

# Borland®

## Borland® Delphi™ at NEC

*“The NFAS/48 system will give us true 24x365 operating capacity. We’ll see regular savings by eliminating production slow-downs and interruptions, and the whole cost of building the system will be recouped by being able to continue full factory operation during a single two-day mainframe maintenance shutdown. On top of that, building the system in Delphi™ was fun, not drudgery.”*

—Roger G. Aylstock,  
Programming Section Manager  
MIS Department, NEC Electronics Inc.

# NEC

### NEC Electronics Inc., USA

NEC Corporation is a leading international supplier of electronic products. Their manufacturing plant operates 24x365 on a mainframe factory-automation system, pausing only for a semiannual 48-hour maintenance shutdown. NEC management wanted to create (and eventually replace) a backup system that could seamlessly assume control during any shutdowns or system failures.

NEC chose Borland® Delphi™ to build this critical application, providing the most appropriate and reliable solution to meet company needs.

### Application Overview

- The automated manufacturing process is controlled by a mission-critical production control system written in COBOL and residing on an NEC mainframe. Shutting down twice a year for software and hardware maintenance meant all factory operations had to stop.
- The system is controlled using extremely complex and highly interrelated semiconductor industry-standard messages. Any message missed by the control system can spoil an entire production lot—a very costly occurrence. The production system is mandated to have 100% availability, and a factory message can never be lost without great consequence.
- NEC needed to avoid costly system shutdowns and failures by implementing a backup system that could automatically assume production control whenever the mainframe falters or fails.

### Results

- Using Borland® Delphi™, NEC developers were able to build a fully redundant Non-Stop Factory Automation System.
- Delphi visual rapid application development and component reuse capabilities made building the system easy and fast, enabling 9 developers to build the NFAS/48 system in 10 months.
- Backing up the mainframe production system, NFAS/48 eliminates the high costs of production slowdowns and interruptions.
- The application’s entire cost will be recouped during the first mainframe maintenance shutdown.

# Delphi™

# case study

## The NEC Situation

The NEC Electronics Inc. plant in Roseville, CA, is one of the largest state-of-the-art semiconductor manufacturing facilities in the world. The factory specializes in memory and custom electronic devices. The automated silicon-wafer manufacturing process is controlled by a mission-critical production control system written in COBOL residing on an NEC mainframe. The factory operates 24 hours a day, seven days a week. At least twice a year, the mainframe system must be shut down for 48 hours for hardware and software maintenance. All factory operations stop during these shutdowns.

The automated production system is controlled using semiconductor industry-standard messages. When a machine sends a "ready to start" message, the mainframe control unit checks whether all required conditions are in place and, if so, issues a "start" message. When the operation is complete, the machine sends a "finished" message, along with a set of process measurements, which are stored in the database. The process repeats continuously. Similar sequences control other factory processes. The processes are extremely complex and highly interrelated, to the extent that any message missed by the control system can spoil an entire production lot of silicon wafers—a very costly occurrence. The production system is mandated to have 100% availability, and a factory message can never be lost.

Management wanted to create a client/server production backup system that could seamlessly assume the automated control operation during scheduled semi-annual mainframe maintenance. The backup system would also operate continuously during the rest of the year, and it would automatically assume factory control during a mainframe slowdown or failure, averting expensive production interruptions. Choosing Delphi to build the parallel system, NEC's developers explored various approaches that could provide the redundancy required for backend services, databases, and infrastructure components to meet the availability and reliability requirements.

Technology	
Application	Non-Stop Factory Automation System (NFAS/48)
Tool	Delphi™ Client/Server
Other Tools Evaluated	Paradox®, PowerBuilder® Oracle® Developer 2000 Gupta SQL Windows,
Database Server	Oracle
Number of Users	300-400 Machines
Team Size	9 developers
Development Time	10 months

# Borland®

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## The Borland Solution

While most client/server applications are built on a routine request/reply model, NEC's developers concluded that they could meet the NFAS/48 system redundancy requirements by employing a novel new publish/subscribe methodology.

In the request/reply model, the GUI sends a request for information and the database or other agent returns a reply. In the publish/subscribe model, each side "subscribes" to messages of the types it wishes to receive and at the same time "publishes" requests for specific messages when it needs them. For example, when a machine is ready to begin an operation, it publishes a request for a "start" response. All the online front-end controllers that subscribe to start requests run simultaneously start-checks and, if conditions are met, publish start messages. Because the waiting machine has subscribed to receive start messages, it executes the first response it receives and disregards redundant messages that follow.

Delphi was used to develop both the GUI controller front-ends and the services that link factory machines to the database. The publish/subscribe methodology enabled developers to build NFAS/48 with no single point of failure. Not only does the system stand in for the mainframe during planned maintenance shutdowns, but since it runs in the background all the time, it is a backup against mainframe slowdowns or failures such as a disk-drive crash. If a production machine does not receive a mainframe response within a prescribed time, NFAS/48 steps in to provide one. If the mainframe fails completely, the system seamlessly assumes the load. To provide the required redundancy, NFAS/48 includes multiple databases with multiple services running on different servers at different locations. One of the databases can be brought down for changes while the others continue to run.

The Delphi object-oriented design and Rapid Application Development (RAD) capability made building the system easy and fast. Developers built class diagrams, and then implemented them in Delphi. Nine developers completed the system in ten months. Reusing objects and creating new ones on the fly helped speed system development, and a native Oracle® driver optimizes database access. Adding or removing GUI services as needed allows efficient dynamic load-balancing.

**NEC Electronics Inc.'s Roseville plant produces a couple of thousand silicon wafers every day. The entire cost of building the client/server non-stop production control system will be earned back the first time it is used to replace the mainframe for a maintenance shutdown.**



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