THE CIM SOLUTION

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INTRODUCTION

In today's business environment, failure to respond to changing and tougher competition for world markets can mean the permanent failure of a business or even an entire industry. Corporations are increasingly turning to their manufacturing managers to improve profits, product quality and costs to help stay competitive.

These objectives lead manufacturing managers to seek solutions with quality programs, productivity improvements and flexible manufacturing. Perceptive managers realize that information is the key to making these changes, and that CIM (computer integrated manufacturing) is the key to the productive utilization of information resources.

The benefits of CIM can be summarized as follows:

-- higher quality -- CIM means reduced scrap and rework, lower warranty costs and higher customer satisfaction.

-- increased productivity -- With improved resource utilization, reduced cycle times and lower overhead, productivity improves.

-- greater flexibility -- CIM translates into lower inventories, faster response to market demand and less time to get products to market.

In short, CIM means lower manufacturing costs, higher profit margins and better positioning for growth -- a healthier bottom line.

Among the specific applications that deliver these benefits are:

quality -- Quality Decision Management (QDM) from HP;

(RQM) from

Automated Technology Associates.

productivity -- HP's Maintenance Management Package (MMP);

Materials Management (MM) and Production

Management (PM)

Dispatcher from Logisticon.

flexibility -- MM and PM from HP;

Monitrol from Hillco;

StarNet from Denniston and Denniston;

AIM from Billes and Associates;

HP's Just-In-Time software.

As today's manufacturers develop and implement their CIM plans, computer networks, and the information they manage and deliver, are increasingly important.

This paper provides an overview of Hewlett-Packard's CIM Networking Solution. The CIM solution is based on HP AdvanceNet, HP's overall networking strategy, which delivers flexible, scalable solutions and embodies a strong commitment to standards-based networking. Any successful CIM implementation requires an efficient information network as the communications foundation upon which the solution is based.

CIM ACTIVITIES AND ENVIRONMENTS

A discussion of networks begins with a look at basic business and environmental factors. The primary activities that go on in businesses today include administration, planning and control; manufacturing; marketing and sales; engineering; and facilities administration. The activities performed in a given area establish the information needs of that area, and information needs help determine the most appropriate networking technology.

Since networks operate over physical media (at least within buildings), the physical environment will also have an important effect on the choice of networking technology. Office settings tend to be clean, quiet, and include phones on every desk. Computer centers are custom environments designed for computers from the outset, while factory production areas are typically noisy, dirty and can be quite large. Unlike the office, production areas tend to have few phones.

ISLANDS OF AUTOMATION

One of the key problems manufacturing managers face today are the "islands of automation" that exist on their factory floors. These islands are the result of the efforts of many manufacturers to streamline different parts of the manufacturing process. Frequently, each automated process has been designed and engineered without much thought of integrating it with other processes.

Many companies are starting to see the benefits of integrating their information sources, but are having problems communicating with a wide range of "automation islands." Advanced manufacturing companies are looking to information automation as the key to moving beyond "islands of automation" toward an integrated automation environment.

Networks can often make important contributions to control and integration of the physical automation process. Islands of automation merge as individual processes are refined to match the needs of upstream and downstream processes. This merging creates the need for "real-time" communication from machine-to-machine or control point-to-control point.

As the whole process becomes further automated, a network enables information to flow fast enough to permit real-time corrections that can either prevent errors before they happen or spot them fast enough to correct them at minimal cost.

Unfortunately, the manager who recognizes the potential of information-handling networks often encounters a horrible sight just beyond the horizon. At HP, we call this the "CIM Barrier."

THE CIM BARRIER

It's sad but true: the manufacturing manager who wants to improve effectiveness through CIM is often held back by the limitations of poor or non-existent wiring systems and the lack of multivendor compatibility that have characterized the past.

There are several key problems with the traditional approach to using computers in manufacturing. These are:

--sparse connectivity with point-to-point connections to large, inflexible systems in the computer center;

--slow information flow via paper;

--lack of communication among the computers of different vendors;

--low networking expertise in manufacturing companies;

--no systematic approach to wiring.

Collectively these problems make up the CIM Barrier. HP's CIM Networking Solution is designed to enable manufacturers to break through this barrier. The solution is divided into several modules, each of which addresses a particular communications problem. In addition, the HP AdvanceNet solution enables manufacturers to implement their networks in affordable, manageable stages.

CIM NETWORKING MODULES

The modules that comprise the CIM networking solution reflect the hierarchical structure typical of manufacturing sites. This structure starts at the level of shopfloor devices, and moves up to cell controllers, area managers, plant hosts and corporate hosts. Establishing effective communications among the levels of this hierarchy is addressed specifically in the Plant Area Management Module, but such communications can also be seen as the overall goal of CIM.

HP SiteWire Module

Within a manufacturing facility, two kinds of networks are generally found: the site backbone network and subnetworks. The backbone is a common communications channel that connects different workgroups throughout a facility. Subnetworks provide the specific functionalities needed in offices, engineering departments and production areas.

HP SiteWire is the name of the HP AdvanceNet communications wiring infrastructure. CIM networks requires a plant-wide communications backbone to connect people with information; subnetworks need easy access to the backbone from anywhere in the plant. In addition, the backbone network should be able to accommodate moves and changes easily.

The two HP SiteWire backbone options are based on industry standards. The primary and most versatile backbone option is based on the IEEE 802.7 broadband standard. It allows multiple information channels of voice, video and data. It also lets users mix terminals, point-to-point links, LANs and more on a single cable, and it supports an important new industry standard: the Manufacturing Automation Protocol (MAP).

IEEE 802.3 baseband is the second alternative, better suited to less complex situations that don't require video, voice or specialized data services.

End User Workgroup and Access Module

HP AdvanceNet offers a wide range of end-user solutions to enhance local departmental productivity while providing access to information throughout the plant. Options provide for multivendor terminal clusters and the latest in industry-standard LANs. Each option focuses on a specific area of the plant: planning and control, production engineering and the shop floor.

Thanks to terminal cluster solutions, a common problem of the past -- connecting terminals to the systems of different vendors -- isn't a problem of the present. Hewlett-Packard has entered into a special marketing agreement with Ungermann-Bass, the leading independent vendor of terminal servers, in order to provide this capability for its customers. The UB terminal servers operate over both broadband and baseband, and handle systems and terminals from a wide variety of vendors.

A planning and control staff can enjoy greater productivity and effectiveness using industry-standard StarLAN to connect PCs with information systems over low-cost twisted pair. HP StarLAN subnetworks can connect to either CIM backbone; to allow for connection to the broadband backbone, HP has extended its agreement with Ungermann-Bass to include the UB Buffered Repeater. Connecting the HP StarLAN Bridge to the UB Buffered Repeater connects a planning and control HP StarLAN subnet to a broadband backbone.

For production engineering, industry-standard IEEE 802.3 with ARPA and Berkeley networking services connects UNIX workstations. Production engineers can thus share files and peripherals, access mainframe resources and product design groups. Those capabilities can mean getting products to market faster -- a key benefit of CIM.

In the future, X-Windows will become increasingly important for standard graphics, multi-user and multi-application access. It will run on bit-mapped workstations, and,

because of its greater flexibility, will accelerate the replacement of terminals by PCs and UNIX engineering workstations. This will increase the use of LANs, replacing terminal servers.

Production Workcell Module

A key step toward CIM is establishing effective islands of automation. Clearly, CIM is easier to achieve if these islands are designed to communicate with the rest of the plant from the beginning.

There are two major concerns in building effective workcells. The first, and generally the one that receives the most attention, is connecting the cell controller to the shop floor devices that perform the work. The second concerns the linking of workcells together in groups or areas.

HP computers commonly used as cell controllers are the HP 1000, 9000/200 and 300, and the Vectra PC. Which machine is best is a function of cell complexity, real-time needs, programming expertise and interface flexibility.

By far the most common interface to shop floor devices is EIA RS-232. Each HP computer used in cell control provides basic link level interfaces to this important standard. While not as common as RS-232, IEEE 488 (HP-IB) is more important in certain kinds of cells, such as product test and data acquisition workcells.

Once a group of workcells has been set up, users often connect the cells and establish an "area management" function. Area management is implemented to collect data from cells, store and control cell software releases, manage program maintenance and development, and to provide shared resources (discs and printers). Workcell clusters can be created in several ways: by a local subnet that links the cells with a locally owned and operated area manager, or by connecting the cells to a plant-wide backbone to access area management resources in another department or plant data center. HP AdvanceNet offers both options.

While the HP 1000 is an important cell controller today, the future of HP cell controllers is in UNIX systems. When coupled with X-Windows and low-cost PCs, UNIX will offer a powerful range of cell control solutions.

As MAP becomes increasingly well established, a low-cost link for subnets, called carrierband, will link clusters of cell controllers. Cell controllers, the equipment they control and area manager systems will be connected via this low-cost MAP subnet and gain backbone access via a carrierband-to-broadband bridge.

Computer Center Module

Getting more from a data center is easy with IEEE 802.3 ThinLAN subnets for HP and DEC equipment and SNA products for connecting to IBM and compatible mainframes. The HP ThinLAN Hub connects HP 3000s via ThinLAN coax. In addition, HP Network Services provides the capabilities to improve information access, reap the rewards of resource sharing, improve utilization of processors and communicate with other HP systems around the plant.

The future will bring more OSI/ISO networking in the form of direct MAP connections to the backbone or a subnet using TOP (Technical Office Protocol) connected via a bridge. We also expect that UNIX will begin to play a role in data center computing for off-line area management and, evenutally, more traditional applications.

Plant Area Management Module

This is the heart of HP's CIM solution. The major benefit of CIM is information access and integration, and HP AdvanceNet provides it plant-wide and among multiple vendors.

For industry-standard multivendor networking, MAP is available on some HP computer systems now, and will be on all of HP's factory systems in the future. For multivendor applications in production engineering, and for links to product design, HP offers

industry-standard ARPA and Berkeley networking services for all our UNIX workstations and systems. While the ARPA/BSD services will remain important for some time, TOP will become increasingly important, integrating production and design easily into the MAP manufacturing.

Company-Wide Access Module

Here's the module that keeps a manufacturing plant in touch with the outside world. When it's important to communicate with headquarters, suppliers or customers, the alternatives within this module offer different options for doing so. In addition, HP AdvanceNet provides worldwide electronic mail, even if a customer has an SNA company-wide backbone network.

The future again includes OSI/ISO, specifically the X.400 Message Handling Services (MHS). MHS will help provide a standard foundation for Electronic Data Interchange (EDI) for connecting the factory directly to suppliers and customers.

CONCLUSION

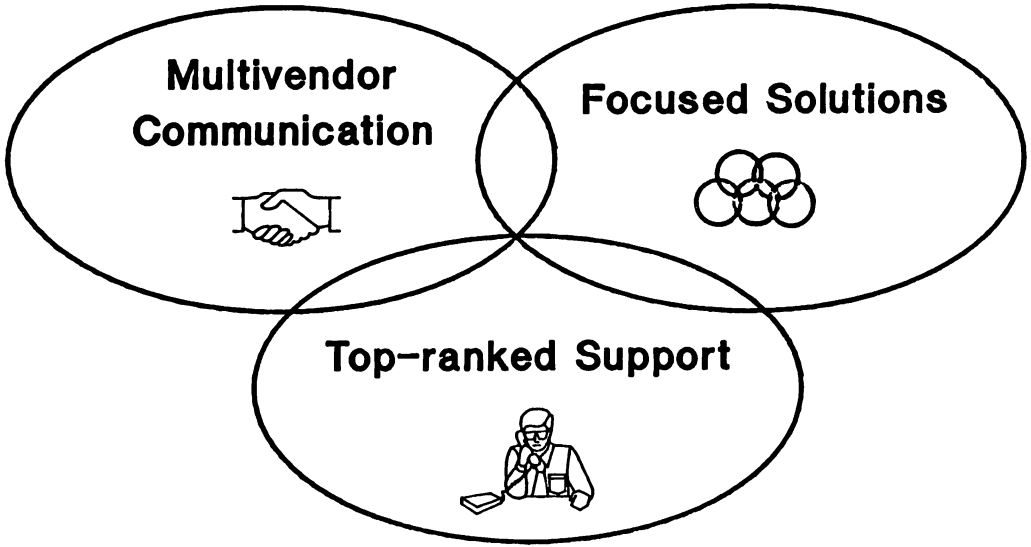
HP's CIM networking solution is divided into modules, each of which addresses a specific aspect of the manufacturing process. But it is important to note that the overall CIM solution is created by the integration of these modules. This modular structure enables users to implement their CIM solutions in manageable, affordable stages, at the rate that is ideal for them.

In the future, UNIX and DOS, linked with MAP and TOP, will become the dominant operating systems in HP's CIM solution.

CIM is an evolving technology that has the potential to deliver dramatic improvements in manufacturing productivity and efficiency. HP has the networking experience and expertise users need to put this technology to work for them.

HP AdvanceNet

A *Strategy* for Integrated Networked Solutions



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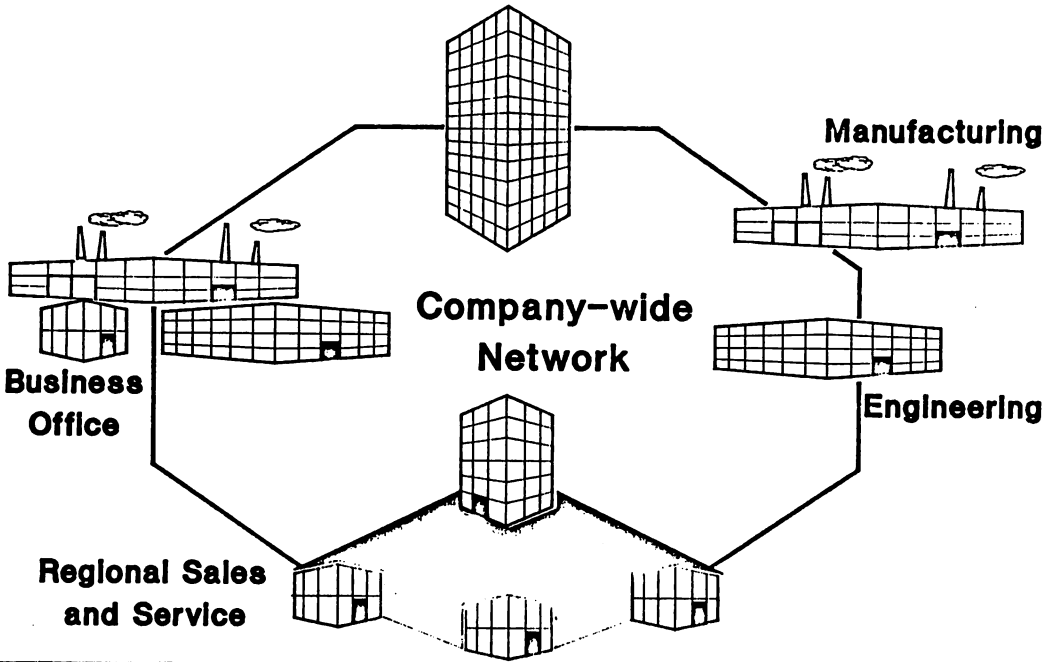
HP AdvanceNet: 5 Networking Solutions



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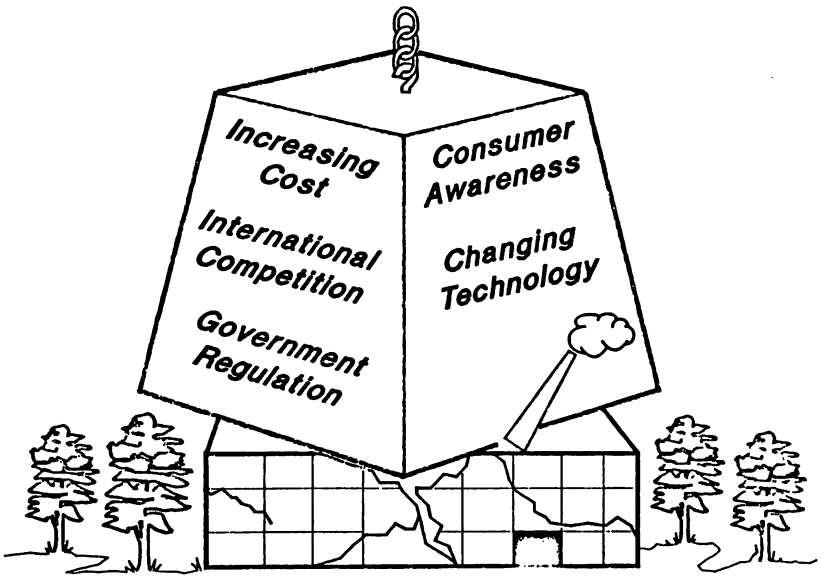
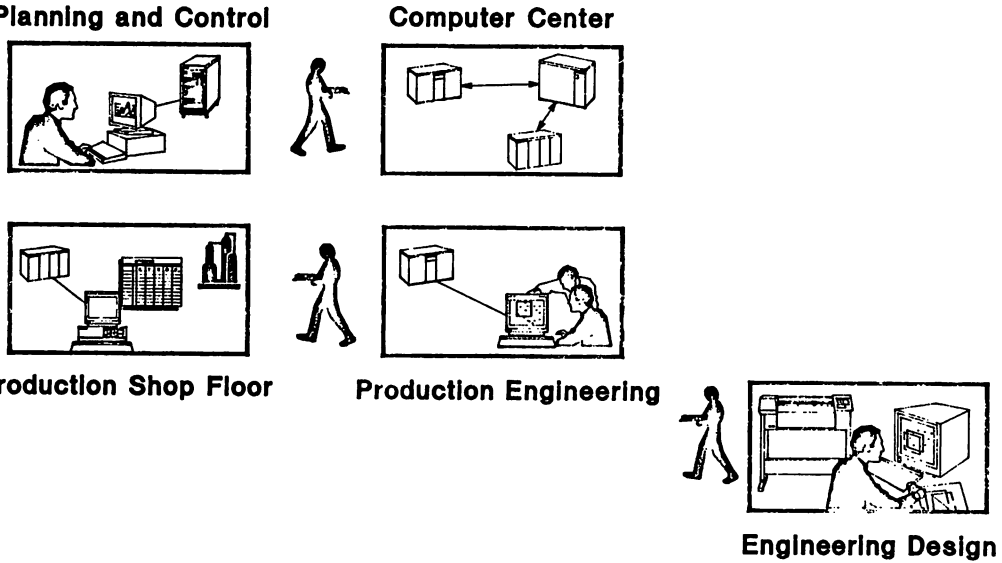
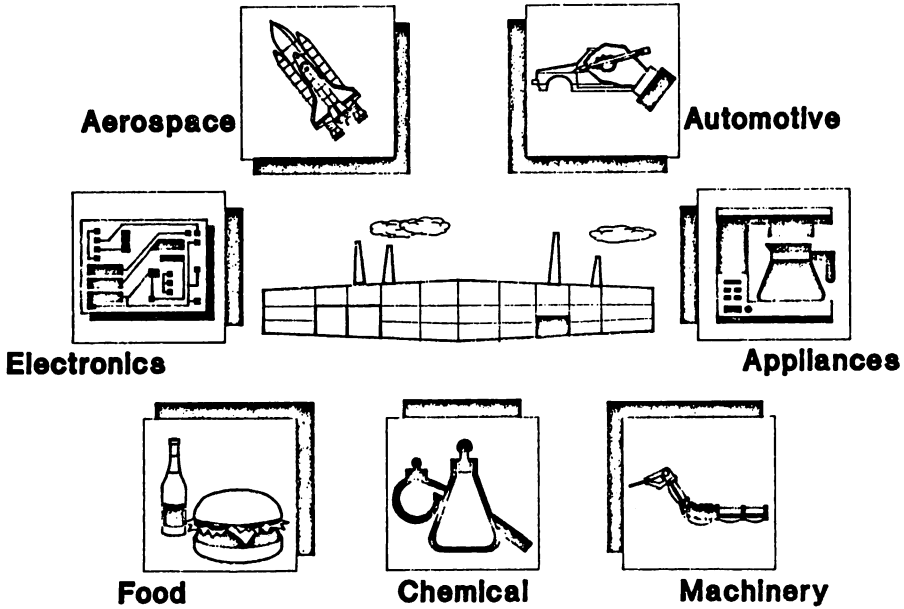
Increasing Pressure On Manufacturing Profitability

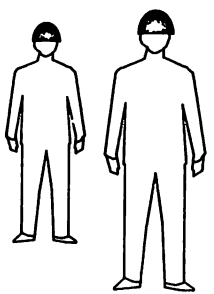


The Manufacturing Environment

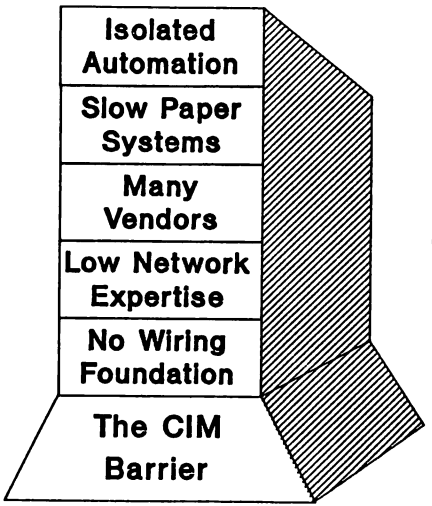


HP AdvanceNet in Manufacturing



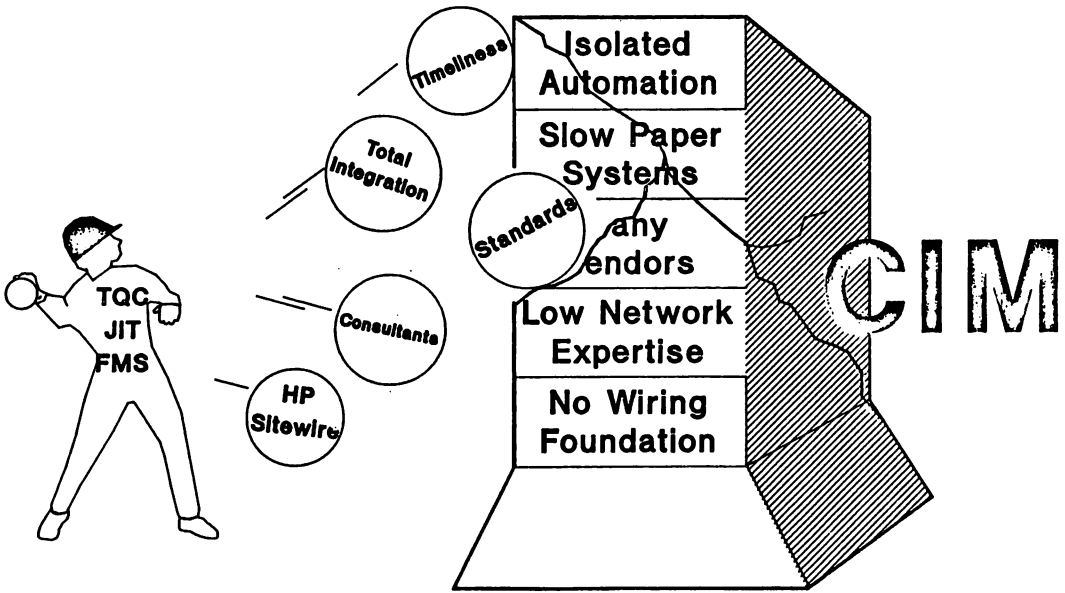


Manufacturing
Plant Manager
& MIS Manager

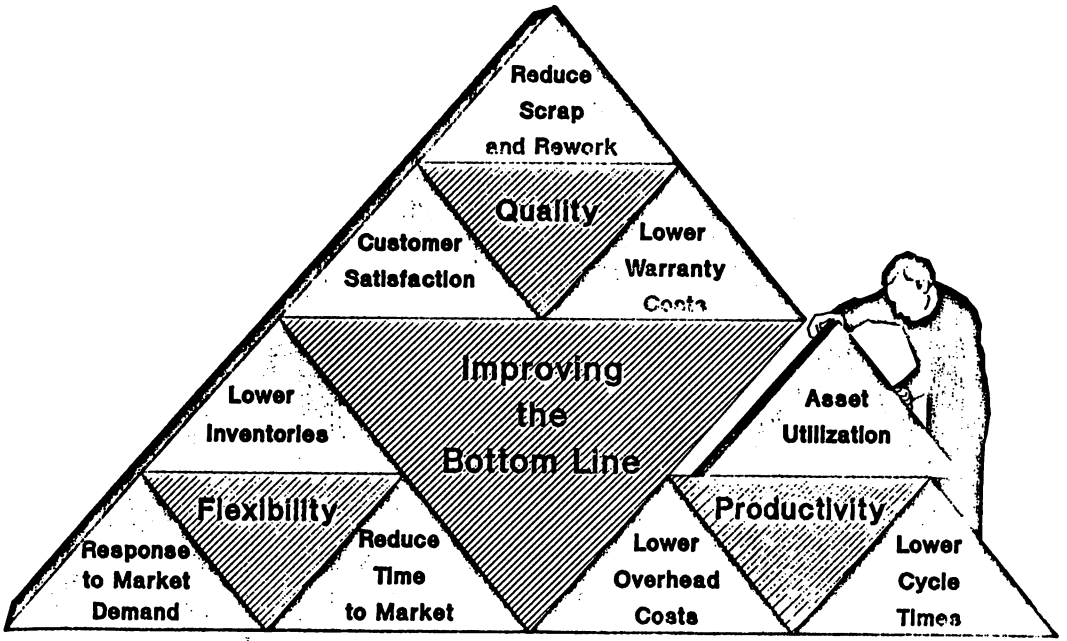


CIM

Breaking the CIM Barrier



CIM: Putting It All Together



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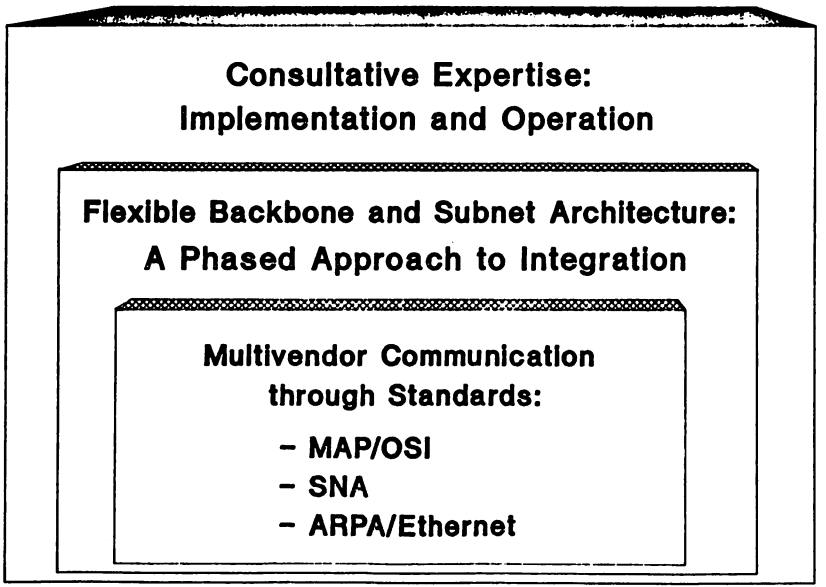
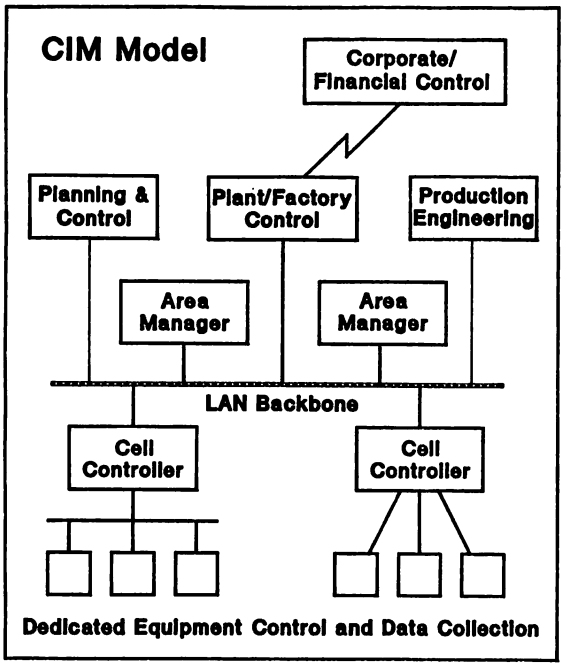
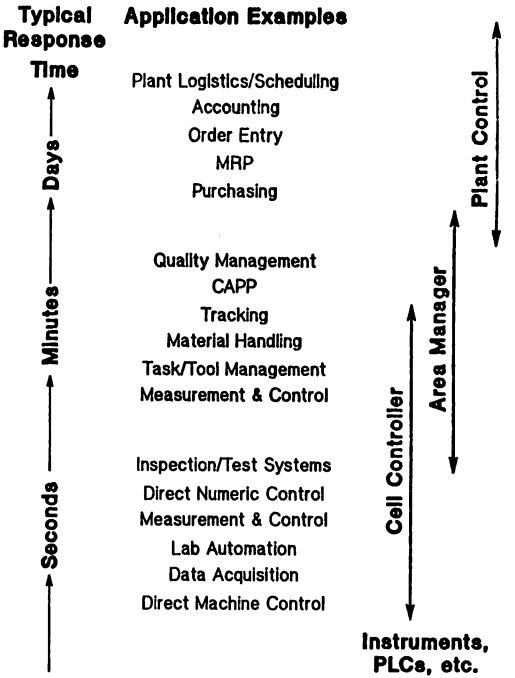
CIM Networking Strategy

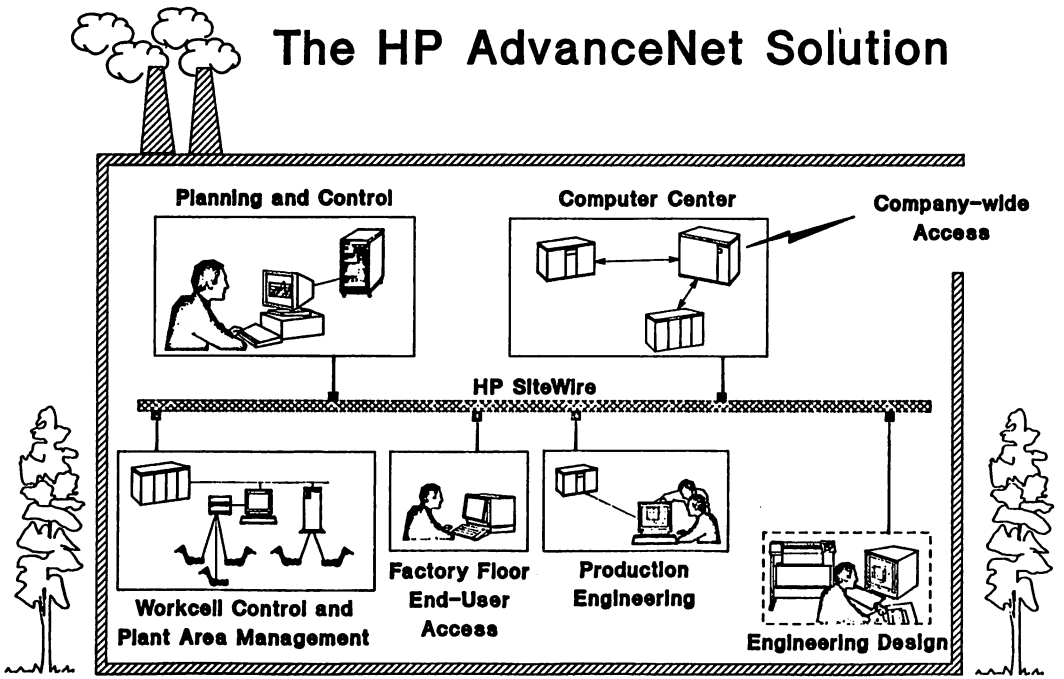


An Architecture for Success





The HP AdvanceNet Solution



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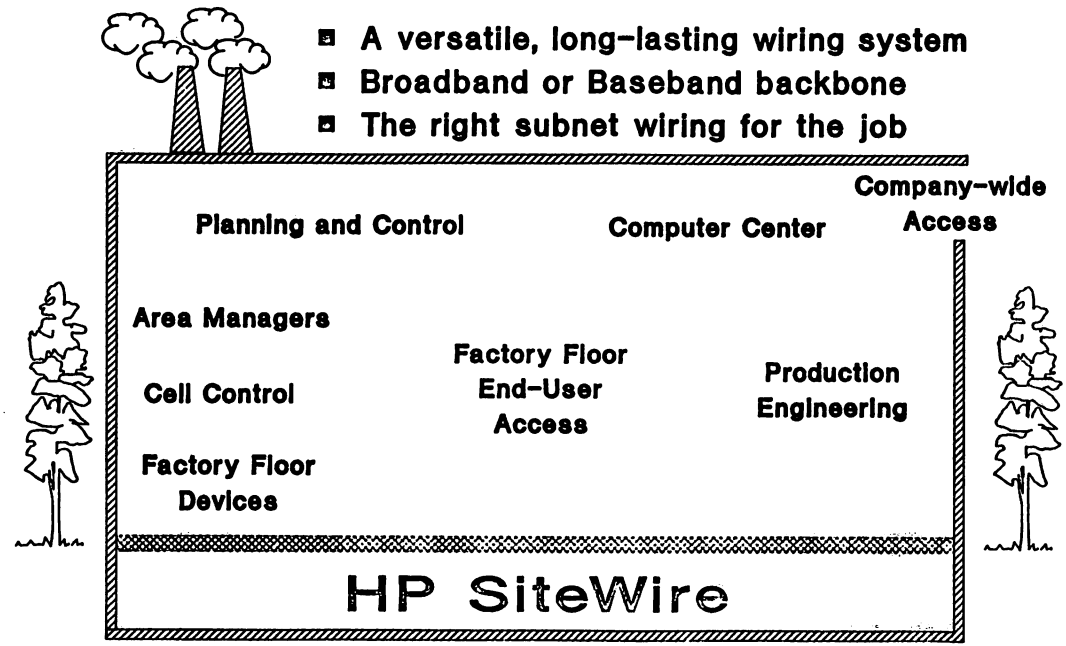
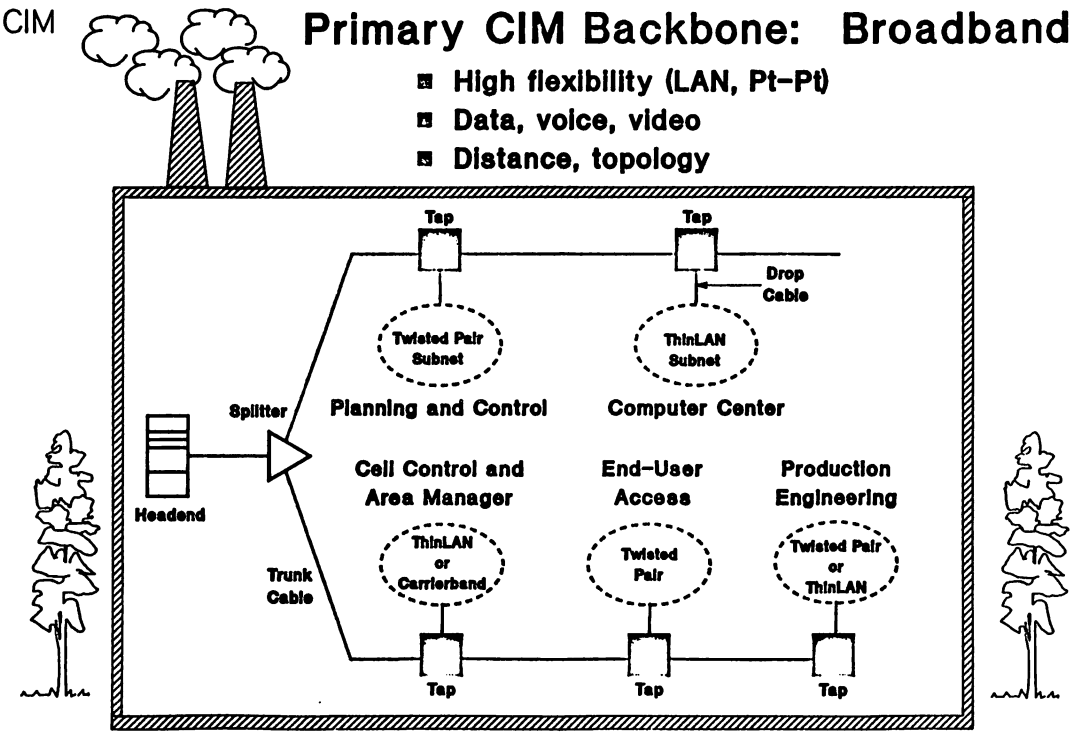
HP SiteWire: The CIM Network Foundation

- A versatile, long-lasting wiring system
- Broadband or Baseband backbone
- The right subnet wiring for the job



Primary CIM Backbone: Broadband

- High flexibility (LAN, Pt-Pt)
- Data, voice, video
- Distance, topology



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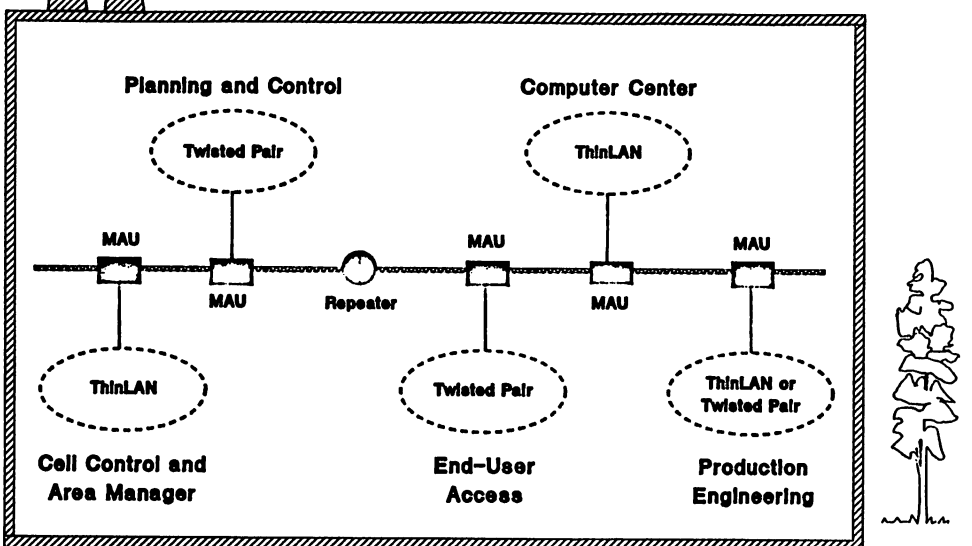
CIM

Alternate CIM Backbone: Baseband

- Lower cost for small plants
- Data only, less flexibility



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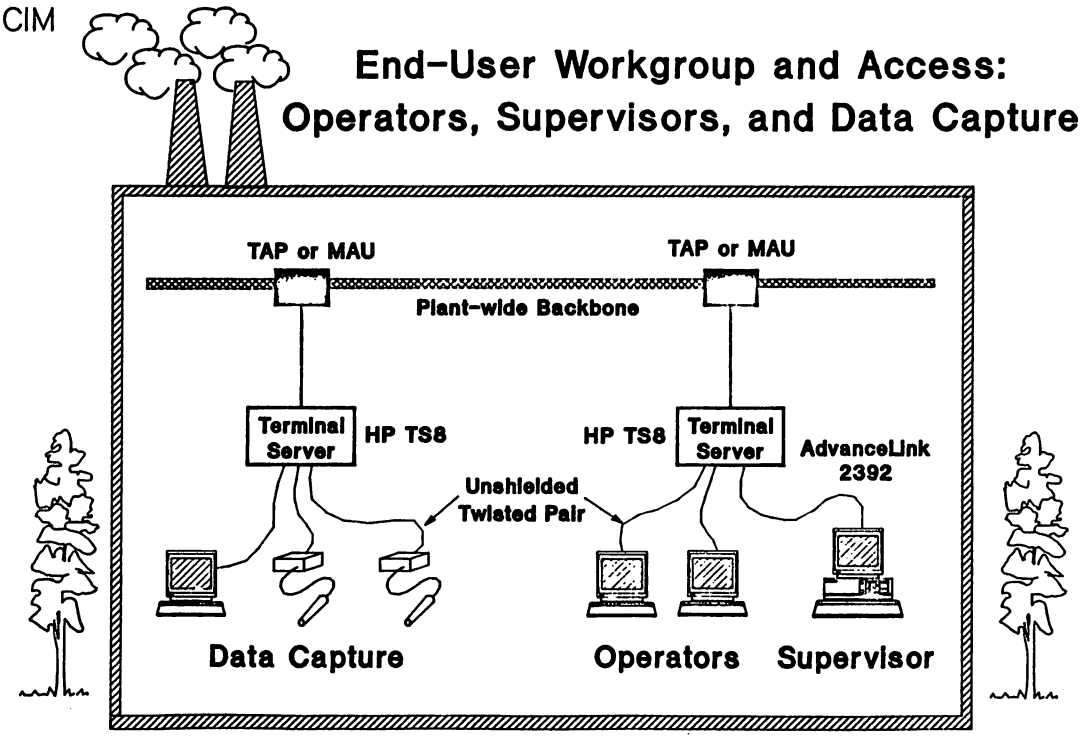
End-User Workgroup and Access: Operators, Supervisors, and Data Capture



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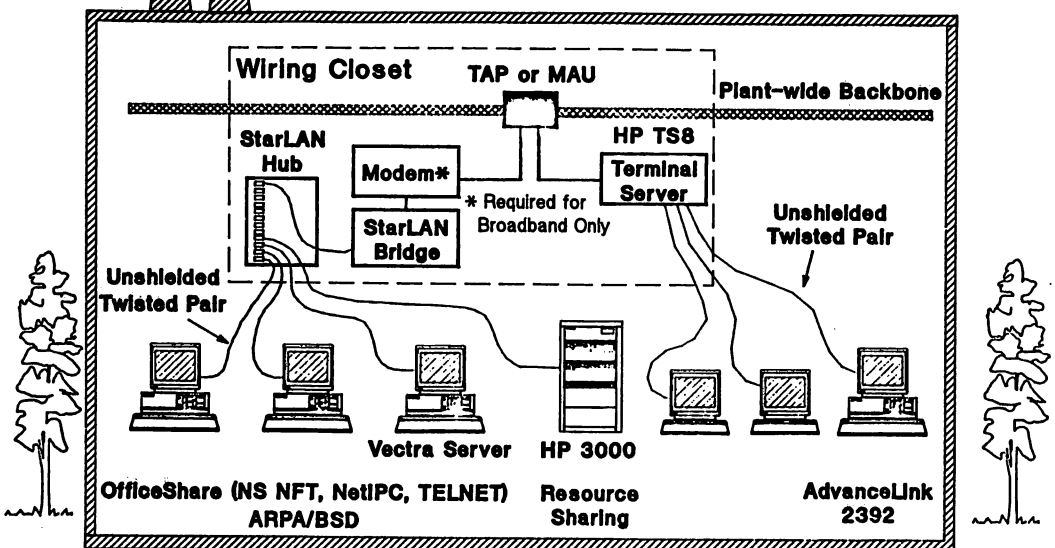
CIM

Planning and Control Subnet

- Uniform unshielded twisted pair wiring
- Easy transition from terminals/RS-232 to LAN



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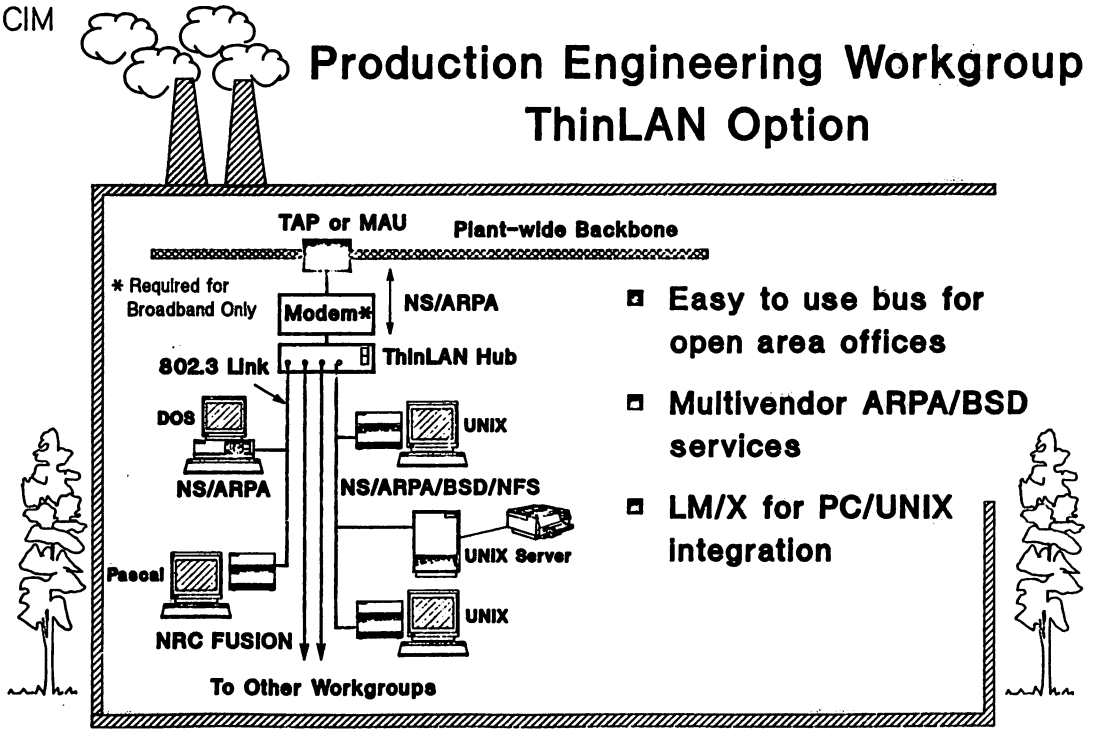
CIM

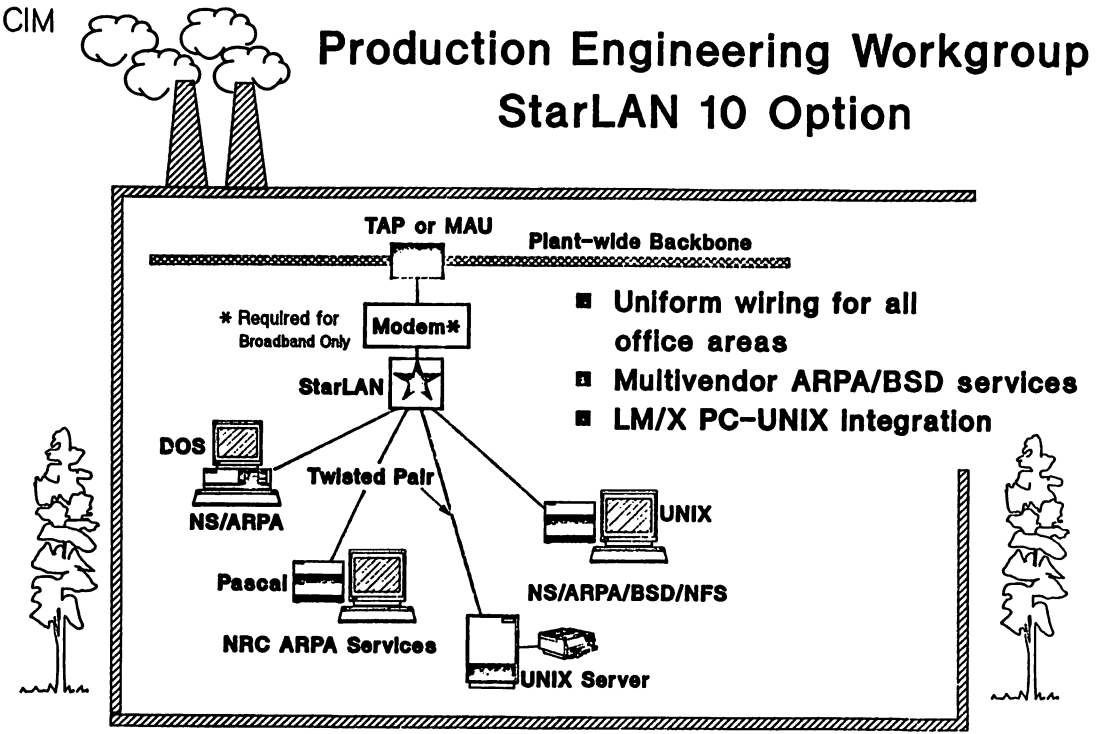
Production Engineering Workgroup
ThinLAN Option



- Easy to use bus for open area offices
- Multivendor ARPA/BSD services
- LM/X for PC/UNIX integration

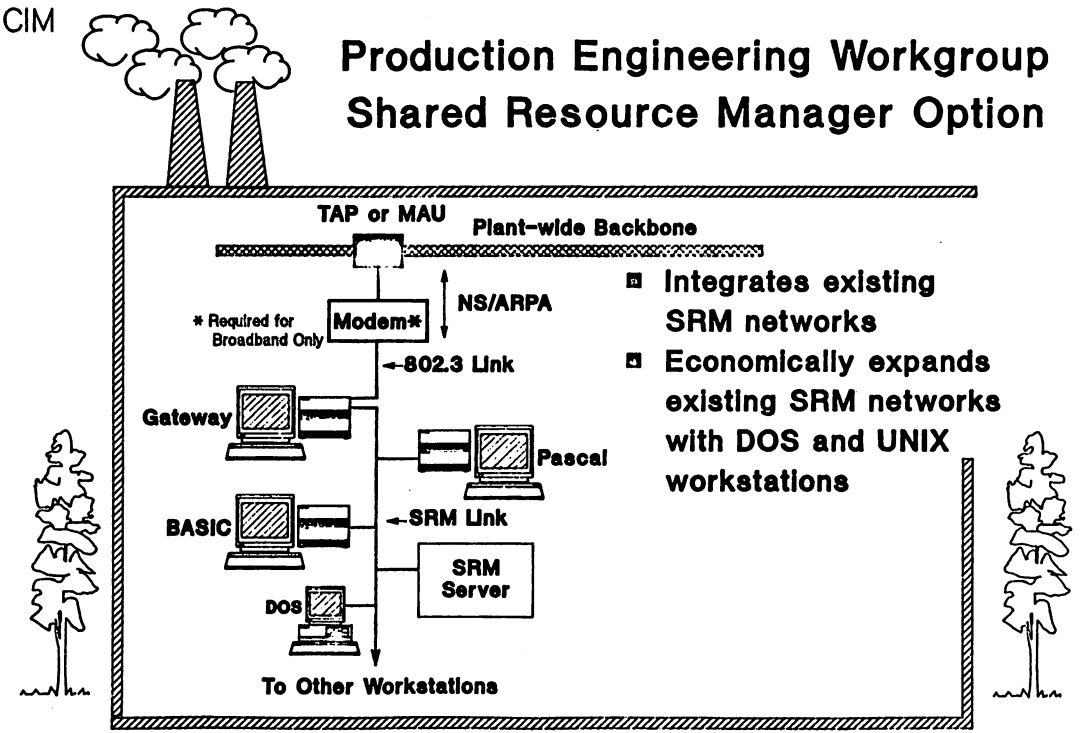
CIM

Production Engineering Workgroup
StarLAN 10 Option



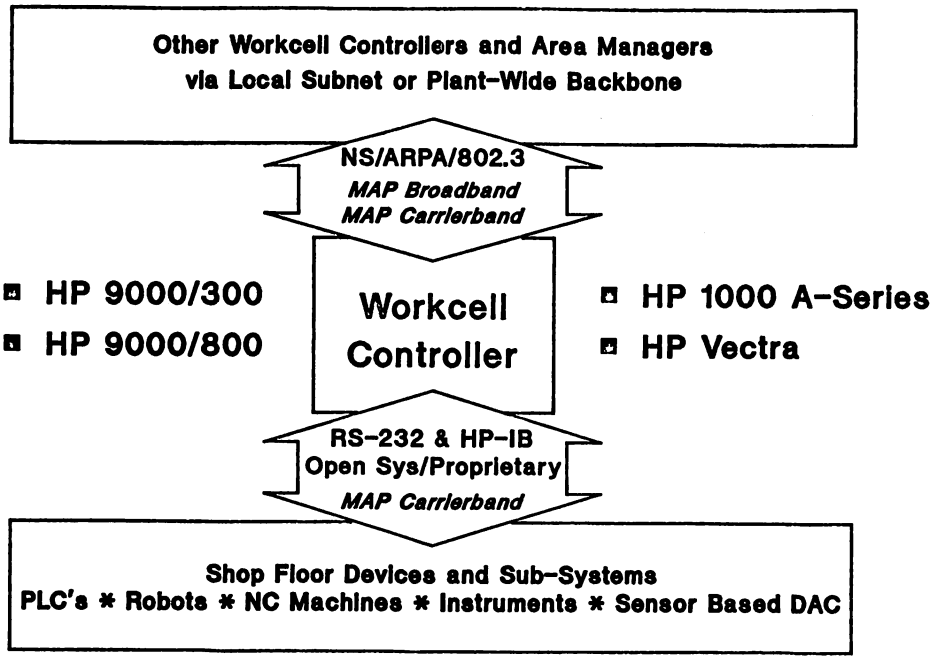
- Uniform wiring for all office areas
- Multivendor ARPA/BSD services
- LM/X PC-UNIX Integration

Production Engineering Workgroup
Shared Resource Manager Option



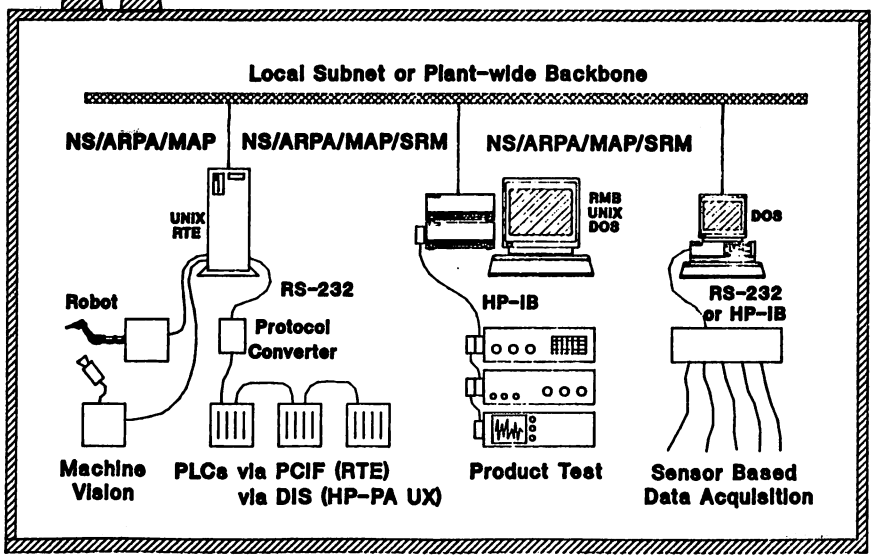
- Integrates existing SRM networks
- Economically expands existing SRM networks with DOS and UNIX workstations

Production Workcells



CIM

Production Workcell
Interfacing to Factory Floor Devices



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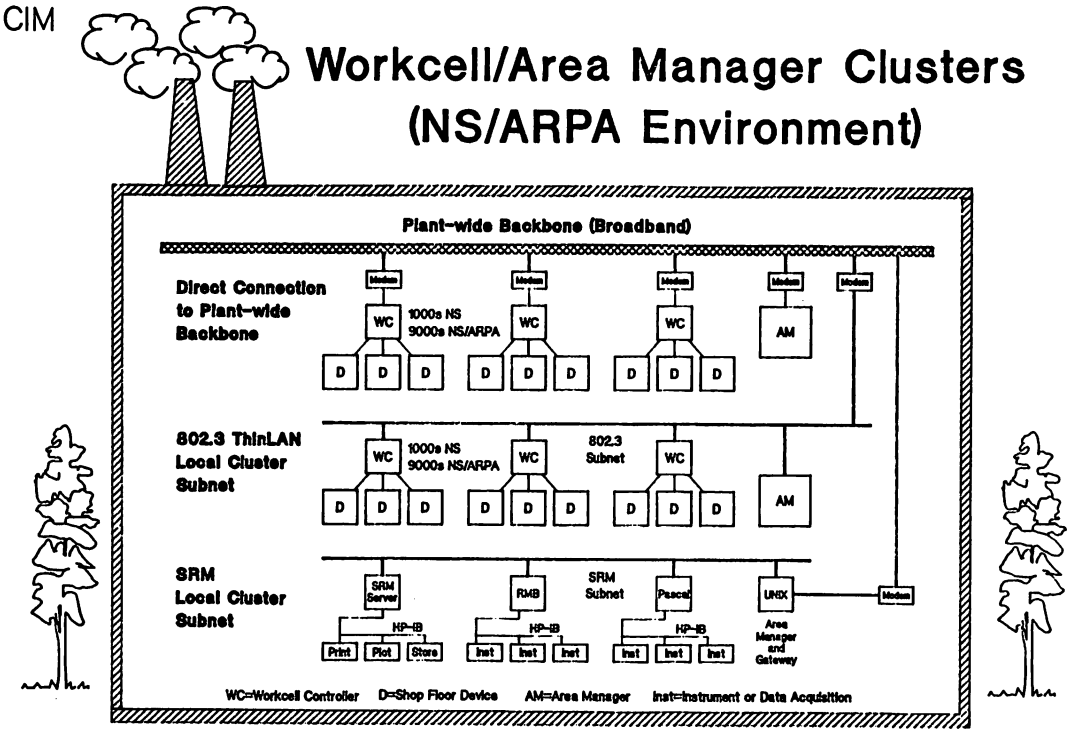
CIM

Workcell/Area Manager Clusters (NS/ARPA Environment)



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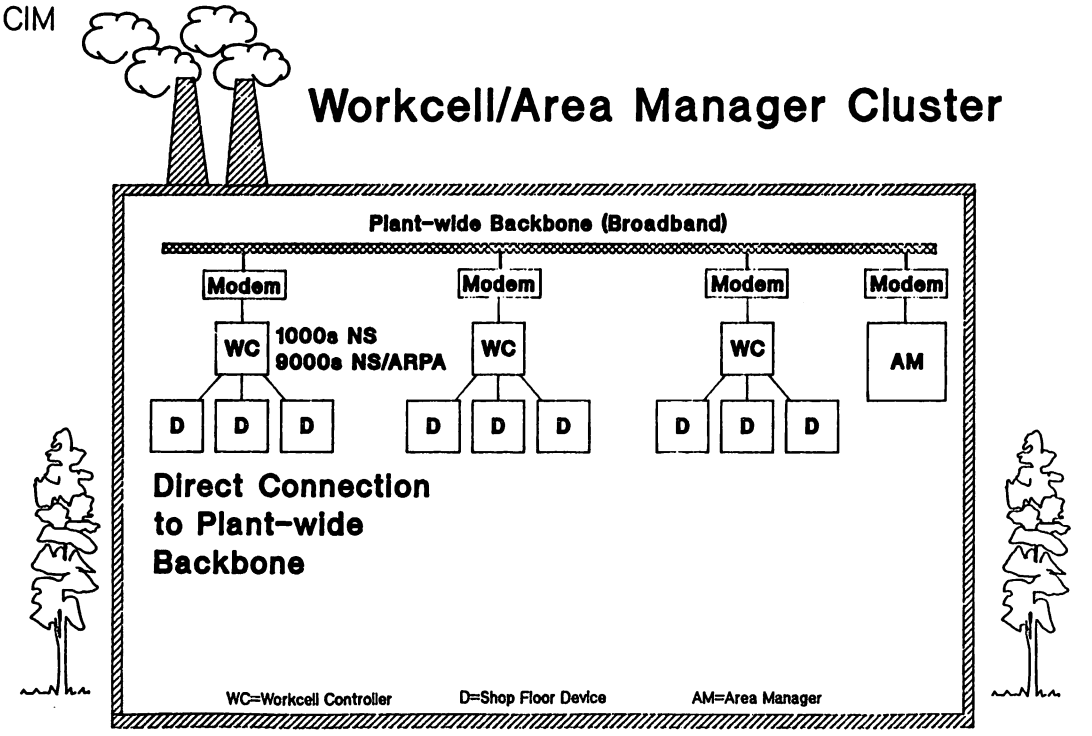
CIM

Workcell/Area Manager Cluster



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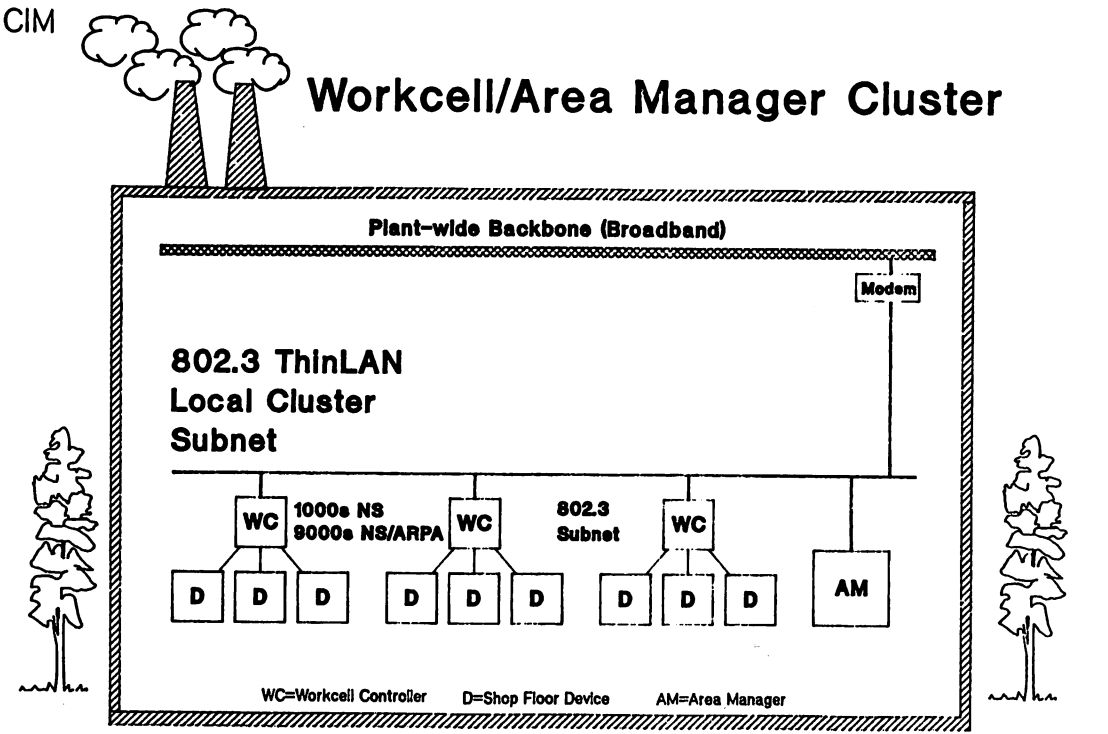
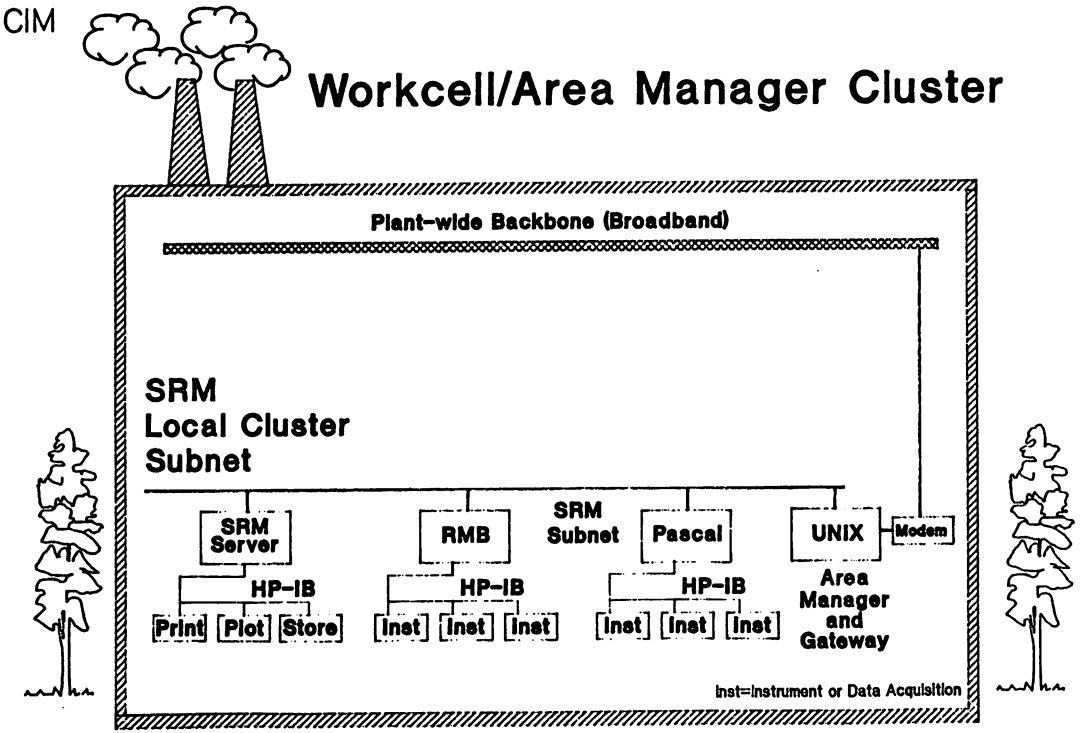
CIM

Workcell/Area Manager Cluster



CIM

Workcell/Area Manager Cluster



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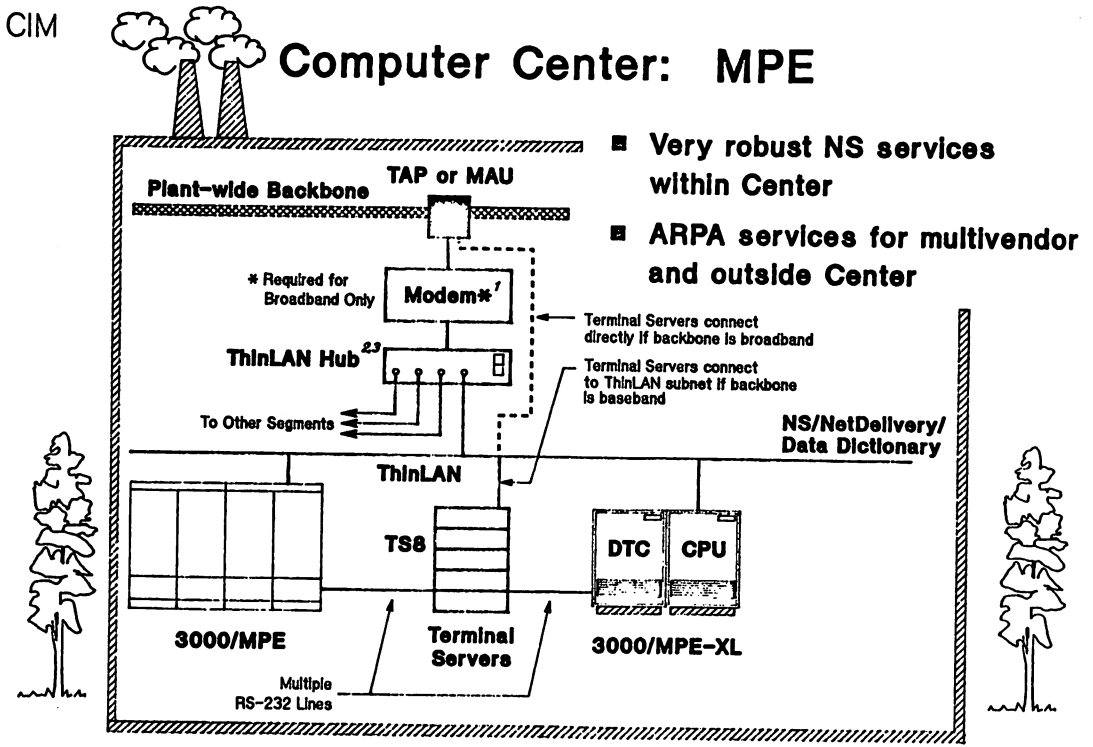
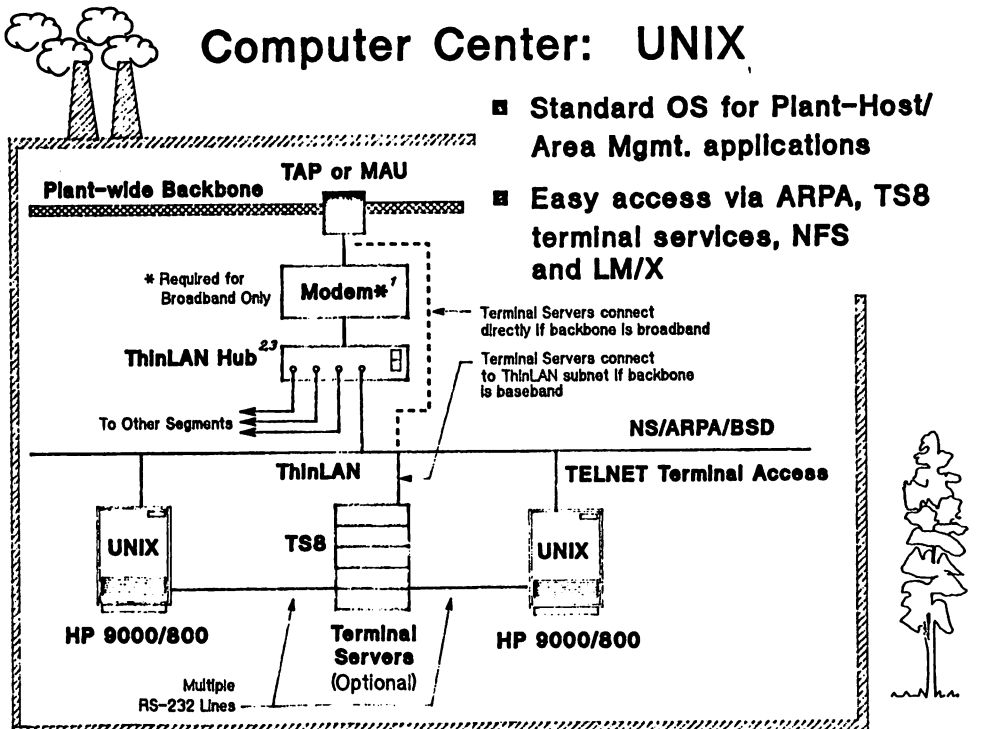
Computer Center: MPE



- Very robust NS services within Center
- ARPA services for multivendor and outside Center

Computer Center: UNIX

- Standard OS for Plant-Host/ Area Mgmt. applications
- Easy access via ARPA, TS8 terminal services, NFS and LM/X



Integration:
Intersystems Networking At-a-Glance

	HP1000 A-Series	HP 3000 MPE	HP 3000 MPE-XL	HP 9000 300-UX	HP 9000 PA-UX	Vectra	Other Vendors
HP NS *	✓	✓	✓	✓	✓	✓	✓ DEC
ARPA	Future	Future	CF	✓	✓	✓	✓ SUN, DEC
Berkeley				✓	✓	✓	✓ SUN, UX
MAP 2.1	✓S	✓S		CF	✓S	CF	✓ COS
MAP 3.0			Future		Future	Future	✓ COS
SNA	✓S	✓	✓G/N	✓G/N	✓G/N	✓	✓ IBM
Bisync	✓	✓					✓ IBM

G/N = Gateway/Native S = Special Quote CF = Consult Factory

COS = Corporation for Open Systems Conformance and Interoperability Support.

* Services supported varies by processor. Refer to Intersystem Matrix.

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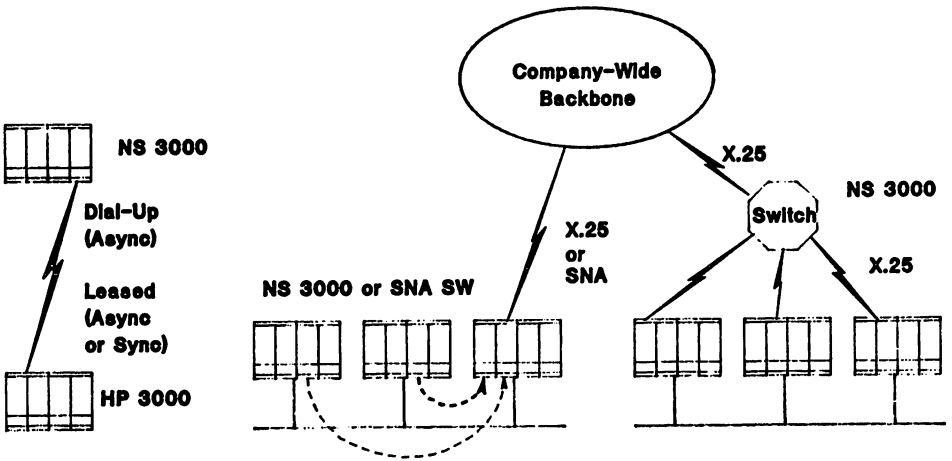
Company-Wide Access



Point-to-Point
Small Nets

X.25 or SNA Gateway
Minimize Access Cost

X.25 Direct
High Traffic, High Performance

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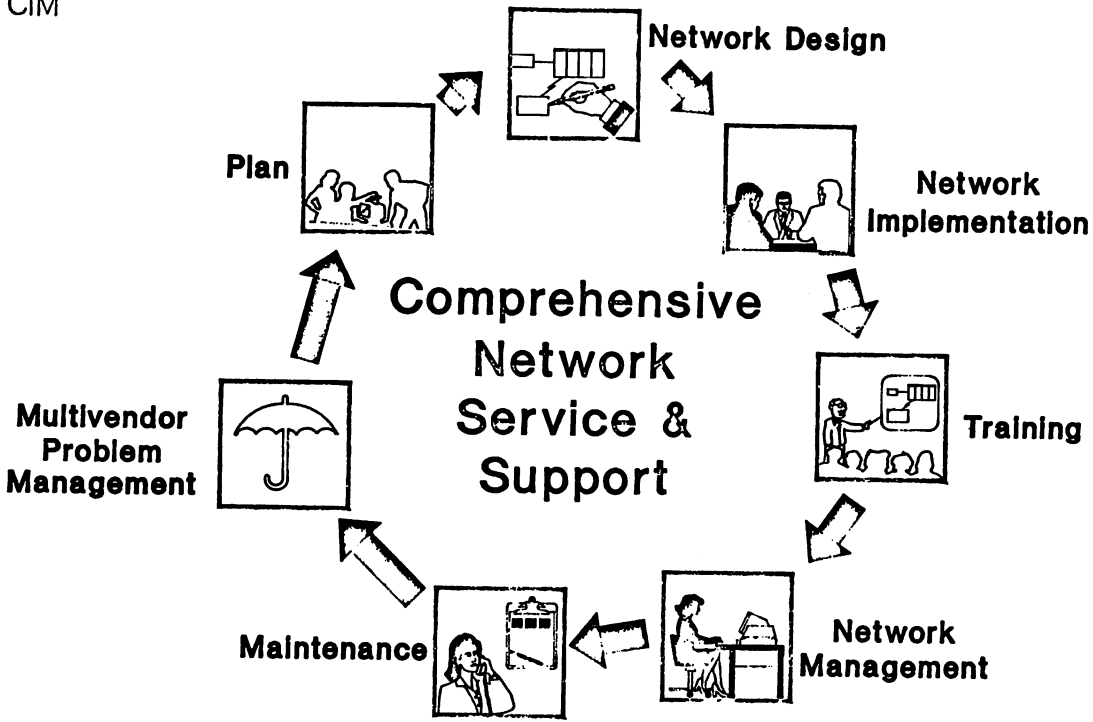
CIM



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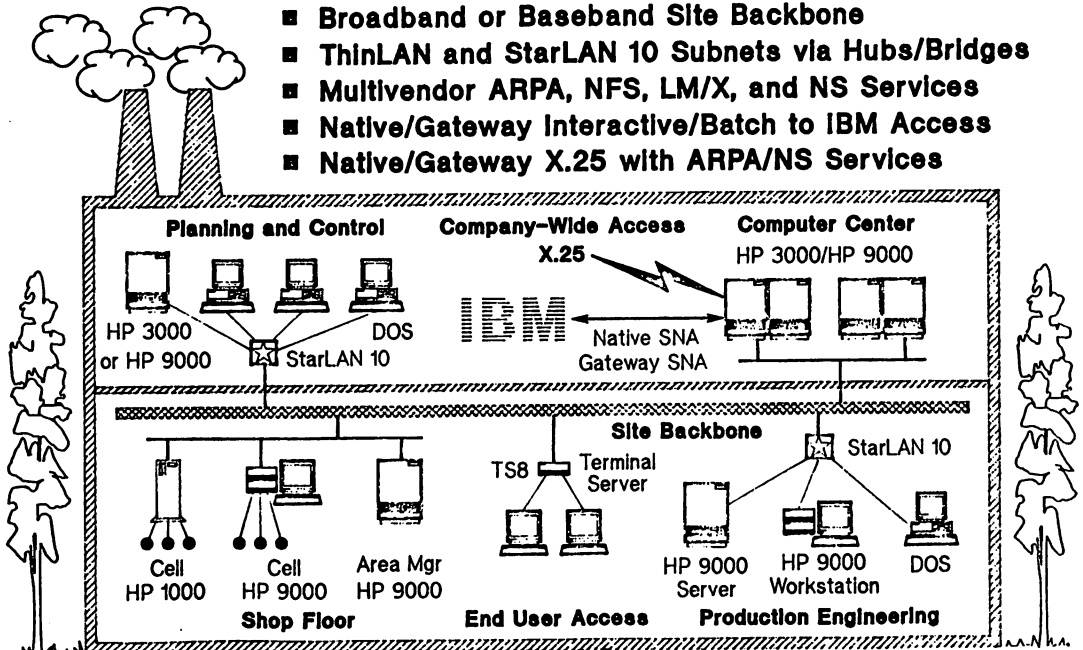
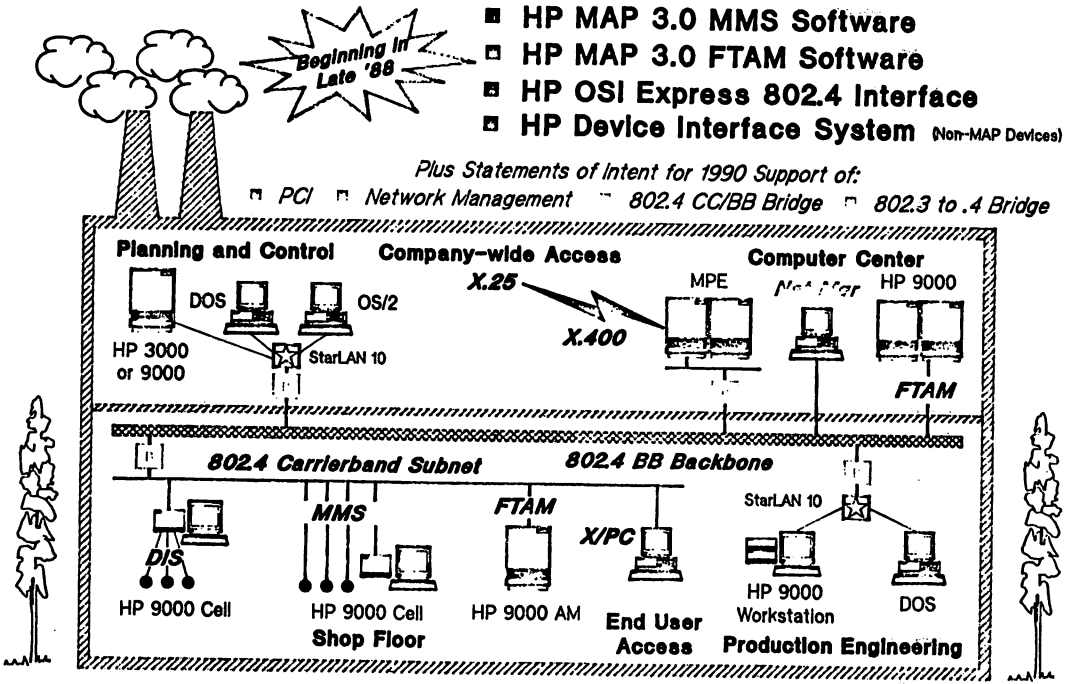
Putting It All Together – ARPA/NS/802.3 Environment

- Broadband or Baseband Site Backbone
- ThinLAN and StarLAN 10 Subnets via Hubs/Bridges
- Multivendor ARPA, NFS, LM/X, and NS Services
- Native/Gateway Interactive/Batch to IBM Access
- Native/Gateway X.25 with ARPA/NS Services



Putting It All Together with MAP/OSI



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