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SYSTIMAX®
SOLUTIONS

SYSTIMAX®
Data Center Design Considerations

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SYSTIMAX® Structured Connectivity Solutions

www.systimax.com

Contents

1. Overview

Enterprises are faced with a growing need for higher bandwidth in the horizontal and backbone to support such applications as Storage Area Networks, Network Attached Storage and high performance computing.

Storage Area Networks (SAN)/ Network Attached Storage (NAS)
SYSTIMAX Structured Connectivity Solutions (SCS) enables cost-effective, high-speed infrastructure for both network attached storage (NAS) and storage area networks (SAN). Technologies such as LazrSPEED® fiber solutions offer ideal platforms for storage networking technologies, including 10 Gigabit Ethernet, Fiber Channel, ATM OC-3, OC-12, and OC-192 and HIPPI (High-Performance Parallel Interface). A SYSTIMAX cabling infrastructure will support high performance SAN and NAS implementations. SYSTIMAX SCS also provides an open platform that supports mixed vendor solutions.

Data Centers (DCs) are an important application for high performance cabling. Organizations build DCs to offer high performance server hosting, data storage and secure redundant business backup. These centers are devoted to providing a secure and reliable environment for large numbers of application servers and storage devices. Providing these servers with redundant high-speed access to the Internet and Corporate Intranet is also a primary feature of these centers. These centers support direct switching and routing via one or more Tier 1 or 2 backbones.

Providing reliable power via redundant facilities and failsafe generator backup is another typical primary DC function. DCs use high-speed equipment and support very high equipment densities, so environmental systems (especially cooling) are also very important. DC's generally also include a control center and various staging areas to support ongoing hardware and software maintenance and upgrades.

Many companies' networks circle the globe and will often establish multiple DC sites. Site locations might be chosen to handle specific regions or metropolitan areas more effectively. Multiple sites can also provide another level of redundancy by allowing remote data backups. Using distributed server load-balancing, companies can also improve network performance by directing network traffic to local DCs where applications are maintained.

Networked communications via the Internet and Intranets dominate the area of telecommunications, computing and information storage. DCs have already become the primary means for supporting high performance Internet communications, especially in supporting server applications for e-business solutions.

With extreme service reliability being a trademark of these installations, DCs must be addressed with high quality cabling solutions. SYSTIMAX products and solutions support DC applications and this document provides guidelines for implementing these solutions.

The customer and SYSTIMAX designer must consider the operational reliability that will be provided by the DC.

Designs must allow for:

- Operational reliability
- Quick changes, including additions and rapid expansion
- On-line monitoring and status
- Life cycle management
- Customer Access

DCs fall into two categories:

- **Corporate DCs** provide Internet and other network services that are devoted to a single corporation. This typically supports:
  - ⇨ **Intranet Services** allowing communications within the corporate workforce.
  - ⇨ **Internet access** for the workforce.
  - ⇨ **A Web Presence** for customer support and remote access.
- **Hosting DCs** are owned and operated by service companies that market web access, hosting, and other Internet based services. A wide range of these services can be defined:
  - ⇨ **Collocation** typically offers customers simple data center space with defined footprints (e.g. partial or full racks/cabinets, locked cages or private suites), network bandwidth, reliability, and security. Customers can install and manage servers, switches, firewalls, and web applications through on-premise visits and remote administrative tools.
  - ⇨ **Managed Collocation** provides extra on-site services such as
    - Storage Area Networks
    - Cashing and other network acceleration features
    - Managed firewalls
  - ⇨ **Fully Managed Hosting** typically includes provision of all switching and server equipment. This might also include management of the web applications by the host. This hosting solution can take the best advantage of the latest IP technology such as network load balancing, caching, and remote storage. Professional web applications services and **complete e-business platforms** are also made available.
  - ⇨ **Outsourced Data Center** service uses Virtual Private Networking (VPN) to provide off site corporate data center operations.

In terms of cabling requirements, there may be very little difference between these because the IP technologies and the equipment configurations may be the same. The Hosting DC generally has more constraints to support the secure segregation between different customers.

Typical enhanced requirements for **Hosting DCs** include:

- Equipment location and configurations for maintaining **segregation** of different hosted customers.
- Operating software and configurations for maintaining **service isolation** between different hosted customers. VLAN technology may be used to partition channel bandwidth and share server capacity.
- Additional private networks using VPN technology.
- **Enhanced security** to establish customer zones and prevent unauthorized or accidental access between different hosted customers. **Locked cages or private rooms** are typically used. Video surveillance and other personnel detection and sensory equipment are also used.
- Customer service areas, including:
  - ⇨ Conference/meeting areas
  - ⇨ Demonstration rooms
  - ⇨ Customer equipment staging rooms

2. Standards

Cabling Standards for DCs have been drafted, these are the TIA/EIA 942 documents in the US and EN50173-5.200X in Europe.

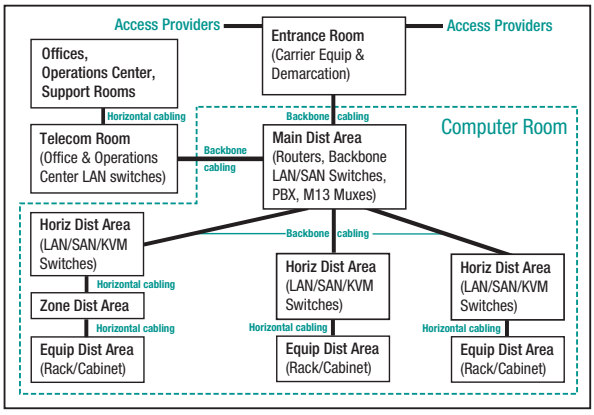
DC cabling generally follows many parts of the TIA/EIA 568B and IS11801 models for structured cabling, but these generally require adaptation to fit the high densities and sizing that are characteristic of DCs. Although TIA/EIA 568B and IS11801 do not specifically address data centers, many of the requirements can be applied.

Overall, the bulk of cabling is comprised of the interconnection between the individual servers and the aggregation switches and from these switches to the backbone switches. A common cabling model is:

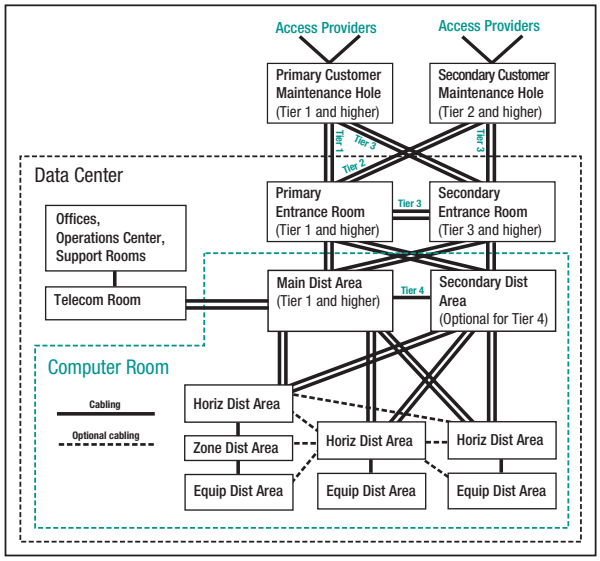
- Condensed horizontal and backbone cabling
- Including an IC (IDF) and an MC (MDF)
- Server links follow a horizontal zone cabling model terminating on consolidation points in server zones
- Servers within zones may be directly connected to the consolidation points

The following figures show the recommended DC designs from the TIA/EIA 942 standard.

Distributed Data Center Design Topology



Distributed Data Center Design Topology with Redundancy



3. Cabling Systems Integration

Being involved early in the planning process and providing input to customer decisions can be valuable towards providing the best cabling solutions. Understanding customer decisions and strategies will help in designing a SYSTIMAX cabling plant that is properly integrated within the data center.

There are four important points that help in addressing systems integration in the construction Master Plan:

- Early Participation in the project. The earlier you start planning to integrate the various systems with SYSTIMAX SCS, the better your chances are to reduce expense and optimize the construction cycle. Systems integration can also result in a significant savings in DC operational expenses.

- Effective Decision Maker for integration. The highest level of decision-making is the most effective position to perform systems integration planning. Separate responsibilities such as DC telecommunications, BAS and electrical services usually come together at this level. It is beneficial to begin a SYSTIMAX SCS project with the Owner/Manager or Executive Management Group that has control over these various disciplines.

- Bid Specification. Traditional bid specifications detail separate systems. Systems integration is most effective when it is done in the bid specifications. Generic bid specifications to perform systems integration are available through your SYSTIMAX® Solutions representative.

- Partnerships. Architects, Consultants and Engineers (ACE) will specify and design, General Contractors (GC) have responsibility for overall building construction, Mechanical/Electrical Contractors install the various systems and services, and Building Automation Systems (BAS) Vendors supply BAS Equipment and develop the Security and Energy Management Strategies.

4. Site Considerations

Corporate DCs are generally placed in or near existing locations or at new locations based on corporate strategies for attracting new employees and/or markets. Location is typically dictated by availability and customer preferences, market based decisions and in many cases involves the re-utilization of existing facilities. DCs are most often located at strategic points along major networks where large amounts of market activity and web access are expected, generally within large metropolitan areas.

Operational Reliability is a primary concern. A requirement for 99.999% uptime still leaves 5 minutes of downtime per year. Typical DC design goals call for "24/7" operation, or 100% uptime. This operational strategy involves unique DC design considerations, but also reliable and rapid customer support strategies.

This 24/7 operational requirement suggests looking at numerous factors such as the following:

- Availability of reliable power is a critical factor. Electrical power delivery is inherently less reliable than network service and network equipment. In most cases this represents a single point of failure that has the potential for shutting down the entire facility. Generally the electrical power quality and electrical backup systems will be one of the largest DC investments. SYSTIMAX designers and maintenance technicians should have a close working relationship with the electrical power engineering team and must be familiar with the electrical systems.

- Network access is critical to the success of any modern data center. Although fiber-optic networks now have enough capacity, speed and span to locate such centers almost anywhere, getting closer to the action is usually more cost effective and reliable. Locations are generally chosen to gain direct access to multiple networks over multiple routes to achieve the highest levels of redundancy. Such arrangements support load sharing configurations and backup strategies.

- **Access to the facility** including roadways, air, train and waterways must be considered. Adequate access is important, although considerations for limiting such access may be more important, since these facilities are primarily devoted to network access.

- **Topographical conditions** such as flooding, potential severe weather conditions and seismic activity should be examined. Historical information for the area or even the state can be useful.

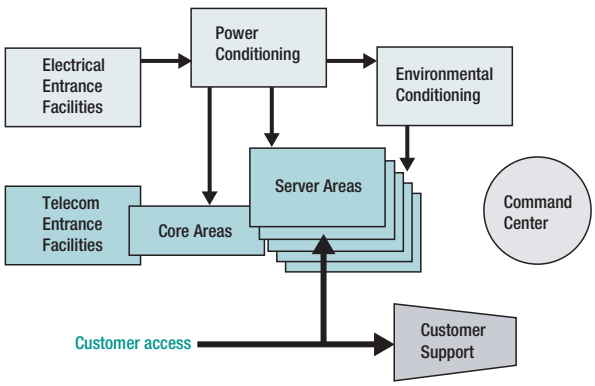
- **Proximity to other facilities** that might represent potential threats should be assessed. Threats have the potential to impair or disable access or operations. Check for national borders, nuclear plants, military bases, industrial processing sites and airports.

5. Building Considerations

The data center design should make optimum use of the building structure and layout. The location of server areas and associated facilities are usually dictated by available space and structural constraints, but for DCs it is important to consider the logical interconnections of:

- Telecommunications entrance facilities
- Electrical entrance facilities
- Electrical power conditioning equipment and spaces
- Environmental (HVAC) equipment and spaces
- Command center
- Equipment and materials access
- Customer access and customer support rooms

Data Center Facilities



For large DCs that utilize an entire building the electrical, environmental, telecommunications and access systems must be integrated to work together throughout the building structure. Each of these systems must be optimized so that they can be easily maintained to provide effective service over the life of the facility. This includes long term and short term service reliability. The design of a well-integrated SYSTIMAX cabling solution requires that SYSTIMAX designers work closely with each facility-engineering group.

For smaller DCs within a large building, selecting a floor close to ground level and locating the equipment rooms close to the electrical and telecommunications entrance facilities is a typical choice. However, it is better to select a location to:

- Optimize the flow of electrical power from the electrical entrance facility through the power conditioning equipment, then to the server areas
- Optimize the environmental equipment and spaces since the air handling spaces are large and since air systems also rely on their own building entrance points

Future plans for the DC should also be considered. Customer migration strategies should be evaluated against any design proposal. Migration strategies might suggest a different floor or building if anticipated plans will not fit the existing choice.

6. Electrical Power Systems

Typical design requirements for large DCs call for a complete building level **On-line UPS**. Advanced UPS provide multiple levels of redundancy. Typical systems consist of:

- **Battery sets** for short-term power interruptions.
- **Generators** for extended outages.
- **Power conditioning** to eliminate power quality problems such as surges or overloaded neutrals.
- As with most electrical distribution, these are usually implemented as multistage systems. **Power Distribution Units** (PDU) on each floor control the final stage of conditioning and backup switching.
- Power distribution may be split up to minimize the scope of effect from power faults. Specific feeders and branch circuits might be designed to higher QOS than others.

At the source, nearly full redundancy is provided, so that the battery set or the generator is each capable of supplying the DC. Electrical cabling pathways from the PDU within the server areas generally run parallel alongside much of the SYSTIMAX cabling, requiring coordination and suggesting common design strategies.

7. Environmental Systems

The heating, ventilation and air conditioning (HVAC) system is another significant part of all large DCs. Access to outside air is required for central air handling ducts allowing fresh air exchange and also for coolant piping and heat exchange equipment.

The **floor level air handling**:

- Must have significantly greater **cooling capacity** than a typical system to support the high equipment densities.
- Can require a considerable amount of space. **Coordination** with cable routing, electrical cabling, lighting and equipment access is important.
- Multiple distribution units support this enhanced cooling capacity and also provide for redundancy.

Controls, sensors and alarms will have **significantly greater point density** than typical building designs.
This will be important for:

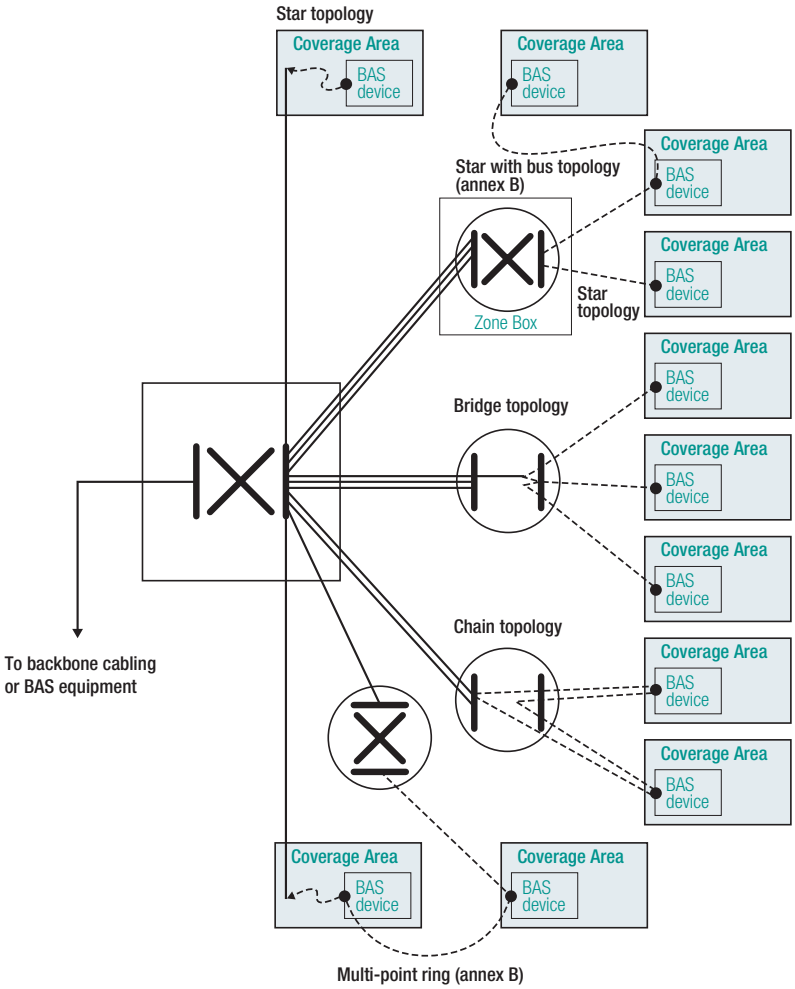
- Monitoring, reporting and maintaining the established service reliability
- Allowing quicker and more effective identification and resolution of failures

8. SYSTIMAX Building Automation Systems (BAS)

The Building Automation Systems or BAS can be implemented on the same structured cabling platform using the SYSTIMAX BAS guidelines. Every BAS management strategy has a SYSTIMAX BAS wire point requirement. These systems include, but are not limited to:

- Uninterruptible Power Supply (UPS), and power quality and metering systems (PQMS).
- Heating ventilation and air conditioning (HVAC), distributed package air conditioning (DPAC)
- Lighting control and reduction (LC&R)
- Variable frequency drive (VFD) motors
- Security Coverage
  - ⇨ Continuous video surveillance (CCTV)
  - ⇨ Card access
  - ⇨ Biometric access and exit sensors
  - ⇨ Security breach sensors and alarms
  - ⇨ Remote electric door strike controls

The Cabling Standard for Commercial Building Automation Systems has been published as TIA/EIA-862. The following figure shows the BAS architecture:



9. Protection

Equipment protection strategies must also be considered. From a protection standpoint, a DC is no different than any other telecommunications installation. Exposed cable plant must have suitable protection where it enters a building. While DCs must meet code requirements (such as the NEC or local adaptations), more stringent requirements are generally adopted:

- Additional safety requirements might also apply.
- A lightning protection system is typically required.
- Typical Equipment Rooms will also have a Data Center Ground Grid.
- For minimizing damaging static discharges, consider using flooring that offers static protection and closely maintain the humidity levels. The high-speed (e.g. 1000BASE-T) equipment might be very sensitive to static discharge and other transient activity.

ANSI T1.313-1997, ANSI T1.318-2000 and ANSI/IEEE Std. 1100 provide guidelines for many of these protection techniques.

10. Network Planning

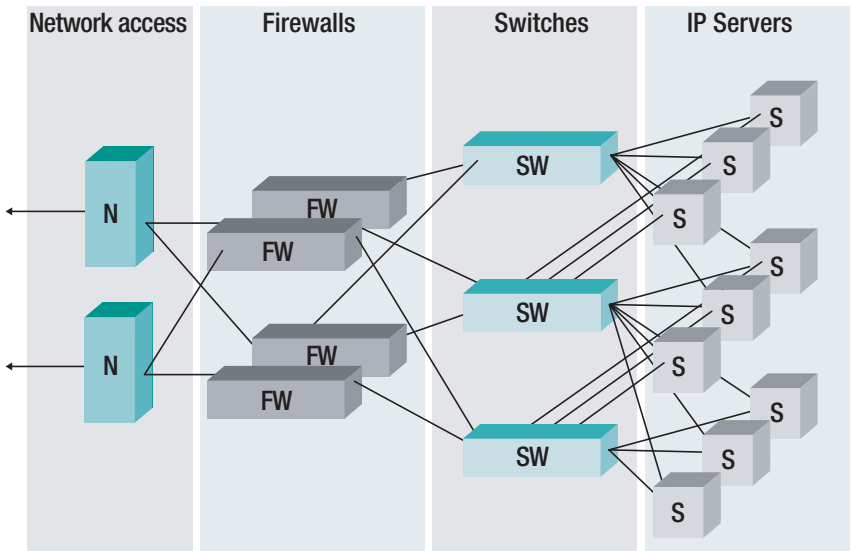
A Network Architecture Plan will establish the necessary equipment and the number of associated SYSTIMAX cabling links. The telecommunications network within the DC provides switched access to the Internet. It is typical to have network connections to multiple carriers. Firewalls are included for protection from network vandalism.

A typical **DC Network Architecture** is shown below. Two (or more) **Network Access Switches** provide for load sharing, redundant service and rapid failover capability in the event that either of the services should experience a problem. These provide the interface between the WAN access link (current speeds are typically OC48 or OC192 for larger IDCs, OC3 or OC12 for smaller DCs) and the internal DC backbones (current speeds are typically 1 or 10 Gigabit Ethernet or Fiber Channel).

The **Firewall Appliances** examine higher TCP/IP protocol levels (Application levels) to block illegitimate access and to protect the data and applications running on the servers from potential service-affecting situations (e.g. Denial Of Service attacks from hackers). Firewalls tend to run slower because of their complexity. To accommodate traffic, multiple stacked firewalls are often utilized in a load-sharing fashion. This distributes transactions among the firewalls.

The **Aggregation Switches** are typically utilized in pairs for redundancy and rapid failover purposes. This can also provide for load sharing. Currently, most servers, switches and firewalls utilize Fast Ethernet interfaces, although the newer generation of high performance storage-array based servers come equipped with Gigabit Ethernet. Storage Area Network solutions also use Gigabit Ethernet and Fiber Channel options.

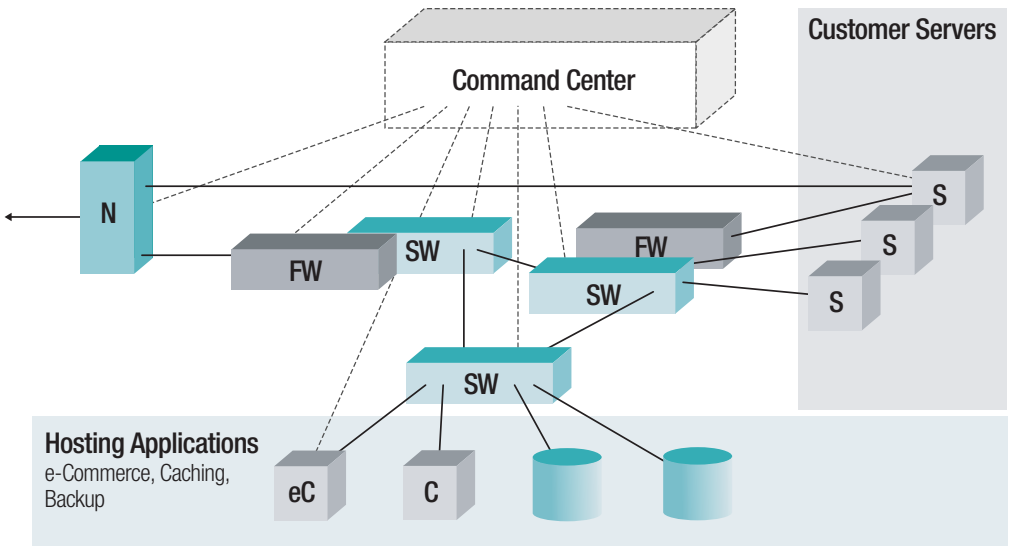
Basic Internet Data Center



Hosting Centers generally offer advanced services that go beyond the basic access and network protection that the previous example covers, however the cabling requirements may not be significantly different. Some of the advanced services consist of the following:

- On-line purchase processing or other **Financial Transaction Processing** may be handled through specialized servers that are set up for Electronic Commerce applications.
- Larger DCs may include a **Command Center** (or Network Operations Center) that monitors site operation, including the energy and cooling systems and allows for detailed network monitoring and analysis of traffic patterns. This Command Center may also have the capability to remotely monitor multiple data centers in a large provider's network.
- **Data backup** services using large redundant disk-array based servers.
- **Serving platform development**, including server trials and testing can be performed on site.
- Another common service is **Caching**. Web pages from servers located in a remote data center or in servers at the same data center are copied for redundancy and to provide quicker access.
- Additional networks, using **Virtual Private Network** (VPN) technology, are also made available to give customers a "backend" private connection to their servers. Separate VPNs may be added alongside the primary DC networks, or partitioned from within the primary DC network. This also allows the DC to support Outsourced Data Center services.
- Individual customers might set up additional firewalls tailored for their own applications.

Hosting Data Center



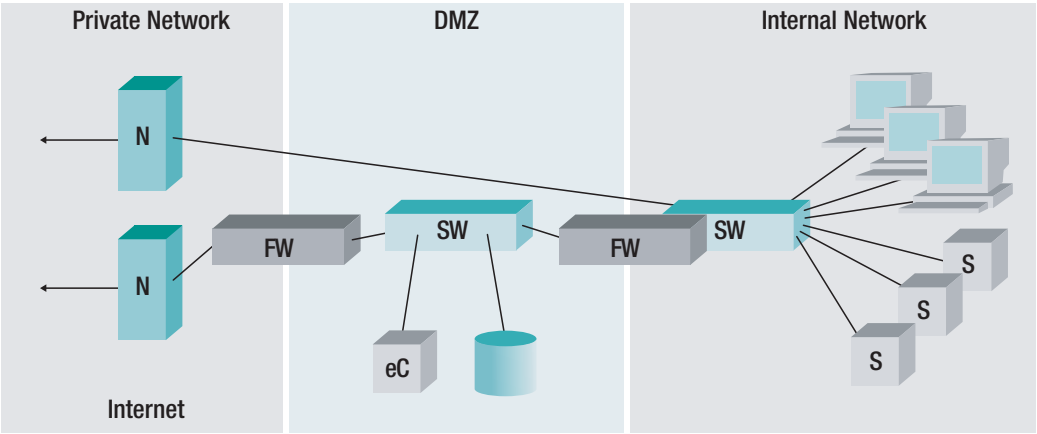
A **Corporate DC Network Plan** might be the same as shown on the previous page for the Hosting Center. Many large corporations maintain their own DC, operating them somewhat independently of their internal networks. However, most will integrate their DC so that it provides Internet access as well as access to their internal networks, as shown in the example below.

In this plan the first bank of firewalls protects what is commonly called a De-Militarized Zone, where servers handle the corporate web presence and on-line business applications. A second bank of firewalls protects the internal network where servers and users have access to proprietary information.

The internal network has access to the DMZ and to the Internet through the DMZ. Virtual Private Networks to remote locations may be set up through this network, or could be set up as separate networks alongside.

This type of topology may also be used in a Hosting Center where secure servers in the internal network feed servers in the DMZ that provide the web service.

Corporate Data Center



11. Core Area Considerations

One or more areas in the DC must be allocated as a **Core Area** where the Network Access equipment is located. In large DCs with multiple floors and more than one **Core Area**, one **Core Area** may be designated as a Primary Network Termination, or different **Core Areas** might be designated as primary for different network terminations, providing additional redundancy.

The first layer of switching equipment, the access switches, and a **Main Cross-connect (MC)** are typically placed in the **Core Areas**. **Data Center Backbones** extend from the **Core Area** out to multiple **Server Areas**.

Direct cabling to the servers is a straightforward approach, however the network designer may prefer to set up intermediate locations for placing distributed switching equipment. These intermediate locations within the **Server Areas** would have an **Intermediate Cross-connect (IC)**. This may be done to:

- Eliminate cabling congestion at the MC
- Handle large quantities of high density (1U) servers
- Avoid concentrated cooling requirements and optimize cooling
- Make Server Area changes and upgrades easier, more localized and less disruptive

SYSTIMAX LazrSPEED® and TeraSPEED™ Solutions are the ideal Data Center Backbone Solution, with the SYSTIMAX LC connector offering superior loss and density in the DC. The SYSTIMAX InstaPATCH Plus System offers additional benefits such as fast, reliable installation, flexibility, high density and ease of moves and changes.

The **Command Center** may be associated with or closely located to a **Core Area**. It would have a **Command Center Cross-connect (CCC)** and similarly the BAS facilities would have **BAS Cross-connects (BASC)**.

12. Server Area Considerations

DC **Server Areas** support large numbers of servers and the associated SYSTIMAX cabling. Firewalls and switches might also be located here. **Server Areas** make up the largest part of any DC and a typical large DC will be divided into multiple **Server Areas**.

Server Area spaces and pathways must be planned and allocated for:

- Electrical distribution
- Lighting
- BAS
- Fire detection/suppression
- Telecommunications
- Air handling
- Personnel access

Within the **Server Areas**, space constraints are especially tight. Further constraints may exist with high redundancy to support fault recovery, for example requirements might specify alternate cabling pathways and switching locations.

The bulk of a large DC is divided into several **Server Areas**. Each **Server Area** can have an **Intermediate Cross-connect (IC)** located adjacent to or incorporating a group of server aggregation switches. **Server Cabling** from the **IC** extends to each server in the Area. As with the **Data Center Backbone**, the design intent is that any server in the **Server Area** can reach a switch with a cabling channel that meets the 100-meter channel requirements.

If the Server Areas utilize IC, server backend networks that are implemented separately alongside the primary DC network may need to go all the way through the IC. Consideration should be given to limiting this total distance to 100 meters.

A typical server might have:

- 2 switch interfaces for supporting redundant connection.
- A backend maintenance connection for the Command Center.
- A backend private network connection.
- The backend connections might be networked among groups of servers to minimize connections through the DC. In a Hosting Center, this might be done among each group of servers from a particular customer.

The SYSTIMAX GigaSPEED® X10D Solution, often combined with the LazrSPEED Solution, is the ideal Server Cabling Solution, delivering flexible design configuration with up to 4 connections in an end-to-end channel.

Within the Server Areas, servers are sub-grouped into Server Zones. A Server Zone might be 3 to 10 adjacent racks where a group of Server Cables terminate in a Server Outlet. This cabling architecture is similar to Horizontal Zone Cabling using a Consolidation Point in each Server Zone.

For a Collocation Hosting Center, each Server Zone might be surrounded with a lockable cage, and set up to accommodate a single customer.

Switching redundancy can be achieved by dividing the aggregation switches and IC into two distinct halves. Locating these to also establish independent Server Cable routing can achieve even greater degrees of redundancy. However, this may further restrict DC size and capacity.

13. Small Data Center Considerations

Smaller size might suggest alternatives to the guidelines above:

- Where space is limited at the IC or MC, switches may be directly interconnected to Data Center Backbones and Server Cabling.
- Centralize the switching, eliminate the IC and cable the servers directly to the MC.
- A plug and play cabling approach, such as the InstaPATCH Plus System, might be feasible. With shorter distances and less cabling congestion, the use of pre-connectorized cabling can allow for quicker setup and upgrades. Servers and switches can be connected to a common Cross-connection point.

14. Data Center Cabling Design Issues

The cabling layout can be derived as follows:

- Electrical and environmental spaces and equipment will be determined within the constraints of the building structure and the service entrance points
- Personnel access points (elevators and stairwells) will determine the best locations for the Command Center and Customer Service Areas
- Network architecture, equipment selections, and overall layout would be established
- Server density and server space allocations are used to establish the Server Zones and quantity of cabling links

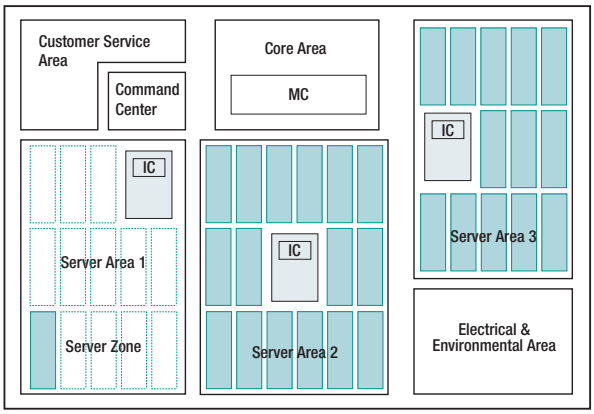
- ⇨ Include **backend network links** from servers
- ⇨ Include **switching administration and maintenance links**
- ⇨ Include **Command Center links**
- ⇨ Include the Building Management access points and Security Coverage points to support a complete **SYSTIMAX BAS** Solution

- **Coordination with other facilities** would determine the cabling pathways

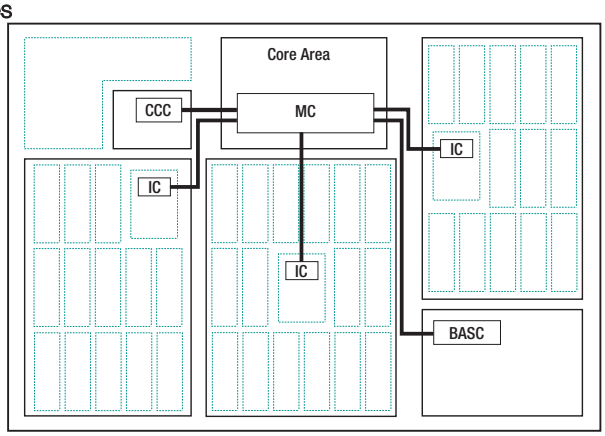
Consult the SYSTIMAX SCS Performance Specification for additional solutions information.

The following figures shows two plan view examples of a single floor DC:

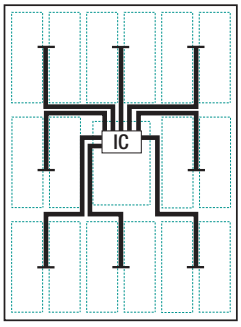
Non-redundant Physical Layout using IC



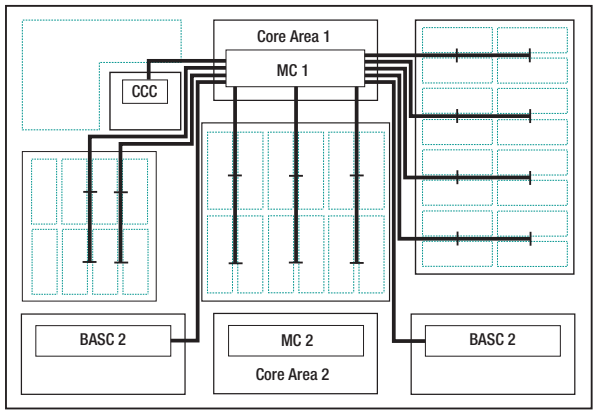
Data Center Backbones



Server Area Cabling Plan



Redundant Facilities (with Direct MC1 Server Cabling)



Typical DC Design Choices

- Lighting, security and fire detection/suppression is generally installed overhead.

- Server equipment in the **Server Zones** is allocated in rows. These could be rows of cabinets or open racks. Open racks provide easier access and are better at maintaining suitable equipment temperatures. The personnel access is between the rows and at the ends. For a typical Hosting Center:
  - ⇨ Rows may be surrounded with locked cages for segregating customers.
  - ⇨ Rows require additional space, allowing each customer to have complete access to the front, rear and ends of their row.
  - ⇨ Additional space should be allocated for customers to bring in additional equipment and work on diagnostics or upgrades.

- Switching equipment is usually located either alongside or incorporated with the **IC**, within each **Server Area**. Firewall appliances may also be located here.

- Common solutions for the cabling and air systems are:
  - ⇨ All systems are installed overhead. Cabling raceways or trays are used. The placement must be coordinated with the lighting, security and fire protection. This allows for the greatest level of System Integration.
  - ⇨ The air systems are installed overhead, while the electrical and communications systems are placed below raised floors. Cabling pathways are generally located directly under the intervening personnel access rows. This allows for access to the pathways without going under the equipment rows.
  - ⇨ The air systems, electrical and SYSTIMAX cabling are all below a raised floor. The cabling may be placed in a multi-channel raceway. Servers are enclosed in cabinets that direct cooling air up from below through openings that also route the server cords. Cabinet partitions may also be used, but airflow and cabling management is needed. In these scenarios care should be taken with regards to cable selection to ensure adequate protection against the spread of fire. SYSTIMAX plenum cables are the ideal choice.

Maintenance planning should also be considered. Each facility should be independently accessible.

Seismic bracing of server racks, cabinets and pathway hardware may also be required.

Pathways

The design of the DC cabling pathways is an important infrastructure concern. There are many types of pathway methods and products available:

- Trays (These are generally the most cost effective and may provide the best solution in a collocation center where cabling change-outs and upgrades are common)
- Raceways (These provide the best cable protection, and partitioned pathway systems allow for both high and low voltage cable to be co-routed, achieving high levels of systems integration)
- Conduits (not recommended)
- Hooks, straps, lashing (not recommended, although hook and loop straps are useful for cord management)
- Slots and Sleeves (typical vertical pathways)
- Vertical Shaft (for high capacity)

Cable Congestion

The high density of server and switching equipment results in a large amount of individual cables terminating at the IC in each Server Area. This may also happen at the MC. Pathways must be designed to accommodate this allowing for:

- Logical flow into the cross-connect fields.
- Enough separation between different Server Zone cables to allow some degree of independent maintenance and upgrade.

15. Data Center Cabling Selection

A cabling system may require a balance of both copper and fiber to cost effectively meet today's needs and support the high bandwidth applications of the future. Rapidly evolving applications and technologies are drastically increasing the speed and volume of traffic on data center networks. Ensuring that your cabling solution is designed to accommodate the higher transmission rates associated with these evolving bandwidth intensive applications is critical.

Due to the versatility and wide range of applications support, SYSTIMAX® Solutions has pioneered the development of UTP/fiber cabling systems to satisfy virtually all of a customers' data center network and building infrastructure needs. In addition to the performance of the cabling solution itself, the right cabling architecture needs to be chosen to optimize the investment and return for the particular building environment.
Balancing cabling system cost versus the electronics, and also the ongoing management and flexibility of the solution is a key part of effective cabling infrastructure design.

The cabling architectures that are commonly used for DC structured cabling systems, require a mix of High-Density, High Reliability, High Performance, with Flexible Design Guidelines, Speed of Installation, Future-Ready and Easy to Use.

SYSTIMAX Solutions™ can combine many of its individual key product and solution benefits to form optimum DC infrastructure designs. The key SYSTIMAX products include:

- The SYSTIMAX GigaSPEED X10D Solution
- The SYSTIMAX iPatch® System
- The SYSTIMAX LazrSPEED Solution
- The SYSTIMAX TeraSPEED Solution
- The SYSTIMAX LC Connector
- The SYSTIMAX InstaPATCH Plus System

By choosing UTP and fiber-optics as the media for the cabling solution, support for the widest range of architectures is possible in the most effective manner. For many users, a combination of advanced UTP cable and multimode/singlemode fiber is the best choice. Both support a wide variety of applications, are specified as media for emerging high-speed LANs and meet the specifications for virtually all cabling standards.

In the past, copper was ideally suited to lower speed applications while fiber was best used for high-speed, longer distance and security-dependent applications. Today, high quality twisted pair copper and fiber-optic cabling system infrastructures overlap in capability up to Gb\s data rates.

For fiber, the InstaPATCH Plus System allows fast, predictable and easy installation of high-density fiber solutions, a common requirement for DC projects. The ribbon fiber cables and MPO connections, coupled with the unique polarity features of the InstaPATCH Plus pre-configured high-density patch panels, allow fiber networks to be deployed effectively onsite in less time, plus providing the necessary density created by grouping many server connections together.

16. SYSTIMAX Copper or Fiber Solutions in the Data Center – Which Is The "Right Choice"?

Network providers are often faced with the question of whether to install a UTP copper or multimode fiber cabling system to the servers. Unfortunately, there is not a clearly defined answer to this question. Most private networks require a mixture of both media to create the most cost-effective networks for voice and data across the horizontal and backbone segments of the network. High performance Category 5e and 6 UTP, such as SYSTIMAX PowerSUM and GigaSPEED XL Solutions respectively, provides the lowest initial cost for today's Local Area Networks (LANs) up to rates of 1 Gb\s. Fiber-based networks can reduce recurring operational charges and clearly have higher performance, however with the introduction of Category 6A systems such as the GigaSPEED X10D Solution, the capabilities of UTP cabling have been substantially increased, pushing out the move to fiber for short distances.

Fortunately, SYSTIMAX Solutions provide complete solutions for both fiber and copper media. The choice of media depends largely on the customer's present and future applications and business situations. A selection made without considering these fundamentals has little chance of providing the best solution. That is why it is important to understand not only the capabilities of each media, but also specific customer needs.

In order to determine which combination of twisted pair and/or fiber to install and in which architecture, each customer must evaluate their application needs, considering the various advantages of each cable type and their relative importance. Cost, ease of installation, moves and arrangements, current and anticipated applications and the expected life of the system are typically major decision factors. Environmental considerations such as electrical noise and clean rooms may also influence the decision, as well as building type, industry sector and cabling system ownership.

The anticipated need for low speed applications, short system lifetimes, and low initial cost might lead to a predominantly twisted pair cabling system. High-speed application, extended distances, harsh environmental conditions and graphics intensive multimedia applications might lead to a heavily fiber based system.
Most systems will fall between these two extremes.

Given that there is some overlap in the customer base and capabilities for Category 5e, 6, and 6A cabling and multimode/singlemode fiber-optic cabling system infrastructures, an understanding of the customer's DC specific requirements is needed to recommend the optimal cabling solution. The decision will incorporate three phases - the definition of strategy, the design of the system, the cost effectiveness of the choice.

For the definition of strategy, within budget restraints, each customer must consider and prioritize the following:

- The sophistication of their network applications
- The kind of traffic expected on the various portions of the DC network based on number of users, data transfer requirements of each user, LAN architecture, etc.
- The life expectancy of the network and cabling infrastructure
- The frequency of moves and changes
- The growth potential of their network over its expected life
- Any adverse physical conditions in the customer's data center

The design, architecture and specification of the system should include the following:

- Outlet density and presentation required
- Resilience
- Patch/jumper density
- Wiring closet/space requirements
- Media selection - UTP and /or fiber

- Media considerations - performance, physical hazards
- Manufacturers support and warranty
- Cable containment including containment types (trunking, ducts, cable tray), and containment design (size, safety, segregation)
- Installation techniques and quality
- Adherence to standards
- Labeling, records and documentation
- Testing and certification
- Maintenance and services.

When evaluating cost effectiveness, the customer should always think in terms of cost over the life of the cabling, rather than only the initial installation cost and also compare the cost to electronic hardware which will be replaced several times over the lifetime of the cabling. The lowest initial cost is not always the cheapest in the long run, however once the contract is placed it is difficult to change. Choose the right system first time. Considering cost effectiveness should include the following:

- Initial installation cost: ensuring it covers adequately the specification to avoid unwanted extras and performance restrictions
- Administration: the network's ability to be easily and inexpensively reconfigured
- Maintenance: the effort required to keep the system operating
- Life cycle value: the assurance of a warranty covering the applications and hardware

SYSTIMAX Solutions offer high performance copper and fiber cabling platforms that will cost effectively allow enterprises to implement DC applications and architectures. Customers need to be careful that in selecting a solution today, they do not limit themselves in the future. With advanced twisted pair and multimode fiber cable, connectors and apparatus, users can support all of their current applications, as well as their emerging and future applications.

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