



SUCCESS STORY MEDICAL DEVICES

PROTEUS MAXIMIZES FIRST-MOVER EDGE IN DIGITAL THERAPIES WITH AWS

Apexon supports end-to-end development lifecycle for healthcare innovator

Proteus is a digital health company that is revolutionizing the life sciences industry with groundbreaking solutions that manage and monitor medical care to improve patient outcomes.

The company's flagship product, Proteus Discover, combines an ingestible sensor, a small wearable sensor patch, a mobile application, and a provider portal. All connected, these elements unlock previously unattainable treatment insights for better clinical outcomes.

Proteus was looking to accelerate its development lifecycle to speed FDA approval and maximize its first-to-market advantage. They had mastered the frontend clinical and diagnostic aspects of the solution but needed help on the backend software development and connectivity and interaction between the different solution elements.

proteus[®]
DIGITAL HEALTH



SERVING 150M PEOPLE REQUIRING NEW FORMS OF THERAPY



540+ PATENTS RECEIVED



1,000+ SYSTEM USE PROTEUS DISCOVER



99.1% POSITIVE DETECTION ACCURACY*



97.6% OVERALL ACCURACY*

* Based on more than 60 studies with more than 500 participants in over 10 years



Apexon worked with Proteus (beginning in 2013) across the end-to-end lifecycle - from application development and software verification and validation to system integration and device expansion. Apexon not only designed a test lab in-house with Patch Test Apparatus (PTA), amplifier and shaker humanoid setup as well as a stimulation setup for patch and firmware testing.

THE CUSTOMER JOURNEY

2013

- Proteus Legacy PL Viewer Systems, V&V & SI

2014

- Development on Android platform

2015

- Development on iOS platform
- Firmware integration

2016

- Re-architecting product
- Portal automation

2017

- Mobile automation
- Simulation & Hooks
- Cloud integration & HIPAA compliance

2018

- Platform release & go-to-market
- MYCITE® deal signed

2019

- Product engineering for mental health Discover & MYCITE®

THE RESULTS

KEY OUTCOMES



FASTER CYCLE TIME

Worked with Proteus across the entire development journey to **speed time-to-market**.



PREDICTED ANALYSIS

Shared predictive analysis of test case requirements enabling a **high level of automation**.



AUTOMATED

1000+ records.



TESTING REQUIREMENTS

Automated **over 65%** of testing requirements using Selenium framework.



TESTING TIME

40% reduction in app testing time.

OUR METHODOLOGY

THE DIGITAL LIFECYCLE

For Proteus, Apexon worked across all 3 stages of the digital lifecycle on multiple projects.



GO DIGITAL

LAUNCH & EXPERIMENT

Enable digital adoption in a quick and agile manner

Apexon Exploration Pod worked with the Proteus team for ideation & blueprinting.

The Blueprinting phase focused on user interviews, personas, analysis, brainstorming, scenario identification and assumption validation to translate ideas into MVP solution requirements and UI/UX design.

Apexon also designed the communication mechanism between the patch, Mobile Apps & Backend. The team also designed & detailed solution architecture and defined the KPIs to track the project.

Apexon team then set up a framework for capturing actionable project intelligence (matrices) aligned to the project KPIs. Apexon team used in-house accelerators such as IoT companion App framework & BLE Framework coupled with our methodologies to provide rapid prototyping and MVPs.

EXPLORATION POD

A multidisciplinary team that studies requirements, develops strategy and defines product



BE DIGITAL

AUTOMATE & ACCELERATE

Build digital infrastructure and foundation for enterprises to scale

Apexon Execution Pod consisting of Backend Squad, Mobile Development Squad & Web Development Squad started maturing the product as per the defined roadmap.

The development team added new UI features, enhanced communication mechanisms, fixed defects and integrated with Google Analytics & Swrve SDK and New Relic to capture analytics data.

The QA team worked on end-to-end system integration tests involving Patch, Cloud, App & Backend. Apexon also automated test scripting and maintenance during sprint-cycle.

Apexon tested BLE and app performance on devices and created real-life test scenarios for the mobile app in use with medication intake in compliance with FDA protocols.

EXECUTION POD

A cross-functional team that implements strategies



EVOLVE DIGITAL

BE INTELLIGENT & AUTONOMOUS

Leverage data engineering to make strategic decisions and get digital right every time

As a part of continuous evolution, Apexon Execution Pod focused on helping Proteus grow by enabling other innovators to develop applications that could work with the Proteus digital pill & patch.

In addition to app enhancements, the Execution Pod developed two SDKs: a BLE-based framework to receive, parse and store patch data in a database, and a Design Mobile Application UI.

Apexon also enabled the continuous tracking of KPIs via the continuous collection of select operational and business data from the project and the ability to generate insights from the collected data.

THE CHALLENGE

A COMPLEX VISION

Proteus' product vision was incredibly compelling but executing on that vision was also complex. The company's core competence was on the frontend – with breakthrough integrations of technology with medicine and in-patient care. However, they had several critical needs on the backend:



Management of regulatory compliance requirements within software product development



Short lead times for product launches in multiple geographies



Time-to-market challenges that prevented proper discipline across the product lifecycle



Bluetooth (BLE) connectivity across multiple devices



Greater control of cost of technology infrastructure; desire to move to an on-demand model



The ability to scale quickly with the increase in the number of connected medical devices and patient networks

THE SOLUTION

SOLVING ONE OF THE TOUGHEST DIGITAL ENGINEERING CHALLENGES

Apexon worked with the company across the entire delivery lifecycle:



APPLICATION DEVELOPMENT

- Apexon enabled the mobile application to communicate continuously via BLE with the patch worn by the patient. Apexon also supported the company on several other development projects including the middleware for the core company application (both Android and iOS), as well as the web frontend portal for the standard patient application.
- The development team added new UI features, enhanced communication mechanisms, and fixed defects.
- It also added new features and improved existing features in the Patient & Provider App in a 2-week development sprint.
- The team worked on the Integration with Google Analytics & Swrve SDK to capture analytics data and with New Relic to capture Application Crash details.



SOFTWARE VERIFICATION & VALIDATION

- Apexon created an end-to-end process to test and QA the entire service offering across the end-to-end application lifecycle. This included:
 - Manual testing of the mobile app
 - Automated testing and QA of the connection of the frontend, backend and middleware
 - Real-life scenarios for testing the mobile app (Patch testing apparatus), physical motion (Step, Incline), medication intake, heartbeat, etc. in addition to generating FDA compliant protocols and documents
- Apexon also configured & broke BLE signals using Hoffman Box for the interruption testing and the app performance on devices - CPU, Memory usage as a part of Performance Testing.



SYSTEMS INTEGRATION & DEVICE EXPANSION

- Apexon set-up a test center to replicate how the systems would operate and communicate with each other in real life.
- This included end to end integration tests involving Patch, Cloud, App & Backend.
- Apexon automated test scripting and maintenance during sprint-cycle. The team was able to automate 600 test cases per platform daily for regression tests.



CLOUD MIGRATION

- Built a 'Gap-Analysis' matrix of Proteus' cloud requirements and recommended AWS as the best choice.
- Leveraged AWS services to enable end-to-end cloud setup, build and deployment in the Proteus production environments.

AWS Lambda - to process medication and patient vitals; Overall cost saving due to this architecture was around 25%.

AWS API Gateway and CloudWatch - as a proxy middleware service to accept HTTP traffic from IoT Gateway and collect data from patient sensor device.

AWS DynamoDB Database - to build a scalable NoSQL database to store Patient data.

AWS CloudTrail - to monitor infrastructure changes and API logs.

Identify and Access Management - to manage AWS users, groups and roles for various services.

AWS Key Management

- to maintain and manage encryption keys for data access protection for HIPAA compliance.

Storage S3, OLAP Redshift, and Data Pipeline - to transform and store patient data for analytics.

AWS VPC, Subnet, Security Groups

- to protect the overall Proteus network and enable access protocols and procedure of AWS cloud resources.

AWS Cognito, STS, SNS - to enable authentication, Security Token Service, and Simple notification service and ensure secure collaboration between physicians, patients, and other users.



SERVICES USED



AWS
Lambda



AWS
API Gateway



AWS
CloudWatch



AWS DynamoDB
Database



AWS
CloudTrail



AWS Key
Management



Amazon Virtual
Private Cloud



AWS
Cognito



AWS STS



AWS SNS

APEXON ALSO DELIVERED SEVERAL OTHER CRITICAL CAPABILITIES FOR PROTEUS:



SECURE, CONTINUOUS COMMUNICATION

via BLE between the Patch and
mobile device and backend systems.



SIMULTANEOUS TESTING

on various mobile devices.



EXTENSION OF EXISTING FRAMEWORKS AND TOOLS

to include more advanced
functionalities.



Apexon is a pure-play digital engineering services firm focused on helping companies accelerate their digital initiatives from strategy and planning through execution. We leverage deep technical expertise, Agile methodologies and data-driven intelligence to modernize systems of engagement and simplify human/tech interaction.

We deliver custom solutions that meet customers' technology needs wherever they are in their digital lifecycle. Backed by Goldman Sachs and Everstone Capital, Apexon works with both large enterprises and emerging innovators — putting digital to work to enable new products and business models, engage with customers in new ways, and create sustainable competitive differentiation.



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FEELING SOCIAL?

