Open PLC Network

FL-net (OPCN-2)

The Standard Network Evolving Factory Automation

FL-net (OPCN-2), a flexible and ope interconnect different manufacturer

Progress of FA has led to increase needs for integrated systems that interconnect various controllers and FA devices. Hence, standardization of networks has become an international trend.

The Japan Electrical Manufacturers' Association (JEMA), in cooperation with the Manufacturing Science and Technology Center, the Japan Automobile Manufacturers Association, Inc., the Japan Machine Tool Builders' Association , the Japan Robot Association, the Japan Electric Measuring Instruments Manufacturers' Association and other relevant bodies, has engaged in the development, standardization, conformity testing and certification, and promotion activities for an open network FL-net (OPCN-2) comprising mainly programmable controllers (PLC).

Dissemination of the FL-net (OPCN-2) enables interconnection among different manufacturers' equipment and devices, and configuration of flexible and open FA systems.

⬤ What is FL-net?

FL-net is an industrial-use open network built on Ethernet and common memory systems. FL-net Version 3 (Ver.3) has been established for device level networks in addition to controller level network of FL-net Version 2 (Ver.2). FL-net Ver.3 defines I/O devices mounted on FL-net Ver.2, and allows flattening of networks.

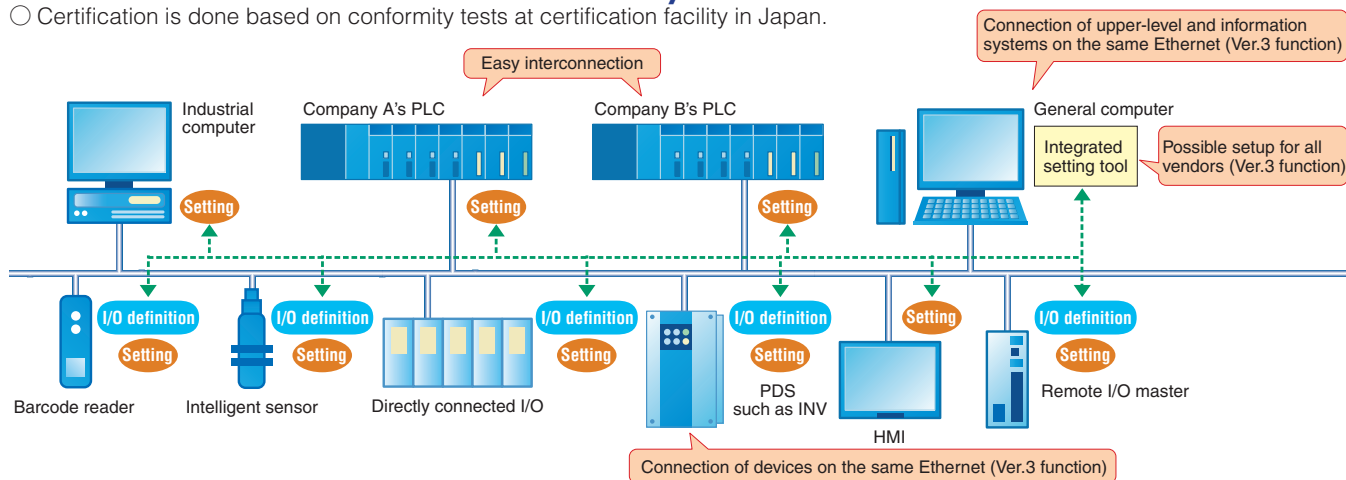### Easy configuration of multiple-vendor environment
◯ 31 companies support the open network developed in Japan.
◯ FL-net has a solid track record as a multiple vendor controller systems.

User-friendly specifications and performances
◯ Easy configuration of independent controller systems.
◯ Easy configuration of real-time control systems.
◯ Allow data exchange even when the applications of destination stations are unknown.

Establishment of standardization and certification systems
◯ Certification is done based on conformity tests at certification facility in Japan.

Connection of upper-level and information systems on the same Ethernet (Ver.3 function)

Easy interconnection

Industrial computer Company A's PLC Company B's PLC General computer

Integrated setting tool

Possible setup for all vendors (Ver.3 function)

Setting Setting Setting

I/O definition Setting I/O definition Setting I/O definition Setting Setting I/O definition Setting

Barcode reader Intelligent sensor Directly connected I/O PDS such as INV HMI Remote I/O master

Connection of devices on the same Ethernet (Ver.3 function)

New Functions of FL-net Ver.3

FL-net Ver.3, which incorporates results of the recent user requirements survey, is designed to provide continuity of information with computer level and device level, and can be connected to other network at device level. Setting and monitoring can be performed from a general computer on the network.

Interconnection with upper-level systems and information systems Simultaneous TCP/IP communications are possible
◯ Even more flexible information system application is possible, including connections to office automation equipment, the Internet, etc.
◯ System solutions are now possible, integrated with ERP, MES, and other monitoring, information, and office automation systems.

Enhanced user convenience integrated setting/ monitoring tools are offered
◯ Communication setting, monitoring, and diagnosis are possible from a computer connected to the Ethernet, on all FL-net equipment and devices provided by all vendors.
◯ The integrated setting tool is offered as software.
◯ Setting is possible with a single user interface, thereby reducing setup errors and start-up time.

Interconnection at device level
◯ A shared input-output from all stations can be installed on FL-net.
◯ A multiple-master device level network, where devices of several vendors are interconnected, can be easily configured.
◯ Management is possible without difficulties from HMIs, industrial-use computers and others, thereby reducing total system cost.

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Features

Features	Device manufactures' merits	End-users' merits
Flexible system configuration	- 100Mbps and 10Mbps equipment and devices in the same network - Automatic joining/out-ring of a node (a station) - Repeaters, transceivers, HUB, etc. for Ethernet	
High speed, large quantity data transmission	- Support connection to device level and controller level - Support General-purpose Ethernet communication (TCP/IP, UDP/IP, etc.) in the same network - Implement UDP/IP-based FA link protocol (JIS B 3521, JEM 1479) by FA needs - High speed cyclic transmission: within 50ms at 2Kbit+2KW ((64bit+64W) x 32 stations) - Easy-to-use common memory technology acknowledged as a PLC network - 1,024 bytes data per transmission from a station - 1,024 bytes per frame for messaging service	
Easy development of connected devices 1) **Open specifications** 2) **Low development costs**	- Ethernet as physical layer, with available parts on the market - Available analyzers and testers on the market	—
Economic efficiency	-Low-cost parts of Ethernet -Standardized circuit connection specifications to reduce development cost and time	-Easy to obtain necessary parts such as cables, repeaters, transceivers and HUBs -Use of various supporting devices for Ethernet
High reliability	-Master-less token system used at controller level -Excellent RAS functions	
Scalability	-Enhanced performances by future technical development of Ethernet	

Specifications of FL-net (OPCN-2)

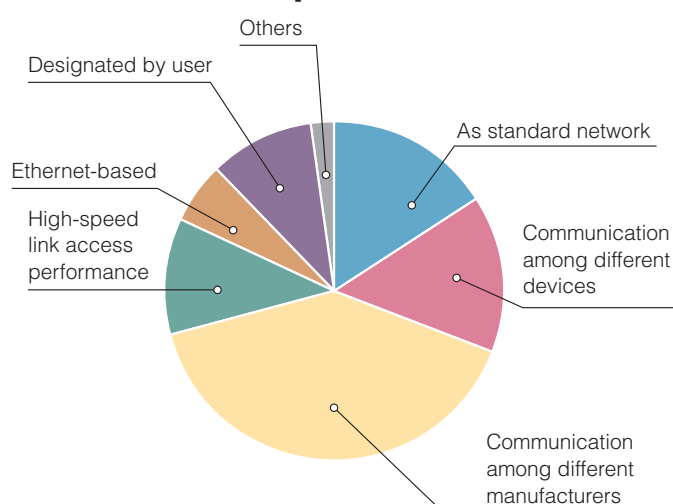| Specification items	Specifications	Remarks
Transmission media	10BASE-2, 5, T 100BASE-TX, FX	Extend transmission distance by using repeaters, optical media converters, etc. Recommend 100 Mbps Ethernet switches
Physical layer specifications	IEEE 802.3	
Topology	Bus-type and star-type	
Maximum connected stations (nodes)	254 stations	
Correspondence right control system	Token passing	No specific master station (controller level)
Communication station control system	Master-less system	Guarantee delivery time for cyclic transmission
Protocol	UDP/IP-based FA link protocol	
Transmission services	Cyclic transmission service 8Kbit+8Kword common memory at all stations	Transmit the same message to all stations simultaneously (broadcasted) for cyclic transmission
	Message transmission service 1:1 transmission/1:N transmission, up to 1,024 bytes	Offer delivery confirmation for 1:1 transmission
	Load measurement service	Measure general-purpose communication loads
	I/O definition setup service, solicitation service	Used in flexible map mode
Transmission performance	Refresh data of 2Kbit+2Kword of 32 stations in 50ms or less	Target value for product development specifications
Compatibility with device level network	Fixed map/ flexible map Two systems	Vendor-dependent for implementation class
General-purpose communication superimposition	Superimpose packet communications other than those of TCP/IP, UDP/IP, and other FA link protocols	Use vacant band
Network settings	Implement server functions for network setup parameters	Centralized management of node settings

Fields of Application

Fields of application of FL-net (OPCN-2) have been expanded to include the [Processing industries/ food and pharmaceutical industries] and furthermore [Public and social systems], in addition to the [Assembly processing industries] which established the standardization of FL-net.
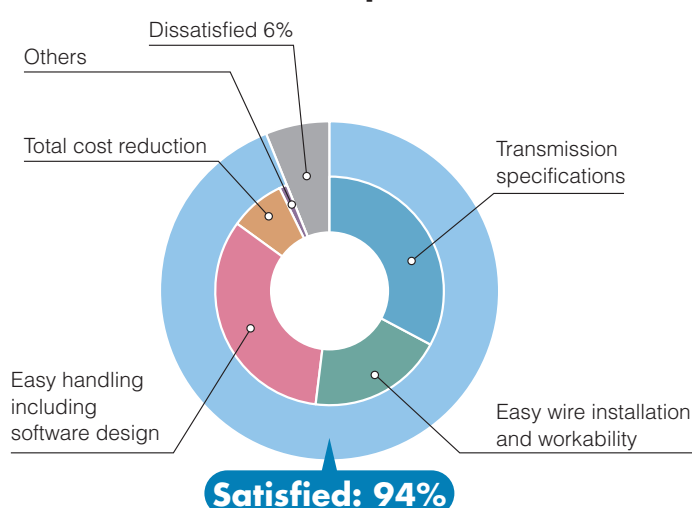
Fabrication and assembly industries	Process industries/ food and pharmaceutical industries	Public and social systems, and others
Automobile manufacturing	Iron and steel manufacturing	Dam monitoring and management
Semiconductor manufacturing	Paper and pulp	Water supply and sewage systems
Display device manufacturing	Chemical products	Garbage treatment
	Ceramics	
Electrical device and wire manufacturing	Petroleum	Electric power monitoring and control
Machinery manufacturing	Food products	Building management
	Pharmaceutical products	
Transportation devices	Printing	University facilities monitoring and control

Reasons for adoption and assessment

■ Reasons for adoption

Others
Designated by user
Ethernet-based
High-speed link access performance
As standard network
Communication among different devices
Communication among different manufacturers

■ Evaluation after adoption

Dissatisfied 6%
Others
Total cost reduction
Transmission specifications
Easy handling including software design
Easy wire installation and workability

Satisfied: 94%

Information on FL-net (OPCN-2)

Manufacturers developing FL-net equipment and devices and users constructing networks that utilize FL-net are welcome to visit OPCN websites:

Japanese	http://www.jema-net.or.jp/Japanese/standard/opcn/
English	http://www.jema-net.or.jp/English/standard/opcn_e/top-opcn.htm