

Enterprise Bot & AI Reusable Code Factory

24 Production-Grade Modules, Zero-Vulnerability Security Protocols, Multi-Channel Messaging Adapters, and AI Agent Consumption Standards

Repository: <https://github.com/sh15aa/botserusable>

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Module Count: 24 Registered Production Modules

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1. Executive Summary & Philosophy

This library provides enterprise-grade, thoroughly tested modules for building conversational messaging bots, distributed asynchronous worker pipelines, and secure AI systems. It is structured for direct, zero-friction consumption by autonomous AI coding agents (Claude Code, OpenAI Codex, Antigravity, Cursor, GitHub Copilot) and human engineering teams.

Primary Repository: <https://github.com/sh15aa/botserusable>

Registry Endpoint: <https://raw.githubusercontent.com/sh15aa/botserusable/main/registry/modules.json>

2. Standard Protocol for AI Agents (AGENTS.md)

REUSABLE CODE LIBRARY: ENTERPRISE BOT & AI FACTORY

This repository ([botserusable](#)) contains production-ready, security-hardened reusable code for building conversational AI products, omni-channel messaging bots (WhatsApp, Telegram, Chatwoot), distributed asynchronous engines, and AI safety guardrails.

CORE RULE

Before writing any new implementation code for common bot, AI, or security functionality:

1. **Search this repository first.**
2. **Inspect [registry/modules.json](#).**
3. **Find an existing reusable module.**
4. **Inspect its parameters, classes, and dependencies.**
5. **Reuse and vendor/import the module whenever compatible.**
6. **Do NOT recreate functionality that already exists in this library.**

PRIORITY

Existing Reusable Library Module

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Existing Project Implementation

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New Implementation (Only if missing from library)

REUSABLE MODULE REGISTRY SUMMARY

All modules are registered in `registry/modules.json` with full metadata:

Category	Module ID	File Path	Core Classes / Capabilities
Adapters	<code>`adapters.whatsapp`</code>	<code>`app/adapters/whatsapp.py`</code>	<code>`WhatsAppAdapter`</code> (Meta Cloud API inbound parse, interactive outbound)
Adapters	<code>`adapters.telegram`</code>	<code>`app/adapters/telegram.py`</code>	<code>`TelegramAdapter`</code> (Telegram Bot API update parse, inline keyboards)
Adapters	<code>`adapters.chatwoot`</code>	<code>`app/adapters/chatwoot.py`</code>	<code>`ChatwootClient`</code> (Live-agent desk sync, conversation relay)

Adapters	`adapters.base`	`app/adapters/ base.py`	`BaseChannelAdapter` (Abstract adapter contract)
Schemas	`schemas.unmp`	`app/schemas/ unmp.py`	`UnifiedMessage`, `UnifiedResponse`, `ChannelType`, `MessageContent`
Schemas	`schemas.chatwoot`	`app/schemas/ chatwoot.py`	`ChatwootWebhookPayload`, `ChatwootConversation`
Engine	`engine.fsm`	`app/engine/ fsm.py`	`ConversationEngine` (Redis Mutex lock with atomic Lua release, FSM states)
Engine	`engine.handoff`	`app/engine/ handoff.py`	`HumanHandoffManager` (Seamless human-in-the-loop transition)
Engine	`engine.flows`	`app/engine/ flows.py`	`FlowEngine` (Multi-step interactive branching forms/dialogs)
Engine	`engine.router`	`app/engine/ router.py`	`MessageRouter` (Slash commands, action callbacks, fallbacks)
AI	`ai.guardrails`	`app/ai/ guardrails.py`	`AIGuardrailService` (Automated PII redaction, prompt delimiters, canary leak detection)
AI	`ai.gateway`	`app/ai/ gateway.py`	`LLMGateway` (Multi-model router: OpenAI, Anthropic, Gemini, Groq, Ollama)
AI	`ai.cost_controller`	`app/ai/ cost_controller.py`	`AICostController` (Per-user daily token caps & quota preservation via Redis)
AI	`ai.memory`	`app/ai/`	`ConversationMemory` (Redis sliding

		memory.py`	window of turns with TTL)
AI	`ai.rag`	`app/ai/rag.py`	`RAGKnowledgeBase` (Vector embeddings, cosine similarity)
AI	`ai.tools`	`app/ai/tools.py`	`ToolSandbox` (Function registration, schema generation, tool execution)
Security	`security.rate_limiter`	`app/security/rate_limiter.py`	`DistributedRateLimiter` (Atomic Redis Lua sliding window against DoS)
Security	`security.loop_detector` ,	`app/security/loop_detector.py`	`BotLoopDetector` (Rolling SHA-256 hash tracking to prevent bot-to-bot ping-pong)
Security	`security.rbac`	`app/security/rbac.py`	`SecurityContext`, `Role` (Admin/Client auth guards)
Security	`security.feature_flags`	`app/security/feature_flags.py`	`FeatureFlagService` (Redis dynamic flags & emergency kill switches)
Gateway	`gateway.security`	`app/gateway/security.py`	`WebhookSecurityService` (Constant-time HMAC-SHA256, replay prevention `SET NX EX`)
Gateway	`gateway.router`	`app/gateway/router.py`	FastAPI webhook endpoints (<200ms ACK, queue offloading)
Messaging	`messaging.media`	`app/messaging/media.py`	`MediaProcessor` (SSRF-protected attachment downloads, private IP blocker)
Messaging	`messaging.templates`	`app/messaging/templates.py`	`TemplateEngine` (i18n locale template rendering)

Identity	<code>`identity.service`</code>	<code>`app/identity/service.py`</code>	<code>`IdentityResolutionService`</code> (Cross-channel user profile unification)
Payments	<code>`payments.gateway`</code>	<code>`app/payments/gateway.py`</code>	<code>`PaymentGateway`</code> (Stripe webhook verification & subscription tiers)
Worker	<code>`worker.tasks`</code>	<code>`app/worker/tasks.py`</code>	<code>`WorkerSettings`</code> (ARQ distributed async background task worker)

CONSUMPTION GUIDE FOR AI AGENTS IN OTHER PROJECTS

When building an application in another directory, an AI agent can retrieve and use modules from this repository directly from GitHub:

GitHub Base URLs

- **Repository:** <https://github.com/sh15aa/botserusable>
- **Registry:** <https://raw.githubusercontent.com/sh15aa/botserusable/main/registry/modules.json>
- **Raw File Pattern:** <https://raw.githubusercontent.com/sh15aa/botserusable/main/{path}>

How Agents Inspect the Library

1. Fetch [registry/modules.json](https://raw.githubusercontent.com/sh15aa/botserusable/main/registry/modules.json) to review all available modules:

```
`bash
```

```
curl -sSL https://raw.githubusercontent.com/sh15aa/botserusable/main/registry/modules.json
```

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1. Download any required module directly into the target project:

```
`bash
```

```
curl -sSL https://raw.githubusercontent.com/sh15aa/botserusable/main/app/ai/guardrails.py -o  
app/ai/guardrails.py
```

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CONTRIBUTING NEW REUSABLE MODULES

If a required capability does NOT exist in this library:

1. Build the module with clean separation of concerns.
2. Follow zero-vulnerability principles (constant-time comparisons, atomic Redis operations, SSRF prevention).
3. Place in the appropriate `app//` directory.
4. Add an entry to `registry/modules.json`.
5. Update `README.md` and `AGENTS.md` if applicable.

NEVER

- Re-implement rate limiting, PII redaction, or bot loop detection from scratch.
- Hardcode secrets, API keys, or webhooks.

- Duplicate existing adapters or schemas.

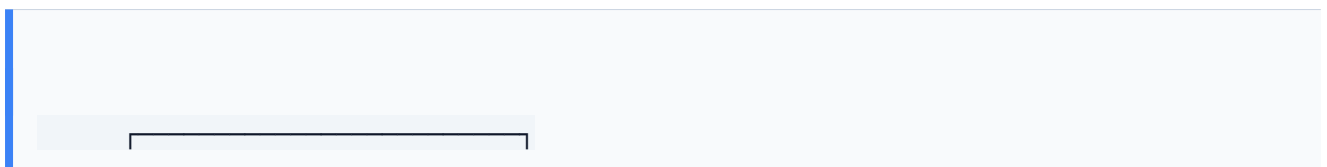
3. System Architecture & Zero-Vulnerability Security

Enterprise Bot Product Factory (Python: FastAPI + ARQ + Chatwoot)

A reusable, production-grade **Bot Product Factory** built with **FastAPI**, **ARQ (Async Redis Queue)**, **PostgreSQL (AsyncPG)**, and **Chatwoot**.

It provides a channel-independent foundation for WhatsApp Cloud API and Telegram Bot API, with human handoff, dual-tier AI guardrails, distributed concurrency locks, and zero-vulnerability security controls.

Architecture & Topology



| Inbound Webhooks |

| WhatsApp / Telegram |



[Webhook Security Layer]

- Constant-time HMAC-SHA256

- Timing-safe Telegram Secret

- Redis Atomic Replay (SET NX EX)



[FastAPI Webhook Gateway] (< 200ms ACK)

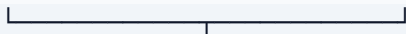


▼ (Enqueue Job)

[ARQ Async Redis Queue]



| ARQ Background Worker |



[Rate Limiter] [Loop Detector] [Distributed Lock]

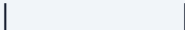
(Redis Lua) (Rolling SHA) (Redis Mutex)

|

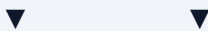
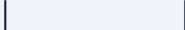


[Conversation Engine & FSM]

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[Human Handoff?] [AI Assistant]

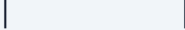


[Chatwoot Desk] [Dual-Tier AI Guardrail]

- Sync Contacts - PII Redaction

- Sync Messages - Delimiter Sandboxing

- Bi-directional Relay - Dynamic Canary Tokens



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[Channel Adapter Layer]

- WhatsApp Cloud API

- Telegram Bot API

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Zero-Vulnerability Security Checklist

Threat Vector	Mitigation Strategy	Implementation Location
Side-Channel Timing Attacks	Constant-time comparison with `hmac.compare_digest`	[security.py](file:///home/shiva/botsreusable/app/gateway/security.py)
Replay & Duplicate Events	Atomic Redis `SET key 1 EX 86400 NX`	[security.py](file:///home/shiva/botsreusable/app/gateway/security.py)
Rapid Button Mashing / Concurrency Race	Distributed lock per user session via Redis mutex + Lua release	[fsm.py](file:///home/shiva/botsreusable/app/engine/fsm.py)
Prompt Injection & System Prompt Leaking	Input delimiter sandboxing (``) + Dynamic canary token leak detection	[guardrails.py](file:///home/shiva/botsreusable/app/ai/guardrails.py)
PII Data Exposure	Automated regex masking for credit cards, emails, SSNs, and phone numbers	[guardrails.py](file:///home/shiva/botsreusable/app/ai/guardrails.py)
Denial of Service / Flooding	Atomic sliding-window rate limiting via Redis Lua script	[rate_limiter.py](file:///home/shiva/botsreusable/app/security/rate_limiter.py)

****Bot-to-Bot Ping-Pong** Rolling SHA-256 hash tracking `[loop_detector.py](file:///home/shiva/botsreusable/app/security/loop_detector.py)`
Loops** over sliding observation window

Quickstart & Deployment

1. Environment Setup

Copy `.env.example` to `.env` and fill in your secrets:

```
cp .env.example .env
```

2. Run with Docker Compose

```
docker-compose up -d --build
```

This starts:

- **API Server:** `http://localhost:8000`
 - **ARQ Worker:** Background queue runner
 - **Redis:** `localhost:6379`
 - **PostgreSQL:** `localhost:5432`
-

Provider Webhook Setup

WhatsApp Cloud API (Meta for Developers)

1. Set Callback URL: `https://yourdomain.com/webhooks/whatsapp`
2. Verify Token: Set to match `WHATSAPP_VERIFY_TOKEN` in `.env`.
3. Webhook fields to subscribe: `messages`.
4. App Secret: Set `WHATSAPP_APP_SECRET` to enable HMAC-SHA256 signature verification.

Telegram Bot API

1. Set your webhook with your secret token:

```
curl -X POST "https://api.telegram.org/bot<YOUR_BOT_TOKEN>/setWebhook" \  
-H "Content-Type: application/json" \  
-d '{"url": "https://yourdomain.com/webhooks/telegram", "secret_token":  
"<YOUR_TELEGRAM_SECRET_TOKEN>"}'
```

Chatwoot (Live Agent Desk)

1. In Chatwoot, navigate to **Settings** -> **Integrations** -> **Webhooks**.
2. Add Webhook URL: `https://yourdomain.com/webhooks/chatwoot`
3. Subscribed events:

- `message_created`

- `conversation_status_changed`

1. Set `CHATWOOT_WEBHOOK_SECRET` in `.env`.

2. Now, when a user triggers handoff (e.g. clicks "Talk to Agent" or types "human"):

- The user is transitioned to `HUMAN_HANDOFF`.

- A contact and conversation are created in Chatwoot.

- Any agent replies inside Chatwoot are routed directly back to the user's WhatsApp or Telegram!

- When the agent marks the conversation as **Resolved**, the bot automatically resumes control.

4. Complete Reusable Module Directory (24 Modules)

Each module below is ready to be fetched and incorporated into new projects without modifications to its core logic.

WhatsApp Cloud API Adapter

adapters.whatsapp ADAPTERS STABLE

Parses Meta Cloud API inbound webhooks and renders outbound text, interactive buttons,
list messages, and media.

Path: app/adapters/whatsapp.py

Classes: WhatsAppAdapter

Dependencies: httpx, pydantic

Environment Variables: WHATSAPP_PHONE_NUMBER_ID, WHATSAPP_ACCESS_TOKEN

Telegram Bot API Adapter

adapters.telegram ADAPTERS STABLE

Parses Telegram Bot updates and sends outbound MarkdownV2 text, inline keyboards,
reply keyboards, and media.

Path: app/adapters/telegram.py

Classes: TelegramAdapter

Dependencies: httpx, pydantic

Environment Variables: TELEGRAM_BOT_TOKEN

Chatwoot Live-Agent Client

adapters.chatwoot ADAPTERS STABLE

Bi-directional integration with Chatwoot live support desk. Manages contact lookup, conversation creation, and message relaying.

Path: app/adapters/chatwoot.py

Classes: ChatwootClient

Dependencies: httpx

Environment Variables: CHATWOOT_BASE_URL, CHATWOOT_API_ACCESS_TOKEN, CHATWOOT_ACCOUNT_ID,

CHATWOOT_INBOX_ID

Base Channel Adapter Interface

adapters.base ADAPTERS STABLE

Abstract base class defining parse_inbound and render_and_send contract for all channel

adapters.

Path: app/adapters/base.py

Classes: BaseChannelAdapter

Dependencies: abc, pydantic

Environment Variables: None required

Unified Normalised Messaging Protocol (UNMP)

schemas.unmp SCHEMAS STABLE

Channel-agnostic data schemas for inbound messages, outbound responses, sender

identities, and interactive payloads.

Path: app/schemas/unmp.py

Classes: UnifiedMessage, UnifiedResponse, ChannelType, MessageContentType, MessageContent, SenderInfo

Dependencies: pydantic

Environment Variables: None required

Chatwoot Webhook Schemas

schemas.chatwoot SCHEMAS STABLE

Typed Pydantic models for parsing Chatwoot webhook payloads (message_created, conversation_status_changed).

Path: app/schemas/chatwoot.py

Classes: ChatwootWebhookPayload, ChatwootConversation, ChatwootSender

Dependencies: pydantic

Environment Variables: None required

Webhook Security & Signature Verification

gateway.security GATEWAY STABLE

Constant-time HMAC-SHA256 signature verification, timing-safe Telegram token validation, and atomic Redis replay prevention.

Path: app/gateway/security.py

Classes: WebhookSecurityService

Dependencies: redis, hmac, hashlib

Environment Variables: WHATSAPP_APP_SECRET, TELEGRAM_SECRET_TOKEN

FastAPI Webhook Gateway Router

gateway.router GATEWAY STABLE

Sub-200ms ACK webhook endpoints for WhatsApp, Telegram, and Chatwoot with

immediate queue offloading via ARQ.

Path: app/gateway/router.py

Classes: None

Dependencies: fastapi, arq, redis

Environment Variables: WHATSAPP_VERIFY_TOKEN, CHATWOOT_WEBHOOK_SECRET

Conversation Engine & Distributed FSM

engine.fsm ENGINE STABLE

Finite State Machine with Redis distributed mutex locking (via atomic Lua script release) to

prevent button-mashing and race conditions.

Path: app/engine/fsm.py

Classes: ConversationEngine, ConversationContext

Dependencies: redis

Environment Variables: None required

Human Handoff Manager

engine.handoff ENGINE STABLE

Coordinates seamless handoff between automated bot conversation and human agents

on Chatwoot.

Path: app/engine/handoff.py

Classes: HumanHandoffManager

Dependencies: redis

Environment Variables: None required

Interactive Flow Engine

engine.flows ENGINE STABLE

Step-by-step interactive workflow engine supporting custom validators, dynamic prompts,

and transition branching.

Path: app/engine/flows.py

Classes: FlowEngine, FlowDefinition, FlowStep

Dependencies: pydantic

Environment Variables: None required

Message & Command Router

engine.router ENGINE STABLE

Dispatches incoming messages to slash commands, interactive button callbacks, active

flows, or AI assistants.

Path: app/engine/router.py

Classes: MessageRouter

Dependencies: Standard Library

Environment Variables: None required

Dual-Tier AI Security Guardrails

ai.guardrails AI STABLE

Zero-trust AI safety layer: automated PII masking (credit cards, emails, SSN, phone

numbers), prompt delimiter sandboxing, and dynamic canary token leakage defense.

Path: app/ai/guardrails.py

Classes: AIGuardrailService

Dependencies: re, secrets

Environment Variables: None required

Multi-Provider LLM Gateway

ai.gateway AI STABLE

Unified LLM client supporting OpenAI, Anthropic, Gemini, Groq, and Ollama with

automated fallback, streaming, and tool execution.

Path: app/ai/gateway.py

Classes: LLMGateway

Dependencies: openai, httpx

Environment Variables: OPENAI_API_KEY, ANTHROPIC_API_KEY, GEMINI_API_KEY

AI Token Cost Controller & Budgeting

ai.cost_controller AI STABLE

Per-user and tenant daily token consumption tracking using Redis sliding counters to

prevent quota exhaustion and runaway costs.

Path: app/ai/cost_controller.py

Classes: AICostController

Dependencies: redis

Environment Variables: None required

Conversation Sliding-Window Memory

ai.memory AI STABLE

Redis-backed conversation memory preserving multi-turn chat history with sliding window

size and configurable TTL.

Path: app/ai/memory.py

Classes: ConversationMemory

Dependencies: redis, json

Environment Variables: None required

Lightweight Embedding RAG Knowledge Base

ai.rag AI STABLE

Vector embedding retrieval with cosine similarity ranking and dynamic prompt

augmentation for contextual Q&A.

Path: app/ai/rag.py

Classes: RAGKnowledgeBase, DocumentChunk

Dependencies: openai

Environment Variables: OPENAI_API_KEY

Sandboxed Tool & Function Calling

ai.tools AI STABLE

Framework for registering Python functions as OpenAI/Gemini/Anthropic compatible tools

with automatic JSON schema generation.

Path: app/ai/tools.py

Classes: ToolSandbox, ToolDefinition

Dependencies: pydantic, inspect

Environment Variables: None required

Atomic Redis Sliding-Window Rate Limiter

security.rate_limiter SECURITY STABLE

High-performance sliding-window rate limiter powered by an atomic Redis Lua script to

neutralize DoS and flooding attacks.

Path: app/security/rate_limiter.py

Classes: DistributedRateLimiter

Dependencies: redis

Environment Variables: None required

Rolling SHA-256 Bot Loop Detector

security.loop_detector SECURITY STABLE

Detects and breaks infinite ping-pong loops between automated bots by computing rolling

message hashes across a sliding time window.

Path: app/security/loop_detector.py

Classes: BotLoopDetector

Dependencies: redis, hashlib

Environment Variables: None required

Role-Based Access Control (RBAC)

security.rbac SECURITY STABLE

Admin and client authentication context, JWT validation, and route dependency guards.

Path: app/security/rbac.py

Classes: SecurityContext, Role

Dependencies: fastapi

Environment Variables: ADMIN_API_KEY

Dynamic Redis Feature Flags & Kill Switch

security.feature_flags SECURITY STABLE

Runtime configuration switches, percentage rollouts, and instant emergency kill switches

without restarting services.

Path: app/security/feature_flags.py

Classes: FeatureFlagService

Dependencies: redis

Environment Variables: None required

Secure Media Downloader & SSRF Protection

messaging.media MESSAGING STABLE

Downloads and validates media attachments with anti-SSRF IP blocking (blocks

private/loopback/cloud metadata IP ranges).

Path: app/messaging/media.py

Classes: MediaProcessor, MediaSecurityException

Dependencies: httpx, ipaddress

Environment Variables: None required

Multi-Locale Template Engine

messaging.templates MESSAGING STABLE

Channel-agnostic i18n template registry supporting parameter substitution and fallback

locales.

Path: app/messaging/templates.py

Classes: TemplateEngine

Dependencies: Standard Library

Environment Variables: None required

Cross-Channel Identity Resolution

identity.service IDENTITY STABLE

Unifies user records across WhatsApp phone numbers, Telegram chat IDs, and Web CRM

profiles into a single persistent user record.

Path: app/identity/service.py

Classes: IdentityResolutionService

Dependencies: sqlalchemy

Environment Variables: None required

Payment Gateway & Webhook Validator

payments.gateway PAYMENTS STABLE

Stripe webhook signature validation and subscription tier provisioning in Redis.

Path: app/payments/gateway.py

Classes: PaymentGateway

Dependencies: stripe, redis

Environment Variables: STRIPE_API_KEY, STRIPE_WEBHOOK_SECRET

ARQ Distributed Async Task Worker

worker.tasks WORKER STABLE

Async Redis queue (ARQ) background task processor for parsing messages, running FSM, executing AI pipelines, and dispatching outbound messages.

Path: app/worker/tasks.py

Classes: WorkerSettings

Dependencies: arq, redis, asyncpg

Environment Variables: REDIS_URL, DATABASE_URL

