

Local Interconnect Network F A Q

GENERAL QUESTIONS

What is LIN?

LIN is a low cost serial communication system intended to be used for distributed electronic systems in cars.

Who are the members of the LIN Consortium?

The founding partners are the car manufacturers Audi AG, BMW AG, DaimlerChrysler AG, Volkswagen AG, and Volvo Car Corporation AB, and the tool vendor Volcano Communications Technologies and the semiconductor manufacturer Motorola.

The LIN Consortium is open to new members. New members are accepted upon application and approval.

Why was the LIN Consortium developed?

Until today no automotive standard in low end multiplex communication has established. The consortium has been developed to standardize a serial low cost communication concept in conjunction with a development environment, that enables the car manufacturers and their suppliers to create, implement, and handle complex hierarchical multiplex systems in a very cost competitive way.

Who are the likely adopters/users of the LIN protocol?

Likely adopters of LIN are automotive manufacturers and their suppliers.

Is the LIN protocol accepted globally?

There has been global interest in the protocol. There have been more than 600 requests from all over the world including USA, Japan and Korea.

Is LIN available to others (for free)?

LIN is an open standard. There will be no license fees for members of the LIN Consortium.

What are the benefits of using the LIN protocol?

The big benefit of LIN is: Standardization! This will ease implementation and reduce costs. Multiplexing is a major enabling factor for distributed electronics.

Is the LIN Specification frozen?

The basics of LIN are frozen, however, some details are subject to change, especially when the first applications are being implemented.

When will we see automobiles on the road with LIN?

First applications based on LIN are under development and will be introduced in cars in 2001 with three to ten LIN nodes per vehicle. The number of nodes is expected to rapidly grow over the next decade to an average of twenty per vehicle or a worldwide volume of approximately 1.2 billion LIN nodes per year, respectively.

Have any other auto manufacturers currently using or plan to adopt the LIN protocol?

There are many auto manufacturers and suppliers outside the founder group of LIN interested in the standard.

Is the LIN market significant?

From 2003 on we expect to have 3-10 nodes per produced car in average worldwide. This figure is expected to increase further. With a total production of 50 Mio vehicles per year, the LIN market can be regarded as significant.

What are the LIN Consortium plans for certification?

The LIN founders group is developing a procedure for LIN certification. The certification shall ensure that LIN products are fully compliant with the LIN Specification for proper interoperability with other LIN products.

Is there an ISO or SAE standardization planned?

The standardization strategy of LIN is first to develop a de-facto standard. This will enable the interoperability of LIN products from different vendors. A formal standardization process is planned at a later point in time.

TECHNICAL QUESTIONS

How does the LIN protocol work?

The protocol is based on the standard SCI (UART) protocol standard and a single-master/multiple-slave concept. Additionally it offers synchronization information to enable low cost nodes without crystal oscillators to communicate.

What topology does the LIN protocol support?

The LIN standard is using a single-wire 12V bus. Other topologies are not supported.

What is the maximum number of nodes in a LIN network?

In theory the maximum number of nodes in a LIN-network is limited only by the number of available identifiers. However, electrical characteristics require a stricter limitation. The number of nodes therefore should not exceed 16.

How does LIN compare/differ with other protocols on the market, such as CAN, TTP, FlexRay, DSI, and BMW's Byteflight?

LIN is a low cost network system. It is designed to connect distributed nodes with low communication requirements. LIN is not designed to replace high performance networks such as CAN, DSI, TTP or FlexRay in high performance applications.

What does 'enhanced ISO 9141' mean?

ISO 9141 has been created for diagnostic purposes for the use in the service garage. In order to use this type of physical layer in a running car modifications were necessary. These include the control of the slew rate to address EMI issues, as well different reception levels to address ground shifts and disturbances.

What is the maximum data field length of a LIN frame?

LIN supports frame lengths up to 8 bytes.

What is the maximum transmission speed of LIN?

LIN operates at transmission speeds up to 20kbps. The recommended data rates are 2400 bps, 9600 bps, and 19200 bps.

Does a microcontroller require an SCI or UART to run LIN.

The protocol is UART based, but it is also possible to emulate the UART with standard I/O port functions.

Why does the LIN protocol use a 13 bit break?

The synchronization break is the only exception from the 8N1 coded byte stream and is transmitted only by the master node. This particular pattern is longer than any regular sequence of dominant bits and can unambiguously be identified as start of a message. The synchronization break provides a regular opportunity for slave nodes to synchronize to the bus clock, or to enter the LIN communication at any point in time, for example after a controller reset.

The synchronization break must be at least 13 bit long to ensure proper synchronization of slave nodes with inaccurate clock sources but can be longer. UART modules on microcontroller that can generate only generate multiples of 10-bit breaks will typically transmit 20 dominant bit. This increases the minimum message length by 6% to 11%, depending on the number of data bytes.

Why does LIN use a simple Checksum rather than a CRC, which is much more secure?

The identifier and the data fields in a LIN message are error protected by parity and checksum information, respectively. The implementation of a CRC requires high amount of resources when implemented in software. On the other hand the weakest security comes already with the ID-field which is protected by two parity bits only. It does not make sense to implement a high level security on the data fields, while the ID-field offers only weak protection.

The particular protection of the identifier is necessary as message header and response may origin from different sources. Thus, the identifier can not be protected by the checksum in the message response.

Are the fault confinement procedures in the LIN Protocol Specification document required?

The actions that master and slave tasks undertake upon a corrupted communication (fault confinement) depend mainly on the system requirements and have to be specified in the application layer. The LIN protocol defines only basic errors such as bit error (transmitted signal is different from monitored signal), checksum error, non-responding slave, and no bus activity. The fault confinement relies mainly on the master node that shall handle as much as possible of error detection and error recovery such as for example the re-scheduling a message.

The LIN-ID field only contains 4 ID-bits. Is it possible to use more than 16 identifiers?

The identifier field denotes the content and length of a message. The field comprises six identifier bits and two parity check bits, forming a set of 64 identifiers. The bits ID4 and ID5 define the number of data fields in the message response. The coding splits the set of 64 identifiers in three sub-sets of 32 identifiers for 2-byte data response, 16 identifiers for 4-byte data response, and 16 identifiers for 8-byte data response.

Identifier fields with identical ID-Bits 0..3 but different length coding denote different message identifier.

APPLICATIONS

What applications will the LIN protocol support?

Typical applications for the LIN bus are assembly units such as doors, steering wheel, seats, climate regulation, lighting, rain sensor, or alternator. In these units the cost sensitive nature of LIN enables the introduction of mechatronic elements such as smart sensors, actuators, or illumination. They can be easily connected to the car network and become accessible to all types of diagnostics and services.

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s LIN only applicable to automotive?

LIN is primarily targeted to automotive applications. However, like CAN which was originally targeted to automotive applications, it is very likely that it will penetrate to other fields of application. It is not exclusively defined for automotive applications and is expected to be also successfully applied to industrial or white-good electronics.

PRODUCTS AND TOOLS

Are LIN capable development tools available?

Development tools are already available. Initially VCT provides a complete LIN tool chain. The main tools are the signal database manager for LIN (SDML), the LIN configuration manager (LCFG) and the bus analyzer (LINspecter). The LINspecter e.g. is capable to analyze the bus-traffic and replace not yet existing nodes. Other tool manufacturers are expected to follow.

Motorola is the only semiconductor supplier on the LIN Consortium, does this mean Motorola is the only LIN compatible semiconductor supplier?

LIN is an open standard. It has been designed to run on any microcontroller. LIN is regarded as technology enabler and will open up new market opportunities. This is beneficial not only Motorola.

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