Email as an AI Endpoint

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***Abstract*—The proliferation of siloed AI services, most with unique endpoints and interfaces, creates integration challenges and adoption barriers for enterprises. We present an architectural pattern that adopts existing email interfaces as standard AI endpoints, enabling organizations to deploy AI services through familiar email workflows. Our approach implements a three-layer architecture: email interface, webhook service, and AI orchestration. We demonstrate that email's inherent characteristics of broad accessibility and asynchronous processing provide distinct advantages for enterprise AI integration, enabling progressive adoption without disrupting existing business processes. A public demonstration of this architecture is available by sending email to interface@integralbi.ai, allowing readers to interact with a production deployment of the architecture.**

***Index Terms*—enterprise AI, system architecture, email, webhook, workflow orchestration, asynchronous processing**

I. Introduction

The proliferation of siloed AI services, most with unique endpoints and interfaces, has created a paradoxical challenge: as AI applications become more powerful and numerous, the complexity of integrating them into existing business workflows limits their adoption. Organizations face mounting pressure to deploy AI tools while simultaneously managing a growing array of specialized interfaces, each requiring distinct security configurations, user training, and management overhead.

We present an architectural pattern that adopts email, a fundamental standard of business communication, as a standard endpoint for enterprise AI integration. This approach enables organizations to deploy AI capabilities behind their existing email infrastructure, allowing employees to interact with AI systems using familiar email workflows while technical teams manage backend operations. By adopting email addresses as AI endpoints, organizations can implement granular access controls and specialized AI workflows without disrupting established business processes. A public demonstration of this architecture is available by sending email to interface@integralbi.ai, allowing readers to interact with a production deployment of the architecture.

Our key contributions include:

1) A three-layer architectural pattern that simplifies AI integration through existing email infrastructure, demonstrating that sophisticated AI workflows can be orchestrated through familiar communication channels
2) Practical implementation patterns that leverage established enterprise security investments rather than imposing new security challenges
3) Insights into the advantages of asynchronous interaction patterns for enterprise AI deployment

This paper presents the design and implementation of Email-as-AI-Endpoint (EaaE). We show that email's inherent characteristics—broad accessibility, built-in authentication, and natural handling of asynchronous workflows—make it an attractive protocol for enterprise AI integration.

II. Related Work

Our development of this EaaE architecture pattern emerged directly from observed enterprise needs and practical systems integration experience. The approach was developed independently, focused on creating an immediately implementable solution rather than an assessment of research and theoretical foundations.

While there is substantial research into combining email and AI, it primarily focuses on specific email-centric problems such as missing attachment prediction, inbox summarization, phishing protection, and spam filtering. Research specifically addressing email as a standard endpoint for AI system integration is notably scarce.

In retrospective research, we identified one relevant academic work from Bhat et al. [1], who explored email-based workflow interfaces to business applications in 2008. While their work conceptually overlaps with ours in recognizing email's potential as a standard interface, their focus was theoretical and pre-dated the present AI capabilities. Their paper discussed architectural possibilities but did not present an implementable solution. In contrast, our work provides an actionable implementation pattern that can be deployed immediately. We detail specific technical approaches for:

1) Message flow and routing using modern network infrastructure
2) State management and workflow orchestration
3) Practical AI model integration patterns

The relative scarcity of research in email-based AI integration may be attributed to multiple factors:

1) The AI developer focus on synchronous interfaces (chat, web, mobile) to quickly demonstrate the intelligence and value of their service
2) The perception of email as legacy infrastructure rather than an integration vector
3) The rapid pace of enterprise AI adoption outpacing research cycles

Our work therefore presents a practical architecture pattern rather than a theoretical advancement. We draw primarily from industry experience in enterprise systems integration, networking, and email systems. The contribution lies in synthesizing these elements into an immediately implementable approach for using EaaE.

III. Architecture Pattern

Our architecture adopts standard email communications as structured AI interactions through three primary layers: the email layer, which serves as the standard interface; the webhook service layer, which handles message transformation and routing; and the AI orchestration layer, which processes requests and generates responses.

A. Email Layer

The email layer adopts the existing email inbox as the primary user interface, capitalizing on users' familiarity. This enables users to interact with AI services through their standard email clients without requiring additional software or training. Each AI service is assigned a dedicated email address, enabling role-based access and specialized processing pipelines.

The email layer handles message transmission and initial processing through standard SMTP/IMAP protocols. Its key responsibilities remain unchanged, such as: message validation, email parsing and sanitization, metadata extraction, and attachment processing. The layer serves as the critical first point of contact for all AI service requests, ensuring proper message handling and preparation for downstream processing.

Email security is maintained through existing enterprise security protocols, including SPF/DKIM validation for sender authentication, DMARC policy enforcement, transport layer encryption, content scanning, and attachment filtering.

B. Webhook Service Layer

The webhook service layer transforms email communications into structured data flows and manages routing to appropriate processing endpoints. The message transformation process begins with converting email content to standardized JSON payloads, preserving email metadata and threading information, and handling attachments.

Routing is performed using a multi-stage delivery process with standard internet protocols and proven enterprise technologies and is depicted in Figure 1. When an email arrives at an AI-enabled address, it is forwarded to a webhook service that can be deployed either locally within the enterprise network or as a cloud service. This service transforms the email into a JSON payload and sends it through a standard webhook delivery pipeline. The webhook delivery uses enterprise-standard routing mechanisms: subdomain resolution for organization-specific routing, dynamic DNS for endpoint management, router port forwarding for internal network direction, and reverse proxy for routing to specific AI orchestration components. This approach leverages widely-adopted, stable technologies to ensure reliable message delivery while maintaining proper separation of concerns.

C. AI Orchestration Layer

The AI orchestration layer, implemented using Langflow in our implementation, manages the processing of AI requests and generation of responses. This layer is depicted in Figure 2.

The processing begins with JSON payload parsing and validation, followed by email metadata and email content separation. Based on email attributes, the orchestration layer executes the tasks associated with the webhook URL and manages response generation. These tasks can be as simple as passing the email body into a prompt and through an LLM or they can be more complex agentic workflows - even sending their own message to trigger parallel AI processes or intermediate human interaction.

Response generation follows a structured approach, implementing template-based formatting, dynamic content assembly, and attachment handling where needed. The system ensures SMTP-compliant email composition and maintains proper threading in responses, providing an intuitive experience for users.

IV. Implementation

Our implementation discusses how the three-layer architecture can be deployed in a manner that maintains enterprise control over data flows and processing.

A. Email Layer Implementation

Implementing the email layer primarily involves configuring new email addresses for AI workflows within the existing email infrastructure. Organizations should first determine their AI email address strategy, including naming conventions and role-based addresses (e.g., hr.ai@company.com, docs.ai@company.com). For each address, configure forwarding rules to direct messages to the associated webhook processing service.

Key implementation decisions at this layer include access control policies and attachment handling. Organizations should configure whitelisting or blacklisting at the email address level to control which senders can interact with specific AI-enabled addresses. Additionally, establish clear policies for attachment handling - whether to process attachments, what file types to allow, and size limitations based on workflow requirements.

Organizations should also consider implementing batch processing strategies for resource-intensive AI tasks. This can be achieved by establishing email conventions for deadline specification (e.g., "process by EOD" or "urgent") which enable efficient scheduling of inference workloads. Companies can then batch similar requests and schedule them during off-hours or when computing resources are most available, optimizing resource utilization while still meeting user deadlines.

B. Webhook Service Layer Implementation

The primary implementation decision for the webhook service layer is whether to use a cloud-based service for email processing and webhook delivery or to implement these services internally. Cloud services can offer immediate scalability and simplified maintenance, while internal implementations

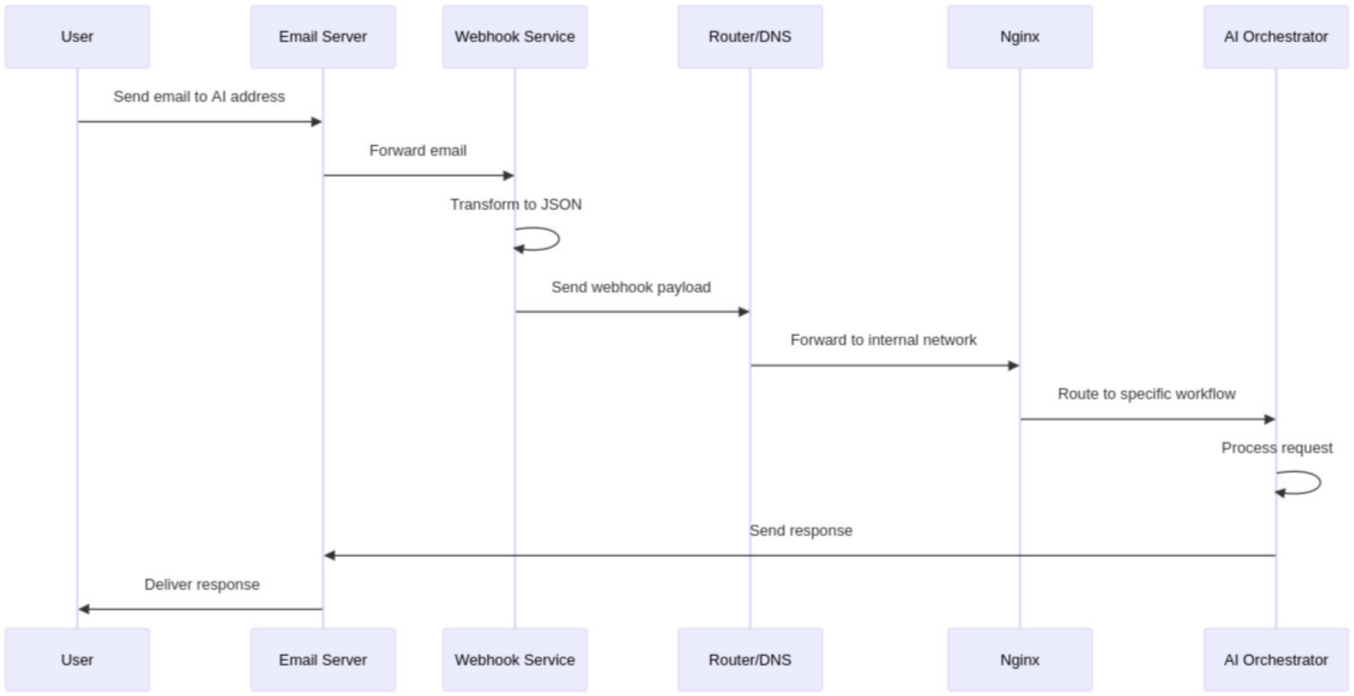

Fig. 1. Message Routing

provide maximum control over data flow and processing. Organizations with specific compliance requirements (HIPAA, SOC2, etc.) may need to carefully evaluate their options or implement hybrid approaches.

After selecting a webhook service approach, organizations must configure their message transmission. For email handling, this involves setting up the necessary DNS records to authenticate domains for sending and receiving email through the webhook service. For routing, organizations need to configure router port forwarding if using internal services, and establish the reverse proxy rules that will direct traffic to the AI orchestration layer.

C. AI Orchestration Layer Implementation

The AI orchestration layer is implemented within an environment such as Langflow, which runs as a server and is the primary platform for conducting AI interactions. We implement a plug-in architecture that supports multiple AI providers and models simultaneously, allowing organizations to integrate various AI capabilities including:

- Large Language Models (LLMs) for output generation
- Local LLMs for secure processing of sensitive data and deployment of proprietary fine-tuned models for organization-specific use cases
- External API integrations with providers such as OpenAI and Anthropic
- Vector databases for Retrieval Augmented Generation

Workflow orchestration can use a state machine architecture that manages the progression of email requests through various processing stages. We implement an asynchronous processing model that maintains responsiveness through intermediate status updates when necessary. The orchestrator maintains transaction logs and handles failure recovery, ensuring request persistence and processing reliability.

The response generation component utilizes a template engine that structures AI outputs into properly formatted email responses. Our implementation includes a custom SMTP sending component that manages email delivery while maintaining threading consistency and proper email headers. The system handles both simple responses and complex multipart messages that may include attachments or formatted content.

D. Performance and Security

Several key implementation decisions significantly impact system performance, security, and operating costs. At the email layer, organizations must implement appropriate access controls through whitelisting or blacklisting of email addresses, and establish clear policies for handling attachments, including size limits and permitted file types.

LLM context window management requires careful consideration. Organizations need to consider truncation processes for oversized inputs that exceed model context windows, as context window requirements directly impact model selection, hardware requirements, and API costs. Between user interactions, proper context reset mechanisms are essential to prevent cross-contamination between model interactions from multiple independent users.

Inference workload management can be implemented through complementary strategies. Batch processing can be enabled by having users specify processing deadlines in their emails, allowing for more efficient resource utilization during off-peak hours. A queue system with user notifications helps manage concurrent users and processing loads, ensuring a smooth user experience even during high-demand periods.

Model selection strategy is crucial for both performance and cost optimization. Organizations can implement hybrid approaches that use smaller, local models for simple tasks like email classification, while routing more complex tasks to cloud-based frontier models. This mixed approach can manage API costs and latency while maintaining high-quality outputs for intelligence-intensive tasks.

E. Reference Implementation

We maintain a public reference implementation of this architecture at interface@integralbi.ai. This deployment demonstrates the core capabilities of the system while operating with restricted computational resources to manage demonstration load. Organizations can interact with this implementation to understand the user experience and message flow patterns, though the demonstration system implements a subset of the full capabilities described in this paper.

The reference implementation provides:

- Immediate response acknowledgment
- Basic natural language interaction
- Demonstration of asynchronous processing patterns

V. Discussion

The EaaE architecture represents a significant departure from current enterprise AI deployment patterns, offering compelling advantages while presenting important implementation considerations. The primary benefit lies in leveraging existing email systems as standard AI endpoints, providing organizations a familiar channel for interacting with AI services that are deployed behind their existing infrastructure.

Our implementation demonstrates that email can serve as more than just another interface option – it functions as a compelling architectural layer for enterprise AI deployment. The ability to create role-specific AI email addresses enables organizations to implement granular access controls and specialized AI workflows while maintaining a familiar experience for end users. This approach particularly shines in enterprises with established email-centric workflows, where technical teams can optimize backend AI operations without disrupting user experience.

While email provides broad accessibility, it does present certain limitations in interactive features and introduces additional processing requirements. Organizations must carefully design their email response patterns and security protocols to balance convenience with robust protection, particularly when handling sensitive information and integrating with external AI services.

A. Leveraging Enterprise Infrastructure

A key advantage lies in utilizing existing enterprise email security investments. Organizations can extend their established authentication mechanisms, content filtering, encryption, and compliance tools to cover AI operations. This represents significant cost savings and risk reduction, as organizations leverage time-tested email security systems rather than implementing parallel security frameworks.

B. Asynchronous Advantages

Email's inherent asynchronous nature provides unexpected benefits for AI deployment. The general acceptance of email response latency enables more efficient resource utilization through batch processing, while reducing pressure to optimize for speed over quality. Complex, multi-step AI workflows can be handled naturally within the email paradigm, with built-in retry mechanisms and fallback processes functioning as users would expect from standard email communications. The asynchronous nature of email interactions creates natural space for deploying more sophisticated reasoning models and test-time compute that would be impractical in synchronous interfaces. This "latency masking" effect can lead to more cost-effective AI deployments while maintaining user satisfaction through alignment with existing business communication norms. For hardware manufacturers, this reduced emphasis on ultra-low latency could enable the development of more energy-efficient AI accelerators that prioritize throughput and batch processing capabilities over rapid individual inference.

C. Interface Strategy

EaaE provides enterprises with an additional option for AI deployment that shields end users from the constant churn of interfaces and capabilities. This architecture pattern works seamlessly with any standards-compliant email client, enabling progressive adoption without disrupting existing business processes or requiring new software deployment. For managers and employees, interacting with AI through email means focusing on their work rather than continually adapting to new tools and interfaces. IT departments benefit from simplified deployment through familiar email administration tools. This stability at the user interface level allows organizations to iterate and improve their AI capabilities without disrupting employees and business processes.

By abstracting AI services behind the email interface, organizations can avoid the organizational inertia that typically slows adoption of rapidly evolving AI tools. When AI capabilities are exposed directly through vendor-specific interfaces, organizations face significant switching costs in terms of user retraining, process modification, and potential resistance to change. EaaE eliminates these barriers—technical teams can evaluate and deploy new AI models or services without disrupting established user workflows or requiring additional change management. This flexibility allows organizations to consistently leverage best-of-breed AI capabilities while maintaining stable business processes.

D. Future Implications

Looking forward, this architectural pattern suggests several possibilities for enterprise AI adoption. Security and compliance frameworks can evolve naturally within established email

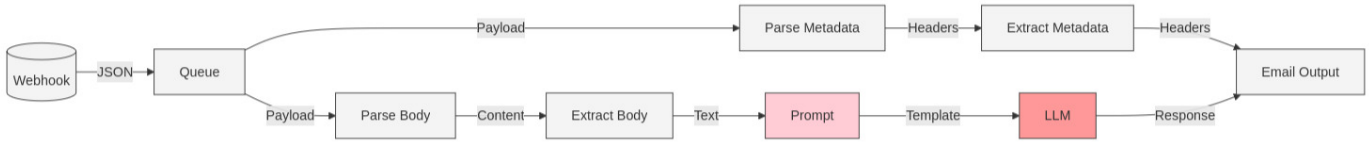

Fig. 2. AI Orchestration Layer Architecture

protocols. Organizations can implement multiple AI models and providers with seamless switching capabilities, deploy custom models for specialized tasks, and conduct systematic A/B testing to optimize performance. Workflow templating and business rule integration can be implemented progressively, with event handling and callback systems providing sophisticated process automation. Furthermore, the potential extends beyond internal operations. Organizations can extend AI accessibility to external stakeholders through specialized email addresses for customers, vendors, and partners.

The clear separation between user interface and AI infrastructure in this architecture points to an emerging organizational need—AI Workflow Engineers who bridge the gap between AI capabilities and domain-specific business processes. These specialists would combine deep understanding of AI model characteristics with business process expertise, designing and testing email-based workflows that effectively integrate AI into existing operations. This role evolution mirrors historical patterns seen with database administrators and web architects, where technological standardization enabled specialized professional disciplines. Such specialists would be responsible for architecting AI interactions that align with business objectives, optimizing response templates, designing multi-step workflows, and ensuring that AI capabilities are effectively mapped to organizational needs.

VI. Conclusion

The current state of enterprise AI adoption has created an opportunity for integration patterns that balance technological sophistication with practical deployment considerations. This paper has presented an architectural pattern that adopts email—a fundamental standard of business communication—as a standard endpoint for enterprise AI integration. By leveraging existing email infrastructure, this approach reduces the proliferation of siloed AI services, most with unique endpoints and interfaces, as a barrier to enterprise AI adoption.

Our key contributions include:

1) A three-layer architectural pattern that simplifies AI integration through existing email infrastructure, demonstrating that sophisticated AI workflows can be orchestrated through familiar communication channels
2) Practical implementation patterns that leverage established enterprise security investments rather than introducing new security considerations
3) Insights into the advantages of asynchronous interaction patterns for enterprise AI deployment

The EaaE pattern represents more than an alternative interface strategy—it provides a foundation for systematic enterprise AI adoption that can evolve alongside advancing AI capabilities. Our implementation demonstrates that this approach can support both current and emerging AI deployment patterns while maintaining enterprise security requirements and operational flexibility. Our public reference implementation at interface@integralbi.ai provides empirical validation of these architectural principles.

Future work in this area could explore several promising directions:

- Intermediate human intervention in AI processing tasks (EG: approvals)
- Investigation of complex multi-agent and RAG workflows orchestrated through email-based interactions
- Optimization of resource utilization patterns for high-volume enterprise deployments
- Integration patterns for emerging AI modalities beyond language models

As enterprises continue their AI transformation journeys, the use of EaaE provides a pragmatic path that builds upon existing infrastructure while enabling future innovation. By reducing the barriers to AI adoption through familiar interfaces, organizations can focus on deriving value from AI capabilities rather than managing new interaction paradigms.

References

[1] S. Bhat, C. Anantaram, and H. Jain, “An Architecture for Intelligent Email Based Workflow Interface to Business Applications,” in *2008 International Conference on Knowledge Management and Information Sharing*, 2008.