

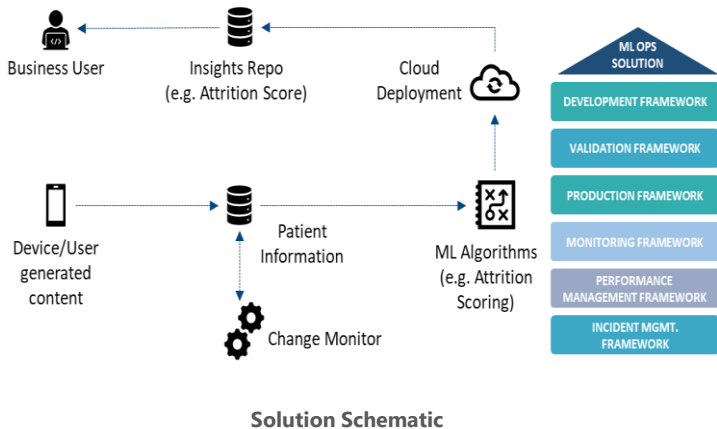
Case Study: MLOps for Digital Services

Client Requirements

Client is a leading medical technology company. Client provided consumer devices for managing diabetes and wanted to provide personalized insights to patients and caregivers.

The client intends to develop an end-to-end MLOps framework. MLOps solution will enable operationalizing customer attrition model for insulin pumps in the short term while building the foundation for future regulatory compliant MLOps platform and addition of new algorithms in the long term.

Client partnered with CitiusTech to establish an enterprise MLOps framework to operationalize AI ML driven digital services for their devices.



CitiusTech Services:

CitiusTech put together an MLOps core team to design, create and demonstrate the architecture for model development, deployment, monitoring and research operations

- Reviewed the current Model development pipeline in Pre-Production and Production environment and refined to cater to multiple models
- Provided unified dashboard to review and track model and infrastructure performance using predefined, mutually identified performance metrics
- Implemented strategy in staging and production to enable automated re-training of models
- Reviewed the existing framework for CI/CD integration and built an automated deployment pipeline
- Standardized and operationalized customer research function to reduce inefficiencies and scale across models

Value Delivered:

- CitiusTech solution helped achieve reduced deployment time for the existing data science models
- The solution delivered also helped achieve standardization of the MLOps process with minimal dependencies
- Provided model monitoring framework for tracking drift and performance and managing models for driving business outcomes

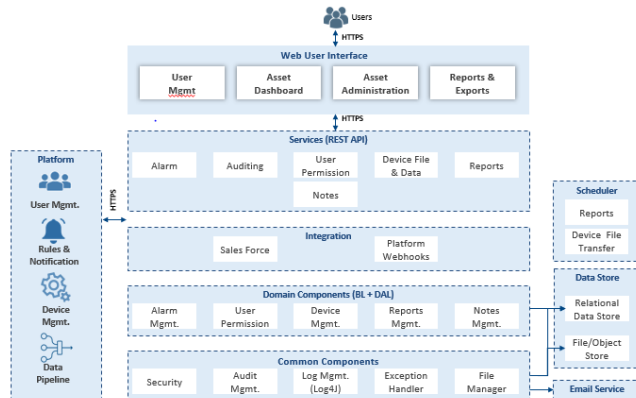
Case Study: Remote Device Care Platform

Client Requirements

Client is a science and technology innovator, helping customers solve complex challenges and improve quality of life. Client has a platform providing IoT operational capabilities to internal consumers

Client wanted to replace existing 3rd party IoT platform with an inhouse IoT platform. Client also wanted to integrate their service case management and device management workflows

Given strong expertise in AWS, IoT and healthcare cloud, CitiusTech built a remote device care system integrated with IoT platform and service case management system for the client and removed the dependencies on the third-party platforms.



Solution Schematic

CitiusTech Services:

- CitiusTech worked on requirement gathering, functionality mapping, planning, UI designing and development of remote device care app

Key Design Considerations:

- **Security:** Data encrypted at rest and in transit with appropriate controls
- **Scalability:** Independent distributed deployment of UI and REST APIs so that each tier can scale horizontally
- **Portability:** OS neutral solution, primarily deployable on Windows and Linux. Deployment portability across clouds, data centers or on-premise
- **Integration:** Seamless integration with client's IoT platform as well as service case management system
- Built a dashboard and alarm system for tracking device metrics by integrating with client's IoT platform

Value Delivered:

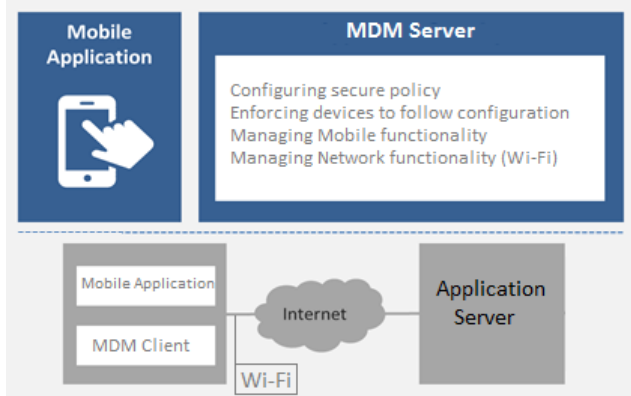
- End to end integrated and homogenous solution for remote management of devices
- Delivered a highly available, performant system and cost optimal solution for remote management of devices
- Minimized the need for on-site visits of service engineers for device care resulting in cost savings
- Seamless integration with client's service case management system on Salesforce

Case Study: Security Assessment of Scanner Mobile App

Client Requirements

Client is a leader in HealthCare solution provider such as medical imaging & IT, medical diagnostics etc. Mobile application security review was carried for an Android application, used by physicians to view the Ultrasound images of patients.

CitiusTech was engaged to perform security review of the android mobile application, installed using a Mobile device management (MDM) over Wi-Fi with different authentication mechanisms.



Solution Schematic

CitiusTech Services:

- CitiusTech Security team performed Security Assessment of the mobile application protected by MDM over the Wi-Fi.
- Created & tested a policy to provide a secure implementation of application on android devices through MDM. Tried to bypass security checks applied by policy.
- Tested the application on different Wi-Fi authentication mechanism and tried bypassing security mechanism within Wi-Fi authentication methods (i.e. WEP, WPA, WPA2 PSK, WPA2 EAP)
- Helped in customizing and testing the Lava android build to fine tune the Wi-Fi Android stack to support the Wi-Fi authentication

Value Delivered:

- Security assessment helped the client to mitigate the weakness in application using MDM features and vice versa.
- Helped the client in developing a strong MDM policy to secure ePHI data.
- Hardening of mobile device with MDM policy & enforcing network configuration with the MDM server & client
- Developed a fully compliant Lava Android build

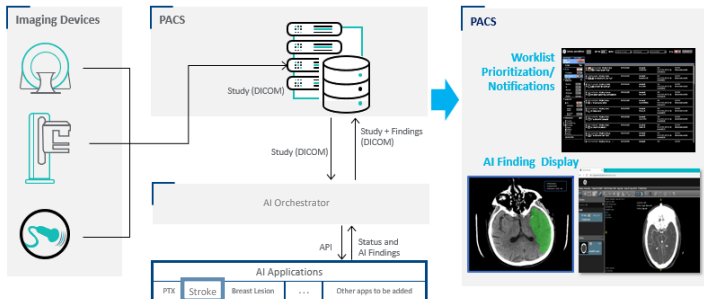
Case Study: AI Orchestration

Client Requirements

Client is a leading medical device manufacturer with a large market share in the imaging space and has a long standing relationship with CitiusTech

Client wanted product engineering support to integrate its AI based application that was used for stroke detection that will process CT,CTA & MRI images

CitiusTech was selected for this initiative for its expertise in product engineering capabilities in medical imaging domain



Solution Schematic

CitiusTech Services:

- Developed AI Orchestration application to route input and output from AI algorithms
- Enabled AI stroke system to send SMS / Email / pager to configured recipients for positive / negative findings
- The processed image highlighted red color to indicate positive findings and green color for negative finding in the ROI
- Ensured the integration to be interoperable with other imaging modalities & radiological PACS
- Helped the AI orchestration to be deployed on-prem, public & private cloud

Value Delivered:

- Built a Class II medical device as a pilot solution which is easily scalable & secure
- Leveraged CitiusTech accelerators like code quality checkers, QA, automation framework for faster implementation
- Provided regulatory compliance according to ISO 14971, ISO 62304 & ISO 62366

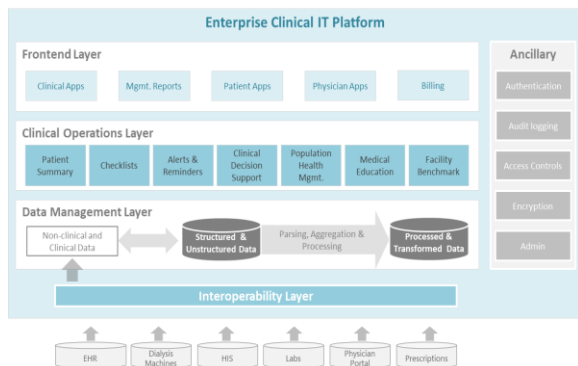
Case Study: Enterprise Patient Engagement Platform

Client Requirements

Client is a leader in Renal care. Client had several legacy apps for patient registration, order entry, dialysis data capture etc.

There were lots of operational inefficiencies due to multiple app screens, 1500+ databases, errors, software upgrades, incompatible code and lack of interoper between the applications.

CitiusTech is helping the client develop a next generation, scalable platform for patient, physician and teammate for an enhanced experience



Solution Schematic

CitiusTech Services:

- CitiusTech started the project with a mix of PDM, POs, BAs, UX developers, data engineers and QA
- Key consideration for the new platform were:
 - One single patient record across ecosystem
 - Automated workflows
 - Consolidation & rewrite of clinical systems
- Phased approach to target ~50 clinics and ~9 Cognos reports initially. Eventual deployment was done to over 3000 clinical with 50+ reports
- Provides a single pane of glass for creating new clinical orders, updating patient information, generating flowsheets, creating lab requisitions, analysis reports, teammate dialysis schedule etc.

Value Delivered:

- Single source of truth for all clinics and apps reducing data redundancy, legacy maintenance effort & error rates
- Superior patient, physician & teammate experience with single application for all clinical operations increasing staff productivity and reduction in burnout

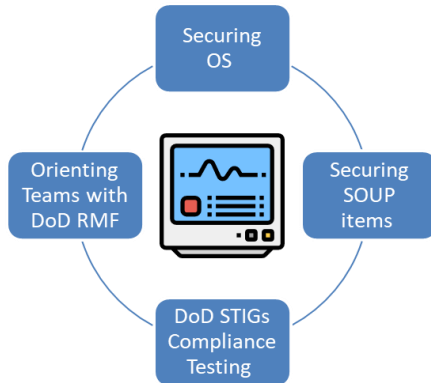
Case Study: Securing Central Station

Client Requirements

Customer is a leader in medical device industry and medical device systems.

Customer engaged CitiusTech to perform vulnerability assessment for OS and all SOUP items of Central Station (SOUP items are third party software's installed in medical devices), carryout STIG compliance testing, orient the Monitoring Solution's Engineering team with DoD RMF process.

Central Station receives data from multiple bedside monitors in the ICU. Nurses can remotely monitor patient data/status from one central station, thus increasing efficiency.



Solution Schematic

CitiusTech Services:

- CitiusTech carried out OS Vulnerability assessment and found 35+ OS level vulnerabilities. Identified, analyzed & deployed all required OS patches
- CitiusTech carried out manual vulnerability assessment for all SOUP items. Found 145+ vulnerabilities. Identified and addressed all vulnerable SOUP items
- CitiusTech conducted knowledge sharing session on DoD RMF and trained 35-40 Engineers with DoD RMF processes
- CitiusTech conducted STIG Compliance testing and found 150+ non-compliant implementations which needed to be addressed prior to releasing the product

Value Delivered:

- All identified Items were successfully upgraded addressing critical system level security vulnerabilities
- Provided a detailed assessment on how the existing vulnerabilities could be exploited by malicious actors to compromise the patient care process.
- Sensitized the engineering leadership to conduct similar assessments across the entire product portfolio

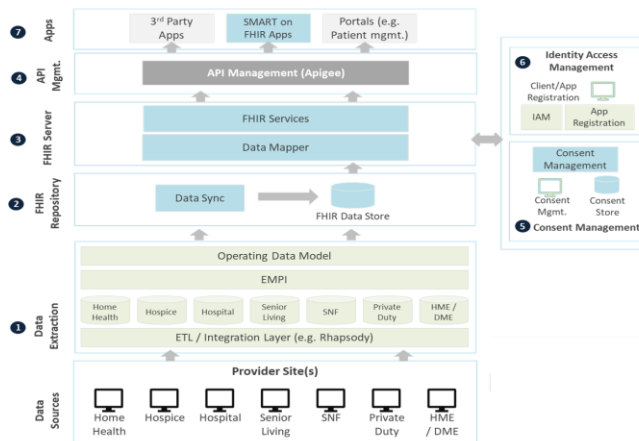
Case Study: FHIR based Consent Management

Client Requirements

Client is a leading provider of respiratory care and sleep solutions.

Client was building a data platform for providing longitudinal health record of patients across post acute care settings. Client required help in accelerating FHIR adoption for its data platform.

Client partnered with CitiusTech to define FHIR interoperability strategy and assist with unified consent management solution across care settings



Solution Schematic

CitiusTech Services:

- CitiusTech assessed client's post acute care platform and interoperability roadmap. CitiusTech services included:
- Provided recommendations for implementing FHIR server, security, consent management, ETL and data mapping
- Enabled FHIR resource and data level patient consent for sharing health data
- Assisted with consent roadmap - Member level consent, Security labelling, 'Purpose of use', consent for Partial sharing, Break the glass, Care Team data sharing, etc.
- Built Consent management framework to manage patient consents, configure business rules and created consent repository
- Suggested enhancements in consent portal to handle scenario where new actors are managing consent on behalf of patients
- Addressed multi-tenancy, scalability and performance related challenges for FHIR platform

Value Delivered:

- Leveraged CitiusTech accelerators for FHIR server and data management to drive adoption of care coordination
- Enhanced consent management workflows to ensure compliance with Federal & State law

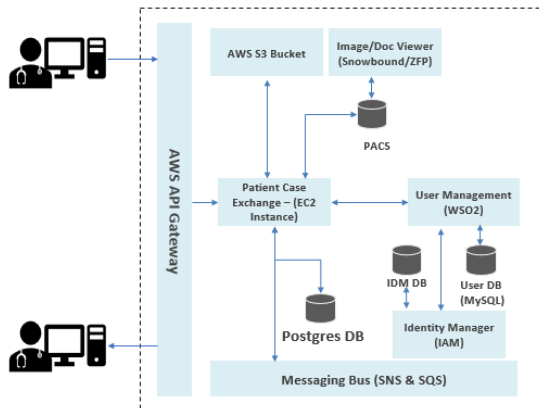
Case Study: Case Exchange & Image Archive Platform

Client Requirements

Client is one of the largest provider of medical imaging systems and scanners.

In order to increase care collaboration & enable faster diagnosis of the patient, client needed to dynamically share cases & connect with the physician, radiologist and other disciplinary team and wanted to build a seamless solution for case exchange between them

CitiusTech was selected for this engagement given its cloud expertise and deep working knowledge of the client's ecosystem



Solution Schematic

CitiusTech Services:

- Enabled case exchange for everyone in the clinical network including the patient
- Developed deduplication functionality for imaging studies to get longitudinal imaging records
- Enabled Uploading of images from edge device to cloud and downloading the images from cloud to edge
- Auto routing functionality for the scans was developed to the available radiologist
- Developed Case locking feature for concurrent users

Value Delivered:

- CitiusTech's strong cloud deployment capabilities helped minimize the solution turn-around time
- Enabled loosely affiliated healthcare providers to share relevant images and associated information quickly and accurately
- Enhanced quality of diagnosis and care by delivering providers the information they need at the right time from anywhere
- Expedited access to patient case during time critical processes (e.g. Emergency room, Operation theatre)

Case Study: Imaging Cohort Builder

Client Requirements

Client is a leading healthcare provider services across US with strong presence in provider network. Client is also involved in multiple research projects and has a solution that helps in identifying patient cohorts which could be used for research.

Existing application has lot of limitation for cohort building and data extraction, in order to address it client wanted to develop an easy to use, self service tool to identify cohorts and extract imaging studies from their cloud platform for research and/or business development.

CitiusTech was selected for this engagement for its deep understanding on imaging domain and expertise around the DICOM and FHIR

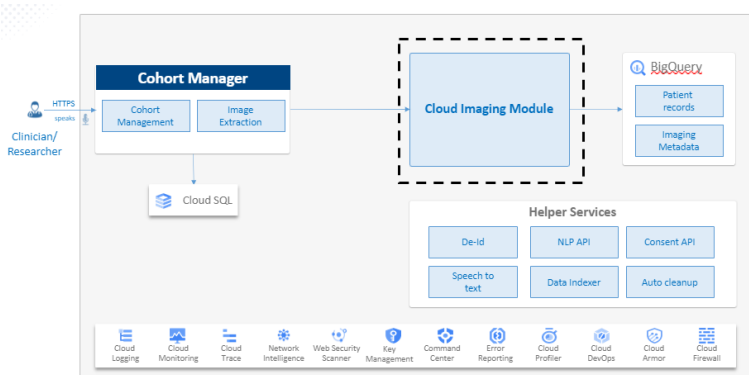
CitiusTech Services:

CitiusTech with domain expertise in medical imaging, cloud partnership and strong technology footprint was asked to build an application (UI concept) which will have the following capabilities:

- Provide a smart search functionality so that the user can search for cohort based on keywords/terms.
- Integrate the cloud cohort Builder with OHIF viewer to collectively view all the Patient/Study data
- Integrate with GCP data repositories on cloud (DICOM/FHIR stores) by leveraging GCP Health API and cloud infra services.

Value Delivered:

- CitiusTech developed a completely cloud native Imaging Cohort tool to allow metadata-based radiology images search
- Integrated NLP capabilities to search cohorts with speech commands
- The solution reduces the manual cohort data extraction for identified cohort.
- Solution is scalable addressing the multi centric approach with IRB validation, viewer integration and auditability
- As a result, the initiative led to reduction of effort which led to cost savings and addressed the needs & pain points effectively.



Solution Schematic