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CASE STUDY

# Smart Pet Dish: AI-Powered Pet Wellness Platform

A leading U.S. pet wellness brand partnered with Anuyat to build an AI-enabled connected dish system that helps pet owners monitor feeding habits, nutrition, and health patterns in real time.

We engineered a distributed IoT-cloud platform linking smart dishes, mobile apps, AI analytics, and e-commerce systems — transforming traditional feeding into data-driven wellness management.

The result: predictive insights, seamless e-commerce integrations, and a 50% reduction in manual support incidents across 20,000+ active devices.


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## Client Details

A top U.S. distributor and retail brand specializing in pet wellness products across 180+ stores and online channels. With increasing demand for connected pet solutions, the company wanted to extend its ecosystem into smart IoT devices — starting with an intelligent dish that could monitor feeding, detect anomalies, and sync with existing wellness apps and stores.

## Business Context

Existing e-commerce, loyalty, and mobile systems operated in silos, limiting the ability to unify device data, user profiles, and purchase behavior into a single analytics layer.

Maintaining accurate and continuous telemetry from thousands of smart dishes across varied home networks required an offline-tolerant architecture with secure, low-latency synchronization.

The client sought to move beyond reactive tracking toward AI-powered personalization — offering diet insights, refill reminders, and predictive alerts to enhance user retention and drive repeat purchases.

- **Fragmented Ecosystem**
- **IoT Reliability & Data Integrity**
- **Personalization & Engagement**

## Technical Challenges (Few of many)

**IoT Reliability**
Ensuring stable device-to-cloud sync

**Data Overload**
Managing continuous multi-sensor streams

**System Integration**
Bridging e-commerce and IoT workflows

## Anuyat Solution

Anuyat engineered a **multi-layer, AI-enabled IoT platform** that seamlessly connects smart dishes, user apps, and enterprise systems.
The goal was to transform standalone feeding devices into an i**ntelligent, cloud-connected wellness network** capable of collecting, analyzing, and acting on real-time behavioral data.

Built on a **modular, distributed architecture**, the system ensures reliability, scalability, and continuous operation — even in offline environments — while maintaining end-to-end security and compliance.

**Edge Architecture**
Offline devices with real-time sync

**Predictive Intelligence**
AI-driven feeding behavior insights

**API Standardization**
Unified communication across systems

**Ecosystem Integration**
Seamless link between app and IoT

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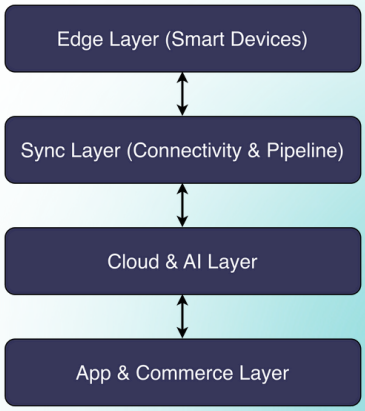
# System Architecture

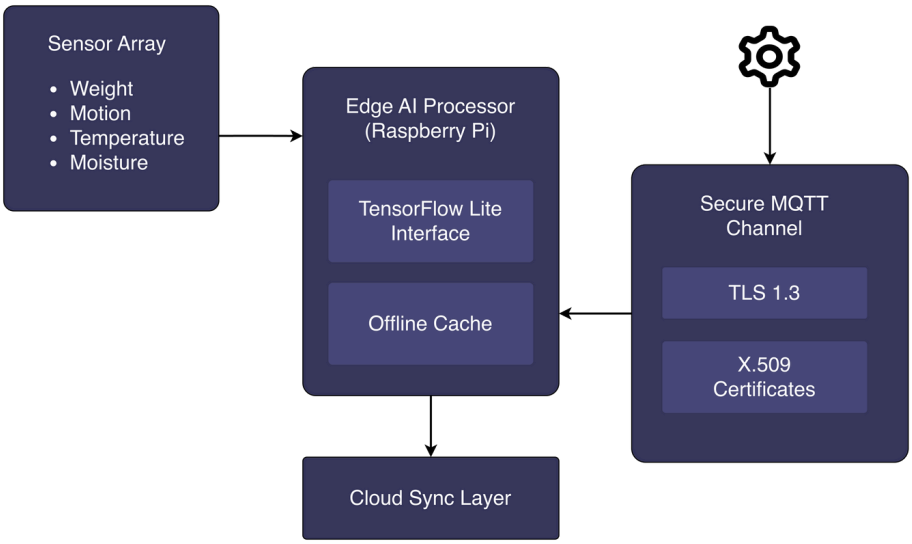
We built a distributed IoT–cloud architecture engineered for reliability, scalability, and offline resilience. Each smart dish functions as an autonomous edge node with local intelligence, real-time data caching, and secure synchronization to the enterprise cloud.




**Edge Layer (Smart Device Intelligence)**

- The Smart Pet Dish functions as an intelligent IoT node powered by a Raspberry Pi controller with multi-sensor input, local caching, and secure cloud connectivity.
- Key Components
- Raspberry Pi Controller – Runs firmware, manages sensor I/O, and executes TensorFlow Lite inference.
- Sensor Array – Monitors feeding, motion, and environment for anomaly detection.
- Local Queue & Cache – Buffers telemetry and syncs automatically when online.
- Edge AI Engine – Processes events locally, reducing data transmission overhead.
- Secure MQTT Channel – TLS-encrypted link to AWS IoT Core with per-device authentication.
- OTA & Diagnostics – Remote firmware updates and local health monitoring.

Result: Each dish acts as a self-reliant edge node, ensuring accurate, secure, and continuous pet wellness tracking even offline.

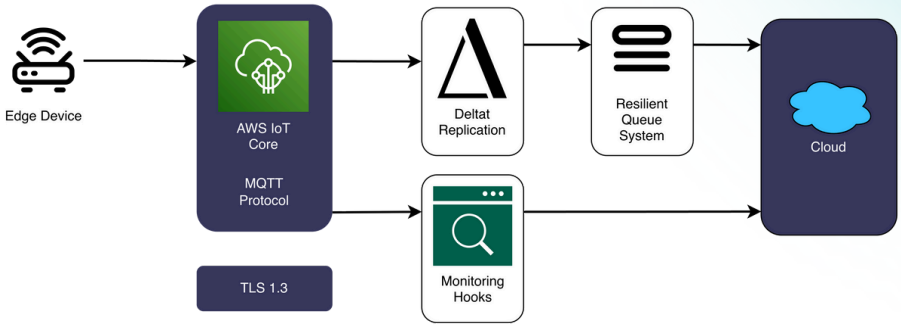


**Sync Layer (Connectivity & Pipeline)**

The Sync Layer ensures reliable, secure, and low-latency communication between thousands of edge devices and the cloud. It manages data flow, authentication, and delivery under variable home network conditions.

- AWS IoT Core – Manages device identities, topics, and policy-based access control.
- MQTT Protocol – Enables lightweight, real-time message exchange between devices and cloud.
- Delta Replication – Transfers only incremental updates to minimize bandwidth usage.
- Resilient Queue System – Handles retries, deduplication, and back-pressure control.
- Data Encryption – TLS 1.3 ensures end-to-end secure communication.
- Monitoring Hooks – CloudWatch and OpenTelemetry for event tracing and latency visibility.

Result: A fault-tolerant data pipeline that maintains synchronization, consistency, and security across all connected pet wellness devices.



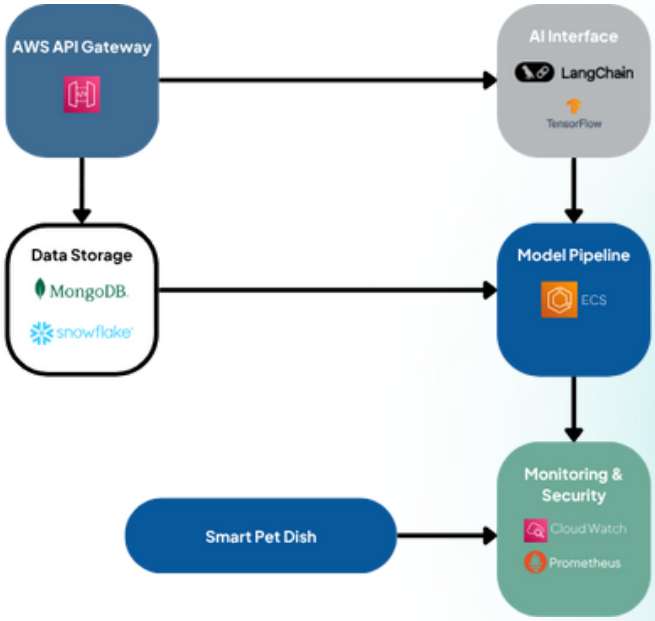

**Cloud & AI Layer**

The Cloud & AI Layer serves as the system's intelligence core — processing data, running analytics, and generating real-time insights.

- API Gateway – Node.js services managing routing, auth, and version control.
- Data Storage – MongoDB for live telemetry, Snowflake for analytics.
- AI Inference – TensorFlow + LangChain models detect feeding anomalies and predict habits.
- Model Pipeline – AWS ECS jobs for periodic retraining and updates.
- Monitoring & Security – CloudWatch and Prometheus for observability and compliance.

Result: A scalable intelligence hub converting IoT data into actionable, personalized wellness insights.

Diagram - Cloud & AI Layer

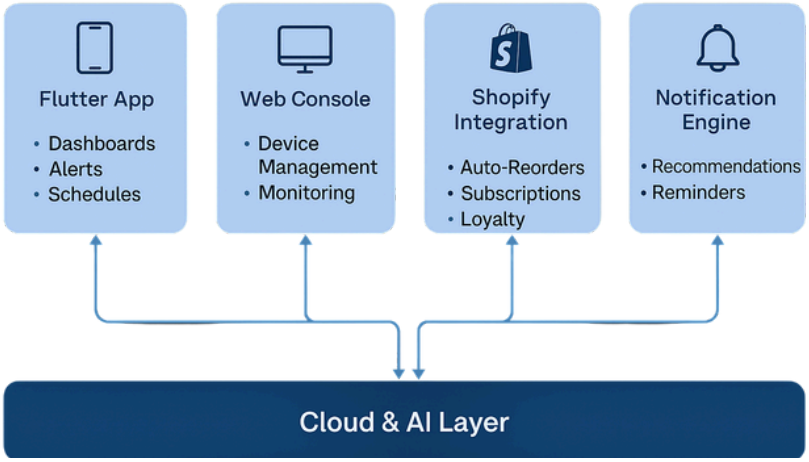



**App & Commerce Layer**

The App & Commerce Layer connects pet wellness insights with digital engagement, combining control, analytics, and commerce into one experience.

- **Flutter App** – Real-time dashboards, alerts, and feeding schedules.
- **Web Console** – Device management and performance monitoring.
- **Shopify Integration** – Auto-reorders, subscriptions, and loyalty rewards.
- **CRM Sync** – Unified customer profiles and engagement data.
- **Notification Engine** – AI-driven recommendations and reminders.

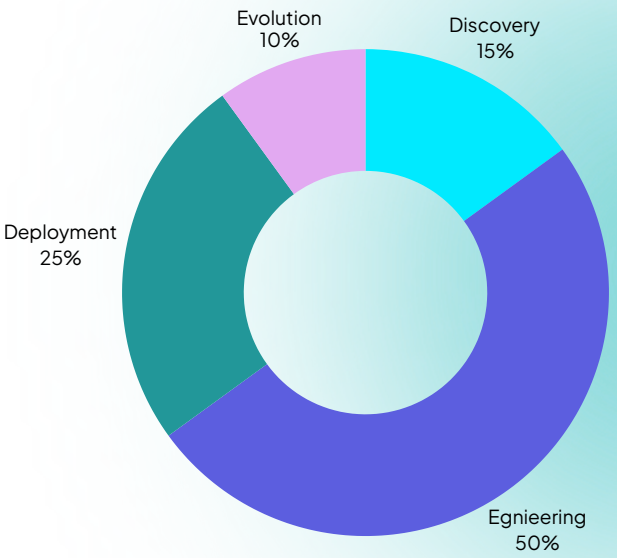
Result:
A unified experience layer combining connected wellness and automated commerce to boost retention and recurring revenue.

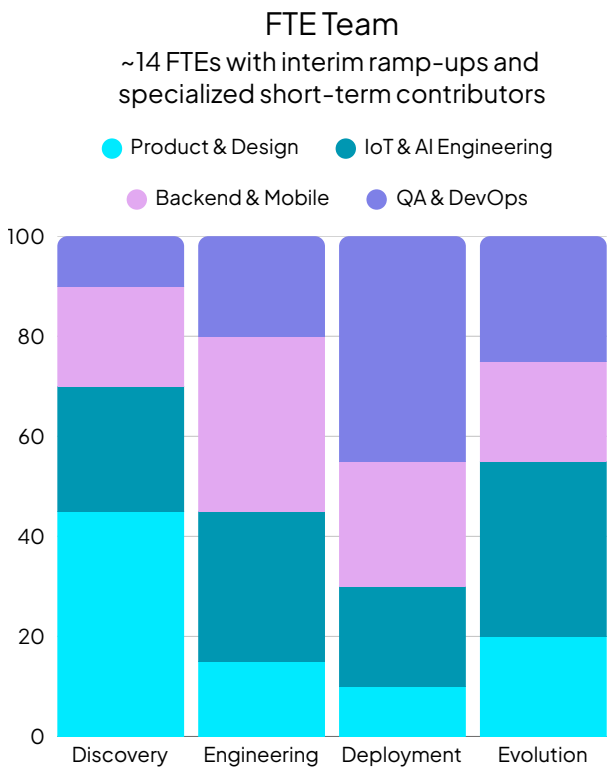


# Engineering Process & Methodology

**Aligned with Anuyat's A3F Methodology**

- **Discovery** — Conducted feasibility studies, defined IoT data models, and established security baselines for connected devices.
- **Engineering** — Built modular microservices, developed Flutter apps, and implemented TensorFlow Lite inference for edge AI.
- **Deployment** — Automated OTA updates and testing pipelines using Jenkins, Docker, and Playwright for reliable rollouts.
- **Evolution** — Enabled continuous telemetry, AI retraining, and UX optimization through CloudWatch and Prometheus.




**Team Composition**

- **Discovery** — Conducted feasibility studies for sensor calibration, IoT connectivity, and data synchronization between devices and cloud systems.
- **Engineering** — Developed modular microservices, Flutter mobile UIs, and TensorFlow Lite–based edge intelligence aligned with A3F design principles.
- **Deployment** — Automated OTA firmware releases and testing pipelines using Jenkins, Docker, and MQTT simulators for scalable rollout.
- **Evolution** — Implemented continuous telemetry with CloudWatch and Prometheus to refine AI models and enhance user experience through real-time insights.

**Tech Stack Summary**

The In-Flight Entertainment platform was engineered using a modern, cloud-native stack designed for scalability, resilience, and intelligent automation. Each layer was purpose-built to align with Anuyat's A3F engineering principles, ensuring rapid iteration, modular deployment, and continuous optimization across devices and environments.

| | | |
|---|---|---|
| Device Firmware | Raspberry Pi, MQTT | Local data collection, sensor fusion, and offline sync |
| Frontend | Flutter | Unified mobile app and web dashboard |
| Backend | node, ex | API gateway, data orchestration, and event routing |
| Database | MongoDB., snowflake | Real-time telemetry and analytical data warehousing |
| AI | LangChain, TensorFlow | Feeding behavior detection and predictive analytics |
| Infrastructure | Cloud Watch, ECS, IOT Core, S3 | Secure connectivity, container orchestration, and observability |
| DevOps | Jenkins, docker, Terraform | CI/CD pipelines and OTA firmware deployment |

**Security, Compliance & Observability**

- End-to-end encryption (TLS 1.3) and X.509 device authentication
- Role-based access via AWS Cognito
- PII anonymization aligned with GDPR compliance
- Continuous scanning with Snyk and SonarQube
- Real-time monitoring via Prometheus, Grafana, and CloudWatch Logs

## Results & Outcomes

Through the A3F-guided engineering process, the Smart Pet Dish platform achieved 65% faster data processing, 70% improved device-cloud sync reliability, and 50% fewer support incidents through proactive anomaly detection and predictive maintenance.

With AI-driven personalization for over 20,000+ connected devices, the system transformed everyday feeding into a data-driven pet wellness experience that bridges IoT, analytics, and commerce.


**Business Impact Summary**

- **Unified Experience:** Delivered a seamless pet wellness ecosystem integrating smart devices, mobile apps, and cloud AI for real-time insights.
- **Operational Efficiency:** Reduced manual support and troubleshooting time through predictive monitoring and OTA automation.
- **Customer Retention:** Increased repeat purchases via automated reorder recommendations and personalized product offers.
- **Scalable AI Foundation:** Established a flexible architecture supporting continuous model retraining and future connected product launches.