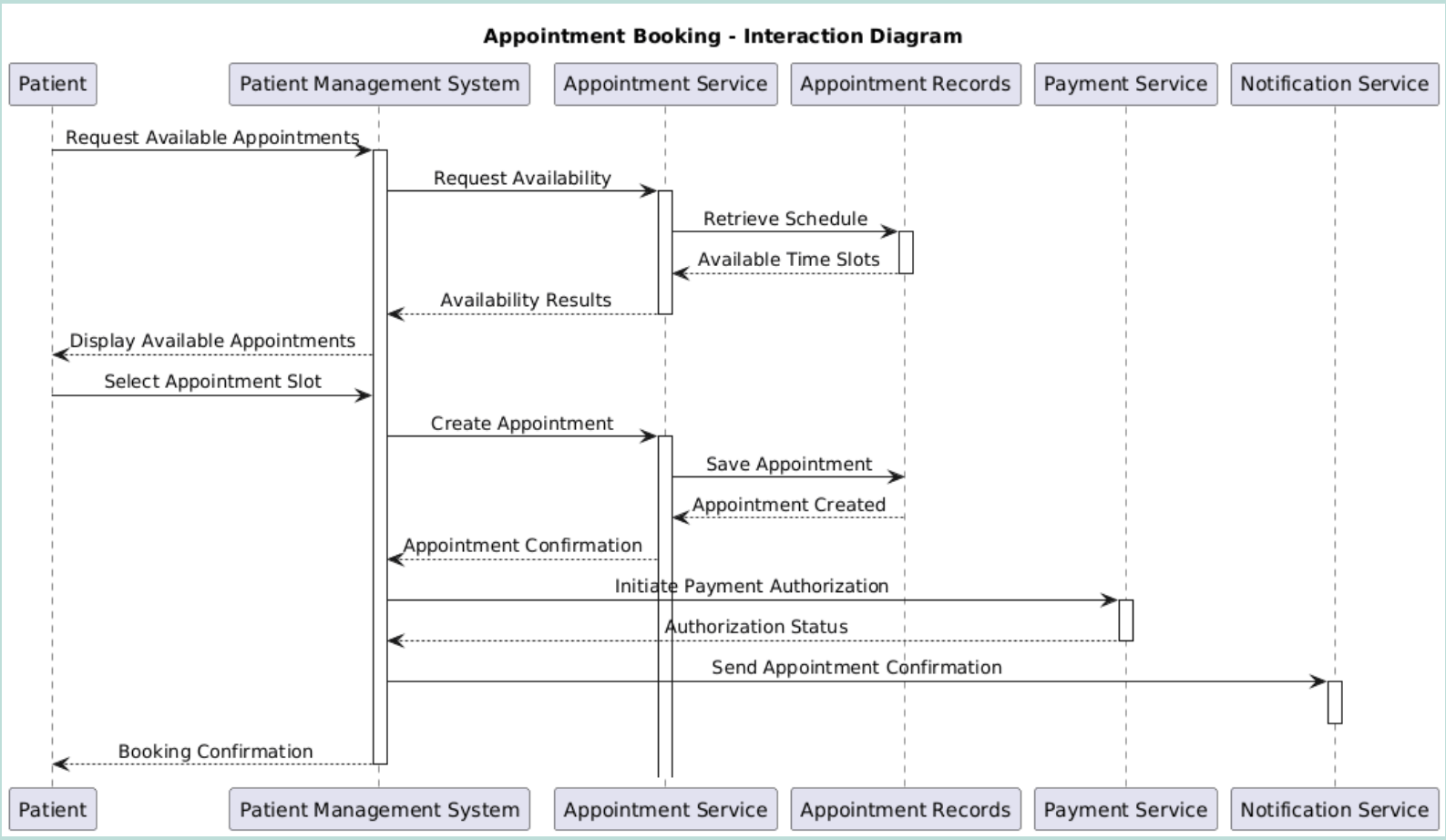

Diagram Explanation - Proposed

This sequence diagram illustrates how XYZ's Patient Management System coordinates the end-to-end appointment booking process. When a patient requests available appointment times, the PMS acts as the primary entry point and delegates scheduling logic to the Appointment Service, which retrieves availability from the Appointment Records store. Once available time slots are returned, the PMS presents these options to the patient and captures the selected appointment. The Appointment Service then creates and persists the appointment record, after which the PMS initiates payment authorization and triggers a notification to confirm the booking. This interaction highlights XYZ's separation of concerns, where the PMS orchestrates user interactions while specialized services handle scheduling, persistence, payments, and notifications.

Requirements

Functional

ID	Functional Requirement	Description
FR-01	Book Appointment	The system shall allow patients to view available time slots and book an appointment.
FR-02	Cancel Appointment	The system shall allow patients to cancel an existing appointment in accordance with cancellation policies.
FR-03	Manage Patient Records	Authorized staff shall create and update patient profile information.
FR-04	Payment Authorization	The system shall authorize payments prior to confirming appointments when required.
FR-05	Notifications	The system shall send confirmation and cancellation notifications to patients.

Non-Functional

ID	Functional Requirement	Description
NFR-01	Security	The system shall encrypt all patient data transmitted to external services.
NFR-02	Compliance	The system shall comply with HIPAA requirements for PHI access and storage.
NFR-03	Performance	Appointment availability queries shall return results within 3 seconds.
NFR-04	Availability	The system shall maintain 99.5% uptime during business hours.
NFR-05	Scalability	The system shall support increased patient volume without architectural changes.
NFR-06	Auditability	All appointment and billing actions shall be logged for audit purposes.

ERD Diagram

Logical ERD for XYZ

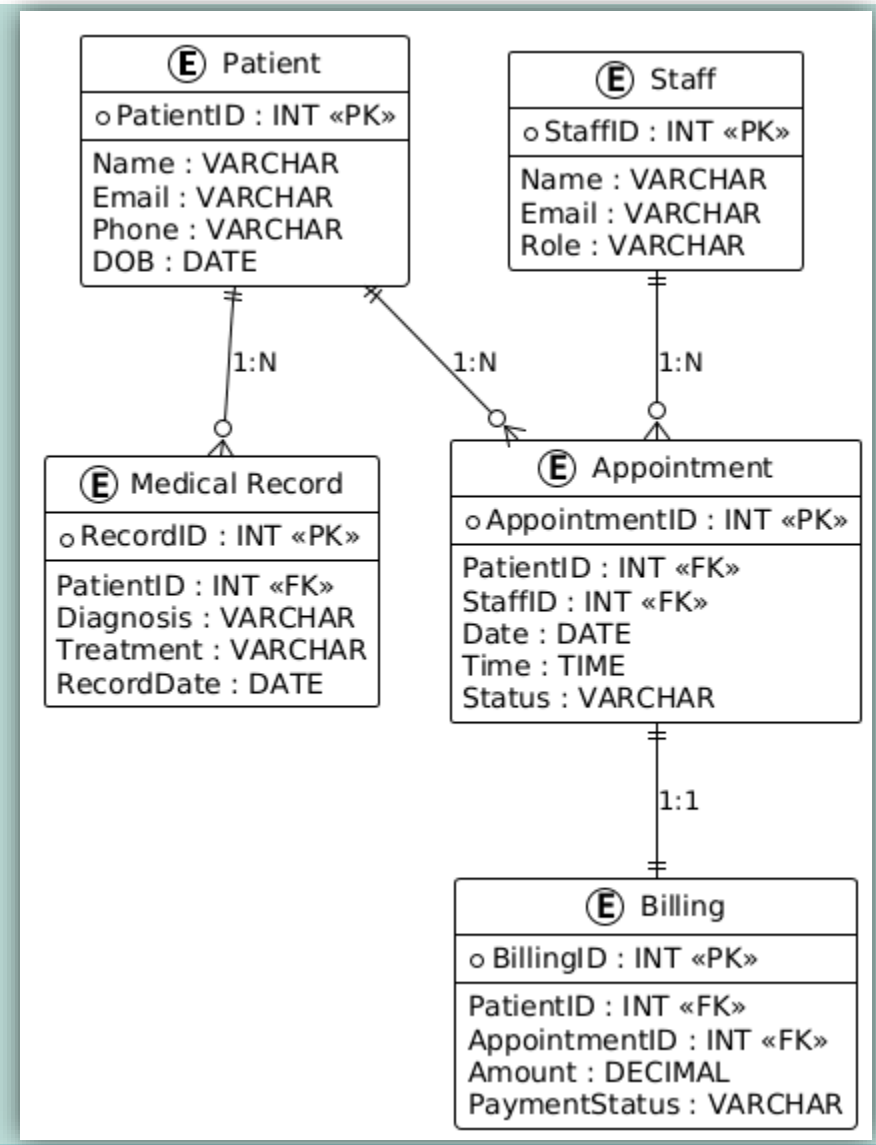

Diagram Explanation

The ERD models the core data relationships within XYZ's Patient Management System. Appointments act as the central entity, linking patients and staff while serving as the trigger point for billing. Patient records are maintained separately to support longitudinal medical history, while billing records are generated as a result of completed appointments. This structure reflects the current operational model of XYZ's legacy PMS and highlights why appointment-centric workflows are critical to system modernization.

Edge Cases

The following edge cases represent exceptions to the primary booking and cancellation flows illustrated in the sequence and data flow diagrams.

Edge Cases and Exceptions

- Appointment slot becomes unavailable between selection and confirmation
- Patient attempts to cancel outside the allowed cancellation window
- Payment authorization fails after appointment creation
- Duplicate booking requests submitted by the patient
- Appointment record exists but associated patient record is incomplete
- Notification delivery fails (email/SMS not received)

Conclusion

This case study demonstrates a practical systems analysis approach to modernizing a legacy Patient Management System without full replacement. By documenting current-state limitations, defining a modular future-state architecture, and modelling system behaviour through data flow, sequence, and entity diagrams, this project illustrates how targeted integrations can reduce manual effort, improve data consistency, and support scalability.

The resulting artifacts provide a clear foundation for phased implementation while maintaining compliance and operational continuity.

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