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ISOBUS – The Future Has Long Since Begun

The development and implementation of ISOBUS as an international standard for tractor-implement communication on the basis of the CAN communication standard ISO 11898 "Road vehicles – Controller area network (CAN)" is an important milestone on the way to the introduction of electronics in agricultural machinery and agriculture, which began at the end of the 80s. ISOBUS is the common specification of the manufacturers for the implementation of the international standard ISO 11783 "Serial control and communications data network". In numerous parts, the application of the ISOBUS standard series has meanwhile provided technical solutions which guarantee independence from systems and manufacturers.

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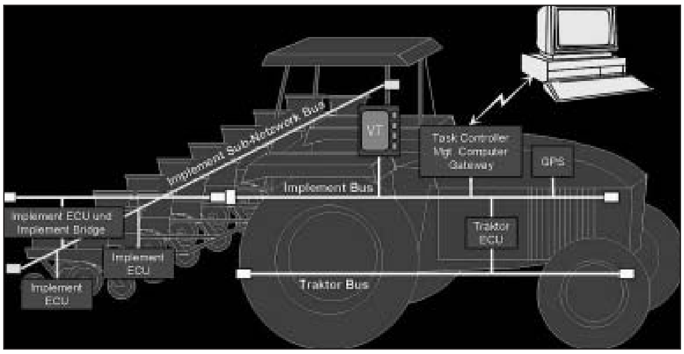

Fig. 1: Structure of the ISOBUS

As the successor to the German LBS standard, ISOBUS is based on the international standard ISO 11783. The definition of the standard processes has been completed, and the product programmes of many manufacturers have already been harmonized with ISO 11783.

Standardization work for ISO 11783 is currently focusing on the optimization of implement operation with regard to ergonomics and safety (ISO 11783, part 6 "Virtual Terminal"), the definition of automated functional sequences in tractor-implement combinations (ISO 11783, part 14 "Sequence Control"), as well as the definition of the diagnostic functions relevant for ISOBUS (ISO 11783, part 12 "Diagnostics").

Implementation is focusing on ISO 11783, part 10 ("Task Controller") with the definition of automated order processing and documentation.

Standard ISO 11783

The structure of ISOBUS is shown in *Figure 1* using a tractor-implement combination as an example.

In order to be able to control mounted implements with the aid of ISOBUS, the following components are necessary: a virtual terminal (VT), a connector on the tractor as part of basic equipment, a control device (Implement ECU) on the machine, and perhaps additional operating units, such as a multi-functional handle. The "ISOBUS Task Controller" enables data to be exchanged with the farm management PC.

The current status of the standard series ISO 11783 is shown in *Table 1*.

Parts 2 to 9 and 11 have been published as international standards. The content of parts 10 and 13 has been determined. These standards will be published in July/August 2007.

Implementation

The manufacturers have obliged themselves to harmonize the introduction and implementation of the standard in order to guarantee the compatibility of the products. This is done by so-called implementation groups, which were formed under the aegis of the VDMA in Europe and the AEM (Association of Equipment Manufacturers) in USA.

Table 1: Standard series ISO 11783, part 1-14

ISO 11783	Standard part	Published/completed	In progress
Part 1:	General Standard	X	
Part 2:	Physical Layer	X	
Part 3:	Data Link Layer	X	
Part 4:	Network Layer	X	
Part 5:	Network Management	X	
Part 6:	Virtual Terminal	X	
Part 7:	Implement Messages	X	
Part 8:	Power Train Messages	X	
Part 9:	Tractor ECU	X	
Part 10:	Task Controller	X	
Part 11:	Data Dictionary	X	
Part 12:	Diagnostics		X
Part 13:	File Server	X	
Part 14:	Sequence Control		X

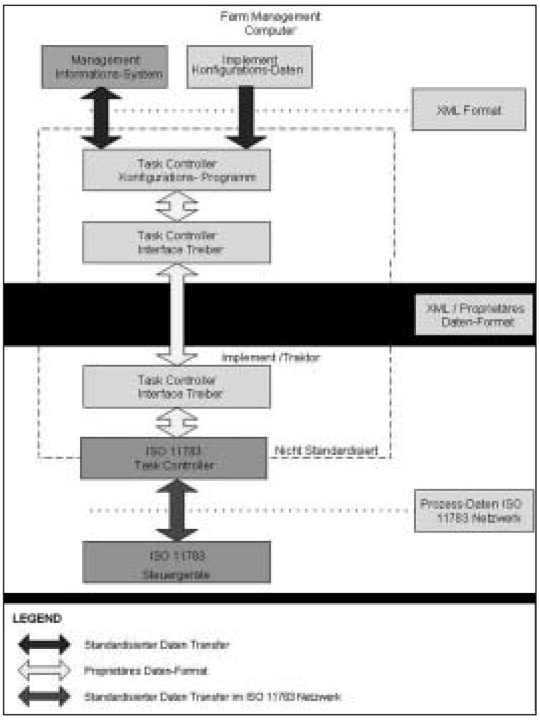

Fig. 2: ISO 11783 task controller

The cooperation of manufacturers and cooperation across borders shows the international acceptance of ISOBUS. This gives the user the guarantee that all ISOBUS components which have been tested and certified by officially accredited laboratories are mutually compatible.

In addition to so-called plugfests, which are held regularly, the specifications of the "ISOBUS Implementation Level" defined by the Implementation Groups contribute to the interoperability of the ISOBUS components. The "Implementation Level" is defined as the uniform, application-oriented implementation of the ISO 11783 standard. An implementation level is specified depending on existing and new parts of the standard with the goal of reaching uniform implementation within a fixed time frame.

Task Processing and Data Management

Precision farming is often seen as the future-oriented form of land use. According to the possibilities of application of "intelligent agricultural machinery", classification into the areas site-specific cultivation, documentation, and fleet management suggests itself.

The content of standard ISO 11783 part 10 ("Task Controller and Management Information System Data Interchange") has been finalized, and the standard is going to be published shortly. It provides the basis for site-specific cultivation and automatic order documentation in the form of a standardized data interface in the future-oriented XML format between the mobile system (tractor and implement) and the farm management system (FMS). According to information provided by different manufacturers, the first implementations based on ISO 11783 part 10 will be shown at the Agritechnica 2007.

ISO 11783, part 10, defines the manufacturer-independent documentation of all work steps in the field as well as data exchange with the FMS. Before processing, task data can be entered and transferred to the mounted implements in the field. There, the tasks are carried out by the task processing unit integrated into the terminal. This system determines the current position, transmits the corresponding set values from the application map to the mounted implements, and records the current location-related actual value. Data are transferred in two directions: the planned tasks are transmitted to the "Task Controller", and the work results are transferred to the FMS, where they are evaluated.

Figure 2 shows data transfer via the implement bus to the "Task Controller" with the aid of defined CAN messages. Between the "Task Controller" and the FMS, data are also transferred in a standardized manner in the ISO 11783 format. The "Task Controller" interface, however, enables data to be transferred thanks to a proprietary data format for the supply of task-related data by the user.

The collected data allow all legal documentation requirements to be fulfilled. Both file-guided field data as well as graphic area data are available (*Fig. 3*).

Data from ISOBUS-capable mounted implements can become part of series data collection. This allows the farmer to enter additional information, such as the application rate, directly on the tractor. The after-collection of data, which is susceptible to errors, can be dispensed with. In addition, so-called events can be recorded. This allows bale deposition during contracted work, for example, to be documented precisely.

An integrated bluetooth interface enables the centrally collected data to be read out through a wireless connection onto a pocket PC carried by the farmer. Afterwards, they are transferred to the FMS.

All in all, precision farming significantly simplifies bookkeeping, controlling, and documentation for the farmer while reducing costs and optimizing crop cultivation.

Off-Board Diagnosis and Service Tools

During off-board diagnosis, an external diagnostic system is connected to the machine. In addition to the machine data, this system may also include service plans and spare part lists for service diagnosis.

The problems of off-board diagnosis in the electronic environment of agricultural machinery equipped with ISOBUS put very great demands on a diagnostic tool because only a harmonized display of the diagnostic functions of different tractor- and implement manufacturers can lead to an application of the tool which can be controlled by the service technician. With regard to the diagnostic protocol and the tools used, action is required for ISOBUS. While the physical diagnostic interface has already been standardized in ISO 11783, part 2, harmonization work on part 12 of ISO 11783, which standardizes basic diagnostic functions, is in progress. Publication as an international standard is expected for the year 2008. The minimum goal of a diagnostic system being one which is able to localize a malfunction in an ISOBUS system such that the source can be found if service is required has already been met using a defined basic diagnosis. With the aid of so-called "level 1" diagnostic functions, it is possible to determine whether the source of a malfunction is located either in the tractor of manufacturer A or in the mounted implement of manufacturer B. In a second step, the working group ISO/TC23/SC19/WG1 is harmonizing the definition of "level 2" diagnostic functions, which contain significantly more detailed machine information. In addition, the requirements for the service tool are defined, which makes the use of proprietary tools unnecessary. The service tool for ISOBUS must meet great demands insofar as not only controller-based diagnostic and network functions of different manufacturers, but also statistical data (bus tension, bus load, CAN bus malfunction) must be displayed and the support of common transport protocols (KWP2000, SAE JI939-73) must be realized.

The topic "level 2" diagnosis is on the agenda of the competent ISO working group.

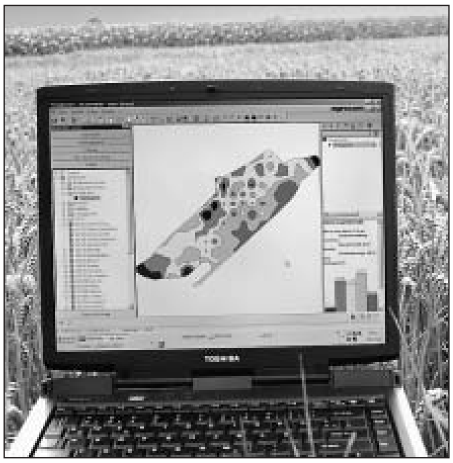

Fig. 3: Crop map for winter barley as an example of precision farming (company photo)

Sequence Control System

ISO 11783, part 14 "Sequence Control" defines a control system (Sequence Control System) for tractor and implement based on automatic functional sequences, which is already included in existing headland control systems. This system enables multiple functional sequences (of the tractor or other control implements connected to the implement bus) to be recorded with the aid of the teach-in method and allows these functional sequences to be reproduced automatically upon a specific command of the driver. Thanks to teach-in functions, user-specific programming and the storage of several sequence control algorithms for a tractor-implement combination become possible. This frees the driver from manual operating tasks (when reaching or leaving the headland, for example).

After the initialization phase, the driver conventionally activates all desired functions of a functional sequence within a work process. Via a CAN-bus, a "Sequence Control Master (SCM)" stores all information of the activated control implement functions together with time- and distance-based parameters. A sequence once recorded with the aid of a teach-in can be started several times as required. The "Sequence Control Master" sends the commands for the start of the functions to the "Sequence Control Clients (SCC)" which participate in the teach-in as soon as an event-, time-, or distance-based trigger event is reached. Afterwards, the SSCs carry out the functions in the same manner as if they had been activated by conventional driver operation.

According to current plans, the functions of ISO 11783 part 14 can be offered optionally by the manufacturers as part of the Implementation Level Process. The publication of this part of the standard is expected for the year 2009.

Conclusions

Complex information technology has been part of agricultural machinery for a long time. ISOBUS standardizes hardware and software, optimizes processes, increases profitability, and guarantees environmental and consumer protection. Supported by the positive reactions and experiences of farmers, agricultural service providers, and manufacturers, the process of standard development is being pursued consistently.

The increasing willingness of the manufacturers to integrate ISOBUS into their products will guarantee that modern communication technology will reach the farmer and can be applied in daily use.

ISOBUS is flexible enough to integrate current and future requirements and to prove its usability.

Literature

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