


Whitepaper

# Network Switches

for Industrial Automation and  
Machinery Operation






**In industrial automation and machinery operations, reliable, efficient, and secure data communication forms the foundation for productivity and innovation.**

Selecting the right industrial switches for machine networks at the OT level is crucial now and for the future, determining the performance, security and reliability of industrial data transmission. Companies must consider factors such as compatibility with various fieldbuses and protocols, robustness against harsh environments, advanced security features, scalability, seamless IT

connectivity, high availability and redundancy. Efficient diagnostic and monitoring functions, as well as user-friendliness and maintainability, are also essential. A careful cost-benefit analysis remains critical to making investments economically while ensuring high quality and comprehensive service from manufacturers for reliability and customer satisfaction. Network switches play a central role in this ecosystem, controlling data flows between devices within a network. The correct selection and configuration of these switches are crucial to meeting the challenges of modern industrial plants while laying the foundation for future technologies and expansions. This guide leads you through the world of network switches, their types, application areas, and specific benefits for industrial automation.



# Contents

Introduction .....	2
Types of <b>Network Switches</b> .....	4
<b>Switch Market</b> Overview .....	5
<b>Managed Switches</b> – The Pinnacle of Network Switch Hierarchy .....	6
<b>Lightly Managed Switches</b> – Controlled Flexibility .....	7
<b>Unmanaged Switches</b> – Simplicity for Small Networks .....	8
<b>Efficient Network Management</b> .....	9
<b>Special Case:</b> Managed Switches .....	10
<b>Industrial Diagnostic Switches</b> Ensure Availability and Security .....	11
<b>Fixed, Modular and Stackable Switches</b> – An Overview .....	12
<b>PoE Switches</b> – Power and Flexibility Combined .....	13
<b>IP Protection Classes</b> .....	14 – 15
<b>OT Network Technology</b> of the Future .....	16 – 17
<b>Indu-Sol:</b> We Make Networks Secure! .....	18
<b>Conclusion</b> on Procuring Industrial Switches .....	19

# Types of Network Switches and Their Applications

70%

## Managed Switches

Network management with port configuration, redundancy protocols and VLAN



16%

## Lightly Managed Switches

with simple configuration options without the complexity of fully managed switches

12%

## Unmanaged Switches

for simple applications without management functions

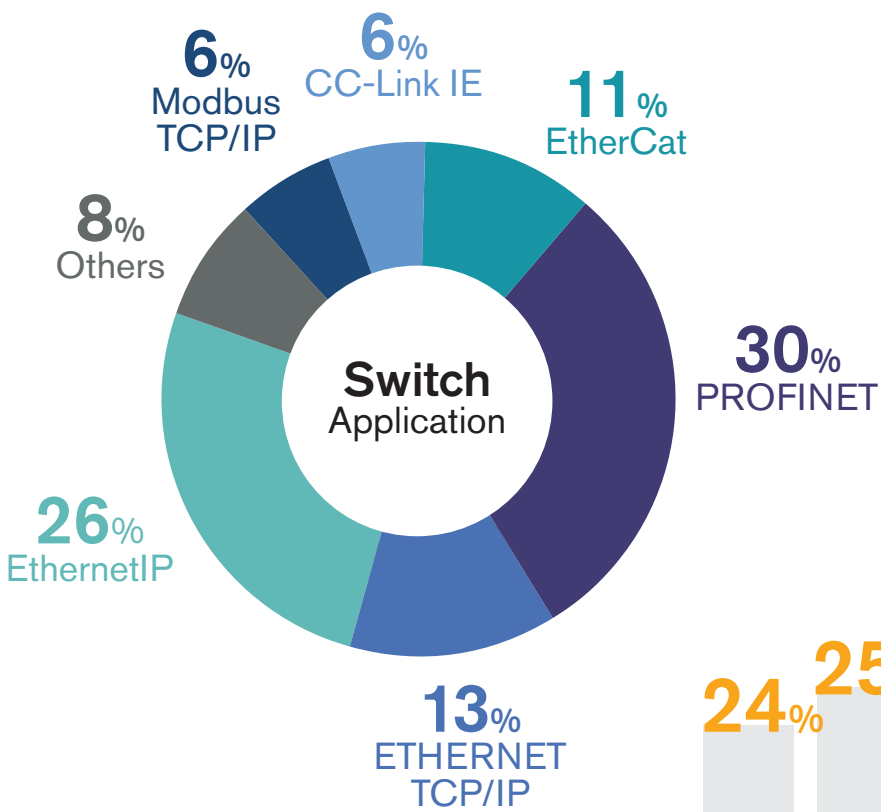
2%

## Managed with diagnostic function

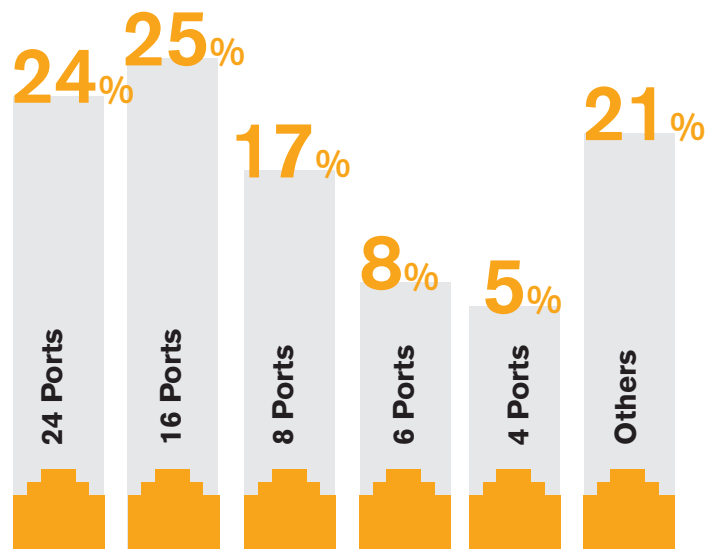
Permanent line diagnostics, condition monitoring and performance monitoring

# Switch Market

## Overview



### Switch Ports



Source: Omidia, Industrial Communication Report 2022

Source: Maia Research



# Managed Switches

## The Pinnacle of Network Switch Hierarchy

### **Managed switches**

represent the pinnacle of the network switch hierarchy and are indispensable for medium to large automation networks due to their extensive configurability and performance. These switches offer hundreds to thousands of configuration options crucial in today's complex IT and OT landscape. Configuration options include access control lists (ACLs), redundancy protocols, VLAN settings, Quality of Service (QoS) to prioritize network traffic, and more, creating a highly customized network

environment to meet specific requirements. Management is typically via a graphical user interface (GUI) for intuitive operation and visual network monitoring. For network professionals seeking deeper control, managed switches also allow administration via a command-line interface (CLI), enabling quick and efficient configuration and the ability to execute complex scripts and commands for fine-grained network management.

# Lightly Managed Switches

## Controlled Flexibility

Smart switches, also known as **lightly managed switches**, provide an effective middle ground between unmanaged and fully managed switches. These devices offer more functionalities than unmanaged switches and are ideal for networks requiring some level of management without the complexity and administrative overhead of managed switches. They support basic network management functions such as creating Virtual Local Area Networks (VLANs), Quality of Service (QoS) for prioritizing network traffic, and port configurations. Configuration is usually via a user-friendly web-based graphical user interface (GUI) for easy management.

# Unmanaged Switches

## Simplicity for Small Networks



**Unmanaged Switches** are the simplest and most cost-effective type of network switches. They are ideal for small networks where no configuration is required, offering a plug-and-play solution. These switches are excellent for simple applications where no network traffic management or specific security or performance requirements exist. For long-term disturbance-free and maintenance-friendly operation, managed switches are generally recommended.







# Efficient Network Management

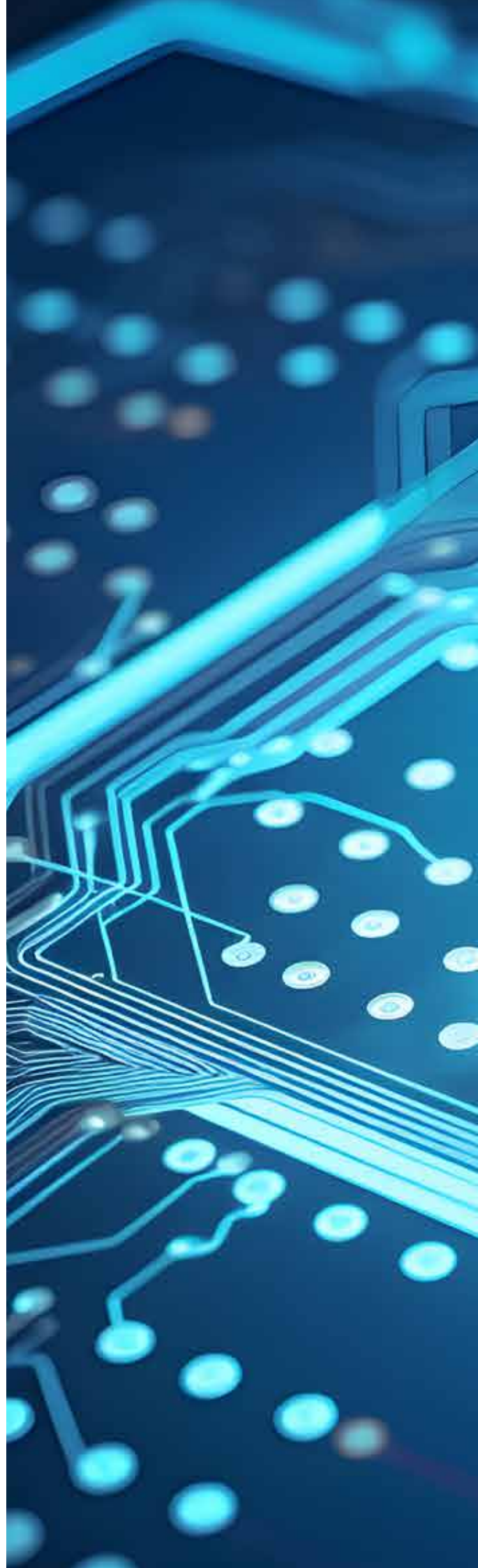
**through targeted  
use of layer 2 and  
layer 3 switches**

## **Layer 2 Switches**

Layer 2 switches, also known as multiport bridge switches, operate at the Data Link layer (Layer 2) of the OSI model and are primarily responsible for forwarding data packets within the same Local Area Network (LAN). They are the building blocks of a network, making efficient decisions based on MAC addresses to ensure quick and targeted data forwarding. In simple or isolated network environments where routing between different networks is not required, Layer 2 switches offer a cost-effective solution to ensure long-term stable network operation.

## **Layer 3 Switches**

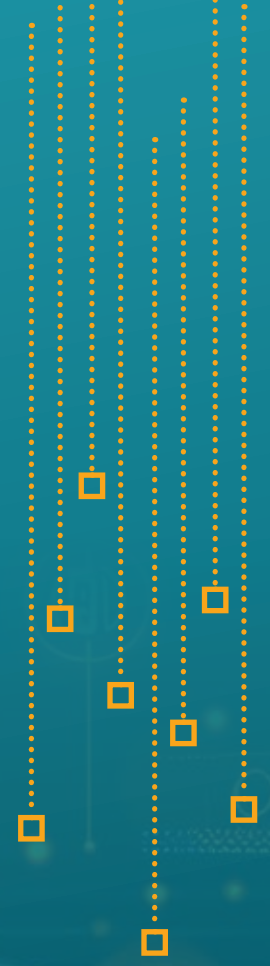

Layer 3 switches or multilayer switches operate at the Network layer (Layer 3) of the OSI model, combining the functionalities of switches and routers. These devices can forward data packets within a network and route traffic between different networks with different IP address ranges. They use IP addresses to make decisions about forwarding data packets, enabling more complex network structures and efficient data processing. Layer 3 switches are particularly beneficial in larger and more complex networks where traffic management and routing between different network areas are required.



## SPECIAL CASE

# Managed Switches

with Network Analysis Function



A standout feature of some **managed switches** is the integrated network analysis function. These switches go beyond traditional network management, providing insights into network traffic and structure essential for predictive maintenance and proactive network infrastructure monitoring. They can identify network issues early, initiate automated maintenance processes, minimize downtime, and optimize network performance. Knowing the current state of lines in a machine network allows proactive avoidance of downtime costs.

Only those who know the current condition of the lines in the machine network can proactively avoid downtime costs.

# Industrial Diagnostic Switches

## Ensure Availability and Security



Permanent network monitoring is a vital measure to ensure the availability and security of industrial networks. With InduSol's PROmesh P switches, you can not only control data flows in your network but also monitor the network's quality and performance.

The PROmesh P switches offer the following advantages:

- Effectively prevent network errors (up to 40%) through:
  - Permanent physical monitoring of data lines
  - Detection of interference currents via EMC monitoring
  - Monitoring of network load (performance monitoring)
- Detection of access to the control cabinet via light sensors
- Detection and potential blocking of network accesses\*

**Identify more than 90% of possible reasons for unplanned plant downtime with the CM&SM system. Find more information [here](#).**

\* Port up/down including transmitted data volume |

\*\* Condition Monitoring & Security Management System

# Fixed, Modular and Stackable Switches

## An Overview

### Fixed Switches

Fixed switches have a set number of ports and do not offer expansion options. These devices are ideal for smaller networks or as part of a larger network where the number of ports is known in advance. They provide a simple, cost-effective solution for stable network environments.

### Modular Switches: Efficient Flexibility and Cost Considerations

Modular switches offer outstanding flexibility in terms of configuration and expandability, ideal for evolving network environments. With interchangeable modules, these switches can be adapted to changing network requirements by adding or swapping ports and functions as needed. While modular switches provide flexibility, it's essential to consider the cost-benefit ratio. The base unit is often designed for maximum expansion,

leading to high initial costs, especially if the current need for ports is low. Companies should conduct a precise needs analysis to avoid unnecessary expenses and find a balance between current and future requirements.

### Stackable Switches: Flexibility and Network Bottlenecks

Stackable switches offer a practical solution, balancing between fixed and modular switches. They allow multiple switches to be logically connected into a single manageable unit. This integration simplifies management and improves scalability. However, stackable switches can experience bottlenecks, particularly if the connections between stacked switches do not provide sufficient bandwidth to handle the data traffic efficiently. When planning a stackable switch solution, it's crucial to ensure that the connection capacity between switches is adequate to transfer expected data traffic without bottlenecks.

# PoE Switches

## Power and Flexibility Combined

PoE switches, which provide power over Ethernet, are increasingly crucial in modern industrial environments. These devices power endpoints, such as IP cameras, VoIP phones, and WLAN access points, directly over the Ethernet cable. This functionality simplifies device installation and maintenance by eliminating the need for separate power sources and corresponding wiring. PoE switches enhance device placement flexibility and reduce overall costs. Different PoE standards can meet various power requirements, making them a versatile solution for a wide range of applications.

### Challenges and Solutions in Industrial Automation

Selecting and configuring network switches is essential to meet the demands of modern industrial plants. Challenges include network configuration complexity, security requirements, reliability, availability, energy efficiency, and costs. Managed switches, especially those with network analysis functions, address these challenges effectively by providing advanced management features, security features, and the ability for predictive maintenance.



# IP Protection Classes

## and Application Areas

Industrial switches must be selected based on the specific industrial environment to ensure they withstand physical challenges without compromising performance or reliability.

IP protection classes are especially important when it comes to the appropriate installation location of electrical equipment like switches and the anticipated environmental conditions. Typically, the following installation locations and required protection classes are distinguished:

### **IP20**

#### **Control Cabinet/Room**

In control cabinets/rooms and terminal boxes, the IP20 protection class provides adequate protection against unintentional contact with electronics.

### **IP67**

#### **Outside Control Cabinets/Rooms**

To be equipped against various influences outside a protected control cabinet/room, an IP67 protection class is recommended in these environments.

### **IP69**

#### **High-Pressure/Steam Jet Cleaning Areas**

Especially in the food and beverage industry, the environment outside control cabinets/rooms is often subjected to high-pressure/steam jet cleaning. Devices in such areas must meet the highest protection class requirements of IP69.



# IP Protection Classes and Application Areas

## Solid Foreign Objects (First Digit)

0	No protection.
1	Protection against solid foreign objects with a diameter of 50 mm or more.
2	Protection against solid foreign objects with a diameter of 125 mm or more.
3	Protection against solid foreign objects with a diameter of 25 mm or more.
4	Protection against solid foreign objects with a diameter of 1 mm or more.
5	Dust-protected. Limited protection against dust; complete ingress is not possible.
6	Dust-tight. No dust ingress.

## Water (Second Digit)

0	No protection.
1	Protection against vertically falling water drops
2	Protection against water drops falling at up to a 15-degree angle
3	Protection against spraying water
4	Protection against splashing water from all directions
5	Protection against water jets from any direction
6	Protection against powerful water jets
7	Protection against temporary immersion in water
8	Protection against continuous immersion in water
9	Protection against high-pressure/steam jet cleaning

### Suitable Devices for Each Environment

Industrial switches are specifically designed to function reliably in demanding industrial environments where they are often exposed to extreme temperatures, dust, dirt, and moisture. To determine a device's suitability for such conditions, IP protection classes (Ingress Protection) are referenced. These international standard classes define the extent to which electronic devices are protected against the ingress of solid objects (including body parts such as hands and fingers), dust, accidental contact, and water.

### The IP Classification Consists of Two Digits:

- The first digit (0 – 6) indicates the level of protection against solid foreign objects.
- The second digit (0 – 9) describes the level of protection against water ingress.

# OT Network Technology of the Future

by Indu-Sol

Indu-Sol GmbH is one of the leading companies in industrial automation and OT network technology. With a comprehensive range of system solutions, including OT network infrastructure components for designing performant and secure networks and automating maintenance tasks for predictive maintenance, Indu-Sol GmbH supports companies in making their industrial plants more efficient, safer, and future-proof. Our expertise allows us to offer customized solutions tailored to the specific needs and challenges of our customers.

## Advanced OT Security

In a time when the security of industrial networks is of utmost importance, Indu-Sol provides advanced OT security solutions aimed at protecting plants from internal and external threats. Our security concepts include both preventive measures and strategies for quickly detecting and resolving security incidents to ensure the integrity and availability of our customers' industrial networks.





### Automating Maintenance and Predictive Maintenance

Automating maintenance processes and implementing predictive maintenance strategies are other core competencies of Indu-Sol. Using state-of-the-art technologies and collecting and analyzing data from the operational environment, we can identify potential problems before they lead to failures. This not only minimizes downtime but also optimizes maintenance planning and execution, resulting in significant cost savings for our customers.

### Condition Monitoring

Our condition monitoring systems provide real-time insights into the condition of machines and equipment. Continuous monitoring of critical parameters allows for early detection of anomalies and the initiation of appropriate measures to maximize equipment availability and extend the lifespan of components. This proactive approach helps operators maintain optimal operating conditions and overall efficiency.



# Indu-Sol

**We Make  
Networks Secure!**

## **Commitment to Excellence and Innovation**

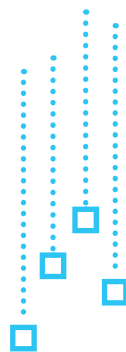
Indu-Sol is committed to excellence in all areas. Our solutions are based on the latest technological developments and industry best practices to ensure our customers benefit from the most advanced and

effective solutions. Through continuous research and development, we strive to deliver innovative products and services that meet the ever-changing demands of the industry.

## **A Competence Partner for the Future**

As your partner for industrial automation and network technology, Indu-Sol GmbH is ready to help you tackle today's challenges and prepare for tomorrow's opportunities. Our comprehensive understanding of industry needs, combined with our commitment to customer satisfaction and technical excellence, makes us the ideal partner for companies seeking success in an increasingly connected world.

Indu-Sol is more than a provider of technological solutions; we are a trusted advisor and partner for our customers. By working with us, you benefit from our deep expertise, innovative power, and relentless dedication.



# Conclusion on Procuring Industrial Switches

Selecting the right industrial switches for machine networks at the OT level is critical for the performance, security, and reliability of data transmission. Various factors must be considered to meet the specific requirements of the industrial environment.

## Compatibility and Robustness

The switches must be compatible with existing field-buses and protocols, such as PROFINET or EtherNet/IP, to ensure easy integration into the existing infrastructure. At the same time, the robustness of the devices is crucial. They must withstand harsh industrial conditions such as dust, moisture, vibrations, and temperature fluctuations, and offer a high degree of electromagnetic compatibility (EMC). This includes a robust housing, an extended temperature range, and a durable circuit design.

## Security and Scalability

Another key aspect is the security of data transmission. Industrial switches offer secure protocols such as HTTPS or SNMPv3 and allow for user authentication and authorization. Additionally, the scalability and flexibility of the switches must be ensured. This means they should have a sufficient number of ports, high bandwidth, and flexible media connections such as SFP slots for either fiber or copper ports to facilitate expansions or changes.

## Connectivity and Availability

Connectivity with the IT level is essential as it forms a bridge between data sources at the OT level and data processing and analysis applications at the IT level. At these transition points, we recommend using switches with firewall

functions to ensure only necessary access to the plant network. Besides permanent network monitoring, a redundant network setup also contributes to high availability by supporting redundancy protocols such as MRP or RSTP

## Diagnosis, User-Friendliness, and Cost-Benefit Analysis

For preventive or simple error detection and correction, the switches should have comprehensive diagnostic and monitoring functions. Practice shows that data lines, EMC impacts, and overloaded networks are responsible for around 60% of all network failures (Indu-Sol Vortex Report 2024). Switches with diagnostic features such as line diagnostics, EMC, and performance monitoring can announce most of these errors through integrated alarm management and enable maintenance before failure

## Quality and service

The quality of the products, service, and solutions of a manufacturer are crucial for customer satisfaction. A good supplier should have high expertise, a good reputation, and comprehensive support





**InduSol America, LLC**  
980 Birmingham Rd Ste 721  
Alpharetta, GA 30004 USA

**Indu-Sol GmbH**  
Blumenstraße 3  
04626 Schmölln

Phone: +1 (678) 880-6910

[info@indusolamerica.com](mailto:info@indusolamerica.com)  
[www.indusolamerica.com](http://www.indusolamerica.com)

Certificate according to DIN EN ISO 9001:2015