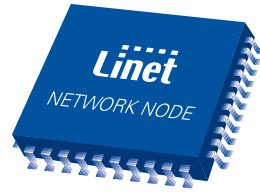


Linet

Light control network

Product description



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US pat 5920253, other patents pending.

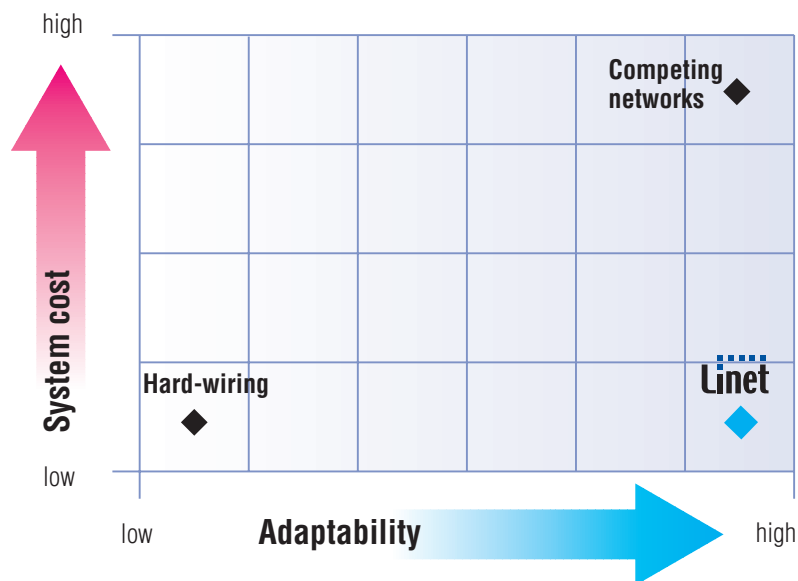
Linnet – the Light network system

is an easy, reliable, low cost network between electrical devices

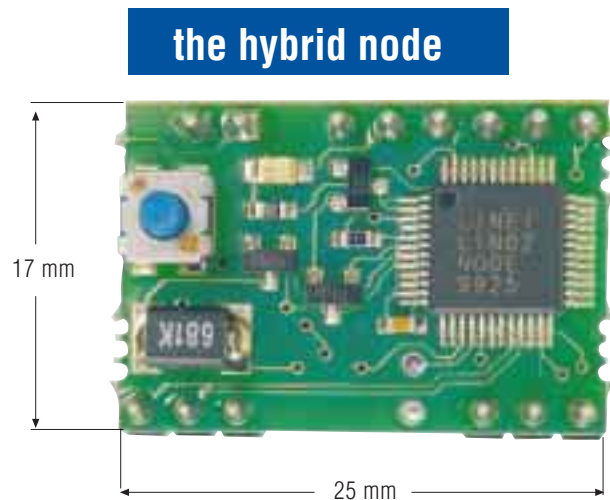
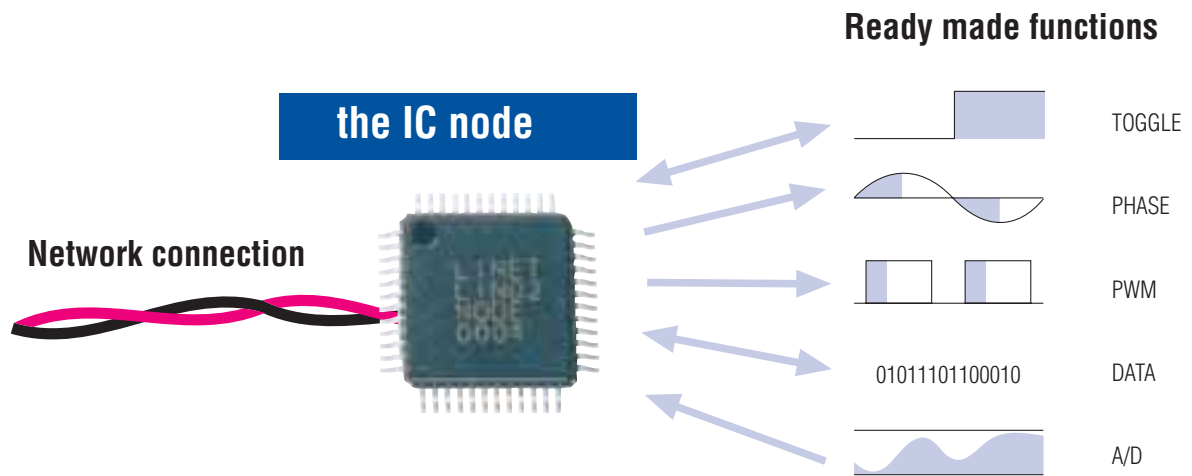
Linnet is a light and easy local operational network system. It is used to control simple devices - relays, heaters, sensors, etc. - without the need to develop application specific software or investments in development tools or learning. For OEM producers Linnet offers more features, less costs, and faster time to market.

To build a traditional distributed control system, you either had to use hard-wired control wiring, or high-end control network developed to communicate between microprocessor systems. The former is laborious to install and static, the latter leads to the use of expensive design tools and complex solutions in simple applications.

Linnet is positioned in between these two approaches. It is a completely new system, designed to fulfil the need for a simple network between simple devices. It is easy to understand and operate, just as fixed control wiring, while offering the dynamics, scalability and other advantages of modern network systems.



This is Linet network - A Linet network consists of a Linet controller and Linet network nodes connected by twisted-pair cabling. The nodes link simple devices into the network. The ready-made functions, such as ON/OFF, are used to transmit the functional signal from a selected device via the Linet nodes and network to another device of your choice. This is the Linet way to implement distributed control systems with minimal hard-wiring and no programming. Other functions, and even data transfer, are performed similarly, using the Linet nodes along with the desired devices.



- All Linet nodes are identical and perform all Linet functions.
- A Linet-networked device contains the node and application specific circuitry depending on the application.
- The IC node is ideal for price and size sensitive high production volume applications.
- The hybrid contains the IC node and necessary external components forming a network card for embedded systems. It is used in small production volumes and for prototyping.

The controller – an intelligent power supply for the nodes

The controller :

- Supplies power to the nodes in the network.
- Supplies carrier and timeslots to the nodes.
- Offers the services to configure and administer the network.
- Can operate as a user interface.
- Operates stand-alone, or forms a link to host systems.

The controller is an intelligent power supply for the nodes in the network. It is the logical link between the nodes in the network, or between the nodes and a host. It also provides network configuration services, eliminating the need for any Linet-specific design or configuration tools.

The controller is shipped with software running the Linet system and offering the basic set of network functions. When application-specific extensions are required, they may be added to the controller software, or the controller may form a link to a computer or a host system.

No tools required

A Linet network is extremely simple to configure. The skill required is comparable to the use of a cellular phone, so learning time is a matter of hours instead of months, as with other network systems. In home automation applications, for example, a tenant can operate a Linet-based home control network instead of relying on services from network specialists or system integrators. No Linet-specific tools are required either.

The Linet controller provides the necessary functions to configure and administer a network. Various user interfaces may be used for this - a PC or other computer running a terminal application or web browser, or a fixed interface consisting of an LCD display and pushbutton softkeys. The interface is required only when the network is configured and can be disconnected at run-time.

Configuration example: a switch on/off application

In a lighting application there can be lighting fixtures in the ceiling and a single or several lighting control pushbuttons. When you want these to operate jointly, they are considered a logical group.

To make the group, select the 'add a new group' - function on the user interface. Then indicate the pushbuttons and fixtures to be included in this group by simply pressing their pushbuttons, one at a time.

That is all you have to do. The Linet system automatically assigns addresses to the nodes, and creates the logical links between them.

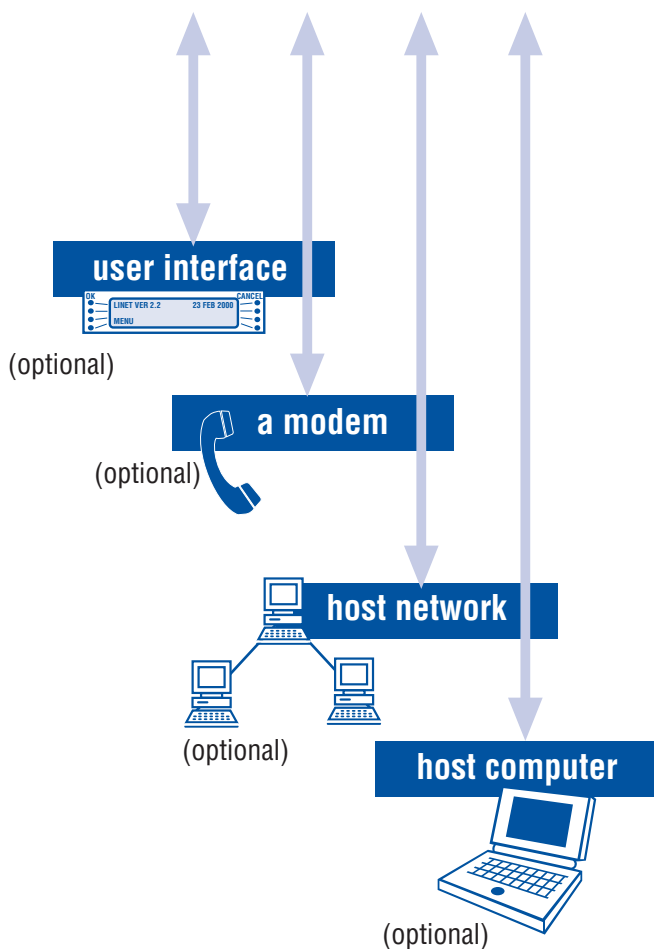
Power and simplicity

The Linet approach combines the benefits of master-slave and peer-to-peer networks. It offers fixed, short propagation delays unforeseen in master-slave systems, while using a fraction of the computing power required by any of the peer-to-peer networks.

A Linet application consisting of up to 200 nodes has only a single device running software - the controller - which also supports remote upgrade-ability. This is a relief for those who upgrade or debug their systems, as a microcontroller-based solution might result in all those 200 devices having to be rewritten.

Internet connection makes your switch accessible from the other side of the world

The controller



Each Linet network offers a real-time connection between up to 200 nodes. These networks may operate stand-alone, when the application consists of single or many discrete systems. In many applications, however, remote accessibility or expandability is desired.

To make systems of more than 200 nodes, or to connect one or several Linet networks to a host computer, use the Linet controller's ethernet connector. With this connection, Linet systems can be linked to Internet or intranet networks.

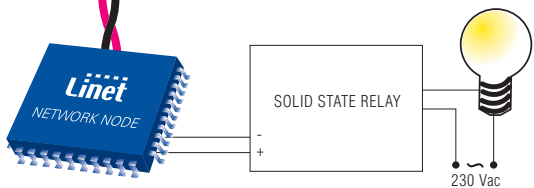
Instead of 'locating IP address into every light bulb', Linet is used to collect information from up to 200 simple devices and transfer the data onto a high capacity information system. This approach combines the benefits of both technologies - the easiness, cost effectiveness and real-time features of Linet systems with a commonly used, standardized IT infrastructure.

Users may connect several Linet networks to cover applications requiring large number of nodes, or a large geographical area. An ethernet connector provides a means of sharing information between nodes and a remote system, which may be, i.e., a computer at a distant location or a GSM phone. An ethernet connector also allows you to connect Linet-based data acquisition or alarm systems to a factory ethernet.

Interfaces between other information systems and Linet, e.g. LONWORKS® building automation network, have been developed by third party companies.

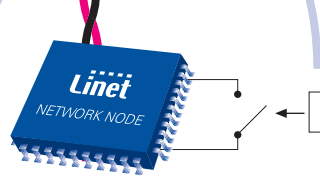
LONWORKS is a registered trademark of Echelon Corporation.

Examples of connections with Linet nodes



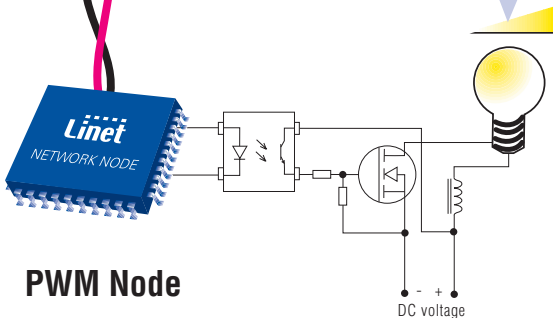
Toggle Node

The Linet nodes can be interfaced to power lines with a readily available solid state relays (SSR). ON/OFF OUT pin can drive directly the LED of the SSR. No other components are needed. Note that the Linet node can control any voltage or current, when the SSR is selected according to the load ratings. Configuration of toggle nodes is extremely simple: the nodes belonging to the same control group are identified to the controller, and the network is functional immediately.



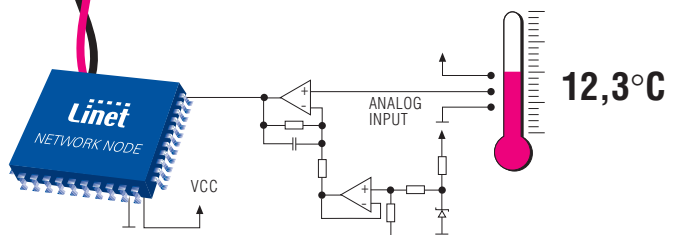
Switch Input Node

A push button switch is needed in most node arrangements as the simplest input device. Any low voltage, low power switch can be used. An optional LED indicates the status of the node, toggling on every activation of the switch. The LED can be omitted, or some other output function can be connected to the output pin e.g. an SSR. Combining the switch input node with the toggle node provides a multi-purpose AC control node for lighting installations, etc.



PWM Node

DC loads can be controlled with the built-in pulsewidthmodulation output (PWM). Without any external triggering, the frequency of the PWM signal is 100 Hz. As with the dimmer node, the power is controlled from the configured input node.



Analog Input Node

Analog input voltages can be converted to digital data with the internal A/D converter. The data is transmitted in serial format to another network node, or to the controller. With some additional components, IC temperature sensors can also be interfaced easily for distributed temperature sensing.

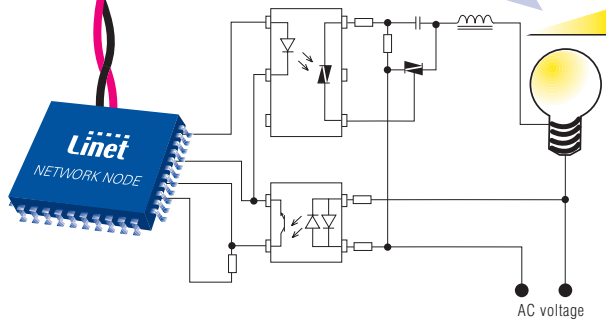
Controller

One controller is needed in each Linet network. Its main functions are to supply the carrier signal to the network and the operating power to the nodes and other circuits in the network. The controller can operate as a stand-alone unit, or it can be connected to a host computer or network.



- ● ● ● RS232/485
- ● ● ● Extension bus
- ● ● ● Ethernet

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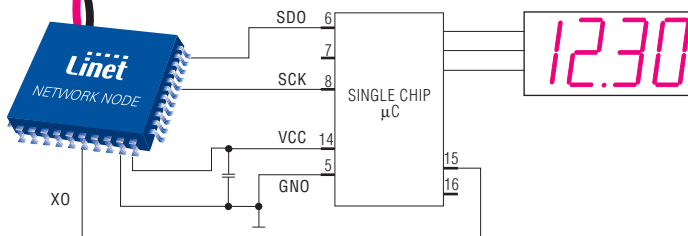


Dimmer Node

The power of AC loads can be easily controlled using the phase-angle control. Linet node contains built-in logic for this. PWM output pin can drive an external TRIAC driver. The synchronization is achieved by sensing the AC line with an optoisolator. The TRIG input receives a positive pulse on every zero-crossing of the power line. Some additional components are needed for RFI suppression.

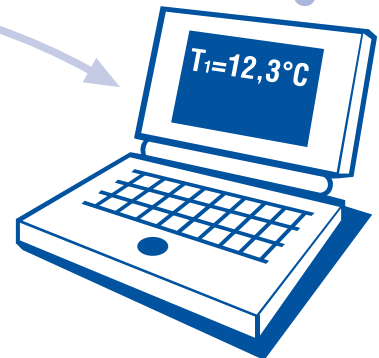
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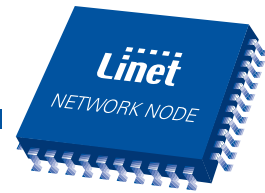


Data Output Node

Digital data can be transmitted in serial format between nodes. Here the received data is interpreted by a microcontroller, which drives an LCD display. In addition to the serial clock and data outputs, the node also provides the power supply and clock for the external microcontroller.



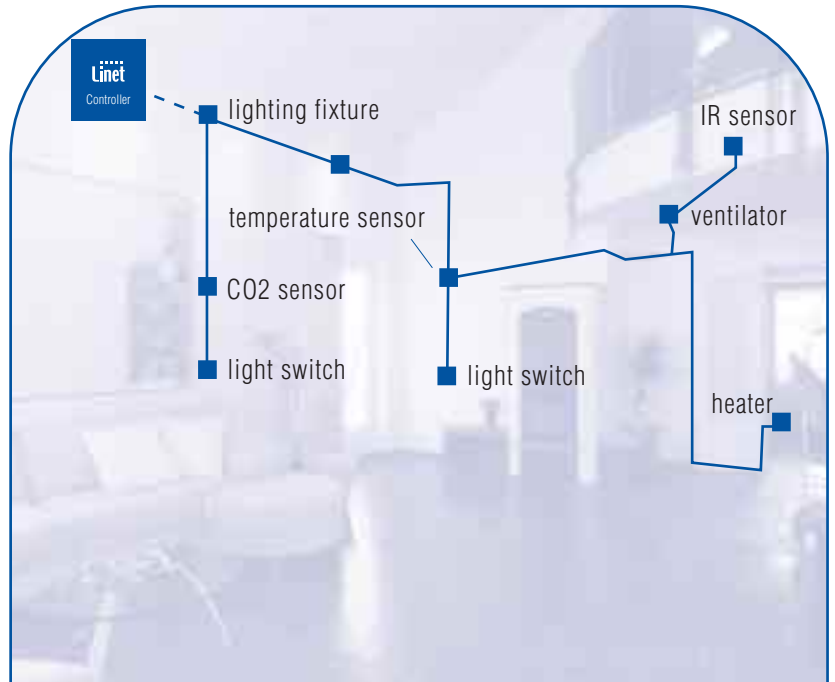
Application examples



Home automation

Use of automation in controlling electrical home appliances improves security and comfort, and reduces energy consumption. Today, many home automation systems are available as separate products that are hard-wired to the building. As separate systems are installed, the total amount of cabling becomes unmanageable. Such a system is difficult, or impossible to modify or expand.

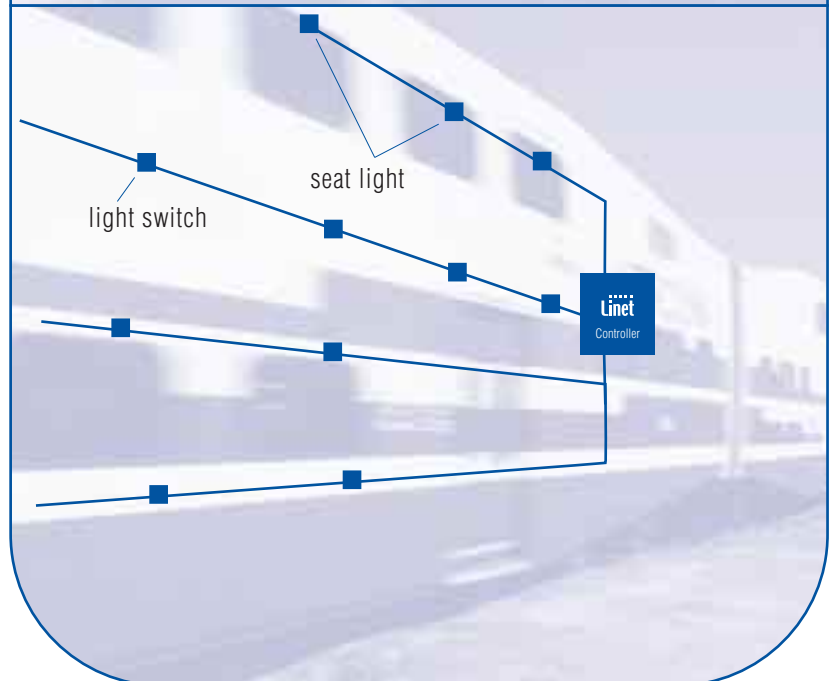
Linnet is an excellent base to expand the use of low-level building automation into one family houses. It offers the functionality that meets the requirements in these applications where its competitors are far too expensive and difficult to adopt.



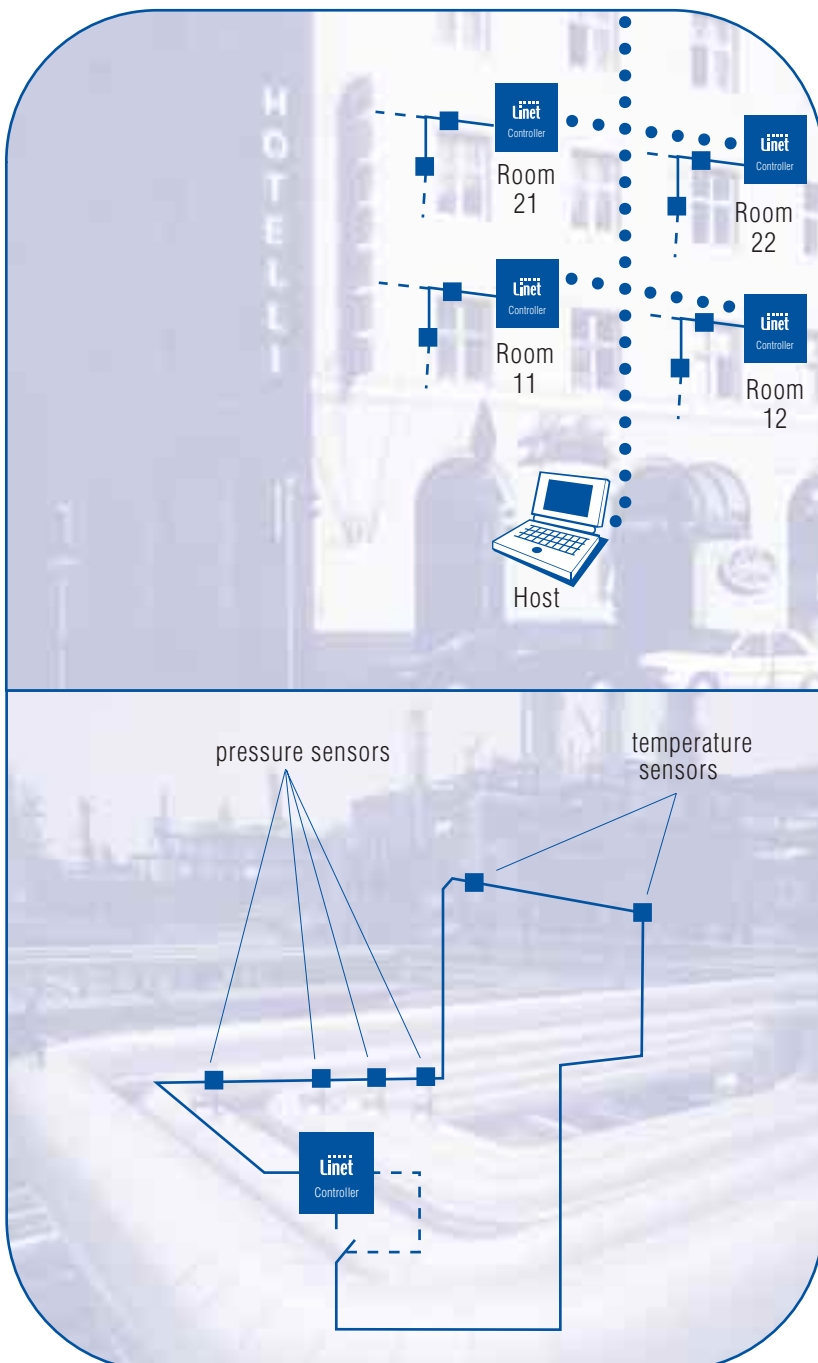
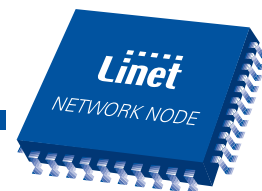
Spot lighting in rail cars

Spot lights and call buttons in rail cars and buses require complex cabling when conventional hard wiring is used. Use of Linnet simplifies this cabling, thus providing lower system weight and installation costs, value added features and savings in maintenance.

Linnet enables passengers to adjust the lighting level at their own seats, with practically no added cost to the system price. All lights may also be controlled on or off simultaneously. The system can also indicate which lamp does not work.



Application examples



Automation in hotel rooms

Building automation in hotels improves comfort and security, and lowers energy consumption and maintenance expenses. A Linet network can control each room, so there is one Linet controller for each room. The controllers are linked together using e.g. intranet.

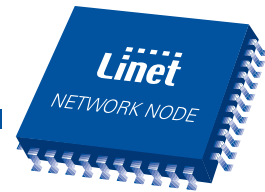
This solution combines the easiness and low cost of Linet and the proven high capacity of the data network.

Alarm systems

Linet can be used as a base in an alarm system when reliability is required. Its patented signalling system operates reliably in a noisy industrial atmospheres. If a node fails, it can be automatically disconnected from the system - even if there is a short circuit on the node. It is even possible to continue operation when there's a break in the network cable.

The Linet controller can be embedded into the control unit of the alarm system. Linet controller's display may be customised according to application, or a driver to any other industrial display may be developed.

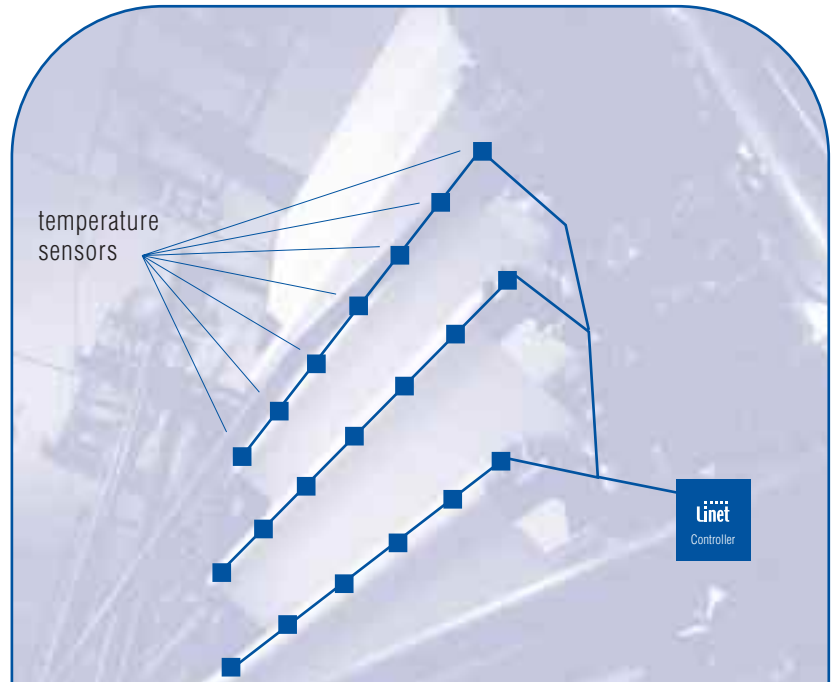
Application examples



Temperature measuring matrix

The Linet network fits into many low-level industrial automation applications. The circuitry on the node is simple, easy and inexpensive to manufacture. Data acquisition systems like sensor matrix, which is widely used in the process industry, benefit from the synchronous time division protocol of the Linet network.

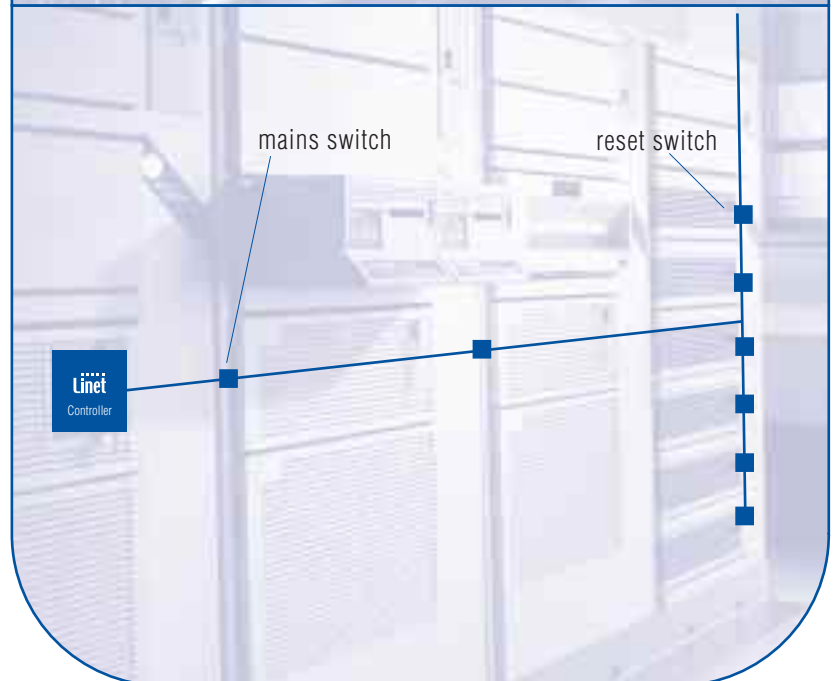
When 12 bits resolution is used, each node can output the A/D-value approx. 4 times per second. This capacity is fixed and is independent of the size of the system. So up to 200 nodes can all output 4 readings per second simultaneously.



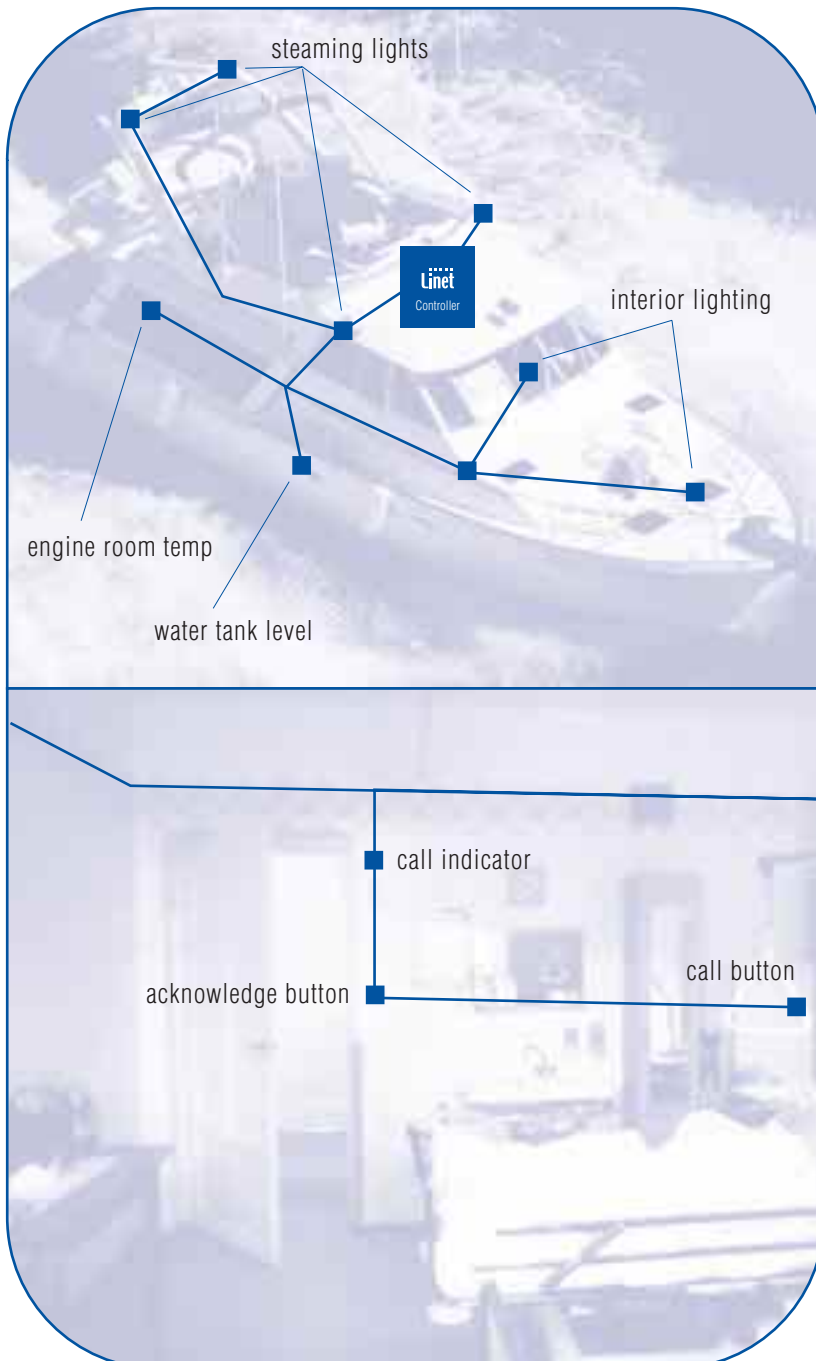
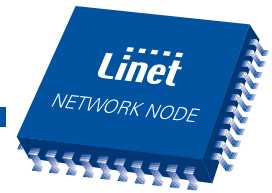
Remote operation to Internet servers

Linet can be used to remotely control a cluster of internet servers or other IT hardware. The Linet node may be mounted to control the main switches, and/or the reset switches of the computers. The Linet controller is connected e.g. to a modem. This way, the servers may be remotely hard-booted.

Cost savings are achieved due to short down-time and less employee involvement. The same Linet system may also control lighting and locking in the location.



Application examples



Building better boats

When the Linnet system controls a boat's interior lighting, the owner can fully configure the system. This is a great advantage as individual demands can be carried out without laborious modifications to the boat's installation.

The same network can be used to collect various information around the boat - water and fuel tanks, engine rooms, rudder, etc. The system may automatically perform pre-defined tasks based on these inputs, or just display them.

Safety systems - like a master switch near the boat exit used to switch off lighting, gas valves, etc. - are another example of added-value functions the Linnet network may perform.

Call buttons in hospitals

Collecting and displaying switch information, such as a nurse call system in hospitals, is another example of the applications the Linnet system is ideally suited for. Fixed wiring is out of date, but network systems besides Linnet would cause high overhead costs and might be a source of unwanted EMI.

About the technology

The innovation is in the signalling

Linet is an innovative local operational network. It has been developed exclusively for interconnection between simple devices, so it is not inherited from data networks and therefore does not include their drawbacks. In fact, the protocol within Linet is not unlike the GSM system. In GSM, all mobile phones connected to the same base station share the same frequency under time division protocol. Similarly, in the Linet system, all nodes share the same resource (twisted pair cable network) under time division, and all information between the nodes is linked by the controller. Linet is a real-time network system with fixed propagation delays, that are non-visible e.g. in lighting applications.

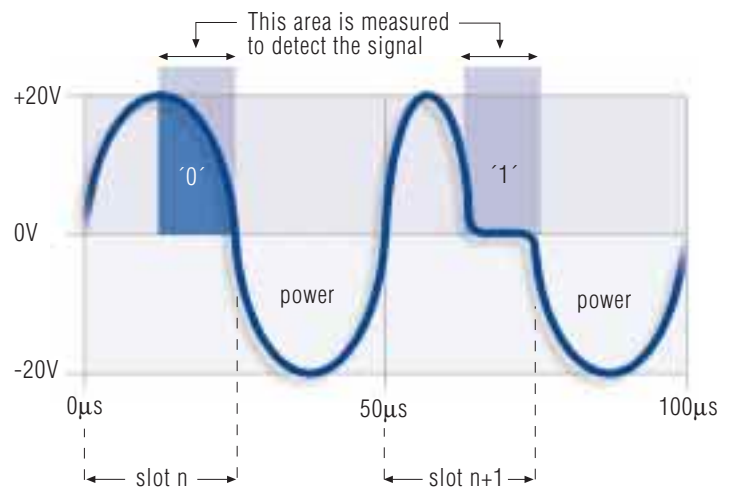
Linet operates on audio frequency (20kHz). All signals are sine-shaped so that radiated noise is almost non-existent. Data and power are distributed to separate half-waves, so that changes in the system's power consumption do not affect its reliability (note that in spite of the polarity of the carrier, the nodes are connected polarity free). Signals are detected by measuring an area from the signal, which provides for excellent reliability as high frequency noise cancels itself out.

The IC node - tiny and smart

The node is the key building block of the Linet network. The node IC includes all control logic and analog network transceiver electronics for (full duplex) bi-directional communication - it receives information as voltage pulses, and simultaneously transmits information as current. An internal power supply generates power to the node and to external circuitry. The node IC also includes the network protocol and interface logic. All this is hard-wired on the node. The node's only programmable parameter is its network address (8 bits) and status word (4 bits). These are automatically written in the node's EEPROM memory when the node is configured.

The node is a mixed-signal integrated circuit consisting of digital, analog and high voltage semiconductor technology. It has been completely innovated and designed by Linet Oy.

The carrier

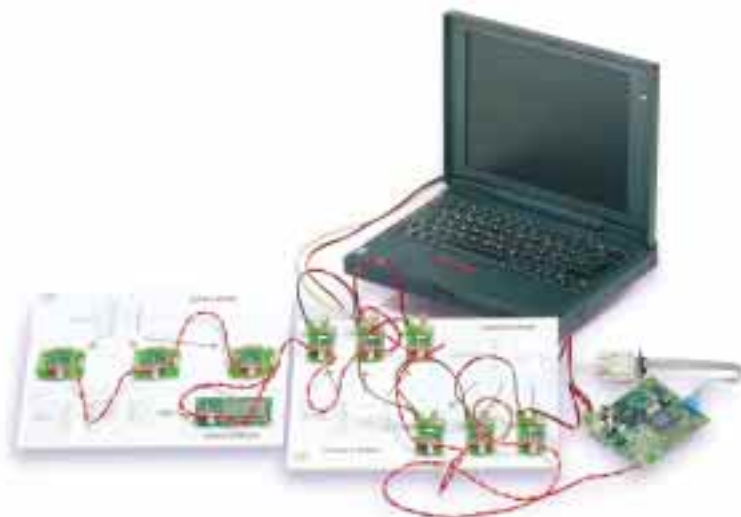


The Linet evaluation kit

The Linet evaluation kit is a demo and test kit for system developers. They can use it to learn about the easy system configuration within Linet and, while developing Linet-based systems, as a testing environment for their designs.

The Linet evaluation kit includes a complete Linet network consisting of the controller, 10 hybrid nodes, and ready-to-use circuit boards illustrating the nodes' functions. With this kit, the user can set up and test all basic functions of the Linet network - switch on/switch off function, PWM output function, internal A/D-converter, and serial data transmission. Users can also connect their own field devices, like limit switches or programmable logic outputs, to the basic network nodes and get instant feedback about Linet network's suitability for their application.

A personal computer is needed to configure the kit. The controller is connected to the PC's serial port and configured using a terminal application. The standard terminal which comes with the PC operating system is used for this. Run-time control instructions can also be fetched using the terminal, or the user may develop host application software to communicate with the Linet network controller.



Linet key features

The network structure

- Single twisted pair cable network.
- Data and node operating power transmitted in the same cable.
- Totally topology and polarity free network.
- No terminating resistors required.
- Max. 200 nodes in each network.

The node

- Ultra low power consumption.
- Limited power supply to external circuitry.
- Polarity-free network connection.
- Integrated switch input/output function.
- Integrated power control output function.
- Integrated serial data input/output function.
- Internal A/D-converter.
- Available as a low-cost IC or a hybrid.
- The IC is based on mixed-signal semiconductor technology.
- The functionality is realised with sequential logic instead of on-chip processor.

The controller

- Stand-alone network power supply and controller.
- Used also as a configuration tool.
- Optionally forms a link to host computers or systems.
- RS232/485 serial interface.
- Extension bus interface.
- Internet interface.
- Other interfaces available from 3rd party companies.

The protocol

- Time division protocol - no collisions.
- Fixed capacity that doesn't depend on system load.
- Fixed propagation delays.
- Low noise system - signalling based on 20kHz sine wave carrier.
- Full-time full-duplex communication.

Benefits for the user

- Complexity hidden from the user.
- Easy system design, network configuration and administration.
- Fast time to market.
- No programming required during application manufacturing, installation or configuration.
- No Linet-specific development tools required.
- Benefits of open systems - no obstacles for multi-vendor installations.

Linet – The Company

Linet Oy is committed to bringing modern network technology within reach of new industrial applications and at new low levels of implementation effort and cost.

We provide the control network technology that is ready for use without major development investments in software or product specifications. We provide low-cost node components making it possible to include networked control system functionality in smaller, high volume products previously outside the scope of local operational networks. These components are available worldwide through our stocking distributors. Up to date information about distribution is available at our web-site, www.linet-network.com.

We at Linet believe that there is a growing number of manufacturers and electrical designers looking for a solution to control simple electrical devices and gather data in industrial applications. Areas of application for Linet technology include home automation, lighting solutions, data collection and control system, and alarm systems, or practically any system with a number of simple devices controlled by a host system.

Linet Oy (Ltd.) was founded in 1995 by a group of electronics designers each having 10 to 30 years of design experience for major international industrial and telecommunications companies.

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The Linet logo consists of the word "Linet" in a bold, black, sans-serif font. Above the letters "i", "n", "e", and "t" are four small blue squares arranged horizontally. The logo is positioned on a white rectangular background that is part of a larger blue design element on the right side of the page.