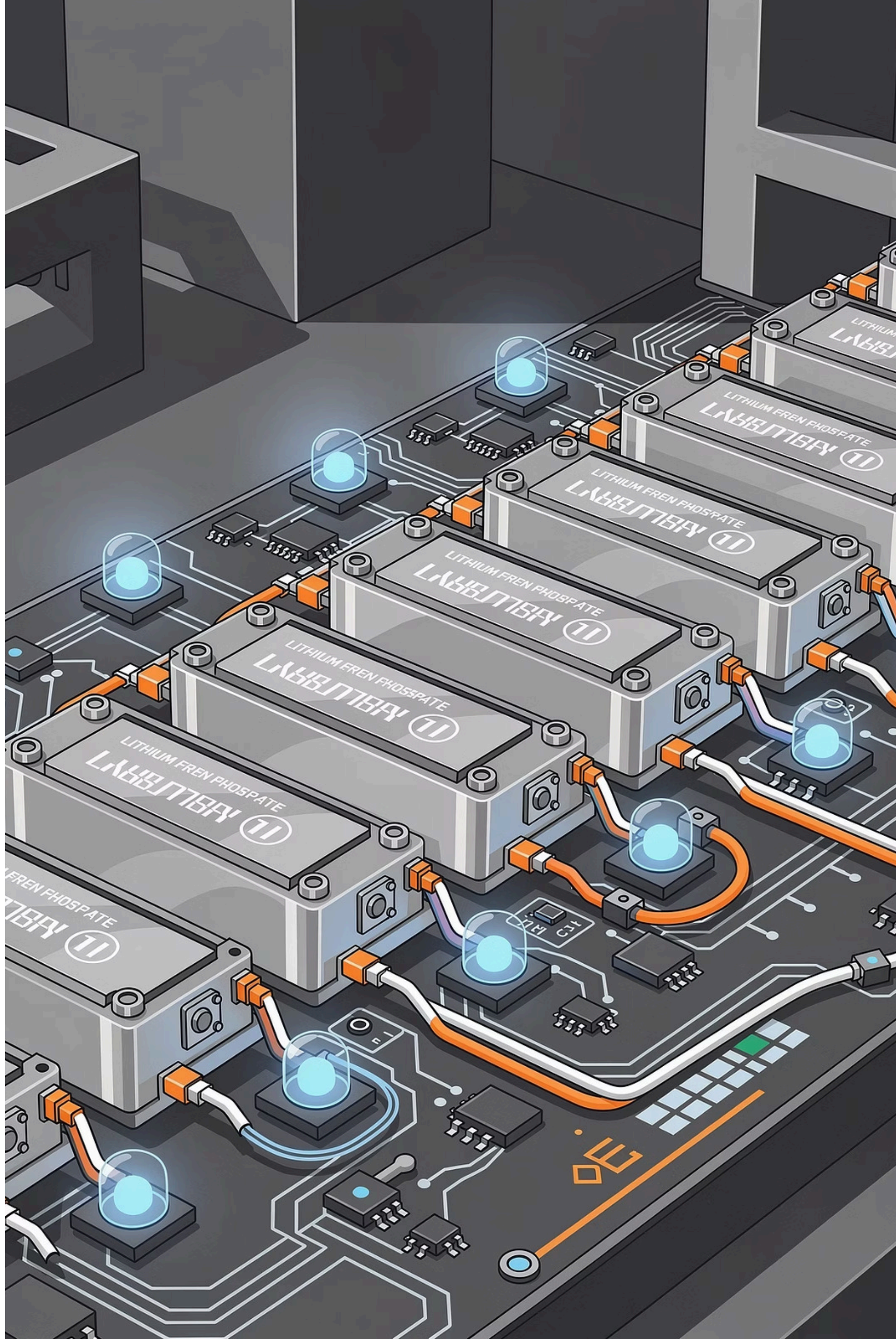
Winston Battery System BMS Selection Logic

System-Level Safety and Control Architecture Guide

Winston Battery



The Core Role of BMS

The Battery Management System (BMS) acts as the **control and protection layer** between individual battery cells, charging equipment, and the load system. It monitors the state of each cell in real-time, ensuring the entire energy storage system operates within safe parameters. BMS is more than just a protective device – it's the cornerstone for the stable operation of the entire power system.

Over/Under Voltage Protection

Prevents single cell voltage from exceeding safe limits, avoiding irreversible damage.

Overcurrent Protection

Detects abnormal currents and disconnects promptly, preventing thermal runaway.

Temperature Monitoring

All-time temperature acquisition and thermal management linkage control.

Cell Balancing

Active or passive balancing to eliminate individual cell differences and extend lifespan.

Communication Interface

Enables data interaction with host computers, PCS, or vehicle controllers.

Why is BMS Selection Crucial?

Inappropriate BMS selection not only affects performance but can also lead to serious safety accidents. The BMS must precisely match the **system architecture**—not just be compatible with the battery chemistry. Below are the potential consequences of improper selection:

Premature Capacity Degradation

Mismatched balancing strategies lead to cumulative SOC differences between cells, causing the overall usable capacity to decline year by year

Abnormal Charging Interruptions

Insufficient voltage acquisition accuracy or incorrect threshold settings cause the system to frequently trigger protective shutdowns

Thermal Stress and Thermal Runaway Risk

Insufficient quantity or accuracy of temperature sensors, making it impossible to promptly warn of localized overheating

System Instability and Safety Accidents

Missing protection logic or delayed response, potentially leading to irreversible consequences under extreme operating conditions

> Incorrect BMS selection is one of the primary causes of energy storage system failures. Please integrate BMS into the system-level design at the early stage of the project.

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BMS Selection Dimension 1: System Voltage

Winston 3.2V Lithium Iron Phosphate cells can be flexibly combined to cover all application scenarios from low voltage to ultra-high voltage. The BMS must be selected according to the **number of series cells** and the **system voltage level**. High-voltage systems also need to meet insulation withstand voltage requirements.

1

Low Voltage System

12V / 24V / 48V
4~16 series cells
Standard BMS is sufficient

2

Medium Voltage System

96V ~ 400V
30~125 series cells
Requires high-precision acquisition

3

High Voltage System

400V ~ 1500V
125~468 series cells
Must use HV-level BMS

Key Requirements for High Voltage Systems

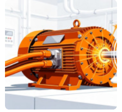
- Matching insulation withstand voltage level
- Distributed acquisition architecture
- Isolated communication bus
- High voltage pre-charge and main contactor control
- Insulation monitoring device (IMD)

BMS Selection Dimension 2: System Power Level

BMS current handling capacity must cover the system's full operating conditions. When selecting, comprehensively consider continuous operating current, peak loads, and short-circuit protection capabilities, especially for industrial and military applications where tolerance levels are more demanding.

Maximum Charging Current

The rated current of the BMS charging MOS or contactor must be ≥ 1.2 times the system's maximum charging current to ensure a safety margin.



Maximum Discharge Current

The discharge channel must withstand continuous full-load operation, and industrial scenarios also need to consider the impact of starting current.

Peak Load Demand

Short-term peak power may reach 2-3 times the rated power. The BMS protection logic must correctly distinguish between normal peaks and faults.

Short Circuit Protection Capability

Military and industrial systems require microsecond-level short-circuit response. The speed of protection action is directly related to equipment and personnel safety.

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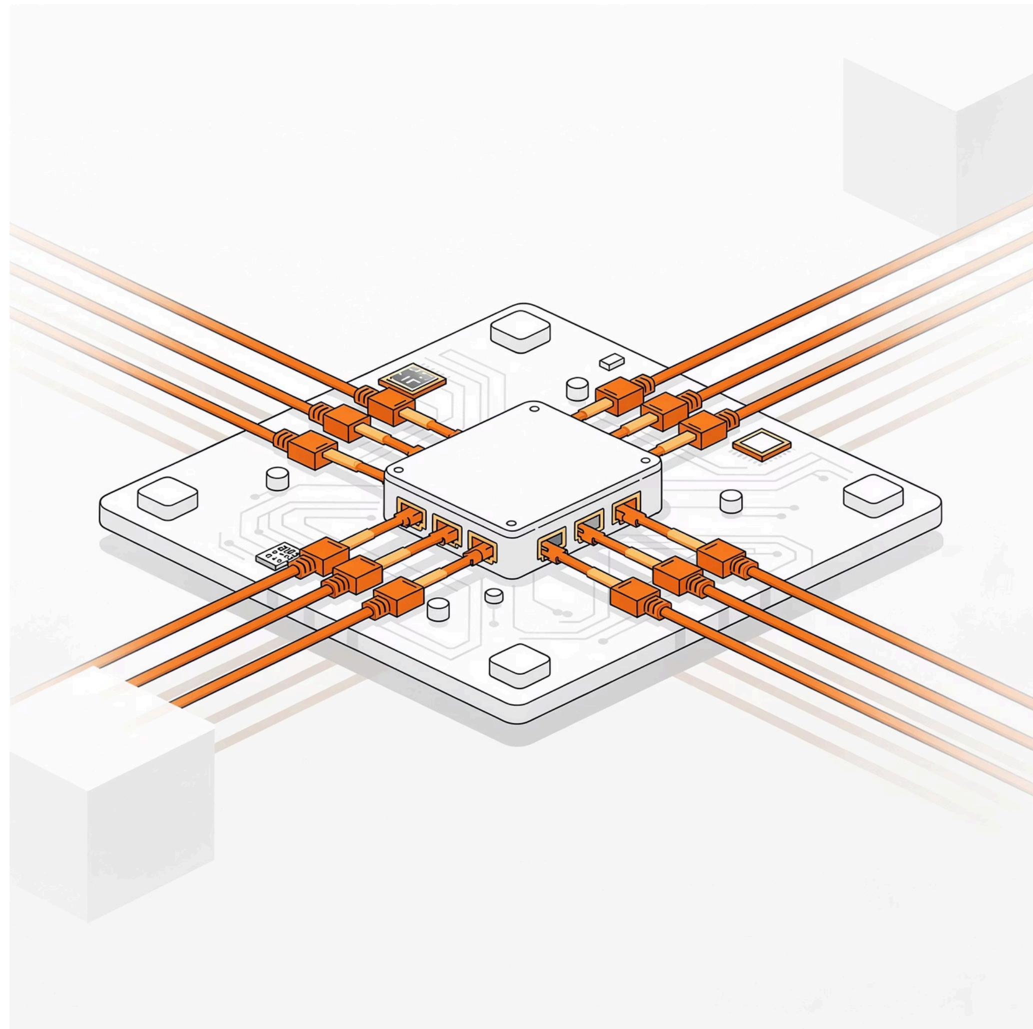
BMS Selection Dimension 3: Communication Requirements

BMS communication protocol selection depends on the system integration architecture. Different application scenarios have vastly different requirements for real-time performance, reliability, and bandwidth of data interaction.

Protocol	Typical Application	Features
CAN	Vehicle, Military Systems	High real-time performance, strong anti-interference
RS485	Industrial Energy Storage	Long-distance transmission, multi-device communication
Modbus	Telecom Base Stations, UPS	Open protocol, wide compatibility
No Communication	Basic Standalone Systems	Low cost, no remote monitoring



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Telecom Systems

Usually require Modbus/RS485 interfaces to connect with environmental monitoring

Vehicle Systems

Mandatory CAN real-time communication, latency ≤10ms

Industrial Systems

Need to support SCADA platform integration and remote operation & maintenance

Environmental Adaptability Requirements

The deployment environment is the most easily underestimated dimension in BMS selection. For systems operating under extreme conditions, the BMS must meet **industrial-grade** or even **military-grade** protection levels, otherwise it will become the weakest link in the entire system chain.

High Temperature Environment (+50°C+)

Deployment in deserts and tropical regions. BMS electronic components need high-temperature resistant design, and sufficient margin should be reserved for heat dissipation solutions.

Extreme Cold Environment (-45°C)

High latitude and high altitude areas. BMS needs to have low-temperature start-up strategies and linkage control capabilities with heating films.

Sand, Dust, and Salt Spray

IP65 or higher protection level, PCB conformal coating treatment, and sealed connector design.

High Altitude and Vibration

Low atmospheric pressure affects insulation performance, continuous vibration tests structural reliability, requiring relevant environmental testing certification.

Centralized vs. Distributed BMS Architecture

The choice of BMS architecture directly determines the system's scalability, ease of maintenance, and monitoring accuracy. Both mainstream architectures have their applicable scenarios, and the architectural choice for high-voltage systems is particularly critical.

Centralized BMS

Applicable Scenarios: Low-voltage systems (≤96V)

- Single board integrates all acquisition and protection functions
- Simple architecture, lower cost
- Longer wiring harness, high noise interference in high-voltage systems
- Single point of failure affects the entire system

Distributed/Modular BMS

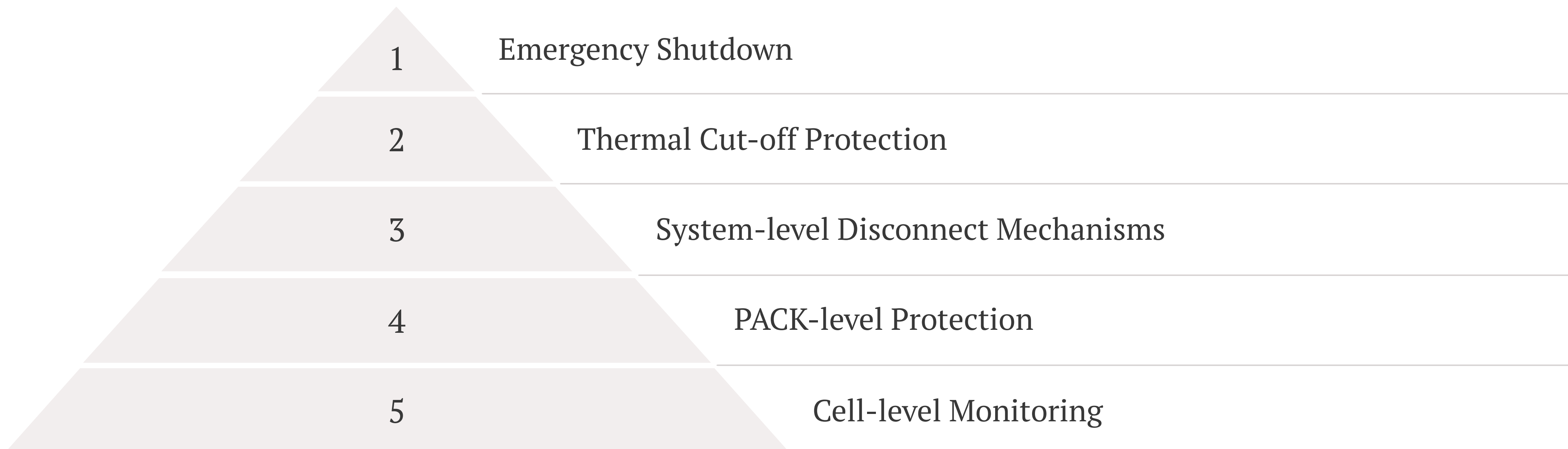
Applicable Scenarios: High-voltage systems (400V+)

- Slave boards collect data locally, master board manages centrally
- Significantly improved monitoring accuracy
- Modular design, flexible expansion
- Single module failure does not affect the overall system

Engineering Recommendation: Systems above 400V must adopt a distributed architecture. This is an industry consensus and a mandatory recommendation for Winston system integration.

BMS Multi-layer Safety Strategy

Reliable BMS safety design follows the principle of **defense in depth** – building multiple safety barriers from cell-level to system-level, ensuring that the system can safely degrade or shut down in the event of any single failure.



Cell-level monitoring is fundamental – real-time acquisition of individual cell voltage and temperature. **PACK-level protection** implements current protection and balancing control. **System-level disconnect mechanisms** (contactors/fuses) physically isolate the battery pack during anomalies. **Thermal cut-off** and **emergency shutdown interfaces** form the last line of defense, ensuring safe power disconnection and isolation during maintenance.

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O&M Diagnostic Capability

An advanced BMS is not just a protection device, but also a data hub for system operation and maintenance. Comprehensive diagnostic functions significantly reduce O&M costs and improve system availability.

1

Fault Log Recording

Comprehensively record the time, reason, and cell status snapshot of each protection trigger for post-event analysis.

2

Real-time Diagnostics

View SOC, SOH, cell voltage, temperature distribution, and balancing status online to monitor system health in real-time.

3

Remote Monitoring

Upload data to the cloud platform via 4G/Ethernet, supporting remote inspection of unattended sites.

4

Predictive Maintenance

Based on historical data trend analysis, predict cell aging and capacity degradation in advance, optimizing maintenance plans.

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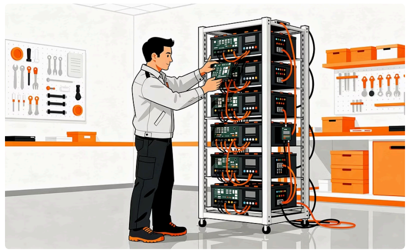
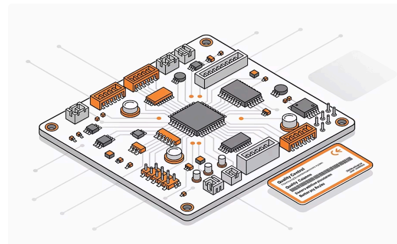
BMS Supply Strategy

Winston Battery **does not restrict** BMS brands but requires the selected BMS to comply with system parameter specifications. Depending on project complexity, BMS can be acquired through the following three paths:



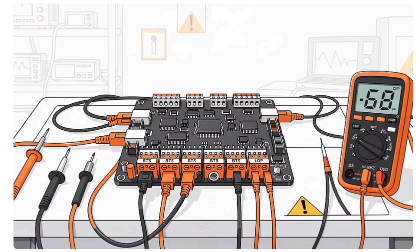
System Integrator Self-Integration

Suitable for integrators with BMS development or adaptation capabilities. Offers the highest flexibility but requires strong technical expertise.



Third-Party BMS Professional Supplier

Choose mature, market-proven BMS products. Pay attention to compatibility parameters with Winston cells.



Customized BMS Engineering Development

Custom development is required for high-voltage and special application scenarios. Winston provides technical coordination support and system compatibility validation.

> Winston Battery provides: BMS selection technical guidance · System compatibility verification · Full technical coordination support

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BMS Key Selection Criteria Overview

The following six criteria form the core evaluation framework for selecting BMS in Winston systems. Neglecting any one of them can increase operational risks.

System Voltage Range

Covers all target voltage levels from 12V~1500V

Maximum Current Rating

Charge/discharge current ≥ 1.2 times the system's peak demand

Future Scalability

Supports system capacity expansion and protocol upgrades

Communication Protocol Requirements

CAN / RS485 / Modbus compatibility with host system

Safety Compliance Standards

UL/IEC/GB and other relevant certifications and functional safety levels

Environmental Resilience

Temperature, dust, and vibration ratings meet deployment conditions

> **Core Principle:** Improper BMS selection is the primary source of system operational risk. Please complete a comprehensive evaluation at the early stage of the project.

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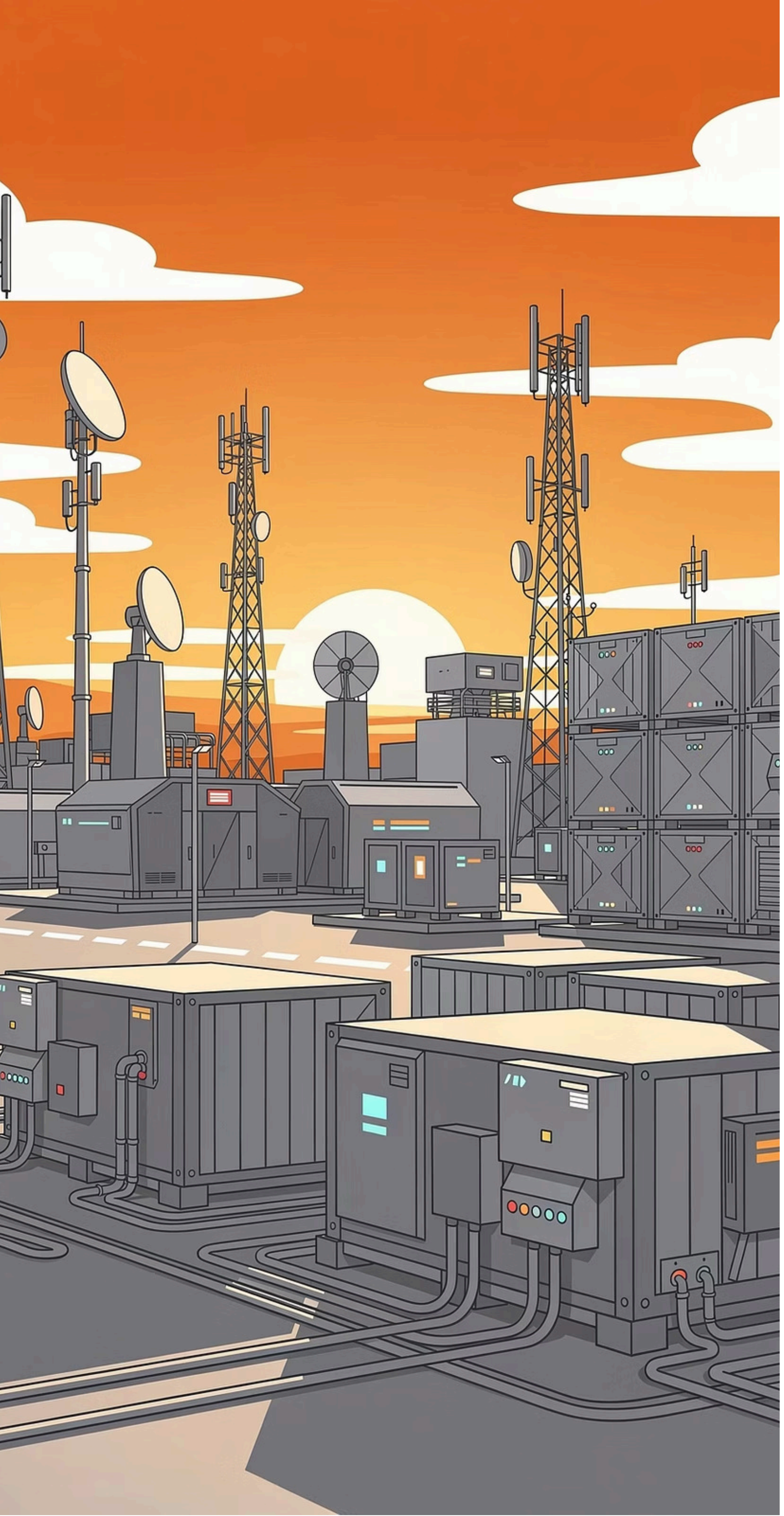

Strategic Perspective

BMS is not an optional accessory,
but the primary safety control layer.

For industrial, military, telecom, and systems, the correct BMS architecture design brings not only safety assurance but also strategic value throughout the entire lifecycle.

3~5×

Extended Battery Life

Precise balancing and protection strategies significantly extend battery pack lifespan

↓80%

Reduced Failure Risk

Multi-layered safety architecture significantly reduces unplanned downtime events

↑99.9%

Autonomous System Availability

Predictive maintenance and remote monitoring ensure continuous reliable operation of infrastructure

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