

Chapter 2 Physical Layer

Abstract The physical Layer defines the electrical and physical level relationship between a node and a physical medium. It defines characteristics such as antenna, air medium, power level, timing of voltage changes, physical data rates, maximum transmission distances, etc. The WirelessHART standard is based on the IEEE 802.15.4 standard. WirelessHART physical layer is a much simplified subset of that defined in the IEEE 802.15.4 standard. This chapter lists the services that the WirelessHART physical layer provides to the upper data link layer. Please refer to the Wireless Physical Layer Specification (HCF_SPEC-65) for more details.

The WirelessHART standard builds on top of the IEEE 802.15.4 standard. With only a few modifications or restrictions, WirelessHART physical layer is a much simplified subset of that defined in IEEE 802.15.4-2006 Section 6. For any WirelessHART device:

- There are only one or two IEEE 802.15.4 messages per 10ms timeslot (broadcast messages are not acknowledged).
- The closest time between two messages is between the two messages within a timeslot, 1ms from the end of the message to the start of the acknowledgement message.
- All WirelessHART messages are IEEE 802.15.4 messages of *data* type.
- Only the 2.4GHz frequency band is defined for WirelessHART.
- Channels 11-25 can be used with the WirelessHART standard. Channel 26, which is not legal in many locales, is not supported.

In summary, the WirelessHART physical layer limits itself to transmitting and receiving IEEE 802.15.4 data messages. The noticeable items in WirelessHART physical layer are:

- *Channel hopping.* In WirelessHART physical channel is changed each transmission.
- *Transmit power.* The IEEE 802.15.4 standard is defined for personal area network with personal operating space of 10 meters. WirelessHART mesh covers a relatively larger area. All devices must provide a nominal EIRP of +10dBm (10mW) \pm 3dB. The transmit power is programmable from -10dBm to +10dBm. The maximum outdoor line of sight transmission distance could be 100 meters.

The targeted radio hardware component of a WirelessHART device is the commercial off the shelf chips designed for the IEEE 802.15.4 standard.

2.1 Physical Layer Services

This section lists the operation of the Service Primitive (SP).

2.1.1 Message SPs

Enabling/Disabling the Transceiver

This service primitive is used to enable/disable channels.

- ENABLE.request(state, channel)
- ENABLE.confirm(state, channel)
- ENABLE.indicate()

Clear Channel Assessment

This service primitive causes the Physical Layer to perform

- CCA.request()
- CCA.confirm(status)

Data Communication Services

These service primitives are used to exchange data packets with the Physical Layer.

- DATA.request(data)
- DATA.confirm(status, data)
- DATA.indication(rsl, data)
- ERROR.indication(status, data)

2.1.2 Management SPs

This service primitive is used to enable/disable channels.

- LOCAL_MANAGEMENT.request(service, [data])
- LOCAL_MANAGEMENT.confirm(service, status, [data])
- LOCAL_MANAGEMENT.request(service, status, [data])

The first parameter is the requested service. The services are listed in Table 2.1.

Table 2.1 Local Device Management Commands.

Service	Data	Description
RESET	-	Initialize the physical layer
READ_TX_PWR_LEVEL	Signed-8 txPwrLevel	Read the transmit power level setting in dBm
WRITE_TX_PWR_LEVEL	Signed-8 txPwrLevel	Write the transmit power level setting in dBm
WRITE_SLEEP_STATE	Unsigned-8 slepState	Write the sleep state of the physical layer. Value is one of: {sleep awake}
WRITE_RCV_OVERFLOW_ENABLE	Boolean rcvOverflowEnable	Enable the receiver overflow error indication. This will be reported in the ERROR.indication() service status

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