The periodically transmitted one-byte Heartbeat message indicates that a CANopen device is still alive and not bus-off or not powered. The Heartbeat consumer knows from the CAN-ID the node which node produced the Heartbeat message. The used CAN-ID has a base value of 700, plus the node-ID. In the payload byte, the Heartbeat protocol indicates additionally its NMT status (pre-operational, operational, or stopped). This is so-to-say the confirmation on the received NMT command. The NMT master device should consume the Heartbeats of all connected NMT slave devices, to prove that the NMT command has been performed correctly.

The periodical transmission of the Heartbeat is configured by means of the Heartbeat producer time (Index 1017) given in milliseconds. The configured period is application-specific. The time should be shorter than the acceptable time to detect the absence of the device. If a device likes or needs to consume a dedicated Heartbeat, its Heartbeat consumer time array (Index 1016) has to be configured. The value is also given in milliseconds. The Heartbeat consumer time should be significantly larger than the Heartbeat producer time. At a first glance and as a rule of thumb, the doubled value is recommended. Of course, this also depends on the application requirements and the system designer may use other values.

The Heartbeat substitutes the old-fashioned Node/Life guarding mechanism. For new designs, CiA has recommended to implement the Heartbeat for more than 15 years. Each CANopen device should produce its Heartbeat. For devices without RPDOs and consumed EMCY messages it is not necessary to consume Heartbeats of other nodes. This is true for simple sensors, for example. Nevertheless, some motion control devices on the market don’t provide Heartbeat consumer functionality. They can’t detect a missing host controller by means of the Heartbeat. The CANopen conformance test tool does not detect this, because it is a matter of interoperability and not of conformity to the CANopen protocols.

The Heartbeat message provides also information about the current NMT status of the device. The NMT master device uses it as confirmation on its transmitted NMT command on the application level. For example: If the NMT master device has broadcasted the transit-to-operational command, it double-checks all received Heartbeats to see if all devices have transited to NMT operational state. Of course, some devices in the network may not be able to transit to the commanded NMT state within one Heartbeat producer period. This means that the NMT master device should be configured accordingly to tolerate a not matching status for a number of Heartbeat messages (in minimum one). Also, this depends highly on the application requirements and the performance of the selected NMT slave devices.

By the way, NMT master devices should also produce the Heartbeat message. Therefore, they need a node-ID assigned by the system designer. If you would like to diagnose the NMT master device regarding the configured Heartbeat producer and consumer times, it must provide an object dictionary.

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