Applications of Industrial Wireless LAN in the PROFINET IO Environment

Industrial Wireless LAN

Warranty and liability

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1 Real–time Communication in Wireless LAN

1.1 WLAN in an industrial environment

Wireless LAN as a radio system is an “allround” system and suitable for almost any kind of application if local radio networks are involved. This applies to all areas, from your living room at home, to offices, to industrial production halls. Even if the basic technology is the same, the requirements differ greatly. Particularly in industrial applications, availability and reliability are required. A basic WLAN will turn into a reliable Industrial WLAN (IWLAN) through the use of industry features (iFeatures).

1.2 IWLAN with PROFINET IO

Customer benefit

PROFINET is particularly suitable for real-time communication in automation systems. Its use is not limited to cable-based networks and it can be used in wireless networks, too. PROFINET und IWLAN features many benefits such as:

- Higher performance and improved diagnostic options
- Flexible integration of stationary and mobile participants
- Clear cost savings - in installation and operation
- Safety applications can be realized with PROFINET via one single medium, also wireless
- Consistency with Ethernet: easy connection to control level and corporate management level
- Fast installation and commissioning thanks to reliable hardware components for wireless communication

Specifics concerning the use of PROFINET

When using IWLAN in a PROFINET IO environment, make sure that the functions corresponding to the quantity structure and the updating time are selected for the IWLAN devices. In addition, ensure a sufficiently strong radio field through radio field planning in order to provide the required security margin for dynamic effects. PROFINET works with cyclic data traffic. If only three data packets (default setting) fail in succession, this will lead to a bus failure. Availability can be ensured through the following criteria:

- Selecting a radio standard suitable for the environment concerned
- Selecting a free radio channel
- Using iFeatures (=special features for the industrial environment), if required
- Avoiding interferences
- Selecting suitable antennas or antenna systems for ensuring signal strength: >60% (max. -64 dB)
- Fast switch-over times in case of roaming
- Adhering to the update time in compliance with the risk analysis.
1.3 Document contents

This guideline describes practical scenarios and gives recommendations as to which products/functions, quantity structures, and updating times to use. The quantity structure in each case is to be considered a recommended standard value. In each individual case, better values may well be reached if the application is specifically defined.

2 Scenarios for PROFINET IO application

2.1 Scenario overview

The diagram below shows an overview of the applications treated in this document: Figure 2-1

![WLAN Diagram]

2.2 Generally applicable WLAN setting

The WLAN settings applying to all scenarios are described below.

**Encryption**

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

- Scenarios in standard WLAN: Authentication method WPA2-PSK and encryption AES.
- Scenarios with iFeatures: Authentication method Open System and encryption AES.

**Roaming Threshold**

If the IWLAN includes several access points with the same SSID for improving the range, the IWLAN client can change between the access points without the data-connection being interrupted (roaming).

A value for the receive intensity of the signals from the access point will be set via the "Roaming Threshold" parameter. If the receive intensity of the currently connected access point falls below this value, the client will search for an access point with better connection quality and will set up a connection to this access point.

This value is set to “medium” in all scenarios.
2.3 PROFINET IO application with standard WLAN

The following chapters will describe typical scenarios for using PROFINET in a standard WLAN. iFeatures will not be used in these scenarios.

2.3.1 With roaming

Scenario 1

PROFINET IO is used with a medium update time. IWLAN participants can move within a large radio field (roaming).

It is ensured that

- not more than 4 participants are within the radio field of one access point
- one PNIO device maximum is connected behind a IWLAN Client Module
- the configuration of the IWLAN Client Modules includes a maximum of two different channels.
  
  The two channels configured under "allowed channels" are the channels that the client is to scan.

Example

A typical application for scenario 1, for example, is an RCoax facility for connecting a S7-300 station.
2.3.2 Without roaming

Scenario 2

PROFINET IO is used with a fast update time. IWLAN participants will not move outside the radio field of an access point.

It is ensured that

- not more than 4 participants are within the radio field of an access point
- one PNIO device maximum is connected per IWLAN Client Module
- the IWLAN Client Module is configured with precisely one channel.

Example

A typical application for scenario 2, for example, is the connection of a S7-400 with a S7-300 via WLAN.
Scenario 3

PROFINET IO is used with a very fast update time. IWLAN participants are directly connected to the access point and are to be connected via a Wireless Distribution System (WDS).

It is ensured that
- only one WDS partner is within the radio field of an access point
- four PNIO devices maximum are connected to the WDS partner.

Example

A typical application for scenario 3, for example, is the connection of devices that are far apart from each other via WLAN. The WLAN range can be increased by using the WDS function.

![Figure 2-4](image)

2.3.3 Measurement values of the scenarios

The following table shows the determined values for applications in standard WLAN:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Communication mode</th>
<th>IWLAN participants per interface</th>
<th>Min. PNIO update time</th>
<th>Max. no. of PNIO devices behind IWLAN Client Module</th>
<th>Max. no. of channels</th>
<th>Roaming</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AP – Client</td>
<td>4</td>
<td>128 ms</td>
<td>1</td>
<td>2</td>
<td>yes</td>
</tr>
<tr>
<td>2</td>
<td>AP – Client</td>
<td>4</td>
<td>32 ms</td>
<td>1</td>
<td>1</td>
<td>no</td>
</tr>
<tr>
<td>3</td>
<td>AP – AP</td>
<td>1 WDS-AP</td>
<td>16 ms</td>
<td>4 (after WDS partner)</td>
<td>-</td>
<td>no</td>
</tr>
</tbody>
</table>
2.4 PROFINET IO application with iFeatures

The following chapters will describe typical scenarios for using PROFINET with the iFeature, iPCF (industrial Point Coordination Function).

2.4.1 With roaming

Scenario 1

PROFINET IO is used with a medium update time. IWLAN participants can move within a large radio field (roaming).

It is ensured that

- not more than 16 mobile participants are within the radio field of an access point
- eight PNIO devices maximum are connected per IWLAN Client Module
- the configuration of the IWLAN Client Modules includes a maximum of three different channels. The three channels configured under “allowed channels” are the channels that the client is to scan.
- iPCF is activated at the WLAN interface (standard iPCF)
- “Next Channel” is set as the scan mode with a threshold of 60%.

Scenario 2

PROFINET IO is used with a medium update time. IWLAN participants can move within a large radio field (roaming).

It is ensured that

- not more than 32 mobile participants are within the radio field of an access point
- eight PNIO devices maximum are connected per IWLAN Client Module
- the configuration of the IWLAN Client Modules includes a maximum of eight different channels. The eight channels configured under “allowed channels” are the channels that the client is to scan.
- iPCF is activated at the WLAN interface (standard iPCF)
- “Next Channel” is set as the scan mode with a threshold of 60%.
2 Scenarios for PROFINET IO application

Example
A typical application for scenario 1 and 2, for example, is an RCoax facility with an overhead conveyor.

Scenario 3
PROFINET IO is used with a slower update time. IWLAN participants can move within a large radio field (roaming).
It is ensured that
- not more than 16 freely mobile participants are within the radio field of an access point
- eight PNIO devices maximum are connected per IWLAN Client Module
- the configuration of the IWLAN Client Modules includes a maximum of three different channels. The three channels configured under “allowed channels” are the channels that the client is to scan.
- iPCF is activated at the WLAN interface (standard iPCF)
- “All Channels” is set as the scan mode.

Scenario 4
PROFINET IO is used with a slower update time. IWLAN participants can move within a large radio field (roaming).
It is ensured that
- not more than 32 freely mobile participants are within the radio field of an access point
- eight PNIO devices maximum are connected per IWLAN Client Module.
- the configuration of the IWLAN Client Modules includes a maximum of eight different channels. The eight channels configured under “allowed channels” are the channels that the client is to scan.
- iPCF is activated at the WLAN interface (standard iPCF)
- “All Channels” is set as the scan mode.
Example

A typical application for scenario 3 and 4, for example, is a facility with freely moving IWLAN Client Modules.
2.4.2 Without roaming

Scenario 5

PROFINET IO is used with a fast update time. IWLAN participants will not move outside the radio field of an access point. It is ensured that

- not more than eight participants are within the radio field of an access point
- eight PNIO devices maximum are connected per IWLAN Client Module
- the IWLAN Client Module is configured with precisely one channel.
- iPCF is activated at the WLAN interface (standard iPCF)

Example

A typical application for scenario 5, for example, is a failsafe communication via IWLAN.

Figure 2-7
2.4.3 Measurement values of the scenarios

The following table shows the determined values for applications using iFeatures.

Table 2-2

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Communication mode</th>
<th>IWLAN participants per interface</th>
<th>Min. PNIO update time</th>
<th>Max. No. of PNIO devices behind IWLAN Client Module</th>
<th>Max. no. of channels</th>
<th>Roaming</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AP – Client</td>
<td>16</td>
<td>32 ms</td>
<td>8 via Layer2Tunnel</td>
<td>3</td>
<td>yes</td>
</tr>
<tr>
<td>2</td>
<td>AP – Client</td>
<td>32</td>
<td>64 ms</td>
<td>8 via Layer2Tunnel</td>
<td>8</td>
<td>yes</td>
</tr>
<tr>
<td>3</td>
<td>AP – Client</td>
<td>16</td>
<td>64 ms</td>
<td>8 via Layer2Tunnel</td>
<td>3</td>
<td>yes</td>
</tr>
<tr>
<td>4</td>
<td>AP – Client</td>
<td>32</td>
<td>128 ms</td>
<td>8 via Layer2Tunnel</td>
<td>8</td>
<td>yes</td>
</tr>
<tr>
<td>5</td>
<td>AP – Client</td>
<td>8</td>
<td>16 ms</td>
<td>8 via Layer2Tunnel</td>
<td>1</td>
<td>no</td>
</tr>
</tbody>
</table>

3 History

Table 3-1

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Modifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1.0</td>
<td>10/2014</td>
<td>First version</td>
</tr>
</tbody>
</table>