https://www.proconference.org/index.php/usc/article/view/usc17-01-024
DOI: 10.30888/2709-2267.2023-17-01-024

UDC 004.7

CLASSIFICATION OF SPECIALIZED DIGITAL NETWORKS, WHICH ARE BASED ON THE CAN NETWORK, BY THE NUMBER OF NODES IN SEGMENT

Babchuk S.M.
c.t.s., as.prof.
ORCID: 0000-0002-1746-5731
Babchuk I.S.
Ivano-Frankivsk National Technical University of Oil and Gas,
Ivano-Frankivsk, Karpatska 15, 76019

Abstract. *The analysis of specialized digital networks, which were created on the basis of the CAN network, was carried out. The maximum number of nodes that segment of the network, which is created on the basis of the CAN network, can have is determined. In a CAN network, there is no theoretical limit to the number of nodes in a network segment. However, in networks developed on the basis of the CAN network, the number of nodes in segment is limited and is a maximum of 255 nodes in the CANaerospace network, and the IDB-C network can have the smallest maximum number of nodes in a network segment (16 nodes). As a result of the conducted research, a classification of specialized digital networks created on the basis of the CAN network by the number of nodes in the segment was developed.*

Key words: *fieldbus, CAN, Controller Area Network, ControlNet, SDS, CANOpen, DeviceNet, CAN Aerospace, TTCAN, GMLAN, SafetyBus p, NMEA-2000, CANKingdom, VSCP, J1939, Duotecno, iNels, IDB-C*

Introduction. Currently, specialized digital networks are the almost irreplaceable basis of control systems. It should be noted that more than one hundred specialized digital networks have been created and are offered to users in the world [1-3].

In the 80s of the last century, the Robert Bosch Gmbh company developed a specialized digital Controller Area Network [4-5] for controlling electrical equipment in cars.

Many original and effective design solutions proposed by Bosch during the development of a specialized digital network Controller Area Network (CAN), as well as many years of using the CAN network for various tasks, have brought this network worldwide recognition.

A limiting factor for the use of the CAN network in new industries and new tasks was the fact that only the first and second levels of the ISO/OSI model are implemented in this network, and the seventh level of this model, which is responsible for user interaction with the network, is not implemented.

In connection with the above, new specialized digital networks were created on the basis of the CAN network, which, as a rule, implemented the seventh level of the ISO/OSI model.

Choosing a specialized digital network to solve a specific task is a difficult task. The above selection will be facilitated by the classification of specialized digital networks, which are based on the CAN network, by the number of nodes in segment.

Main text. During the research, an analysis of specialized digital networks created on the basis of the CAN network was carried out:

- ControlNet;
- SDS;
- CANOpen;
- DeviceNet;
- CAN Aerospace;
- TTCAN;
- GMLAN;
- SafetyBus p;
- NMEA-2000;
- CANKingdom;
- VSCP;
- J1939;
- Duotecno;
- iNels;
- IDB-C.

Table 1 shows the results of studies of the number of nodes in one segment of specialized digital networks, which are created on the basis of the CAN network.

Table 1 – Results of studies of the number of nodes in one segment of specialized digital networks that are created on the basis of the CAN network

Network name	*The number of nodes in one segment*	*The maximum number of active nodes (masters)*
CANaerospace	255	255
VSCP	254	254
CAN Kingdom	255	1
iNels	192	1
CANopen	127	127
TTCAN	120	120
ControlNet	99	99
DeviceNet	64	64
SDS	64	64
Duotecno	64	64
SafetyBUS p	64	1
NMEA-2000	50	50
GMLAN	32	32
J1939	30	30
IDB-C	16	16

Among the specialized digital networks that are created on the basis of the CAN network, two networks have a maximum number of 255 nodes:

- CANaerospace;
- CAN Kingdom.

In the CAN network, all nodes are active and can contact other nodes as needed. Among the networks that are created on the basis of the CAN network, most networks also have such a principle of operation, where all nodes are active. In

particular, network:

- CANaerospace;
- CANopen;
- TTCAN;
- ControlNet;
- DeviceNet;
- SDS;
- Duotecno;
- NMEA-2000;
- GMLAN;
- J1939 IDB-C;
- VSCP.

However, there are three networks that are created on the basis of the CAN network, but only one master-slave data transmission mode is implemented in them, and in these networks only one active node can address other nodes:

- CAN Kingdom;
- iNels;
- SafetyBUS p.

The above facts show that all specialized digital networks that are created on the basis of the CAN network can be classified by the number of nodes in one segment, as shown in Figure 1.

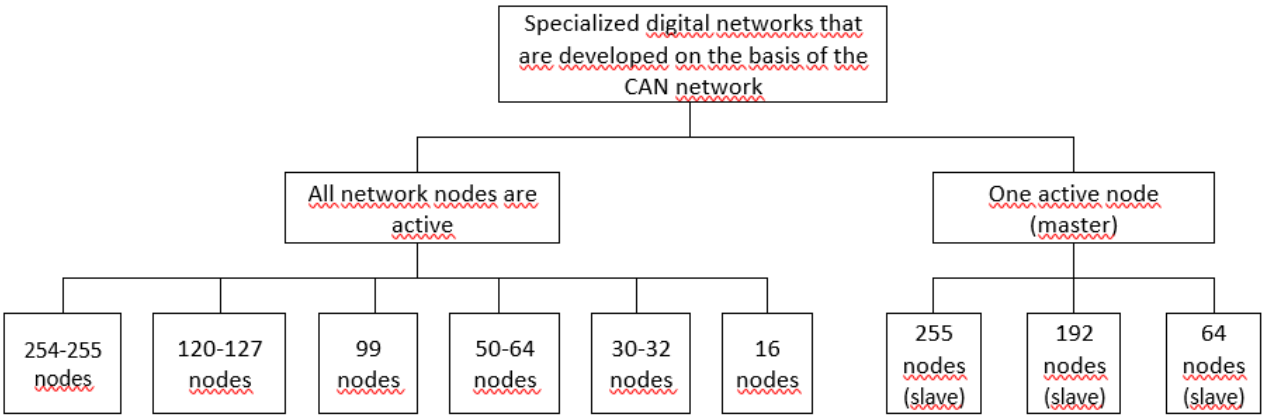

Figure 1 – Classification of specialized digital networks, which are created on the basis of the CAN network, by the number of nodes in one segment

The developed classification of specialized digital networks, which are created on the basis of the CAN network, according to the number of nodes in segment, will help users to choose the necessary specialized digital network.

Summary and conclusions.

The analysis of specialized digital networks, which were created on the basis of the CAN network, was carried out. The maximum number of nodes that one segment of the network, which is created on the basis of the CAN network, can have is determined.

In a CAN network, there is no theoretical limit to the number of nodes in a network segment. However, in networks developed on the basis of the CAN network, the number of nodes in one segment is limited and is a maximum of 255 nodes in the

CANaerospace network, and the IDB-C network can have the smallest maximum number of nodes in a network segment (16 nodes).

As a result of the conducted research, a classification of specialized digital networks created on the basis of the CAN network by the number of nodes in segment was developed.

The developed classification of specialized digital networks, which are created on the basis of the CAN network, according to the number of nodes in segment, will help users to choose the necessary specialized digital network.

References:

1. Babchuk, S.: Classification of Specialized Computer Networks. Journal of Automation and Information Sciences. 2016. № 48. P. 57-64.

2. Babchuk S.M. Specialized computer networks and systems. 2021. 124 p.

3. Babchuk S., Humeniuk T., Babchuk I. Mathematical model dependencies baud rate from the length of the specialized digital network CANopen. Computer systems and information technologies. 2022. № 3. P. 31-39.

4. Marco Di Natale. Controller Area Network. Pisa, Italy. 41 p.

5. History of CAN technology. URL: https://www.can-cia.org/can-knowledge/can/can-history/

sent: 12.03.2023