

# CANopen FD devices identification via LSS

*This article introduces the layer setting services (LSS) used to configure network-ID, node-ID, and bit-timing of devices in CANopen FD systems. The according specification is intended to be released in summer 2021.*

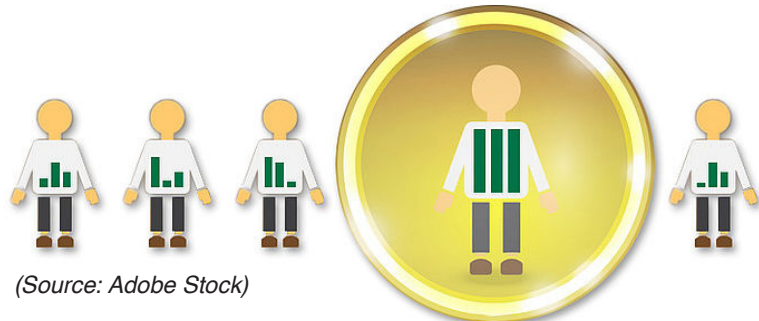
CANopen devices require a node-ID in the value range from 1 to 127 used for unique addressing in different CANopen services. The layer setting services (LSS, defined in CiA 305) allow to assign the node-ID and the bit rate via the CANopen network. LSS is used for CANopen devices without a hardware interface (e.g. DIP-switches, EIA-232) or for applications requiring a high level of plug-and-play support. In September 2017, CAN in Automation (CiA) has published the CiA 1301 CANopen FD application layer and communication profile. Since then, the CiA SIG (special interest group) LSS FD discusses how CANopen layer setting services should be adapted to CANopen FD.

The basic requirement for participating devices is the availability of the identity object (1018<sub>h</sub>) with four implemented 32-bit sub-indexes: vendor-ID, product code, revision number, and serial number. In combination, the sub-indexes provide a 128-bit value, which is called LSS address. The LSS address is a unique number for any CANopen (FD) device. The vendor-ID (object 1018<sub>h</sub>, sub-index 01<sub>h</sub>) is mandatory for all classic CANopen and CANopen FD devices. CiA assigns the vendor-ID uniquely to the device manufacturers.

LSS distinguishes between an LSS manager (typically residing in the host controller) and the LSS server, formerly named the LSS master and the LSS slave. The terms LSS manager and LSS server have to be finally approved by the CANopen (FD) community. In a CANopen network, the LSS Fastscan service is used to identify the unconfigured LSS servers. LSS Fastscan service requires up to 128 messages to be exchanged. Using the new service for CANopen FD (LSS switch state selective FD) the complete LSS address can be identified after exchange of maximum 33 messages. This service replaces the LSS switch state selective service in CiA 305. It will be specified in CiA 1305 CANopen FD layer setting services (LSS) and protocols. Benefited from the larger payload of CANopen FD, the complete 128-bit LSS address can be sent in one request.

In case several unconfigured LSS servers exist in a CANopen FD system, they can be identified by means of the LSS switch state selective FD service. All unconfigured nodes will handle the switch state selective FD requests from the LSS manager. All other (configured) nodes will ignore such requests. This service allows the LSS manager to select LSS servers based on their LSS address or portions thereof.

To fulfill the service, the 128-bit LSS address was divided into 32 pieces (nibbles) of four bit each. The nibbles are numbered from 0 to 31 (most significant bit to lowest significant bit). The LSS manager consequently asks the LSS servers



(Source: Adobe Stock)

for the values of each nibble. 16 messages with the CAN-IDs from 07D0<sub>h</sub> to 07DF<sub>h</sub> are used as possible feedback. When the LSS manager requests the value of the first nibble, the LSS servers reply with 07D0<sub>h</sub> if their first nibble is zero, 07D1<sub>h</sub> if it is one and so forth until 07DF<sub>h</sub> if their first nibble is 0F<sub>h</sub>. Then, the LSS manager takes the first response (all others are ignored for this cycle) and packs the first nibble value into the next request. The LSS servers with the first matching nibble inform the LSS manager about the second nibble value using the 16 messages with the mentioned CAN-IDs. Then, the LSS manager packs the detected first and second nibble value (from a node responded first) into the next request. This cycle is repeated until all nibbles have been processed and a single, unconfigured LSS server is identified. Then, the identified LSS server is switched into the LSS configuration state in which a network-ID and a node-ID can be assigned.

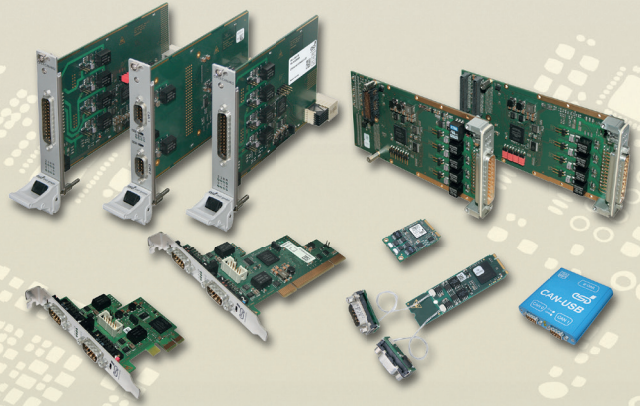
To decrease the boot-up time in CANopen FD systems that may be modified by the end user, the LSS manager could store LSS addresses that have been identified. On each power-up, the LSS manager could try those LSS addresses first and if there is then still an unconfigured LSS server left in the system, the LSS switch state selective FD cycle is started.

## Example scan cycle

In the example (see Figure 1) the LSS manager sends a request to check the value of nibble number 3 (nibno = 3<sub>h</sub>). The field portion (a portion of the LSS address that is already determined) contains the value 006<sub>h</sub> (from nibble 0 to nibble 2). The LSS manager uses the CAN data frame with the fixed CAN-ID 7E5<sub>h</sub>.

If the nibble 0 to nibble 2 of a server's LSS address match with the requested value, the server responds. The response informs about the server's nibble 3 value via the used CAN-ID calculated as follows:  $CAN-ID = 7D0_h + value\ of\ the\ nibble$ . The value of the requested nibble 3 in the example is D<sub>h</sub>. Thus, the LSS server responds using the CAN-ID 7D0<sub>h</sub> + D<sub>h</sub> = 7DD<sub>h</sub>. The LSS manager processes the response and packs the value of the nibble 3 into the next request. The LSS manager sends the next request for nibble number 4 (nibno = 4<sub>h</sub>). Now, the portion LSS address contains the value 006D<sub>h</sub>. The LSS server handles the request as described above. ▶

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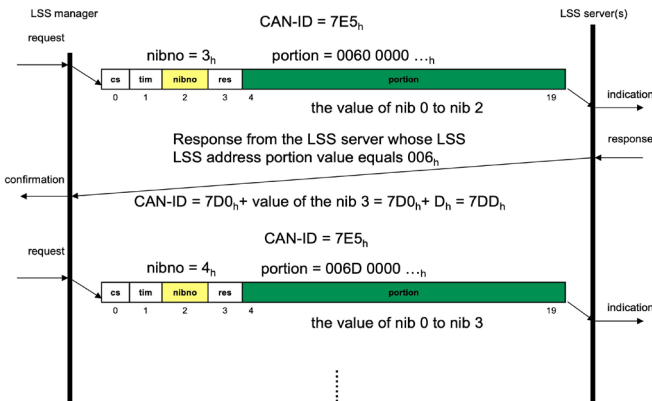


Figure 1: LSS manager request for nibble number 3 (Source: CAN in Automation)

When the nibble number in the LSS manager request reaches the value 32, it means that this is the final request. As there is no nibble with the number 32, this value indicates that the field portion contains an already determined LSS address. The corresponding LSS server sends now the final response with the fixed CAN-ID  $7E4_h$ , and switches itself into the LSS configuration state. In this state, the network-ID and node-ID of a CANopen FD device can be configured.

If the LSS manager knows the complete LSS address of an LSS server on the network, a single request is sufficient to select one LSS server. The LSS manager sets the requested nibble number to 32. The portion LSS address equals the known LSS address of the LSS server. The selected LSS server replies with the CAN-ID  $7E4_h$ . After switching of the LSS server into the LSS configuration state, the network-ID and node-ID are configurable.

If only a part of the LSS server's address is known, the LSS manager packs the known portion into the request and scans for the unknown nibbles according to the procedure as shown above.

## Summary

The new service LSS switch state selective FD makes the operation sequences for identifying of LSS server simpler and more flexible. The CiA 1305 CANopen FD layer setting services and protocols will be expectedly released by CAN in Automation in the summer of this year. The CiA 1305 specification is not backward compatible to the CiA 305, as CAN FD is not backward compatible with Classical CAN. The LSS switch state selective FD mechanism can also be applied on different CAN FD based systems using other higher-layer protocols.

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