

CiA 320

CANopen specification for sleep and wake-up handling



Switching-off and switching-on CANopen devices is especially in battery-powered systems important. CiA 320 describes services and protocols to do so.

CANopen devices, which support low-power modes, can be set to a mode of reduced energy consumption by means of the CiA 320 services and protocols. The specification supports also CAN transceiver chips providing low-power mode or selective wake-up functionality as standardized in the ISO 11898 series.

CANopen sleep and wake-up handling are implemented for example in light electric vehicles, add-on modules for special-purpose cars, service robots, or any other application that operate on a limited amount of energy, and in which energy management is therefore essential.

The CiA 320 services enable the power management master (PM master), which is residing at the active CANopen NMT master, to control the local Sleep finite state automaton (FSA) and the remote Sleep FSA of all power management devices (PM devices) in the network. The PM master protocol uses messages mapped to CAN data frames in classical base frame format (CBFF) with the CAN-ID 691_h to send commands to PM devices. PM devices respond with messages mapped to CBFF with the CAN-ID 690_h, or the EMCY write protocol as specified in CiA 301 to transmit requests to the PM master. Good to know: The CANopen parameter 117F_h provides information about the reason for CANopen devices to stay awake or to request sleep.

Finite state automaton (FSA)

For power management purposes, the Sleep FSA as specified in Figure 1 shall be implemented for sleep and wake-up handling. This FSA specifies the behavior of a PM device, from an operating mode with full energy consumption to an operating mode with reduced energy consumption. The definition of any relationship between an application-specific FSA such as e.g. given in CANopen device profiles and CANopen application profiles, and the Sleep FSA is not in the scope of CiA 320. The FSA shall support the Sleep FSA state transitions as given in the specification.

Services and protocol specification

There is a range of services required for the sleep and wake-up handling, which is specified in the CiA 320 document. These services include query sleep objection, sleep objection and set sleep, set alive, wake-up of PM device, wake-up of PM master, and request sleep. Furthermore, the CiA 320 services allow an automatic transition to Sleep state of a PM device, in case there are no live-signs of the PM master.

The protocols specified in CiA 320 implement these quoted services. They exchange messages between the PM master and the PM device(s). As already mentioned in the beginning of the article, the PM master uses CAN data frames with the CAN-ID 691_h. The PM device uses CAN data frames with the CAN-ID 690_h, or Emcy write protocol as specified in CiA 301.

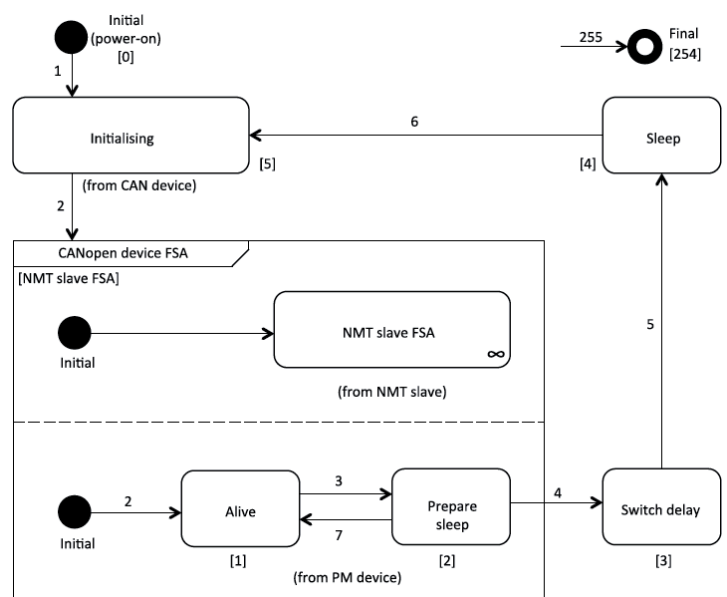


Figure 1: Sleep FSA (Photo: CiA)

CAN Repeater, Bridges and Gateways

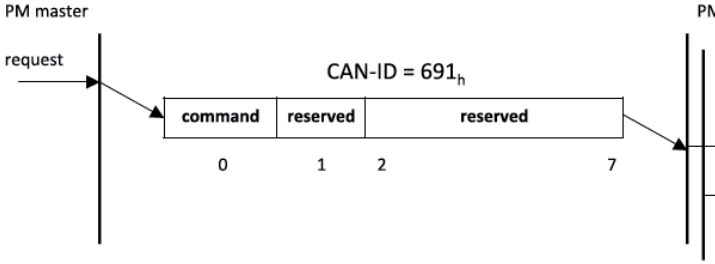


Figure 2: The Query sleep objection protocol as specified in this figure and Table 1 shall be used to implement the service query sleep objection (Photo: CiA)

Table 1: Value definition for query sleep objection

Field	Data type	Value	Description
command	UNSIGNED8	01 _h	Command specifier for "query sleep objection" service
		00 _h ; 02 _h to FF _h	Reserved by CiA
reserved	Reserved by CiA, always 0.		

Error and diagnostic handling

CANopen devices compliant to CiA 320 shall support the service Emcy write service, as specified in CiA 301. This service is triggered by internal errors in the CANopen device. In addition to the emergency error codes (EEC) given also in CiA 301, a PM device compliant to CiA 320 supports additional emergency error codes.

Battery-powered CANopen devices, for example in Pedelecs (CiA 454) or in special-purpose cars (CiA 447), need such sleep and wake-up functionality, in order to reduce power consumption during longer standstills. The same applies for battery-powered service robots and automated-guided vehicles with embedded CANopen networks.

"Up to now, all those sleep and wake-up-capable CANopen devices used proprietary protocols," explained Holger Zeltwanger, former CAN in Automation Managing Director. "The release of CiA 320 unburdens system designers to invent on the application level sleep and wake-up functionality." Now, they can buy interoperable products providing sleep and wake-up capability.



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