# Home Appliance Control System (HACS)

## Non‑Functional Requirements & Operating Environment

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## 1. Purpose of This Document

This contributor document extracts, consolidates, and strengthens the Non‑Functional Requirements (NFRs) and Operating Environment for HACS. It provides measurable criteria, acceptance targets, and test methods that can be traced in verification and validation. It is designed to be directly merged into the main SRS.

## 2. Non‑Functional Requirements

Each requirement includes: ID, Statement, Rationale, Measure/Target, Verification Method.

### 2.1 Performance

PERF‑01: Respond to appliance ON/OFF commands ≤ 2 s. | Rationale: Responsiveness. | Target: p95 ≤ 2 s; p99 ≤ 3 s. | Verify: Load test with 50 devices.

PERF‑02: Authentication within ≤ 3 s. | Rationale: Smooth access. | Target: p95 ≤ 3 s; p99 ≤ 4 s. | Verify: Concurrent login test.

PERF‑03: Sustain ≥ 100 requests/min. | Rationale: Throughput baseline. | Target: Error rate < 1%. | Verify: Soak test 60 min.

PERF‑04: Support ≥ 50 concurrent devices. | Rationale: Multi‑device homes. | Target: CPU < 70%, memory ≥ 30%. | Verify: Device simulator test.

PERF‑05: Scheduled actions within ± 5 s. | Rationale: User trust. | Target: Deviation ≤ 5 s. | Verify: NTP sync test.

### 2.2 Reliability & Availability

REL‑01: ≥ 99.0% availability. | Rationale: Continuity. | Target: ≤ 7.3 h downtime/month. | Verify: Monthly report.

REL‑02: Auto‑reconnect within ≤ 10 s. | Rationale: Resilience. | Target: Mean recon ≤ 10 s. | Verify: Network flap test.

REL‑03: Backup daily. | Rationale: Data protection. | Target: RPO ≤ 24 h; RTO ≤ 30 min. | Verify: Quarterly drills.

REL‑04: Restore last state after crash. | Rationale: Recovery. | Target: Consistency ≥ 99.9%. | Verify: Chaos test.

### 2.3 Security

SEC‑01: Username/password auth. | Rationale: Prevent unauthorized use. | Target: 100% entry points protected. | Verify: Auth tests.

SEC‑02: Passwords hashed+salted. | Rationale: Protect credentials. | Target: No plain storage. | Verify: Code/pen test.

SEC‑03: Auto‑lock after 5 min idle. | Rationale: Mitigate unattended risk. | Target: Idle timeout = 5 min. | Verify: Session test.

SEC‑04: RBAC enforced. | Rationale: Least privilege. | Target: Role checks applied. | Verify: Privilege test.

SEC‑05: TLS for all in‑transit data. | Rationale: Confidentiality. | Target: 100% TLS. | Verify: TLS scan.

SEC‑06: Secrets in vault/keystore. | Rationale: Hygiene. | Target: No secrets in code. | Verify: Repo scan.

## 3. Operating Environment

Defines hardware, software, network, and external services required.

### 3.1 Hardware

CPU: Dual‑Core 2.0 GHz (Min), Quad‑Core 3.0+ GHz (Rec)  
Memory: 4 GB (Min), 8–16 GB (Rec)  
Storage: 500 MB (Min), 5 GB (Rec)  
Display: 1024×768 (Min), 1920×1080 (Rec)  
Controller: USB/IP (Min), IP with Wi‑Fi/Ethernet (Rec)

### 3.2 Software

OS: Windows 10/11 or Ubuntu 20.04+  
Runtime: JDK 11+  
Database: SQLite/MySQL/Postgres  
CI: Maven/Gradle  
Time Sync: NTP

### 3.3 Network

LAN/Wi‑Fi for server‑controller; Internet for remote.  
TLS for all endpoints.  
1 Mbps uplink per site.

### 3.4 Peripherals

Standard printer; optional label printer.

### 3.5 Backup

USB/cloud storage.  
Nightly backups; 30‑day retention.  
Encrypted; restore drills quarterly.

### 3.6 Dependencies

Device SDKs; optional AI/weather APIs.  
Secrets via keystore/vault.