Advantage and communication strategy and protocol IFSF LONWORKS in the contemporary level measuring

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Abstract: This article investigates IFSF - an international standard for automation based on LON (Local Operating Network) technology designed for the oil industry. Modern leveling systems receive data on the composition and quantity of fuel probes installed inside the fuel storage tanks. Leveling converters can be included as part of the structure of the automated systems for wireless data exchange offered by modern communication technologies, using different protocols and standards. IFSF is a protocol designed for petroleum products and industrial installations internationally recognized that easily integrates equipment interconnectivity and communication standards . The aim is to create a completely open and interoperable system able to connect any device from any manufacturer in the same network for seamless exchange of data and instructions to create the interconnection between disparate devices by setting standards for equipment that is compatible with the TCP / IP.

Key words: standards, IFSF, topology interface, LonWork, protocol, topology, network

I. INTRODUCTION

In 1993 began the introduction of computer systems at service stations to deal with control, cards for paying through POS terminals, reporting of quantities of fuels in tanks and dispensers and more. International Standard IFSF has been tested in the U.S. , Europe and around the world and has considerable success in terms of cost savings and compatibility of technologies by applying network devices based on open standards for systems . European Organisation IFSF, based in the UK, is developing standards for connecting devices at gas stations (petrol pumps , level tanks and external payment terminals) . New devices can use existing standards for IFSF.

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IFSF design is simple and allows less testing. Systems are with a single architecture which simplifies applications and interfaces. The evolution of IFSF standards avoids problems with aging equipment. LONWORKS cable topology is a network platform with a dedicated management applications with a wide range of operation, high reliability, easy installation and maintenance. Created by the company Echelon Corporation in 1988, the technology rapidly expands its application range and in 1999 its communication protocol called LonTalk, was submitted to ANSI. The Institute accepts and imposes it as an official standard for network management. |It is subsequently adopted by a number of organizations or become the basis of other standards, such as: International Forecourt Standards Forum (IFSF). The standard has been adopted by SEMI - international trade organization of manufacturers of equipment and materials for fabrication of semiconductor devices such as integrated circuits, transistors, diodes and thyristors, as well as by the IEEE for management and equipment. IFSF is fully compatible with TCP/IP. By Open Systems- based technologies, in most platforms there are no restrictions on the compatibility of devices , interfaces and communication protocols . This simplifies installation and maintenance . When applying different standards, selection of systems and equipment from one or several different manufacturers is available. In both cases, there are serious drawbacks[1].

The most significant advantages of IFSF are :
- switching between producers in the same network without restrictions option;
- Freedom of various compatible devices IFSF in each country;
- Development of a single IFSF interface;
- the number of protocol converters to be purchased is reduced;
- the opportunity to choose the best devices, regardless of existing sites;
- new equipment can be introduced faster to IFSF network;
- easier on-site installation of central systems and applications across the IFSF network without a lot of developments of different interface;
- LON topology reduces cable junction boxes, ducts, pipes and wiring requirements.

II. LONWORKS TOPOLOGY

By 2010, about 90 million devices have been installed with LonWorks technology. Manufacturers in various sectors including building, housing, street lighting, transport, utilities, and industrial automation adopted the platform as the basis for their product and service offering. The technology for network devices connection allows end users to remotely connect, monitor, control, and data mine and diagnose intelligent devices. LonWorks is a networking platform with a dedicated management applications. LonWorks protocol is listed as one of the physical layer to connect the data. LonWorks is a type of networking technology for the development of local networks. As each local operating network LonWorks too contains intelligent devices or nodes that are interconnected through one or more transmission environment that communicate using a common protocol. Nodes are programmed to send messages to one another according to the changes in different conditions and perform certain actions in response to messages received. LON nodes can be accepted as objects that react to different inputs, activating the desired outputs [2].

There are four main elements:
• protocol LonTalk;
• Neuron chips;
• transceivers ;
• Network management software.

Neuron

Neuron chip is based on LonWorks technology. Its name - neuron is selected coincidentally. The aim of the developers was to show the similarity of LonWorks to the human brain. It is known that there is a central point of control in the brain - millions of neurons are connected in the network structure, as each provides information to the other in a number of ways. Each neuron usually performs a specific function, but the loss of any not necessarily affects the overall activity of the network. Chip-integrated communication protocols do not need development or programming of the information exchange. Neuron provides the first 6 layers of ISO OSI. The only thing that remains to be done, is the programming and configuring in the seventh application layer. The chips are programmed by the language Neuron C, which extends the standard ANSI C to maintain an object-oriented access to develop distributed applications . Neuron C provides direct support to LonWorks objects such as network variables and SNVT. All services provided by the programs in the language Neuron C, are provided by specialized software (firmware) of the Neuron (fig.1).
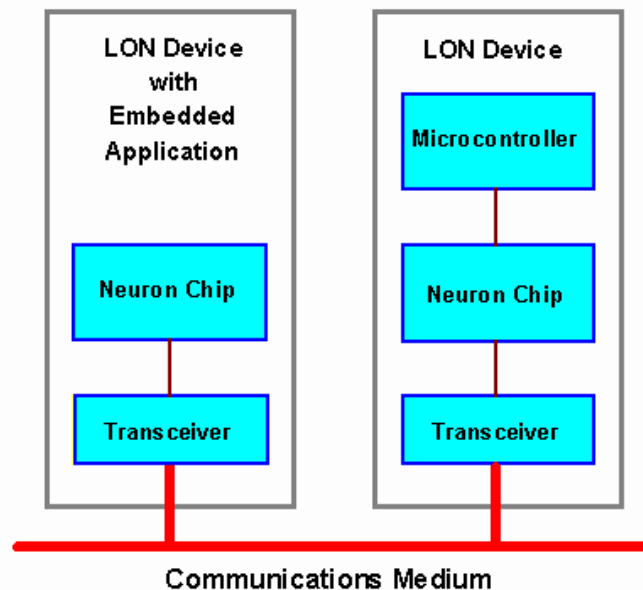
Fig. 1

Communications Medium

Fig. 2

Transceivers

Each network device contains a transmitter and receiver , called a transceiver that physically provides the communication interface node with LonWorks network. Furthermore, transceivers simplify the development of LonWorks compatible devices and are used for various transmission medium .

LonTalk

LonTalk protocol is a set of messages that support reliable communication between nodes and makes efficient use of the transmission medium. Data transfer is 1.25m bps and then the protocol supports over 500 transactions per second. Given the main application area of the standard, many of the LON nodes are relatively simple devices. Even in the development of LonTalk the use of small, simple network components was provided. LonTalk is layered, packet-based communication protocol from the type peer-to-peer. The construction of the LonTalk is consistent with the reference model for open systems interconnection in the International Organization for Standardization - ISO and the OSI seven-layered model that describes the structure of open communication protocols .

LonWorks implements all seven layers of the model. By adapting to each of them, LonWorks protocol provides specific solutions for working and sustainable communication in control applications. Each layer provides services to the next higher in the hierarchy as this remains hidden to the superior layers. Changes can be made to a layer without affecting the others [6].

■ Physical layer of the network (PHY). The shortest definition for it is electrical connection . PHY addresses the specifics of the wiring and connections between the components of the network. The physical layer defines the transmission of the net quantity of bits through the communication channel. This layer provides 1 bit transmitted from the source device to be accepted as the first bit of all devices for which it is intended.

■ Layer for data connection (DLL). It defines methods to access the medium and to decode of information to ensure the efficient use of the communication channel. The net amount of bits are broken down into information structures (data frames). The connetion layer determines when the source device can transmit information structure and how the devices for which it is intended can get it and find errors in the transmission. DLL also defines a mechanism for priority to ensure the delivery of important messages.

■ Network layer. Specifies the way to determine the route of communication packets from the source device to the devices for which they are intended. This layer defines the naming and addressing of nodes to ensure correct delivery of packets. Moreover, it defines the route for messages between source and recipients.

■ Transport layer. It sets the type of service required for messages of the devices depending on the level of security required by the application. Services provided are: addressing depending on the number of recipients-broadcast, i.e. to all the nodes, one-point and multipoint - aimed at a group of nodes - addressing; confirmed, unconfirmed and repeated message; detecting duplicate packets; plausibility check . The level of service required by the application to establish when each node is installed in the network.

■ Session Layer. It provides management of the information exchange in the lower hierarchical layers. It also supports remote operation, so that the customer has the opportunity to make a request to a remote server and receive a reply to his request. Session layer also defines the protocol for authentication that allows the recipients of the message to determine whether the message sender is authorized to do so.

■ Presentation layer. It aims to structure the exchange of data from lower layers by defining the decoding of the information in the messages. They can be decoded as network variables, messages for applications, or external communication structures. Reconciliation of decoding of network variables is provided by SNVT.

■ Application layer . Services provided at the application layer, simplify the development of applications that serve as interface to specific sensors, actuators and external microprocessors. It performs application compatibility of the information exchange from the lower layers. Standard objects contribute to the compatibility by ensuring that applications use a common semantic interpretation of the information. This interpretation ensures that different applications will show general behavior when updating network variables. Among the main activities in this layer are: providing memory to storage applications, implementation of a real-time operating system, driver programs for Neuron I/O hardware, maintaining SNVT (Fig. 2).
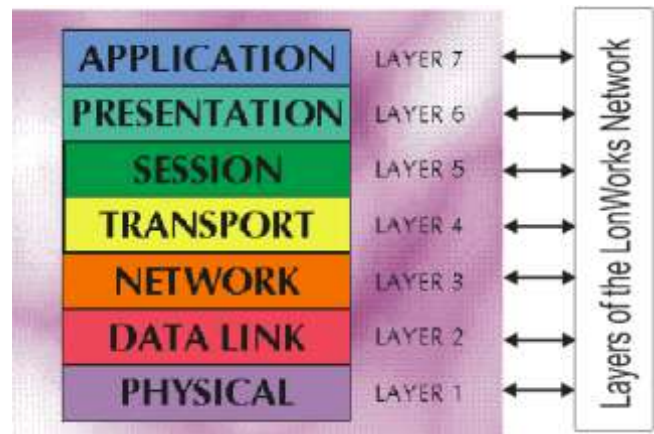

fig.2

Messages in LonTalk:

■ without confirmation - system nodes send messages on the network each time the application determines them to be appropriate. This mode provides the highest data transfer ;

■ without confirmation/repetition - as the previous one, but in return the messages are sent repeatedly, identified as number during the installation of the device on the basis of network variables.

■ with confirmation - it is important whether the message was received to the desired address. The pause for snoozing the message is determined when the node is installed and SNVT are distributed between devices. This mode reduces the useful transfer of information in the network. Application compatibility in the LonTalk protocol is facilitated by the use of Standard Network Variable (SNVT)[5][4].

■ Priority service – it`s provided through allocation of priority time intervals in the transmission medium in order to increase the response time of critical information packets . For each priority interval must be ensured that only one node is designated for it`s use. This mode severely limits data transfer and should be used sparingly .

Addressing

LonTalk is a hierarchical form of addressing. The algorithm defines the way data packets are routed from source device to one or more devices for which they are intended. Packets can be addressed to a single node, a group of nodes or to all nodes. To simplify the routing of messages LonTalk protocol defines a hierarchical form of addressing using a domain, an individual subnet or a separate node . Each node is a device physically connected to the transmission medium, ie to a particular information chanal. The area is a logical set of devices to one or more channels . Communications can take place only between devices from a general area – therefore the area forms a virtual network. Several areas may occupy the same channel , but can not be used to prevent interference between nodes of different networks . A subnet is a logical set of up to 127 nodes in the area. LonWorks allows to define up to 255 subnets in a separate area. All devices on the subnet must be on the same channel or on channels associated with

bridges. Subnets can not cross routers. If a device is configured as belonging to two areas, it must be set to the same subnet, within each area. Each node of the subnet has a unique identification number. Specific division of LonWorks network is the group. It represents a logical set of nodes within a region, but its members do not have to share the same channel, as is typical for the subnet . Each node has a unique 48-bit identification number assigned during manufacturing.

Types of addresses in LonTalk
- Physical address – it is a unique 48-bit identifier called Neuron ID. The physical address can not be changed during the lifetime of the device.
- Device address – it is set on the device, when being installed in a LonWorks network. Device addresses are used instead of the physical address as it is more efficient from routing of the messages standpoint, and simplifies the replacement of faulty devices. The address of a device containing three components - ID for the district, ID for the subnet and ID for the node.
- Group address - unlike subnet nodes are grouped regardless of their physical location in the field. For packets addressed to multiple devices, groups are an efficient way to optimize network communications.
- Universal (broadcast) address - this address applies to all devices on the subnet or all nodes in the area. It also provides an effective method of communicating with many devices, and is sometimes used instead of group addresses in order to preserve their limited number .

Each LonWorks package aired on the network contains the address of the transmitting node, i.e. the address of the source and address of the receiving devices, i.e. the addresses of the recipients.

Network management and interface
Support is built into every node of the LonWorks platform. Thus ensuring that all devices, regardless of their origin, can run LonTalk commands from the devices designed to perform network management functions. Among them are: detection of unconfigured nodes and loading the network addresses; stop, start and reset the application; configuring routers and bridges; loading new applications; changing the configuration table with network variables.

Network interface card or module is used to connect a host computer with computers running different operating systems. Interface itself does not work with the application. Instead it provides a layer or layers of Control Network Protocol of ISO/IEC (CNP), plus transceiver implementing layer and firmware for sharing another layer packets to the connected computer. The most frequently used network interfaces are:
- U10/U20 USB Network Interface - a small USB device that plugs into a USB port on your computer and transmits on free topology through a twisted pair of wires
- U10 or a power line for a U20 channel.

- i.LON SmartServer - a controller that can be used as a network interface
- an IP connection to the host computer.
- i.LON 600 IP - 852 router that can be used as a network interface with an IP connection to the host computer.

III. IMPLEMENTATION AND EVALUATION OF THE DEVELOPMENT OF IFSF

A completely open and interoperable system has to be created. This makes it possible to connect different devices from different manufacturers in the same network for seamless exchange of data and instructions.

As a result, there is freedom in the choice of speakers, controllers, level probes tanks of different dimensions, POS terminals and other payment modules necessary for the operation of the station. All this can be connected to a network with different protocols and interfaces and communicate with each other. To the network can be added COP and car wash. Switching between producers in the same network is without restrictions. The developed interface allows entering on site systems` and central applications data within a IFSF network. A little processors and protocol converters are embedded [1].

Advantages of the unified IFSF architecture:
- Uniform technology, which allows a smaller set of skills;
- A single engineering center of expertise is created;
- new modules relate to the sites faster;
- the development and approval of duplicate interfaces is avoided;
- new devices can use existing standards for IFSF;
- IFSF design and engineering are simplified, which means less testing on site;
- the unified system architecture simplifies applications and interfaces;
- controlled development of IFSF standards avoids sudden obsolescence;
- recommended LonWorks® topology is more efficient and very flexible;
- wiring failures are reduced by about 75%;
- IFSF fully supports TCP / IP;
- Fault diagnosis is easier because all devices are similar;
- units are interchangeable;
- system architecture is simpler in the central support.

When IFSF is installed using a circular topology is considerably easier than the traditional configuration star. The main advantages of LONWORKS ® wiring: free wiring star, loop, bus or a combination is shown in (fig. 3).
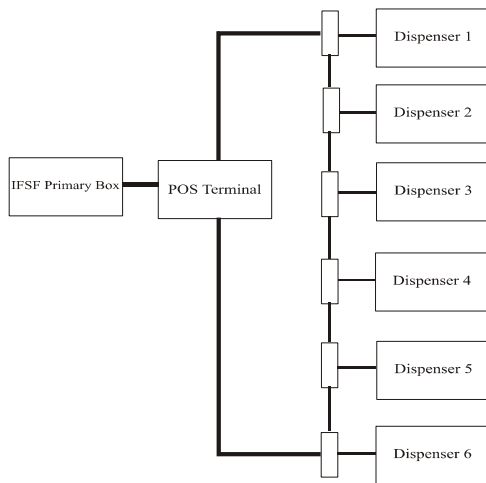
fig.3

Networking principles

The front part of sensors and lighting can be controlled effectively, with BMS applications, 45% energy efficiency in cooling, air conditioning, lighting, chillers, multifunctional alarms like smoke and fire can be achieved. These are combined with interactive control that is possible in the IFSF network - for example, reducing the lighting of the dispenser, BMS devices are managed by software, so there is no need for staff. This solution significantly increased the consumption compatible equipment, which in turn facilitates the installation and execution .

Adding additional items of equipment on the job site, such as activation of the payment, terminal or car wash, installation of newly developed devices for identification of vehicle, are two main aspects of the management strategy. The expansion of the network is greatly simplified if all objects have a unified system architecture that is designed for communication between devices from different manufacturers. In some cases, the expansion can be achieved with less additional equipment (fig.4)
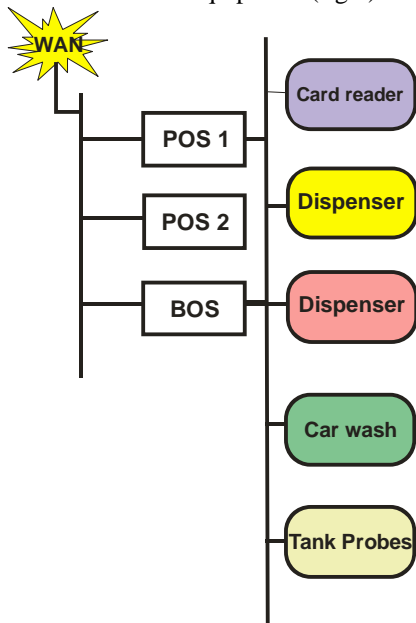

fig.4 Expansion on IFSF Site

Protocol converters and duplicate processes

There are many devices that do not require protocols` transducers. Architecture, which uses a proprietary interfaces may require significant resources. In achieving interoperability, this problem is eliminated. Additional software is not required either to connect the plurality of devices using a single IFSF protocol [3].

The ability to work without interruption requires system architecture with no common point of error . Traditional work area has many single points of failure, such as cable ties, controllers or some of the protocol converters. IFSF architecture of the site can remove individual points of failure and increase endurance. Experience shows, that this stability reduces non-tradable events by a factor of three or four of a typical configuration of the site.

Own architecture becomes more complex and tends to increase the number of processors, for example, one for each epic, controller, tank gauge controller or control system delivery. IFSF architecture includes fewer devices connected to the site and controllers that have sufficient capacity to process all applications. When a system may require a separate processing power and software manufacturer, IFSF solution would be to use simple sensors in the tank with the implementation of site-controlling PC, along with other applications (Fig. 5).
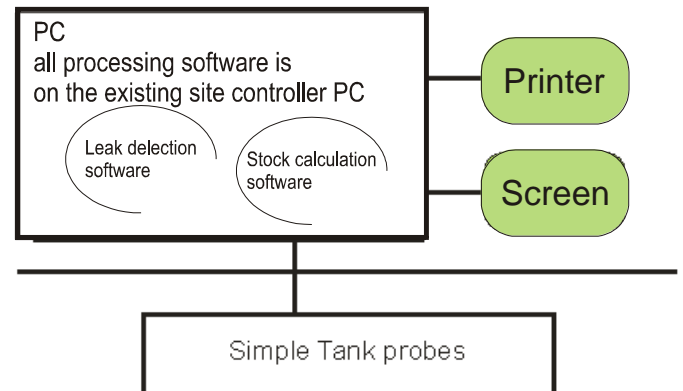

fig. 5 IFSF Network

IV. CONCLUSION

The wide range of products and systems creates prerequisites and trends to transfer to centralized control systems. Equipment is produced based on open standard for control and network architectures that feature intelligent distributed control, using standard communication protocols and easily available products with low cost. These are solutions that ensure reliability, flexibility, lower cost, faster development and control. Large and complex systems can be divided into two or more, with centralized management and communicate with each other. In network management, intelligent devices communicate using common protocols. Each device contains a built-in intelligence that carries out the

necessary functions. Each device on the network can perform a simple task, to be more complex, performing multiple tasks or complex system supervisory control and data acquisition, monitoring of other devices on the network and automate processes. Network management require different types of platforms and applications. Distribution and processing of data using a network protocol provides open access to any device, reduces overall installation costs and increases the life cycle. It is based on management systems that have many common requirements, network management and control, IP standard package, on which are built internet messages worldwide, without translation of foreign protocols. IP compatibility for LONWORKS network can be presented by LNS Server, i.LON SmartServer or LonBridge Server.

The potential for integration provided using IFSF and large capacity is great. It is assumed that nowadays the most widely common communication technology is the TCP / IP. IFSF works with manufacturers and National Association of Convenience Stores, to publish alternative communication IFSF Layer Protocol based on TCP / IP. There is a IFSF site for TCP / IP specifications. IFSF guidelines use IT features of TCP / IP and ensure that IFSF applications operate with TCP / IP and LONWORKS ®. Each filling station network can become a member. Current members are: BP, ExxonMobil, Kuwait Petroleum, OMV, Shell, Statoil.

V. REFERENCES

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Thanks