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A man in a light blue shirt is shown from the side, looking at a tablet. The scene is overlaid with various digital icons and text, including a '24/7' circular arrow icon, a 'NEWS' header, a 'Home' button, and a network diagram with three nodes. The background is a blurred industrial setting with a clock on the wall.

Areas of Operation for Industrial Wireless LAN in a PROFINET IO Environment

Industrial Wireless LAN

<https://support.industry.siemens.com/cs/ww/en/view/22681042>

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1 Real-time communication in Wireless LAN

1.1 WLAN in industrial environments

As a radio system, wireless LAN is an "all-rounder" that is suitable for virtually any type of application involving local radio networks. This applies to any area, from household living rooms to offices or to industrial production halls. Although they share the same basis in technology, they have very different requirements.

Availability and reliability are vital especially in industrial environments. In this case, so-called industrial features (iFeatures) are used to transform a simple WLAN into a reliable industrial WLAN (IWLAN).

1.2 IWLAN with PROFINET IO

Customer benefits

PROFINET is intended for real-time communication in automation systems. Its application is not limited to wired networks, it can also be used in wireless networks.

PROFINET via IWLAN has many advantages:

- higher performance and improved diagnostics options
- flexible integration of stationary and mobile nodes
- significant cost savings - for the installation and operations
- safety applications with PROFINET are possible via a single medium, including wireless
- integration with Ethernet: simple connection to the control and enterprise management level
- fast installation and startup thanks to reliable hardware components for wireless communication

Special considerations when using PROFINET

When operating IWLAN in the PROFINET IO environment, it is important to ensure that the functions corresponding to the data volume and the update times are selected for the IWLAN devices. In addition, a good radio field must be ensured through radio field planning in order to provide sufficient security for dynamic effects.

PROFINET works with cyclic data exchange. If just three data packets (default setting) fail in succession, this will lead to a bus error.

Availability can be ensured using the following criteria:

- Selection of a radio standard appropriate to the given environment
- Selection of a free radio channel
- Use of industry features if required
- Interference avoidance
- Selection of suitable antennas or antenna arrangement to guarantee signal quality: > 60% (min. -64 dB)
- Fast switching times when roaming
- Compliance with the update time in accordance with the hazard analysis.

1.3 Document content

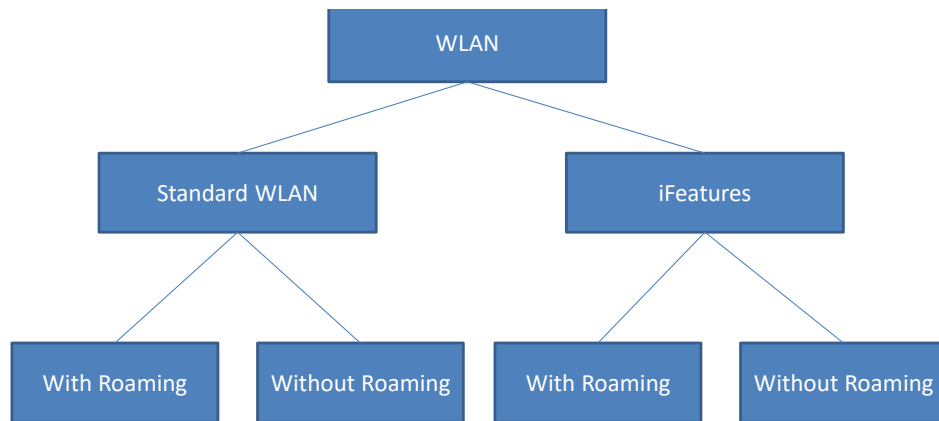
Practical scenarios are described in this guide, including recommendations on which products/functions, data volumes and update times are to be used. The respective data volume is to be understood as the recommended reference value. In individual cases, a more precise definition of the application could result in better values.

2 Requirements for the use of PROFINET IO

2.1 Overview of scenarios

The following graphic shows an overview of the application cases covered in this document:

Figure 2-1



2.2 General WLAN settings

The following lists the WLAN settings that apply to all scenarios.

Encryption

All application examples are subject to data communication encryption. The following assignments apply:

- Scenarios in standard WLAN: Authentication method WPA2-PSK and AES Encryption.
- Scenarios with iFeatures: iPCF Authentication and AES Encryption.

Roaming threshold

If the IWLAN includes several access points with the same SSID to improve the range, the IWLAN Client Module can switch between the access points without the connection being terminated (roaming).

The "Roaming Threshold" parameter is used with standard WLAN and iPCF-MC to determine when a client connects to a new access point on the basis of various values, primarily the reception strength.

For the iPCF iFeature, the Roaming Threshold specifies the time without a frame after which the client searches for a new access point. This value is set to "medium" for all scenarios.

2.3 Using PROFINET IO in Standard WLAN

The following chapters present typical applications for the use of PROFINET in standard WLAN. iFeatures are not applied in these scenarios.

2.3.1 With roaming

Scenario 1

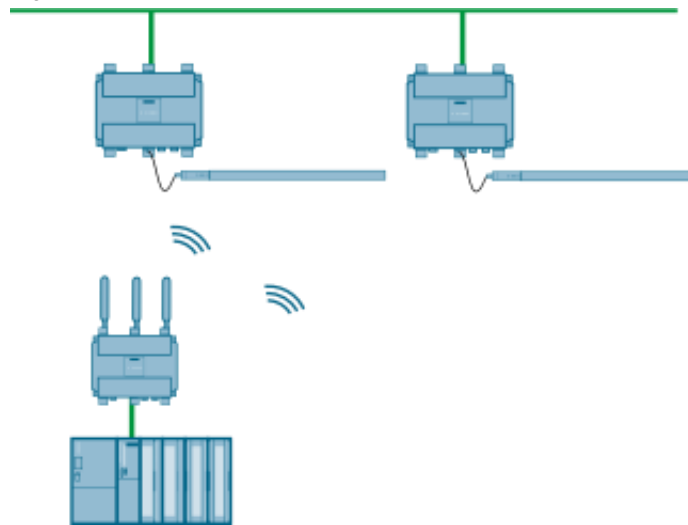
The use of PROFINET IO is desired, which accepts a moderate update time. The IWLAN nodes can move in an extended radio field (roaming). It is ensured that

- there are no more than four nodes in the radio field for one access point.
- a maximum of one PNIO device is connected per IWLAN client module.
- the configuration of the IWLAN Client Modules has a maximum total of two different channels.
The two channels configured under "Allowed Channels" are the channels that are to be scanned by the IWLAN Client Module.

Example

A typical application case for scenario 1, for example, is an RCoax system for connecting an S7-300 station.

Figure 2-2



Measured values

The following table shows the determined values for the application case in the standard WLAN with roaming.

Communication via standard WLAN is based on random selection, as no iPCF is used to ensure deterministics

Table 2-1

Scenario	Communication mode	IWLAN nodes per interface	Min. PNIO update time	Max. number of PNIO devices behind IWLAN client modules	Max. number of channels	Roaming
1	AP client	4	128 ms	1	2	yes

2.3.2 Without roaming

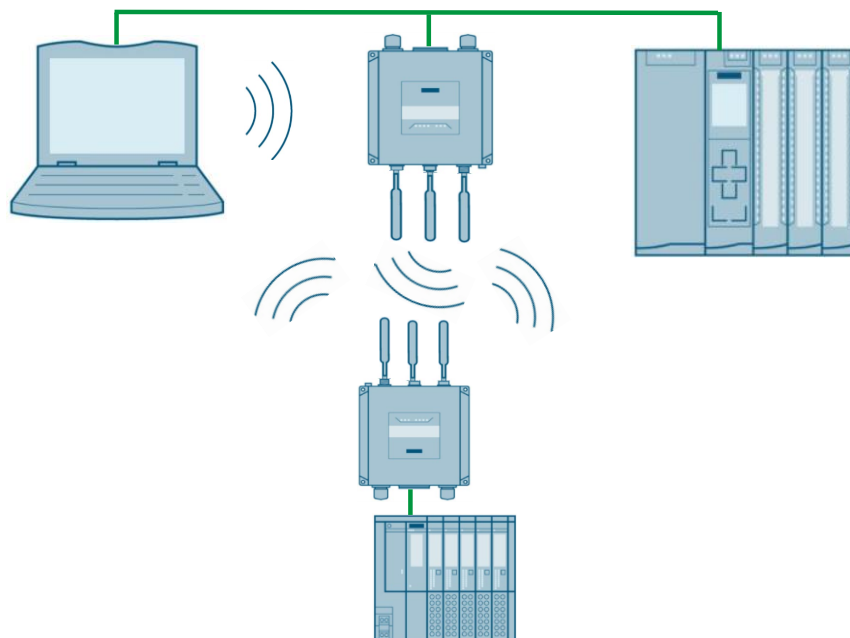
Scenario 2

The use of PROFINET IO is desired, in which a high update time is demanded. The IWLAN nodes do not move beyond the radio field of an access point. It is ensured that the configuration of the IWLAN Client Modules is exactly one channel, and the background scan is disabled.

Example

A typical application case for scenario 2, for example, is the coupling of an S7-1500 and an ET 200SP via WLAN.

Figure 2-3



Measured values of the test cases

The following table shows the detected values for the test cases with SCALANCE WxM76x-1 based on IEEE 802.11ax without roaming.

Tabelle 2-2

Test case	Communication modus	IWLAN nodes per interface	Min. PNIO update time	Max. number of PNIO devices behind IWLAN client modules	Max. number of channels	Roaming
1	AP-Client	1	16 ms	8	1	nein
2	AP-Client	8	32 ms	8	1	nein
3	AP-Client	16	64 ms	8	1	nein

2.4 Use of PROFINET IO with iFeatures

The following chapters present typical application cases for the use of PROFINET with the iFeature iPCF (Industrial Point Coordination Function) and iPCF-MC (Management Channel).

2.4.1 With roaming

Scenario 1

The use of PROFINET IO is desired, which accepts a moderate update time. The IWLAN nodes can move in an extended radio field (roaming).

It is ensured that

- there are no more than 16 mobile nodes in the radio field for one access point.
- a maximum of eight PNIO devices are connected per IWLAN client module.
- the configuration of the IWLAN Client Modules has a maximum total of three different channels. The three channels configured under "Allowed Channels" are the channels that are to be scanned by the IWLAN Client Module.
- iPCF is activated on the WLAN interface (standard iPCF).
- "Next Channel" is set as scan mode with a threshold of 60%.

Scenario 2

The use of PROFINET IO is desired, which accepts a moderate update time. The IWLAN nodes can move in an extended radio field (roaming).

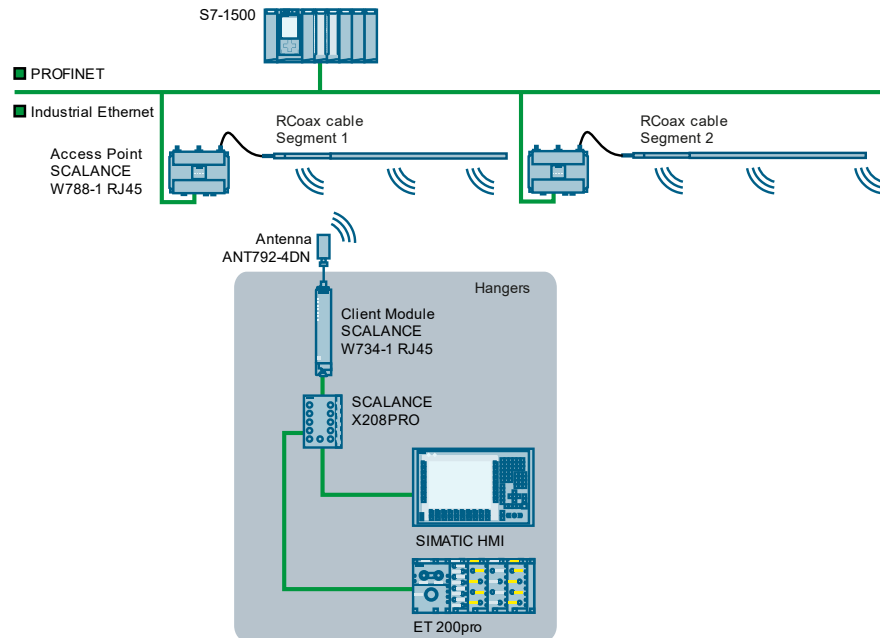
It is ensured that

- there are no more than 32 mobile nodes in the radio field for one access point.
- a maximum of eight PNIO devices are connected per IWLAN client module.
- the configuration of the IWLAN Client Modules has a maximum total of eight different channels. The eight channels configured under "Allowed Channels" are the channels that are to be scanned by the IWLAN Client Module.
- iPCF is activated on the WLAN interface (standard iPCF).
- "Next Channel" is set as scan mode with a threshold of 60%.

Example

A typical application case for scenario 1 and 2, for example, is an RCoax system with freely moving Client Modules.

Figure 2-4



Scenario 3

The use of PROFINET IO is desired, in which a low update time is accepted. The IWLAN nodes can move in an extended radio field (roaming). It is ensured that

- there are no more than 16 freely moving mobile nodes in the radio field for one access point.
- a maximum of eight PNIO devices are connected per IWLAN client module.
- the configuration of the IWLAN Client Modules has a maximum total of three different channels. The three channels configured under "Allowed Channels" are the channels that are to be scanned by the IWLAN Client Module.
- iPCF is activated on the WLAN interface (standard iPCF).
- "All Channels" is set as the scan mode.

Scenario 4

The use of PROFINET IO is desired, in which a low update time is accepted. The IWLAN nodes can move in an extended radio field (roaming). It is ensured that

- there are no more than 32 freely moving mobile nodes in the radio field for one access point.
- a maximum of eight PNIO devices are connected per IWLAN client module.
- the configuration of the IWLAN Client Modules has a maximum total of eight different channels. The eight channels configured under "Allowed Channels" are the channels that are to be scanned by the IWLAN Client Module.
- iPCF is activated on the WLAN interface (standard iPCF).
- "All Channels" is set as the scan mode.

Scenario 5

The use of PROFINET IO is desired, in which a low update time is accepted. The IWLAN nodes can move in an extended radio field (roaming).

If the radio quality deteriorates, a change to another access point should be planned and quickly implemented. The client should scan its environment continuously for alternative access points in this case.

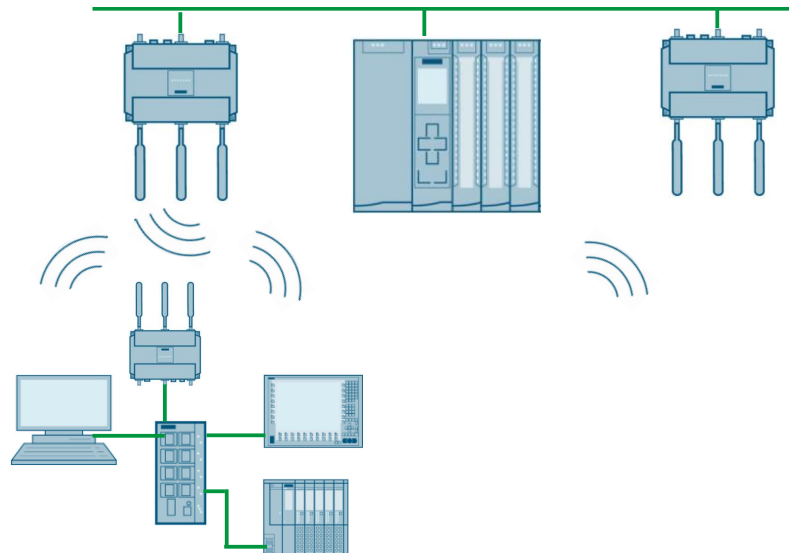
It is ensured that

- there are no more than 16 freely moving mobile nodes in the radio field for one access point.
- the access point has at least two radio interfaces. Both of these radio interfaces must be operated in the same frequency band and align in their radio coverage
- a maximum of eight PNIO devices are connected per IWLAN client module.
- iPCF is activated on the WLAN interface.

Example

A typical application case for scenario 3, 4 and 5, for example, is a system with freely moving IWLAN Client Modules.

Figure 2-5



Scenario 6

The use of PROFINET IO is desired, in which a low update time is accepted. The IWLAN nodes can move in an extended radio field (roaming), whereby the position of the subscribers is known to an application (for example, a PLC).

In case of decreasing radio quality, a change to another access point should be done very quickly via the application. A 99.9% reliability of the roaming process is accepted.

It is ensured that

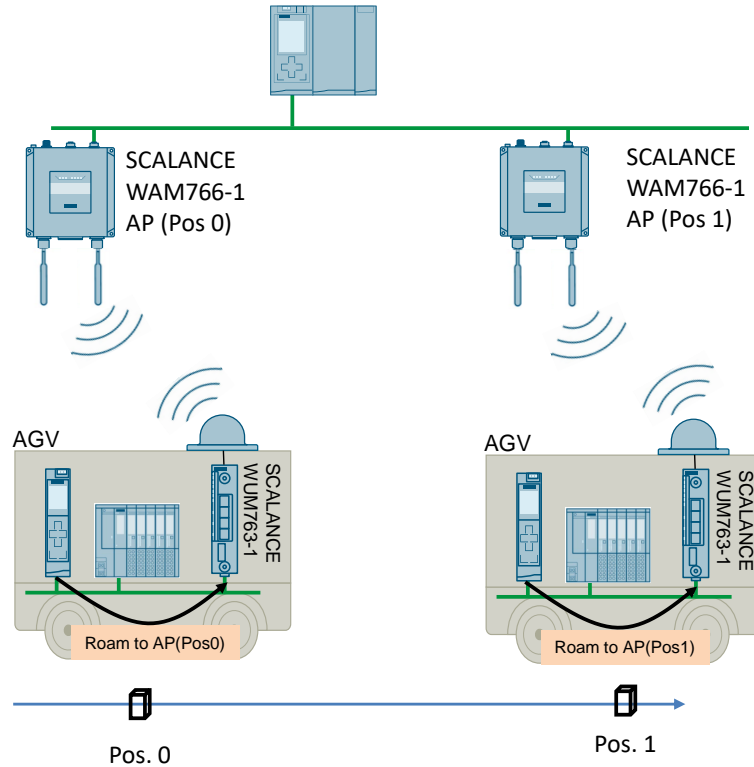
- there are no more than 16 freely moving mobile nodes in the radio field for one access point.
- a maximum of eight PNIO devices are connected per IWLAN client module.
- iPCF-2 is activated on the WLAN interface.

- TCP event roaming is used for controlling the change of a WLAN subscriber to another access point (frequency, channel, BSSID).

Example

A typical use case for scenario 6, for example, is a plant with free-moving AGVs with IWLAN client modules and a mobile CPU that knows the positions of the AGV and the access points.

Figure 2-6



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Measured values for the scenarios

The following table shows the determined values for the application cases of [2.4.1](#) when using iFeatures with roaming.

Table 2-3

Scenario	Communication mode	IWLAN nodes per interface	Min. PNIO update time	Max. number of PNIO devices behind IWLAN client modules	Max. number of channels	Roaming
1	AP client	16	32 ms	8 over Layer2Tunnel	3	iPCF
2	AP client	32	64 ms	8 over Layer2Tunnel	8	iPCF
3	AP client	16	64 ms	8 over Layer2Tunnel	3	iPCF
4	AP client	32	128 ms	8 over Layer2Tunnel	8	iPCF
5	AP client	16	64 ms	8 over Layer2Tunnel	-	iPCF-MC
6	AP client	16	64 ms	8 over Layer2Tunnel	-	iPCF2

2.4.2 Without roaming

Scenario

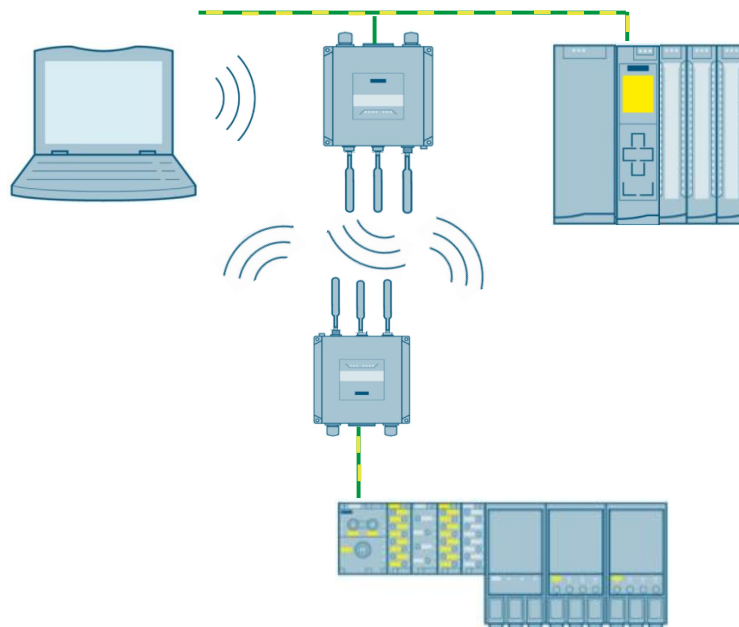
The use of PROFINET IO is desired, in which a high update time is demanded. The IWLAN nodes do not move beyond the radio field of an access point. It is ensured that

- there are no more than eight nodes in the radio field for one access point.
- a maximum of eight PNIO devices are connected per IWLAN client module.
- the configuration of the IWLAN Client Modules is exactly one channel.
- iPCF is activated on the WLAN interface (standard iPCF).

Example

A typical application case for this scenario, for example, is a FailSafe communication via IWLAN.

Figure 2-7



Measured values of the test cases

The following table shows the detected values for the test cases with SCALANCE WxM76x-1 based on IEEE 802.11ax without roaming.

Tabelle 2-4

Test case	Communication modus	IWLAN nodes per interface	Min. PNIO update time	Max. number of PNIO devices behind IWLAN client modules	Max. number of channels	Roaming
1	AP-Client	1	16 ms	8	1	nein
2	AP-Client	8	32 ms	8	1	nein
3	AP-Client	16	64 ms	8	1	nein

3 Appendix

3.1 Service and support

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3.3 Links and literature

Table 3-1

No.	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to this entry page of this application example https://support.industry.siemens.com/cs/ww/en/view/22681042
\3\	

3.4 Change documentation

Table 3-2

Version	Date	Modifications
V1.0	10/2014	First edition
V2.0	04/2018	Update; Values for iPCF-MC
V2.0.1	12/2021	Table of measured values "Scenarios measured values"
V2.1	01/2022	Content adjustments and update of images
V2.2	01/2023	Scenario 6 added