# WirelessHART performance metrics

In WirelessHART[1] network the statistics and events are reported to the Network Manager (act like PCE in 6TiSCH) through the following commands:

1. Report “Device Health”

This report is sent periodically toward the Network Manager. The report summaries the communication statistics of a device.

|  |  |  |
| --- | --- | --- |
| Byte | Format | Description |
| 0-1 | Unsigned-16 | Number of packets generated by this device since last report |
| 2-3 | Unsigned-16 | Number of packets terminated by this device since last report |
| 4 | Unsigned-8 | Number of Data-Link Layer MAC MIC failures detected |
| 5 | Unsigned-8 | Number of Network Layer (Session) MIC failures detected |
| 6 | Enum-8 | Power Status |
| 7 | Unsigned-8 | Number of CRC Errors detected |

1. Report “Neighbor Health List”

This report is sent periodically toward the Network Manager. The report includes the statistics of linked neighbors.

|  |  |  |
| --- | --- | --- |
| Byte | Format | Description |
| 0 | Unsigned-8 | Neighbor table index |
| 1 | Unsigned-8 | Number of Neighbor entries read |
| 2 | Unsigned-8 | Total number of neighbors |
| 3-4 | Unsigned-16 | Nickname of neighbor |
| 5 | Bit-8 | Neighbor Flags |
| 6 | Signed-8 | Mean RSL (Receive Signal Level in dBm) since last report |
| 7-8 | Unsigned-16 | Number of Packets transmitted to this neighbor |
| 9-10 | Unsigned-16 | Number of Packets received from this neighbor |
| 11-12 | Unsigned-16 | Packets received from this neighbor |
| 13-… |  | Number of entries based on response byte 1 |

1. Report “Neighbor Signal Levels”

This report is sent periodically toward the Network Manager. The report includes the statistics of discovered (but not linked) neighbors. These neighbors might be discovered when a device has heard the neighbor communication in the discovery links. A device that wish to join a network, send a join request to the Network manager, including this report.

|  |  |  |
| --- | --- | --- |
| Byte | Format | Description |
| 0 | Unsigned-8 | Neighbor table index |
| 1 | Unsigned-8 | Number of Neighbor entries read |
| 2 | Unsigned-8 | Total number of neighbors |
| 3-4 | Unsigned-16 | Nickname of neighbor |
| 5 | Signed-8 | RSL of neighbor in dB |
| 6-8 |  | Repeats (as needed) based on response byte 1 |

1. Alarm “Path Down”

The alarm is sent upon detecting a path failure.

|  |  |  |
| --- | --- | --- |
| Byte | Format | Description |
| 0-1 | Unsigned-16 | Nickname of neighbor to which path failure was detected |

1. Alarm "Source Route Failed"

This alarm is sent upon detecting a source route failure.

|  |  |  |
| --- | --- | --- |
| Byte | Format | Description |
| 0-1 | Unsigned-16 | Nickname of unreachable neighbor in the source route |
| 2-5 | Unsigned-32 | Network-Layer MIC (i.e., the MIC generated using the session key) from the NPDU that failed routing |

1. Alarm "Graph Route Failed"

This alarm is sent upon detecting a graph route failure.

|  |  |  |
| --- | --- | --- |
| Byte | Format | Description |
| 0-1 | Unsigned-16 | Graph Id of the failed route |

# ISA100.11a performance metric

In ISA100.11a[2], the L2 performance metrics are reported to the System Manager (act like PCE in 6TiSCH) and can be classified into (1) DL\_Connectivity alert and (2) NeighborDiscovery alert.

1. DL\_Connectivity alert

The DL\_connectivity alert can be classified into (a) Per-neighbor reports and (b) Per-channel reports.

* + **Per-neighbor report**

Per-neighbor reports are the performance metrics about the neighbors connection and are reported to the System Manager. These statistics are accumulated in the “dlmo.NeighborDiag” attribute, for each neighbor. This report is similar to “Neighbor Health List” report in WirelessHART.

Each node in ISA100.11a might be asked to report the following statistics about its neighbor:

|  |  |  |
| --- | --- | --- |
| Octets | Format | Description |
| 1 | Signed-8 | RSSI (level) |
| 1 | Unsigned-8 | RSQI (level) |
| 1-2 | ExtDLUint | RxDPDU(count): Number of valid Packets received from this neighbor  |
| 1-2 | ExtDLUint | TxSuccessful (count):Count of successful unicast transmissions to the neighbor  |
| 1-2 | ExtDLUint | TxFailed (count): Number of unicast transmission, without getting any ACK or NACK |
| 1-2 | ExtDLUint | TxCCA\_Backoff (count): Number of unicast transmission aborted due to CCA |
| 1-2 | ExtDLUint | TxNACK (count): Number of NACKs received |
| 2 | Signed-16 | ClockSigma (level): A rough estimate of standard deviation of clock corrections |

* + **Per-channel report**

In addition, in ISA100.11a, several performance metrics are reported based on channel for all neighbors to the System Manager. These statistics are accumulated in the “dlmo.ChannelDiag” attribute. This report is similar to “Device Health” report in WirelessHART.

|  |  |  |
| --- | --- | --- |
| Byte | Format | Description |
| 0-2 | Unsigned-16 | Count (Number of attempted unicast transmissions for all channels) |
| 3 | Integer-8 | $NoACK\_{0}$ (Percentage of time transmissions on channel 0 did not receive an ACK) |
| 4 | Integer-8 | $CCABackoff\_{0}$ (Percentage of time transmissions on channel 0 aborted due to CCA) |
| … |  |  |
| 33 | Integer-8 | $NoACK\_{15}$ (Percentage of time transmissions on channel 15 did not receive an ACK) |
| 34 | Integer-8 | $CCABackoff\_{15}$ (Percentage of time transmissions on channel 15 aborted due to CCA) |

1. NeighborDiscovery alert

In ISA100.11a, each node sends a report, including a list of candidate (overheard) neighbors, to the System Manager to make a potential new routing decisions. The “dlmo.Candidates” attributed is used to store those information in each node in the L2. This report is similar to the “Neighbor Signal Levels” report in WirelessHART.

|  |  |  |
| --- | --- | --- |
| Octets | Format | Description |
| 1 | Unsigned-8 | N (count of discovered neighbors) |
| 0-2 | ExtDlUint | $Neighbor\_{1}$ address |
| 0-1 | Signed-8 | $RSSI\_{1}$  |
| 0-1 | Unsigned-8 | $$RSQI\_{1}$$ |
| … |  |  |
| 0-2 | ExtDlUint | $Neighbor\_{N}$ address |
| 0-1 | Signed-8 | $RSSI\_{N}$  |
| 0-1 | Unsigned-8 | $$RSQI\_{N}$$ |

**References**

1. IEC 62591: Industrial Communication Networks - Wireless Communication Network and Communication Profiles - WirelessHART.
2. IEC 62734: Industrial communication networks - Fieldbus specifications - Wireless systems for industrial automation: process control and related applications - ISA100.11a.