The Automation Decision -
Choosing the Right Open Network

Your control process is the foundation of your company's success. With this responsibility comes immense pressure – pressure to keep production on target... pressure to make the budget... pressure to provide future production growth without disruption...

With all you have to worry about, wouldn't it be nice if you had an intelligent control system that could reduce downtime by alerting you of potential problems before they happen? An intelligent control system that could inform you of a potential motor drive overload condition or a burnt-out pilot light? An intelligent control system that is affordable and flexible to accommodate your growing control needs? And, of course, an intelligent control system that is the industry's de facto standard – one that allows the interchangeability and interoperability of control devices from hundreds of manufacturers worldwide?

That intelligent control system is here today
DeviceNet is a low-cost intelligent control network that connects a wide range of intelligent devices such as sensors, valve manifolds, bar code readers, actuators and variable frequency drives to PCs and programmable controllers. DeviceNet allows industrial devices to be easily networked and managed remotely.

As an open network standard, DeviceNet is ideal for applications that can benefit from tight integration between devices. Whether your application is machine or cell control, line or plant control, when you choose DeviceNet, you join the growing ranks of users in industries ranging from automotive to semiconductors, material handling to food and beverage, electronics to packaging.

When you choose DeviceNet, you choose the best that today’s technology has to offer, including…

- an open communication standard that assures multi-vendor device interoperability
- fast, easy installation – resulting in space and time savings
- future-ready, for easy additions as your needs expand and change
- improved uptime through intelligent insight into device operations
- efficient bandwidth utilization through producer/consumer communications
- on-the-fly configurations and additions without powering down

DeviceNet provides interchangeability of “like” components from multiple vendors
DeviceNet eliminates hardwiring and its related labor and space
DeviceNet provides power for easy network additions
DeviceNet alerts you to network events so you can act quickly
DeviceNet efficiently uses available bandwidth so important messages always get through
DeviceNet doesn’t stop – even when you’re adding to it
Installation’s a Snap

DeviceNet reduces wiring and associated costs

Gilman, a division of Giddings & Lewis Inc., engineers and manufactures custom assembly systems for the automotive, appliance, commercial and industrial markets. These systems often require assembly and checkout for customer acceptance testing on their factory floor, then disassembly and reassembly at the customer’s location.

DeviceNet’s ease of assembly features are well suited to Gilman’s fast-paced schedule. Power and signal in a single cable eliminates wiring up power supplies to remote areas. Simple plug connectors speed reassembly. And, with DeviceNet, the I/O terminations and junction boxes disappear, eliminating the 25% of installation labor normally associated with wirework. With DeviceNet, terminations are a thing of the past!

“We significantly reduced wiring at our facility by migrating from a hardwired I/O system to DeviceNet,” said Steve Jessup, Maintenance Engineer, Rhode Island Beverage Packaging.

For OEMs, this means that choosing DeviceNet gives them a faster installation, with no specialized labor or hidden start-up costs. For end users, this means having your system up and operational quickly – meeting your commitments and deadlines.

Integration’s a Breeze

DeviceNet’s de facto open communications standard eases integration

The DeviceNet standard allows products from different vendors to communicate because of their common device profile technology. “GM has numerous manufacturing facilities,” said Gary Workman, Development Engineer. “The common device profile technology allows each facility to choose the vendor they are most comfortable with, and still maintain consistency from plant to plant.” Profiles define the parameters, diagnostics, and required features of DeviceNet-compatible products.

Because top control companies manage it, DeviceNet has an agile revision process that allows it to adopt the latest technology quickly. All DeviceNet features are backwards compatible, meaning that DeviceNet products bought three years ago are compatible with DeviceNet products bought today, or even five years in the future. This gives you the confidence to design automation networks knowing that products you pick and choose from the hundreds of worldwide DeviceNet vendors will interoperate now and into the future.
DeviceNet provides insight into operation specifics

DeviceNet is the only communications network that gives you in-depth information on device problems – so you can fix the problem on the first try, every time.

“Our plant has a 24-hour, 365-day operation schedule. This requires a control system that provides early indication of plant problems to reduce down time, as well as the ruggedness to withstand repeated exposure to corrosive chemicals,” said Dominique Alibeckoff, Director of Engineering, at Nylonge, a manufacturer of cellulose sponges in Elyria, Ohio. “No other control system has the ability to report, for instance, when a light bulb filament burns out unless you go through the hassle of putting in control code to test it. With DeviceNet, however, the light socket has intelligence! It is able to monitor itself and can notify you when it is being given power, but not consuming any current.”

Knowing exactly what to fix and where is half the battle in improving uptime. With DeviceNet, you’re immediately aware of unstable conditions. With other systems, when a device is broken or misaligned, the problem could remain undiscovered until it is too late. DeviceNet systems, on the other hand, perform self-diagnostics internally and report the working status of each device over the network – even when a machine is in standby mode. When a fault does occur, the advanced diagnostics can identify the precise location, eliminating the timely process of tracing I/O back to the control panel. Taking precise action helps create higher availability and that means improved production.

Smooth Operation’s Assured

DeviceNet’s flexible and efficient architecture minimizes bandwidth utilization

Two of DeviceNet’s bandwidth saving techniques are change-of-state and cyclic data production. With change-of-state, a device produces data only when it changes. To be sure the consuming devices know that the producer is still alive and active, DeviceNet provides an adjustable, background heartbeat rate. Devices send data whenever there are changes to report or the heartbeat time expires. This serves to keep the connection alive and lets the consumer know that the data source has not faulted in some way. The minimum time on the heartbeat prevents inherently noisy nodes from dominating the network. By having the device generate the heartbeat, the controller is not burdened by having to send a nuisance poll periodically just to make sure the device is still there.

Cyclic data production can reduce unnecessary traffic and packet processing. For example, instead of a temperature or analog input block being scanned dozens of times every second, intelligent DeviceNet devices can report data on a regular, deterministic basis, consistent with the rate of change it can detect. This preserves bandwidth for more rapidly changing critical I/O data and eliminates the need for inefficient polling of a single master device.
“DeviceNet’s quick connect media saves Gilman time!”

Paul Terpstra, Manager, R&D, Gilman

Quick connect media and self-power benefits:
• Fast device connection for ease of assembly
• Eliminates remote power supplies
• Eliminates junction boxes and I/O terminations
• No wire re-work
• No hidden start-up costs

“We significantly reduced wiring at our facility by migrating from a hardwired I/O system to DeviceNet.”

Steve Jessup, Maintenance Engineer, Rhode Island Beverage Packaging

Reduced wiring benefits:
• Shorter installation time
• Fewer physical breakage points
• Lower maintenance costs and less troubleshooting time
• Less documentation
• Lower start-up costs

“In areas that must stay operational at all times, DeviceNet products can be “hotswapped” or exchanged easily without shutting down the lines.”

Jim Georgioff, Director of Maintenance, Teeny Foods

Hot-swap benefits:
• On-the-fly re-configurations
• Reduced line down-time
• Maintenance without scheduling a line stop
• Added flexibility – add or swap devices any time
“DeviceNet lets me remotely monitor my systems, and even program and configure during run-time!”

Jeff Danielson, Lead Electrician, Black Hill Bentonite

Automated operation provides:
• Remote insight into devices
• Remote configuration and re-configuration
• Easy, software-driven monitoring
• Compatibility with existing automated management systems, preserving your investment
• Less down-time through superior information

“DeviceNet’s high performance communication increased my system throughput!”

Jeff Kornetzke, Systems Manager, Planar Standish, Inc.

Communications methods preserve bandwidth:
• Devices produce data only when a change occurs (change-of-state)
• Reporting on regular, deterministic basis reduces unnecessary bandwidth utilization
• Bandwidth preserved for most important communications
• Inefficient polling eliminated
• Fast information flow assures fast problem response

“DeviceNet lets me remotely monitor my systems, and even program and configure during run-time!”

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Advanced diagnostics provide:
• Insight into plant operations for higher availability and improved production
• Early warning of plant problems
• Pinpointed problem diagnostics – even to a light bulb!
• Fast problem turn-around through precise diagnostics
• Root cause identification

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Changes Are As Easy As 1-2-3

DeviceNet supplies power to ease configuration changes and allows on-the-fly configuration and reconfiguration.

DeviceNet’s two twisted pairs provide 24Vdc power and signal, unlike other networks that only supply the signal. DeviceNet allows end users to configure online, and to add a device or a machine to a production line without powering down the network. Devices can be configured over the network while the network is operating (on-the-fly).

Jeff Kornetzke, Systems Manager, of Planar Standish, Inc. the largest manufacturer of custom and standard LCDs and LCD modules in North America, adds, “In areas that must stay operational at all times DeviceNet products can be ‘hot-swapped’ or exchanged easily without shutting down the line.” By providing power, DeviceNet eliminates the need to pull extra wire, wait for an electrician to be available, or place power supplies in hard-to-reach places.

And programming for configurations and reconfigurations is as easy as 1-2-3!

1. Configure the device address.
2. Plug in devices to tap ports.
3. Follow the software’s point and click instructions for specific configurations.

In addition, many DeviceNet vendors offer software for automating configuration as well as other remote management tasks. And, of course, DeviceNet works with your favorite manufacturing management software package, preserving your investment in solutions you’ve already installed. You will find that, with DeviceNet, you’re allowed as little or as much software control of your operation as you want!

Semiconductor Producers Choose DeviceNet

Time is money

The demand for semiconductors is exploding. Huge capital expenditures for new 300 mm fab tools can produce three to five times as many chips per hour, but the new tools take six to eight months of exhausting trial-and-error to bring online.

DeviceNet compresses the start-up and commissioning time with on-the-fly reconfiguration, hot swapping of devices, and the industry’s most insightful diagnostics. All of these features allow companies like Applied Materials, Brooks Automation, Watkins-Johnson, and Gasonics to shorten the process of bringing higher capacity chip-making tools online, resulting in DeviceNet being chosen by the majority of all manufacturers (Venture Development Corporation).
HELPFUL QUESTIONS TO ASK WHEN CHOOSING AN OPEN NETWORK

How do you compare open network performance?

Performance of an open network should be based on the following criteria: baud rate, control architecture, and communication model.

Baud rate will tell you how fast data can travel from one node to another. However, baud rate will not tell you the efficiency of that data transfer. The baud rate measurement can be compared to an automobile speedometer. The automobile speedometer will inform you how fast the automobile can go when there is little or no traffic on the road. In reality, however, there is always traffic when traveling from one point to another.

With the exception of DeviceNet, most open networks do not allow you to control this traffic. How can you control traffic? Through the use of change-of-state and cyclic interval messaging that can only be provided by a flexible control architecture and through the use of the producer/consumer model (the modern communication model).

Why scan each I/O device in a constant cycle and create an abundance of unnecessary traffic when a device can send the controller a message every time its I/O data changes (change-of-state)? Or why not have the device report its own data (cyclic production) instead of wasting bandwidth with a master request and slave response? Why send a message to each node individually (source/destination model) when you can send a message to all nodes simultaneously so all nodes that want the message can consume it at the same time (producer/consumer)? Network performance is a function of data speed (baud rate) and network efficiency (control architecture and communication model).

How do you compare the available diagnostics of one open network to another?

Most of the open network technical overviews will explain their diagnostic capabilities...if they have any. The best way to know if a network has advanced diagnostics is to view customer application examples that explain their use of the diagnostics or speak directly to users of a particular open network. Organizations such as the Open DeviceNet Vendor Association (ODVA) can provide you with application notes and customer references. Remember, diagnostics that negatively impact I/O performance are of little value.

Should you install a prototype network before making a final decision?

Yes. This is the only way you will know if an open network performs as the sales literature suggests. Many vendors offering open network solutions also offer open network evaluation toolkits which contain I/O, cables, software, and a controller inexpensively so you can afford to evaluate that open network.
There are many reasons why you should make the DeviceNet choice – the intelligent choice – when choosing an automation system. One of the most important is the strength of industry support behind DeviceNet. Every day, the hundreds of companies globally that belong to the Open DeviceNet Vendor Association (ODVA) are hard at work providing the latest in automation technology to DeviceNet users. The combined strength of all the ODVA Members assures that the DeviceNet solution is, indeed, a solid, intelligent choice now and into the future, and that numerous devices will be available for you to choose from.

ODVA is an independent organization that manages the DeviceNet Specification and supports the worldwide growth of DeviceNet. ODVA also works with vendors by providing developer training, test software to assist developers, conformance testing services and marketing activities. ODVA publishes the DeviceNet product catalog and supports vendor Special Interest Groups in developing Device Profiles for specific classes of products.

In addition, ODVA offers end users three superior benefits:

1) Free technical support from DeviceNet specialists (Dr. DeviceNet) and downloadable files on the web,

2) Development tools and configuration software for quick start-up, and

3) A wide selection of interoperable products that you can draw upon for best-in-class solutions.

Join the many companies who have made the intelligent choice of DeviceNet as their automation communications solution. An intelligent solution that saves time, improves production, and reduces the pressures of your job by providing you the most in-depth information on your operations.

Call your DeviceNet sales rep today for more information on the intelligent choice for device level control.

For more information on DeviceNet, visit ODVA’s web site at www.odva.org.
# DEVICENET SPECIFICATIONS

## PERFORMANCE

<table>
<thead>
<tr>
<th>Communication System</th>
<th>Producer/Consumer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Architectures</td>
<td>Strobe I/O, Polled I/O, Change of State I/O, or Cyclic Interval I/O</td>
</tr>
<tr>
<td>Speed Example</td>
<td>Below one millisecond for eight closed loop controllers</td>
</tr>
<tr>
<td>Maximum Network Length and Bus Speed</td>
<td></td>
</tr>
<tr>
<td>Baud Rate</td>
<td>Distance</td>
</tr>
<tr>
<td>125 Kbps</td>
<td>500 meters (1,640 ft)</td>
</tr>
<tr>
<td>250 Kbps</td>
<td>250 meters (820 ft)</td>
</tr>
<tr>
<td>500 Kbps</td>
<td>100 meters (328 ft)</td>
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</tbody>
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## PHYSICAL LAYER

| Bus Topology | Linear (trunkline/dropline); power and signal on the same network cable |
| Media | 1 twisted-pair for power, 1 shield twisted pair for signal in a single shielded cable |
| Device Power | 24 VDC, Network is rated at 8 Amp |
| Number of Nodes | Up to 64 |

## DATA LINK LAYER

| Standard Used | CAN (ISO 11898) |
| Media Access Method | Multi-cast messaging, all nodes receive all messages (producer/consumer) |
| Size of Data Packet | Variable, 0-8 Bytes. Larger messages are sent as many 8 data bytes packets. |

## APPLICATION LAYER

| Device Profiles | Standard profiles available from ODVA specification. Users can expand functionality beyond standard profile definitions. |
| Messaging Types | I/O messaging master/slave, I/O messaging peer-to-peer, explicit messaging |

## OTHER

| Governing Body | Open DeviceNet Vendor Association (ODVA) |
| DeviceNet Protocol Specifications | Available from the ODVA in paper or CD-ROM version, in English or Japanese |
| Chip Cost | CAN chips are inexpensive and available as standard products from Motorola, NEC, Philips, Siemens, Intel, and Hitachi |
| DeviceNet Training | Contact the ODVA |

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