PDR Cloud Platform Architecture v3.1

CONFIDENTIAL AND PROPRIETARY

Polar Dynamics Robotics, Inc.

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1. OVERVIEW AND SCOPE

1. This document describes the cloud platform architecture ("Platform") that supports Polar Dynamics Robotics, Inc.'s ("PDR") IceNav(TM) Autonomous Mobile Robot ("AMR") system and related services.

2. The Platform architecture detailed herein represents PDR's proprietary infrastructure design and is protected under U.S. Patent No. 11,847,XXX and related intellectual property rights.

2. SYSTEM ARCHITECTURE

1. Core Components

- Central Command Infrastructure (CCI)
- Distributed Edge Processing Units (DEPUs)
- Thermal Management Control System (TMCS)
- Real-time Navigation Processing Engine (RNPE)
- Cold Environment Data Analytics Suite (CEDAS)

2. Infrastructure Layer

- Primary data centers: AWS US-East-1 and US-West-2
- Edge computing nodes: Minimum of three (3) per deployment site
- Redundant backup systems: Geographic distribution across four (4) regions
- Cold storage optimization layer with proprietary thermal monitoring

3. SECURITY ARCHITECTURE

1. Authentication and Access Control

- Multi-factor authentication (MFA) required for all system access
- Role-based access control (RBAC) with granular permissions
- PKI infrastructure with 4096-bit RSA encryption

- Hardware security modules (HSMs) for key storage

2. Network Security

- Dedicated VPC per customer deployment
- End-to-end encryption for all data in transit
- Custom firewall rules for cold-environment sensors
- Real-time threat detection and response system

4. DATA MANAGEMENT

1. Storage Architecture

- Primary storage: Aurora PostgreSQL clusters
- Time-series data: InfluxDB optimized for sensor metrics
- Cold storage: Custom S3 implementation with thermal metadata
- Backup retention: 90-day rolling window with daily snapshots

2. Data Processing

- Real-time processing: Apache Kafka streams
- Batch processing: Spark clusters optimized for thermal analytics
- Machine learning pipeline: TensorFlow with custom cold-environment models
- Edge processing: Proprietary DEPU algorithms

5. SCALABILITY AND PERFORMANCE

1. System Capacity

- Maximum supported AMR units per deployment: 500
- Maximum concurrent users per instance: 1,000
- Maximum sensor data processing: 10,000 events/second
- Storage scaling: Automatic up to 1PB per customer

2. Performance Requirements

- Navigation command latency: <50ms
- Sensor data processing: <100ms
- API response time: <200ms

- System availability: 99.99%

6. DISASTER RECOVERY AND BUSINESS CONTINUITY

1. Backup Systems

- Hot standby in secondary region
- Automated failover capability
- 15-minute Recovery Time Objective (RTO)
- 5-minute Recovery Point Objective (RPO)

2. Contingency Procedures

- Automated system health monitoring
- Incident response team on 24/7 standby
- Emergency shutdown protocols for thermal events
- Customer data isolation guarantees

7. COMPLIANCE AND CERTIFICATION

1. Standards Compliance

- ISO 27001:2013 certified
- SOC 2 Type II compliant
- GDPR compliant
- FDA 21 CFR Part 11 compliant (where applicable)

2. Audit Requirements

- Quarterly security audits
- Annual penetration testing
- Monthly compliance reviews
- Continuous monitoring and logging

8. PROPRIETARY NOTICES AND CONFIDENTIALITY

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2. No part of this architecture may be reproduced, modified, or distributed without express written

permission from PDR's Chief Technology Officer.

9. DOCUMENT CONTROL

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AUTHORIZATION

APPROVED AND ADOPTED by the undersigned authorized representative of Polar Dynamics Robotics, Inc.

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Date: January 11, 2024

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