2022

CAN in rolling stock

Embedded CAN-based control networks

We shape the future!

From Classical CAN via CAN FD to CAN XL

Classical CAN

Since 30 years, Classical CAN is used in rolling stock

In particular, Classical CAN has been used on sub-system level as well as on consist-level, in so-called light rail vehicle applications, such as commuter trains, metros, or tramways. The IEC 61375-3-3 standard specifies the CANopen-based control network for locomotives, coaches, and consists. In addition to that, Classical CAN has been used in multi-purpose rail vehicles as well.

SAE J1939 is mainly used in diesel powertrains

The J1939 Digital Annex provides standardized application data, assembled to so-called parameter groups (PGs). PGs determine the unique PG Number (mapped into the 29-bit CAN-ID field) as well as the repetition rate, for communicating the grouped application data via CAN. This enables a high degree of off-the-shelf plug-and-play capability.

Suppliers of CANopen devices often implement CiA profile specifications

CiA enhances IEC 61375-3-3 by CANopen device and application profiles. This includes generic device profiles such as CiA 401 (digital/analog I/O modules), CiA 402 (drive and motion control), or CiA 406 (encoders). Additionally, there are CANopen application profiles dedicated for rail vehicles. The CiA 421 application profile specifies the CANopen interfaces of different sub-systems that can be available within one rail vehicle or consist. The CiA 423 and CiA 430 CANopen application profiles, specify the CANopen interfaces of different functional units that can be required for controlling the diesel engine respectively the accompanying auxiliary units for example power train cooling or pre-heating.
A standardized CANopen-based passenger information system is specified in EN 13149-4/5/6.

CANopen and J1939 comprise functional safety protocol extensions

CANopen Safety is standardized in EN 50325-5. It complies with IEC 61805 (SIL 3). IEC 61131-3 programmable host controllers, supporting CANopen Safety, are available on the market. SAE has released the J1939-76 functional safety protocol extension.

The 2nd CAN protocol generation is ready to be used

The 2nd generation is also known as CAN FD (flexible data rate). The bit rate can be higher than 1 Mbit/s. The CAN FD data field has a length of up to 64 byte. CAN SIC transceivers (CiA 601-4) enable transmission speeds of more than 5 Mbit/s in the data phase, even in not optimized network topologies.

The necessary building blocks for CAN FD device and system design are available from different sources. This includes hardware (protocol controllers and transceivers), as well as higher-layer protocol software (e.g. CANopen FD and J1939-17/22). Related tools are available from different suppliers.

CAN FD building blocks enable interoperability

Standardization bodies have updated their higher-layer protocols for CAN FD. In addition, CiA maintains a set of CAN FD device and system design recommendations and specifications:

- CiA 601-1, CAN FD physical interface,
- CiA 601-2, CAN FD controller interface,
- CiA 601-3, CAN FD system design,
- CiA 601-4, CAN FD signal improvement circuitry,
- CiA 601-6, CAN FD cable,
- CiA 1301, CANopen FD application layer,
- J1939-17, physical layer,
- J1939-22, mapping of PGs to CAN FD.

CAN XL is the 3rd generation of CAN

With the introduction of Ethernet backbone networks, there is a need to tunnel TCP/IP via CAN-based networks. This requires CAN data frames able to contain TCP segments. Under patronage of CiA, car makers, suppliers, and chipmakers develop CAN XL, offering a payload of up to 2048 byte. The CAN XL data frames also comprise several layer management functions, which allow running multiple higher-layer protocols on the same cable. Additionally, there are some data link layer add-on functions under development such as frame fragmentation or cybersecurity measures (CANsec). CAN XL networks can use any CAN transceiver technology. CAN SIC XL transceivers can run in the dataphase more than 10 Mbit/s depending on the used network topology.

Start now!

CAN in rail vehicles

CiA has scheduled a web-based workshop. CiA members and invited guests are going to discuss requirements of future embedded control in rail vehicles. In this respect, they also · evaluate already developed CiA application profiles:

- CiA 421 series: Train vehicle control system,
- CiA 423 series: Train power drive system,
- CiA 424 series: Rail vehicle door control system,
- CiA 426 series: Rail vehicle exterior lighting control system,
- CiA 430 series: Rail vehicle auxiliary operating system,
- CiA 433 series: Rail vehicle interior lighting control system,
- CiA 449 series: Rail vehicle HVAC system.

Agenda

- Brief overview on CiA profiles for rolling stock
- Overview on latest CAN technologies
- Contributions by workshop attendees
- Identification of CiA document review and new feature requests
- SIG rail vehicle workplan

The agenda is subject to change

Participants

Decision makers as well as embedded device and system designers.

Registration

Please register by email: secretary@can-cia.org (CiA non-member may participate on request).

Date and time

September 30, 2022

14:00 to 17:00 (UTC+2)

e-meeting

CiA

CAN in Automation e. V.
Kontumazgarten 3
DE-90429 Nuremberg
Phone: +49-911-928819-0
www.can-cia.org