

Kisan Sahayak AI **Architecture**

A modern, AI-powered microservices ecosystem designed for agricultural scalability and impact.

System Overview

A decoupled, highly available, and secure microservices architecture bridging advanced Python AI models with a robust Spring Boot backend.

Architectural Paradigm

- **Separation of Concerns:** Transactional workloads (Java) are strictly isolated from computationally heavy AI modeling (Python).
- **Single Entry Point:** Spring Cloud Gateway routes all incoming traffic, shielding the internal network.
- **Dynamic Discovery:** Eureka Server enables seamless scaling, health checking, and automatic service location.
- **Client Experience:** A responsive Progressive Web App (PWA) built on Angular ensures cross-platform accessibility for farmers.



Gateway & Client Layer



Angular PWA

The primary interface for farmers and administrators, optimized for low bandwidth and mobile-first interactions.



Spring Cloud Gateway

Acts as the centralized entry point.
Manages internal routing, load balancing, rate limiting, and CORS handling.



Security Validation

Ensures that all incoming requests are authenticated via JWT before routing traffic to the internal private subnets.

Spring Boot **Microservices**



User & Scheme Service

Manages farmer profiles, authentication flows, and determines government scheme eligibility.



Crop & Yield Service

Handles core farm data, maps soil types, and calculates expected yields based on historical data.



IoT & Weather Service

Consumes IMD APIs and real-time farm sensor telemetry to dispatch urgent automated alerts.

Python **AI Services**

Model Ecosystem

A dedicated Flask/FastAPI service hosting optimized .pkl machine learning models. It exposes lightning-fast REST endpoints for critical operations including Crop Recommendation, Fertilizer Planning, and visual Disease Detection via image processing.

Core Integrations

Bridging the transactional Spring Boot environment with deep learning capabilities. Internal services query this layer securely to aggregate predictive analytics directly into the farmer's unified dashboard view.

Memory-Based **AI Assistant**

The Challenge

Farmers require accessible, multilingual AI support (both Text + Voice) to navigate scattered information across government schemes and complex crop manuals. Static, stateless chatbots fail to provide contextual, multi-turn conversational experiences.

The AWS Solution

A completely serverless Memory-based RAG (Retrieval-Augmented Generation) AI Assistant. It unifies Text and Voice queries, leveraging Amazon Bedrock for generative intelligence and DynamoDB for persistent chat memory.

Serverless RAG Flow



Lambda & Gateway

API Gateway routes requests. AWS Lambda orchestrates text/voice business logic, handles cross-origin requests, retrieves chat history, and calls Bedrock for completions.



Amazon Bedrock KB

Splits extensive agricultural documents into chunks, storing embeddings in OpenSearch Serverless. Uses the `retrieve_and_generate` API for contextual RAG responses.



Transcribe & Polly

Voice queries sent in base64 are converted to text via Amazon Transcribe. Multilingual RAG responses are synthesized back into natural audio via Amazon Polly.

State & Knowledge Storage

DynamoDB: Chat Memory

- **Table:** KisanChatMemory
- **Partition Key:** session_id
- Stores the conversation messages array efficiently.
- Maintains the last 5 exchanges to enable highly contextual, multi-turn interactions.

Amazon S3: Data Lake

- Stores foundational Knowledge Base documents (PDF, DOCX) such as farming manuals and scheme details.
- Acts as a secure, temporary storage layer for incoming base64 voice audio files.
- Synchronized via GitHub CI/CD workflows for continuous document updates.

Ecosystem Integrations

3+

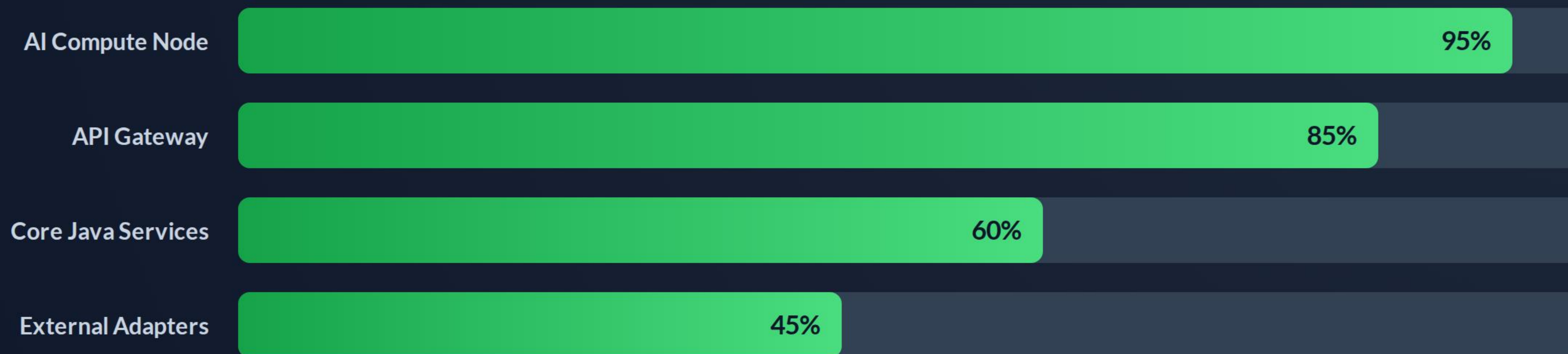
Major API Streams

Connected to the Grid

The architecture relies on high-fidelity external data sources to empower the farmer. The Mandi Service connects directly to **Data.gov.in** and **Agmarknet** for daily market prices.





The Weather Service ingests localized forecasts from **IMD APIs**, while the Admin Service utilizes AWS for resilient, secure, and infinitely scalable document storage.

Scalability Profile

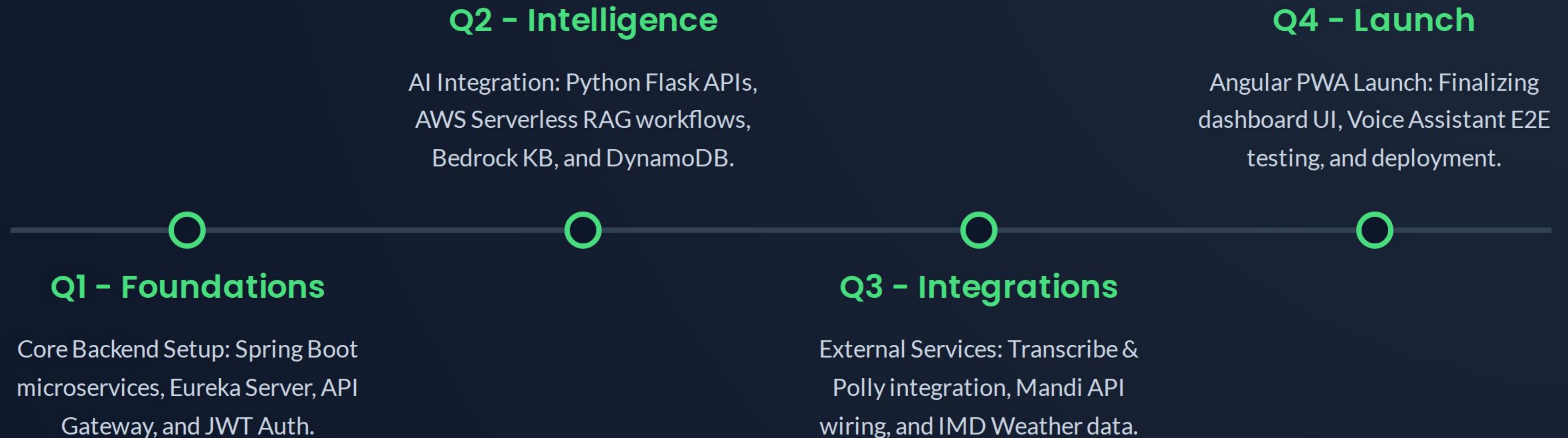


Decoupling ML inference and AWS Serverless flows from Core Services allows independent horizontal scaling. The AI nodes can dynamically scale up to 95% capacity during peak seasons without impacting standard application usage.

Defense in Depth

-  **JWT Authentication:** Stateless, highly scalable token validation is strictly handled at the API Gateway level to sanitize all inbound traffic.
-  **Network Isolation:** Core domain and AI services reside in a Virtual Private Cloud (VPC) subnet, completely inaccessible directly from the internet.
-  **IAM Least Privilege:** Serverless AWS Lambda functions execute under strict IAM roles, limiting access solely to designated S3 buckets, DynamoDB tables, and Bedrock models.
-  **Data Segregation:** A strict database-per-service pattern is enforced to ensure bounded context, limiting the blast radius of any potential compromise.

Development Phases





Empowering the Future

Bringing enterprise-grade, highly available, and intelligent microservices architecture directly to the grassroots of Indian agriculture.

Questions?

Thank you for your attention and time.

www.kisansahayakai.in | contact@kisansahayakai.in

Image Sources



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