# Scope

This document specifies the fundamental architectural, communication, and behavioral requirements of an intelligent fan microgrid system, referred to as **FLAS (Fan Local Area System)**.

The purpose of this specification is to define a **common, open, and interoperable framework** enabling plug-and-play operation, coordinated control, and intelligent management of fans and similar electromechanical devices within **Low Voltage Direct Current (LVDC)** based systems.

This document defines:

- the **system-level architecture** of a FLAS network;
- the **minimum communication capabilities** required to enable interoperability;
- the **behavioral principles** governing device discovery, commissioning, normal operation, and fault handling;
- the **foundational requirements** supporting local and distributed intelligence, including AI-based functions.

This specification intentionally focuses on **functional and behavioral aspects** rather than prescribing specific hardware implementations, communication technologies, or software platforms. It aims to allow technological evolution while ensuring consistent system behavior and interoperability.

This document is applicable to:

- ventilation systems;
- fan arrays;
- air-moving devices and similar equipment;
- intelligent airflow systems in buildings, industrial plants, and infrastructure.

This document does **not** specify:

- detailed electrical safety requirements;
- specific semiconductor technologies, processors, or operating systems;
- detailed AI algorithms, models, or training methods;
- cloud services or vendor-specific implementations.

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# Introduction

Electric ventilation systems represent a significant share of global electricity consumption and are a key target for energy efficiency improvements. The widespread adoption of variable-speed drives and electronic control has improved efficiency, but current solutions often remain fragmented, complex to install, and poorly interoperable at the system level.

At the same time, modern buildings and industrial facilities are undergoing a structural transformation driven by:

- the electrification of energy systems;
- the increasing use of **LVDC distribution**;
- regulatory frameworks targeting **Zero Emission Buildings (ZEB)**;
- the growing role of **Building Automation and Control Systems (BACS)**;
- the emergence of **artificial intelligence** for energy optimization and predictive maintenance.

In this context, traditional fan systems—typically designed as isolated devices—are no longer sufficient. There is a growing need for **fan networks** capable of operating as coordinated, intelligent subsystems within larger electrical and digital infrastructures.

The FLAS concept addresses this need by introducing a **microgrid-oriented approach** to ventilation systems. Instead of treating each fan as an independent unit, FLAS defines a system in which multiple devices operate as nodes within a shared power and communication environment, enabling:

- simplified installation through plug-and-play behavior;
- coordinated control and optimization at system level;
- reduced system complexity and total cost of ownership;
- native support for digitalization and AI-based functions.

A core design principle of FLAS is the **separation between fixed interoperability points and open implementation freedom**. The specification defines a small set of mandatory behaviors and interfaces that ensure predictable system operation, while leaving ample flexibility for manufacturers to innovate in hardware design, control strategies, and intelligent services.

Another fundamental principle is **AI openness**. FLAS is designed to support intelligence at different levels:

- local intelligence embedded within devices;
- centralized intelligence at system level;
- distributed or cloud-assisted intelligence.

The specification does not mandate any specific AI architecture. Instead, it defines the conditions under which intelligent functions can be safely and interoperably integrated into the system.

By providing a clear, open, and technology-agnostic foundation, this document aims to support:

- interoperability between devices from different manufacturers;
- future standardization activities at international level;
- alignment with energy efficiency policies and LVDC standardization efforts;
- the transition from component-based ventilation products to system-oriented, intelligent airflow solutions.

# 3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

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### 3.1 FLAS (Fan Local Area System)

**FLAS** is an intelligent microgrid system for fans and similar devices, based on a shared power and communication infrastructure, enabling coordinated operation, plug-and-play behavior, and system-level intelligence.

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### 3.2 FLAS system

A **FLAS system** is a functional assembly composed of one or more FLAS nodes interconnected through a common power distribution and communication environment, operating according to the architectural and behavioral requirements defined in this document.

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### 3.3 FLAS node

A **FLAS node** is any device participating in a FLAS system and capable of exchanging power, data, or both, with other nodes in accordance with this specification.

NOTE A FLAS node may be a fan, a controller, a gateway, a sensor, or another functional element.

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### 3.4 FLAS device

A **FLAS device** is a FLAS node that performs an active physical function, such as air movement or actuation, and whose operation can be monitored and controlled within a FLAS system.

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### 3.5 Central intelligence node

A **central intelligence node** is a FLAS node responsible for system-level coordination, control, optimization, or supervision of a FLAS system.

NOTE A FLAS system may include one or more central intelligence nodes, or may operate without a centralized node, depending on the implementation.

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### 3.6 Local intelligence

**Local intelligence** refers to control, decision-making, or adaptive functions executed within an individual FLAS device.

NOTE Local intelligence may include basic control logic, protection functions, or advanced data processing.

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### 3.7 Distributed intelligence

**Distributed intelligence** refers to control or decision-making functions that are executed cooperatively across multiple FLAS nodes within a FLAS system.

NOTE Distributed intelligence may involve peer-to-peer communication or coordinated algorithms without reliance on a single central entity.

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### 3.8 Plug-and-play behavior

**Plug-and-play behavior** is the capability of a FLAS device to be automatically detected, identified, and made operational within a FLAS system with minimal manual configuration.

NOTE Plug-and-play behavior includes discovery, commissioning, and integration into normal operation.

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### 3.9 Device discovery

**Device discovery** is the process by which a FLAS system detects the presence of a newly connected FLAS node and acquires its basic identification and capability information.

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### 3.10 Commissioning

**Commissioning** is the process by which a FLAS device is configured and authorized to operate within a FLAS system after discovery.

NOTE Commissioning may be automatic, semi-automatic, or manual.

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### 3.11 Operational state

An **operational state** is a defined mode of operation of a FLAS device or FLAS system, including normal operation, reduced operation, standby, or fault conditions.

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### 3.12 Safe behavior

**Safe behavior** is a predefined response of a FLAS device or FLAS system intended to reduce risk to people, equipment, or the environment in the presence of faults, abnormal conditions, or loss of communication.

NOTE Safe behavior is application-dependent and may include controlled shutdown, fallback operation, or degraded performance.

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### 3.13 Communication channel

A **communication channel** is a logical or physical medium used for data exchange between FLAS nodes.

NOTE A FLAS system may support one or more communication channels.

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### 3.14 Interoperability

**Interoperability** is the ability of FLAS devices from different manufacturers to operate together within a FLAS system in accordance with this specification.

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### 3.15 Conformance

**Conformance** is the fulfillment by a FLAS system or FLAS device of the mandatory requirements defined in this document.

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### 3.16 Artificial intelligence (AI)

**Artificial intelligence (AI)** refers to computational techniques enabling adaptive, data-driven, or autonomous behavior within a FLAS system.

NOTE This specification defines conditions for the integration of AI-based functions but does not specify AI models or algorithms.

# 4 System Architecture

## 4.1 General

A FLAS system shall be based on a **system-oriented architecture** in which multiple FLAS nodes operate as part of a coordinated microgrid rather than as isolated devices.

The FLAS architecture is defined at **system level** and is independent of specific hardware technologies, software platforms, or communication media.
It establishes a set of **logical roles, domains, and interactions** that enable interoperability, plug-and-play behavior, and intelligent operation.

A FLAS system shall consist of one or more FLAS nodes interconnected through:

- a shared power distribution environment;
- one or more communication channels;
- a logical control and coordination framework.

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## 4.2 Architectural domains

The FLAS system architecture is structured into the following logical domains:

- **Power domain**
- **Communication domain**
- **Control and intelligence domain**

These domains may be implemented using separate or shared physical infrastructures, depending on the implementation.

---

### 4.2.1 Power domain

The **power domain** provides electrical energy to FLAS nodes and enables their physical operation.

A FLAS system shall:

- operate within a **Low Voltage Direct Current (LVDC)** power environment;
- allow multiple FLAS devices to be supplied from a shared power source;
- support scalable system configurations, from small fan groups to large arrays.

NOTE 1
This specification does not mandate voltage levels, grounding schemes, or protection topologies.

NOTE 2
The power domain may also be used as a carrier for communication, but this is not mandatory.

### 4.2.2 Communication domain

The **communication domain** enables information exchange between FLAS nodes.

A FLAS system shall provide at least one communication channel capable of supporting:

- device discovery;
- identification and capability exchange;
- operational status reporting;
- command and configuration messages.

The communication domain shall support **logical addressing** of FLAS nodes.

NOTE
The communication domain may be implemented using wired, wireless, or hybrid technologies, including but not limited to power line communication.

### 4.2.3 Control and intelligence domain

The **control and intelligence domain** governs the behavior, coordination, and optimization of the FLAS system.

A FLAS system shall support:

- local control at FLAS device level;
- system-level coordination functions;
- integration of intelligent functions, including AI-based functions.

Control and intelligence functions may be:

- centralized;
- distributed;
- hybrid.

This specification does not mandate a specific control architecture.

## 4.3 Logical roles within a FLAS system

A FLAS system shall support the following **logical roles**.
A single physical device may implement one or more roles.

### 4.3.1 FLAS device role

A FLAS device role shall:

- perform a physical function (e.g. air movement);
- expose operational states and parameters to the FLAS system;
- accept control commands according to its declared capabilities.

A FLAS device shall be capable of participating in plug-and-play behavior.

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### 4.3.2 Coordination role

A coordination role shall:

- manage or support system-level coordination of multiple FLAS devices;
- handle commissioning and configuration processes;
- enforce or distribute control policies.

NOTE
The coordination role may be implemented by a central intelligence node or distributed across multiple nodes.

---

### 4.3.3 Supervision role

A supervision role shall:

- monitor the operational status of FLAS nodes;
- collect system-level data;
- provide diagnostic or optimization functions.

NOTE
Supervision may be local or remote and may interface with external systems.

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## 4.4 System topology

A FLAS system shall support flexible topologies.

Permitted topologies include, but are not limited to:

- bus topology;
- daisy-chain topology;
- star topology;
- hybrid topologies.

The architecture shall not require point-to-point wiring between all devices.

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## 4.5 Scalability and modularity

A FLAS system shall be **scalable**.

It shall be possible to:

- add or remove FLAS devices without redesigning the entire system;
- extend the system by connecting additional segments;
- operate subsets of the system independently if required.

Scalability shall not compromise basic interoperability or plug-and-play behavior.

---

## 4.6 Separation of mandatory and optional functions

The FLAS architecture distinguishes between:

- **mandatory system functions**, required for interoperability;
- **optional or advanced functions**, allowing differentiation and innovation.

Mandatory functions include at least:

- device discovery;
- commissioning support;
- operational state reporting;
- command reception.

Advanced functions may include, but are not limited to:

- predictive maintenance;
- energy optimization;
- adaptive or AI-based control.

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## 4.7 Openness and extensibility

The FLAS architecture shall be **open and extensible**.

It shall allow:

- vendor-specific extensions;
- future functional expansion;
- coexistence of devices with different capability levels.

Extensions shall not prevent basic interoperability with FLAS-compliant devices.

# 5 Behavioral Model and Plug-and-Play Operation

## 5.1 General

A FLAS system shall operate according to a **defined behavioral model** that governs the interaction between FLAS nodes throughout their lifecycle.

The behavioral model specifies:

- how FLAS nodes join and leave a FLAS system;
- how devices are discovered and commissioned;
- how normal operation is maintained;
- how abnormal conditions and failures are handled.

The behavioral model is independent of specific communication technologies or control algorithms.

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## 5.2 Lifecycle states of a FLAS device

A FLAS device shall support a set of **lifecycle states**.

At minimum, the following states shall be supported:

- **Disconnected**
- **Discovered**
- **Commissioned**
- **Operational**
- **Degraded**
- **Fault**

NOTE
Additional states may be implemented by manufacturers, provided that mandatory behaviors are preserved.

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### 5.2.1 Disconnected state

In the *Disconnected* state, a FLAS device:

- is not electrically powered or not logically connected to the FLAS system;
- does not participate in system communication.

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### 5.2.2 Discovered state

In the *Discovered* state, a FLAS device:

- is electrically powered;
- has been detected by the FLAS system;
- provides basic identification and capability information.

A FLAS device in the Discovered state shall not perform uncontrolled physical actions.

---

### 5.2.3 Commissioned state

In the *Commissioned* state, a FLAS device:

- has been accepted into the FLAS system;
- has received or confirmed its configuration parameters;
- is authorized to transition to operational behavior.

Commissioning may be automatic, semi-automatic, or manual.

---

### 5.2.4 Operational state

In the *Operational* state, a FLAS device:

- performs its intended physical function;
- responds to control commands;
- reports operational status and relevant parameters.

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### 5.2.5 Degraded state

In the *Degraded* state, a FLAS device:

- operates with limited functionality;
- maintains safe behavior;
- reports its degraded condition to the FLAS system.

NOTE
The Degraded state may be entered due to partial failures, communication issues, or external constraints.

---

### 5.2.6 Fault state

In the *Fault* state, a FLAS device:

- detects a condition preventing safe or correct operation;
- applies predefined safe behavior;
- reports the fault condition, when possible.

A FLAS device shall not resume normal operation from the Fault state without an explicit transition mechanism.

---

## 5.3 Plug-and-play operation

A FLAS system shall support **plug-and-play operation**.

Plug-and-play operation shall include at least:

- automatic device discovery;
- identification of device type and capabilities;
- integration into system coordination without manual wiring changes.

Plug-and-play operation shall not require system shutdown.

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## 5.4 Device discovery behavior

When a FLAS device is connected to the power domain and communication domain, it shall:

- announce its presence to the FLAS system;
- provide a unique identifier;
- declare its functional capabilities.

The FLAS system shall be capable of detecting newly connected devices within a bounded time.

---

## 5.5 Commissioning behavior

The FLAS system shall provide a commissioning process.

During commissioning:

- device parameters may be assigned or negotiated;
- operational constraints may be applied;
- logical grouping may be established.

A FLAS device shall not enter the Operational state before successful commissioning.

---

## 5.6 Normal operation behavior

During normal operation:

- FLAS devices shall follow control commands consistent with their capabilities;
- operational data shall be made available to the FLAS system;
- coordination functions may optimize system-level behavior.

The behavioral model shall support:

- coordinated operation of multiple devices;
- individual override when required.

---

## 5.7 Loss of communication

A FLAS device shall detect loss of communication.

Upon loss of communication:

- the device shall transition to a predefined safe or degraded behavior;
- uncontrolled operation shall be prevented.

NOTE
The specific response to communication loss is application-dependent.

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## 5.8 Dynamic system changes

A FLAS system shall support dynamic changes, including:

- addition of devices;
- removal of devices;
- temporary disconnection.

Such changes shall not compromise the safe operation of remaining devices.

---

## 5.9 Support for intelligent functions

The behavioral model shall allow integration of intelligent functions, including AI-based functions.

Intelligent functions may:

- observe system behavior;
- influence control decisions;
- adapt system operation over time.

Intelligent functions shall not bypass mandatory safety or behavioral constraints.

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## 5.10 Determinism and predictability

While a FLAS system may include adaptive or intelligent behavior, it shall ensure:

- predictable responses to defined events;
- bounded reaction times for critical behaviors;
- consistent safe behavior under abnormal conditions.

# 6 Communication Fundamentals

## 6.1 General

A FLAS system shall provide a **communication framework** enabling information exchange between FLAS nodes in support of discovery, commissioning, operation, supervision, and coordination.

The communication framework is defined at a **functional level** and does not mandate specific communication technologies, protocols, or physical media.

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## 6.2 Communication objectives

The communication framework shall support the following objectives:

- interoperability between FLAS nodes from different manufacturers;
- plug-and-play operation;
- reliable exchange of operational information;
- support for coordinated and intelligent system behavior.

---

## 6.3 Communication model

The FLAS communication model shall support:

- **logical addressing** of FLAS nodes;
- **bidirectional communication** between nodes;
- **asynchronous message exchange**.

The communication model may be:

- centralized;
- distributed;
- hybrid.

This specification does not mandate a master–slave or peer-to-peer architecture.

---

## 6.4 Minimum communication capabilities

Each FLAS node shall support communication capabilities sufficient to:

- announce its presence to the FLAS system;

- provide identification and capability information;
- receive configuration and control messages;
- transmit operational status information.

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# 6.5 Addressing and identification

Each FLAS node shall:

- have a **unique identifier** within the FLAS system;
- support logical addressing independent of physical topology.

NOTE
The unique identifier may be factory-assigned, derived, or dynamically assigned.

---

# 6.6 Message categories

The communication framework shall support at least the following **message categories**:

### 6.6.1 Discovery messages

Discovery messages shall support:

- detection of newly connected FLAS nodes;
- announcement of node presence;
- retrieval of basic identification information.

---

### 6.6.2 Configuration and commissioning messages

Configuration and commissioning messages shall support:

- assignment of operational parameters;
- authorization to enter operational states;
- logical grouping or role assignment.

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### 6.6.3 Control messages

Control messages shall support:

- start, stop, and modulation of device operation;
- transitions between operational states;
- override or fallback commands.

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### 6.6.4 Status and monitoring messages

Status and monitoring messages shall support:

- reporting of operational state;
- reporting of alarms, warnings, or faults;
- transmission of measured or computed parameters.

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### 6.6.5 Diagnostic and maintenance messages

Diagnostic and maintenance messages may support:

- detailed fault reporting;
- performance indicators;
- maintenance-related information.

NOTE
Support for diagnostic and maintenance messages may be optional.

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## 6.7 Timing and performance

The communication framework shall support **bounded communication latency** appropriate for ventilation and airflow control applications.

This specification does not require hard real-time communication.

NOTE
Typical FLAS applications require predictable but not sub-millisecond response times.

---

## 6.8 Reliability and robustness

The communication framework shall be designed to tolerate:

- transient communication errors;
- temporary loss of connectivity;
- dynamic changes in system topology.

Loss or degradation of communication shall trigger defined behavioral responses as specified in Clause 5.

---

## 6.9 Security considerations

The communication framework shall support measures to:

- prevent unauthorized control;
- ensure message integrity;
- protect system operation from unintended interference.

NOTE
Specific security mechanisms are implementation-dependent and not specified in this document.

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## 6.10 Extensibility

The communication framework shall support:

- vendor-specific extensions;
- future functional expansion;
- coexistence of FLAS nodes with different capability levels.

Extensions shall not prevent basic interoperability with FLAS-compliant devices.

# 7 Conformance and Compliance

## 7.1 General

This clause specifies the requirements for **conformance** of FLAS systems and FLAS nodes to this document.

Conformance ensures that FLAS-compliant devices and systems:

- can interoperate with other FLAS-compliant elements;
- exhibit predictable plug-and-play behavior;
- respect mandatory safety and behavioral constraints.

Conformance to this document is defined at **system level** and **device level**.

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## 7.2 Conformance statement

A manufacturer claiming conformance to this document shall provide a **FLAS conformance statement**.

The conformance statement shall declare:

- the conformance level claimed;
- the roles implemented by the device or system;
- supported optional functions and extensions.

---

## 7.3 Mandatory requirements

A FLAS-compliant system or device shall implement all **mandatory requirements** specified in this document.

Mandatory requirements are expressed using the keyword **“shall”**.

Failure to implement any mandatory requirement constitutes **non-conformance**.

---

## 7.4 Optional requirements

Optional requirements are expressed using the keywords **“should”** and **“may”**.

Implementation of optional requirements:

- is not required for basic conformance;
- shall not compromise mandatory behaviors or interoperability.

---

# 7.5 Conformance levels

This document defines the following **conformance levels**:

### 7.5.1 FLAS Base Conformance

FLAS Base Conformance defines the minimum set of requirements necessary for interoperability and plug-and-play operation.

A FLAS Base compliant device or system shall:

- support device discovery;
- support commissioning;
- implement the mandatory lifecycle states defined in Clause 5;
- support minimum communication capabilities defined in Clause 6;
- exhibit defined safe behavior under fault or communication loss.

FLAS Base Conformance is sufficient to participate in a FLAS system.

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### 7.5.2 FLAS Advanced Conformance

FLAS Advanced Conformance defines additional capabilities enabling enhanced coordination, supervision, and intelligent functions.

A FLAS Advanced compliant device or system shall:

- support extended monitoring and diagnostic messages;
- support coordination of multiple devices;
- allow integration of intelligent or adaptive control functions.

NOTE
FLAS Advanced Conformance builds upon FLAS Base Conformance.

---

# 7.6 Role-based conformance

Conformance shall be evaluated with respect to the **roles implemented** by a device or system.

A FLAS device may conform as:

- FLAS device role;

- coordination role;
- supervision role;
- a combination of roles.

Each role shall satisfy the mandatory requirements applicable to that role.

---

# 7.7 Interoperability requirements

FLAS-compliant devices from different manufacturers shall:

- interoperate at the communication and behavioral levels defined in this document;
- not rely on proprietary mechanisms for mandatory functions;
- tolerate the presence of devices with different capability levels.

---

# 7.8 Extensions and proprietary functions

Vendor-specific extensions are permitted.

Extensions:

- shall not interfere with mandatory communication and behavior;
- shall not prevent interoperability with FLAS Base compliant devices.

NOTE
Extensions may be declared in the conformance statement.

---

# 7.9 Compliance testing considerations

Compliance testing may include:

- verification of mandatory behaviors;
- validation of lifecycle state transitions;
- evaluation of plug-and-play operation;
- verification of safe behavior under fault conditions.

NOTE
This document does not define specific test procedures.

---

# 7.10 Claim of compliance

A product or system may claim compliance with this document only if:

- all applicable mandatory requirements are fulfilled;
- the claimed conformance level is supported;
- the roles implemented are correctly declared.

# **Annex A

(informative)
Example System Behaviors and Use Cases**

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## A.1 General

This annex provides **informative examples** illustrating typical behaviors and use cases of a FLAS system.

The examples in this annex:

- are provided for explanatory purposes only;
- do not introduce additional requirements;
- do not override normative clauses of this document.

---

## A.2 Example of plug-and-play device integration

### A.2.1 Scenario description

A new FLAS device is physically connected to an existing FLAS system while the system is in normal operation.

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### A.2.2 Example sequence

1. The FLAS device is connected to the power domain.
2. The device powers up and enters the *Discovered* state.
3. The device announces its presence through the communication domain.
4. The FLAS system detects the new device.
5. The device provides identification and capability information.
6. The FLAS system initiates commissioning.
7. Configuration parameters are assigned.
8. The device transitions to the *Commissioned* state.
9. The device transitions to the *Operational* state and joins coordinated operation.

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### A.2.3 Result

The device becomes operational without manual wiring changes or system shutdown.

---

# A.3 Example of coordinated operation

### A.3.1 Scenario description

Multiple FLAS devices operate as part of a coordinated ventilation group.

---

### A.3.2 Example behavior

- The coordination role assigns a common operational objective (e.g. airflow demand).
- Individual FLAS devices adjust their operation according to their capabilities.
- Operational status is continuously reported.
- System-level optimization adjusts individual setpoints over time.

---

### A.3.3 Result

The FLAS system achieves the required airflow with optimized energy use and balanced device loading.

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# A.4 Example of loss of communication

### A.4.1 Scenario description

A FLAS device temporarily loses communication with the FLAS system.

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### A.4.2 Example behavior

1. The device detects loss of communication.
2. The device transitions to the *Degraded* state.
3. A predefined fallback behavior is applied (e.g. reduced speed).
4. The device periodically attempts reconnection.
5. Communication is restored.
6. The device resumes *Operational* state after authorization.

---

### A.4.3 Result

System safety and predictability are maintained despite communication loss.

---

# A.5 Example of fault handling

### A.5.1 Scenario description

A FLAS device detects an internal fault affecting safe operation.

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### A.5.2 Example behavior

- The device detects the fault condition.
- The device transitions to the *Fault* state.
- Safe behavior is applied (e.g. controlled shutdown).
- The fault condition is reported to the FLAS system.
- Maintenance action is triggered.

---

### A.5.3 Result

The fault is isolated without propagating instability to the rest of the system.

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# A.6 Example of system scalability

### A.6.1 Scenario description

A FLAS system is expanded by adding a new segment of devices.

---

### A.6.2 Example behavior

- New devices are connected to the existing infrastructure.
- Discovery and commissioning occur automatically.
- The coordination role integrates the new devices into system control.
- Existing devices continue normal operation.

---

### A.6.3 Result

System capacity is increased without redesign or reconfiguration of existing devices.

---

# A.7 Example of intelligent function integration

### A.7.1 Scenario description

An intelligent optimization function is introduced into an existing FLAS system.

---

### A.7.2 Example behavior

- The intelligent function observes operational data.
- Optimization recommendations are generated.
- Control decisions are adjusted within defined constraints.
- Mandatory safety and behavioral rules remain enforced.

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### A.7.3 Result

System performance improves over time while maintaining predictable and safe behavior.

---

## A.8 Informative system diagram (conceptual)

A typical FLAS system may be conceptually represented as:

- a shared LVDC power domain;
- multiple FLAS devices connected through a common communication environment;
- one or more coordination and supervision roles;
- optional interfaces to external systems.

NOTE
This conceptual representation is independent of physical topology or implementation technology.