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SYSTIMAX® Solutions

CommScope® Intelligent Building Infrastructure Solutions (IBIS)

LonWorks® Design Guide

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1.0 Introduction

CommScope® Intelligent Building Infrastructure Solutions (IBIS) is a modular, flexible cabling infrastructure system that supports voice, data, video and building automation system (BAS) by providing a robust and cost effective connectivity for all of a building's BAS and communication systems. IBIS utilizes twisted pair and/or fibre optic cables to provide connectivity in an open architecture environment.

CommScope IBIS supports cabling for the installation of LonWorks technology based systems using various SYSTIMAX PowerSUM, GigaSPEED XL or GigaSPEED X10D solutions. The purpose of this guide is to help customers identify and implement CommScope IBIS connectivity solutions for systems based on LonWorks Technology.

LonWorks Technology offers manufacturers a solution to designing, building, installing, and maintaining control networks. This technology is based on a peer-to-peer architecture and needs no central controller because intelligent nodes (control devices) communicate directly with each other. Each node has the intelligence to perform control functions and can communicate with other nodes using the LonTalk® protocol. These nodes can be linked together to implement applications in consumer electronics, factory automation, commercial building automation, home automation, vehicle controls, etc. Contact an Echelon® Representative for further information.

LonWorks technology provides the components and tools required to design applications that distribute intelligence and control throughout a system. A central component in the LonWorks product family is the Neuron® Chip, which contains the LonTalk protocol stack and a dedicated applications processor. When nodes are required to communicate over long distances, transceivers are used. The LonWorks FTT-10A Transceiver is a free topology device that provides a physical communication interface between a Neuron Chip and a LonWorks twisted pair network. The FTT-10A is used to implement node-to-node communication, and may also be used as elements of repeaters and routers to extend networks.

A number of cabling arrangements in support of LonWorks systems are possible and should be considered in relation to the various applications that customers plan to use. For these different applications and cabling configurations, there are signal loss budgets and other performance issues for signaling. The number of devices placed on a link or bus, and the cabling distances supported, are determined according to the electrical characteristics of the cable and of the different types of applications and configurations. Because of the many aspects that must be considered, an Application Guide is desirable to help our customers identify and implement various connectivity solutions. This document contains information and instructions for the installation of LonWorks FTT-10A communication channels. Systems employing the FTT-10A transceiver will usually have interfaces to endpoint devices (that is, temperature sensors, dampers, etc.). This guide does not cover endpoint devices. Contact your CommScope and/or your LonWorks representative to determine the support for endpoint devices.

2.0 LonWorks TECHNOLOGY

LonWorks is a set of components and tools that are used to implement distributed intelligence and control functions into products. The components consist of:

1. A Local operating network
2. LonTalk Protocol
3. Neuron Chip Family, and
4. LonWorks Transceivers

A network of intelligent nodes are connected together by communication media (for example, SYSTIMAX x061/x071/x081/x091 cable) and communicate with each other using the LonTalk Protocol. The Neuron Chips are the processors in the intelligent nodes. These chips process the LonTalk Protocol, provide I/O monitor/control, execute application-specific (for example, Temperature Control and setback) functions and provide memory for the application. LonWorks Transceivers encode and decode the transmitted and received data for transmission over long distances. The LonWorks Transceiver supported by CommScope IBIS is the FTT-10A.

2.1 FTT-10A Transceiver

The FTT-10A Free Topology Twisted Pair transceiver supports star, bus, and loop wiring architectures. The FTT-10A transceiver uses transformer isolation and 78 kbps differential Manchester coded data signals. Nodes equipped with the FTT-10A communicate via a twisted-pair cabling channel. The cabling channel may be comprised of multiple segments separated by physical layer repeaters. The FTT-10A transceiver may be used as an element of a physical layer repeater or router to extend the number of nodes and distances of the network. A free topology architecture has no topology restrictions. CommScope IBIS employs the free topology capability in a modified star structured cabling system. The following sections illustrate SYSTIMAX configurations. The channel segment parameters are listed in Table 1.

TABLE 1: LONWORKS FTT-10A PARAMETERS

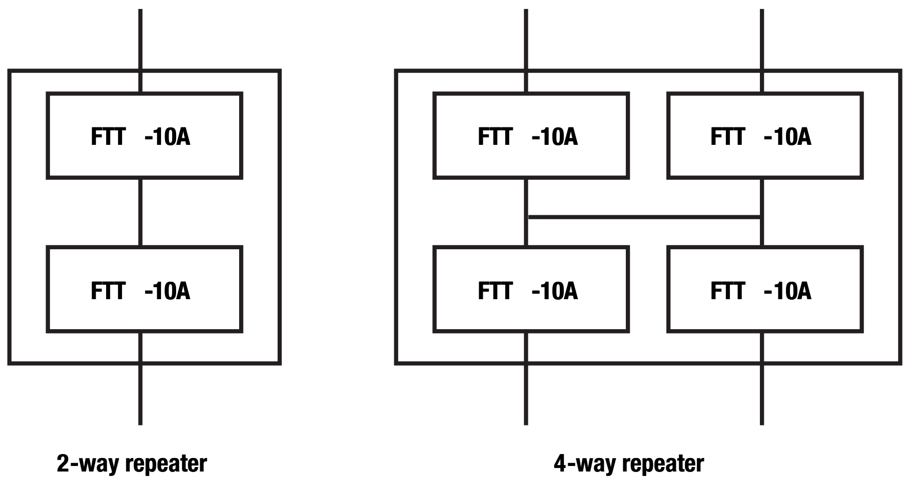
LonWorks FTT-10A Free Topology Transceiver					
Transceiver	Rate (Kbps)	Topology	Nodes/ Segment	x061/x071/x081/x091 (m)	Maximum node-to-node distance (m)
FTT-10A	78	Bus (Note 1)	64	500 (900 m electrical length)	
FTT-10A	78	Free (Note 2)	64	450	250

Note 1: Doubly terminated Bus; 3 meter stubs, SYSTIMAX implements this as star wiring with chained branches.
Note 2: Requires one termination; SYSTIMAX implements this as star wiring with bridged branches.

2.2 Repeaters and Routers

The FTT-10A repeater function may be implemented as an N-way repeater as shown in Figure 1. The repeaters in Figure 1 have multiplicity of 2 (2-way) and 4 (4-way). Each port of the repeater connects to a different FTT-10A channel segment. Each segment is implemented as described for CommScope IBIS in this guide. Only one repeater may be used per channel, but there is no limit on the multiplicity of the repeater (that is, the value of N is not limited). However, traffic engineering should be performed to ensure network performance criteria are met. When there are high levels of traffic, LonWorks routers may be used to meet performance criteria. When networks are partitioned, routers will forward messages to other channels as necessary.

Figure 1: FTT-10A Repeater Examples



A LonWorks router is used to cascade different channels (single or multiple segment channels). There is no limit on the number of cascaded routers, but performance criteria and traffic engineering will control the number of cascaded routers. Repeater and router parameters are summarized in Table 2.The router and/or repeater will count as a single node towards the maximum nodes per channel segment.

The repeater is connected to the end of a network channel segment and extends the total distance and node count of the network. The router may be connected at any point on the network channel segment.

TABLE 2: LONWORKS REPEATER/ROUTER PARAMETERS

LonWorks Repeater and Router Parameters for LONs				
Device Name	Max. Number of Repeaters with Multiplicity N	Max. Number of Routers	FTT-10A Distance per Segment with Repeater or Router	Maximum Nodes per Segment
Repeater	1	N/A	See Table 1	See Table 1
Router	N/A	unlimited	See Table 1	See Table 1

When the number of nodes (intelligent nodes/controllers) is small, the distribution of nodes within a network will be determined mainly by logical groups (for example, lighting control, access control), physical considerations (for example, location of entrances, size and location of class rooms, etc.), the number of endpoint devices (for example, card readers, lights, temperature sensors, motion sensors, etc.), and the location of the main workstation (if a main workstation is present). As the number of nodes grows, factors such as the traffic load, performance, availability, capacity, and network management and expandability will increase in importance.

The topology selected will depend on the traffic flow and the physical layout of the channel segments to be joined together. Typical network topologies are shown in Figure 2 (a through c). Passive loops on any free topology segment are permitted to increase system availability in the event of a cable break.

Figure 2: Typical LonWorks Network Topologies (a – c)

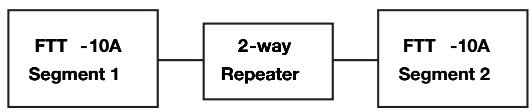


Figure 2 (a): The Simple Repeater Connection one channel of two segments

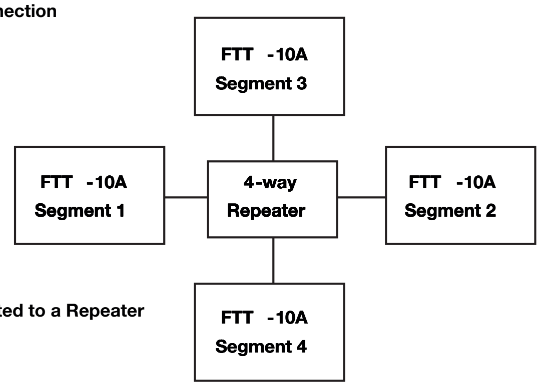


Figure 2 (b): Multiple Segments Connected to a Repeater one channel of four segments

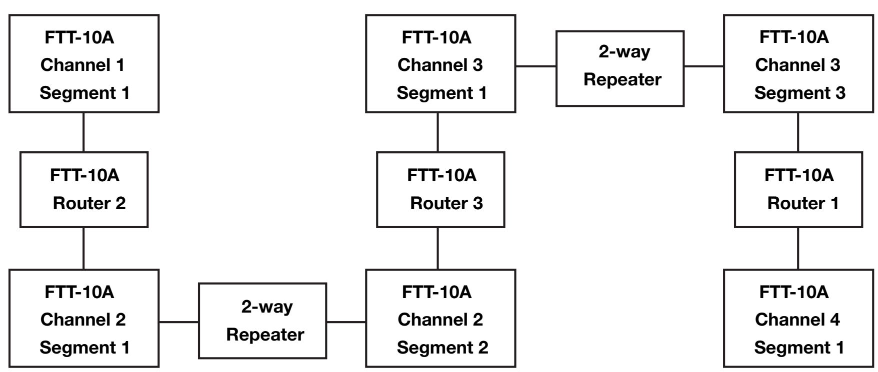


Figure 2 (c): Multiple Repeaters and Multiple Routers

3.0 LonWorks and SYSTIMAX Configurations

LonWorks technology is designed into many network solutions including industrial and commercial applications (for example, power monitoring, utility metering, process control, etc.), and Building Automation Systems (BAS) such as EMS, HVAC, Fire & Life Safety, Security and Access Systems. The CommScope IBIS connectivity concepts employed to implement these solutions are described in this guide.

3.1 Building Control System Topologies

The workstations, controllers, repeaters, and devices of LonWorks FTT-10A systems are configured using bus and star topologies, and CommScope IBIS.

The IBIS design for many building types are facilitated by the use of point-to-point, daisy-chain bus, star, and distributed star configurations. The following LonWorks FTT-10A systems and IBIS topologies are examples of using these design concepts.

3.1.1 Centralized and Distributed Controllers

In Figure 3, a workstation communicates through a gateway to a server on an Ethernet 10BASE-T LAN connection. The workstation software enables a user (single or multiple) to manage buildings (for example, load programs, scheduling, alarm resolution, reports, etc.). The workstation may operate directly on the FTT-10A bus (requires a FTT-10A interface for the PC) and/or it can communicate with remote sites in a wide-area network (WAN) over telephone lines. The workstation centralizes the management of network controllers.

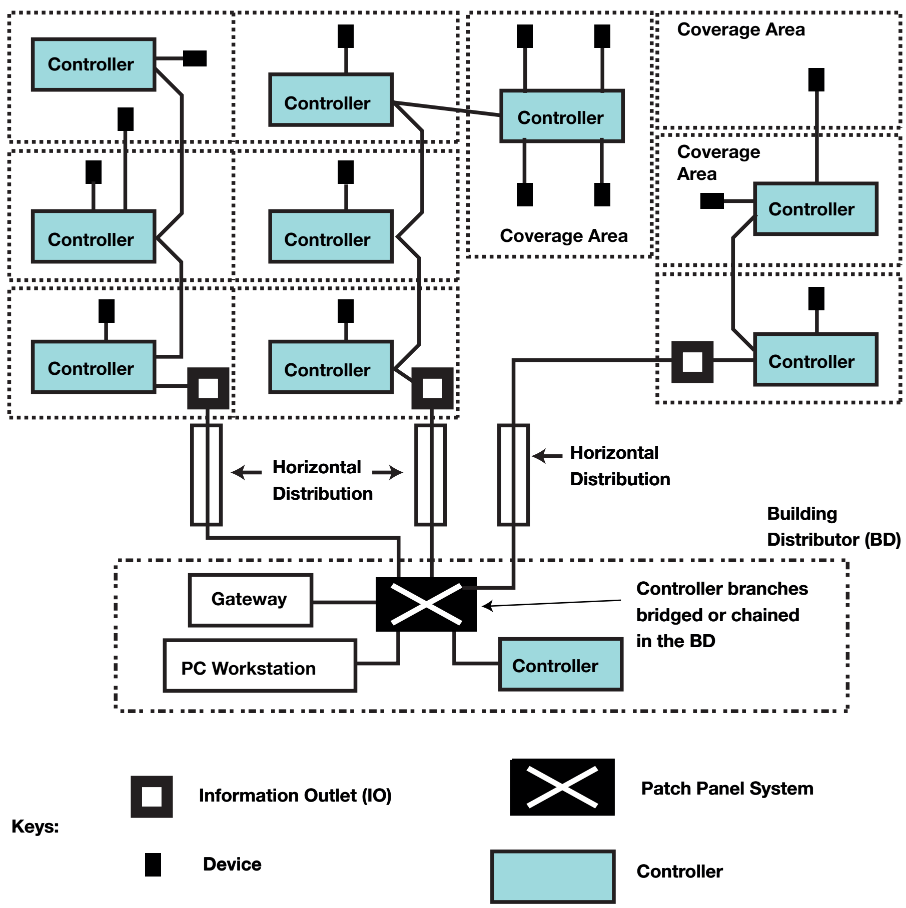
The workstation and FTT-10A controllers are the focal points for the BAS and (when possible) are centralized in the Building Distributor (BD) (also referred to as Entrance Facility (EF) or Equipment Room (ER)). The preferred location for the controllers is the BD in Figure 3. Their endpoint devices (sensors and actuators) are connected to horizontal wiring via the blue field as point-to-point wiring (singe device or daisy-chained devices). Devices on other floors are connected through the Backbone wiring to the blue field of the other floors. When the number of controllers required are distributed throughout the building at distances that prohibit localization in the BD, they are distributed in the Floor Distributors (FDs) (also referred to as Telecommunication Rooms (TRs)) and the horizontal subsystem.

A sequence of daisy-chained controllers in the horizontal is referred to as a branch. To provide the proper device density on a floor, more than one branch may be required. Each branch will usually have a number of controllers on the bus. The administration subsystem (white, blue, and purple fields of the cross-connect) is used to bridge branches and or chain (that is, serially connect) the branches together.

3.1.2 Single-Floor Controller Layout

An example of a single-floor layout is shown in Figure 3. The primary controller placement strategy is to centralize the controllers (including workstations if applicable) in the BD (see Figure 3, workstation, controller, gateway, etc.). The factors determining the device(s) density for the floor include the type of device, the type of building (for example, office) and/or the building owner and/or codes. For example, each office (size 100 sq. ft or 9 sq. m) and each conference room (size 600 sq. ft or 54 sq. m) may require one thermostat and one variable volume/variable temperature (VVT) controller. The horizontal cabling is routed via the distribution method (for example, raceways, building support members, etc.) from the devices to the controller(s) in the BD.

Figure 3: Example of Single-Floor Layout



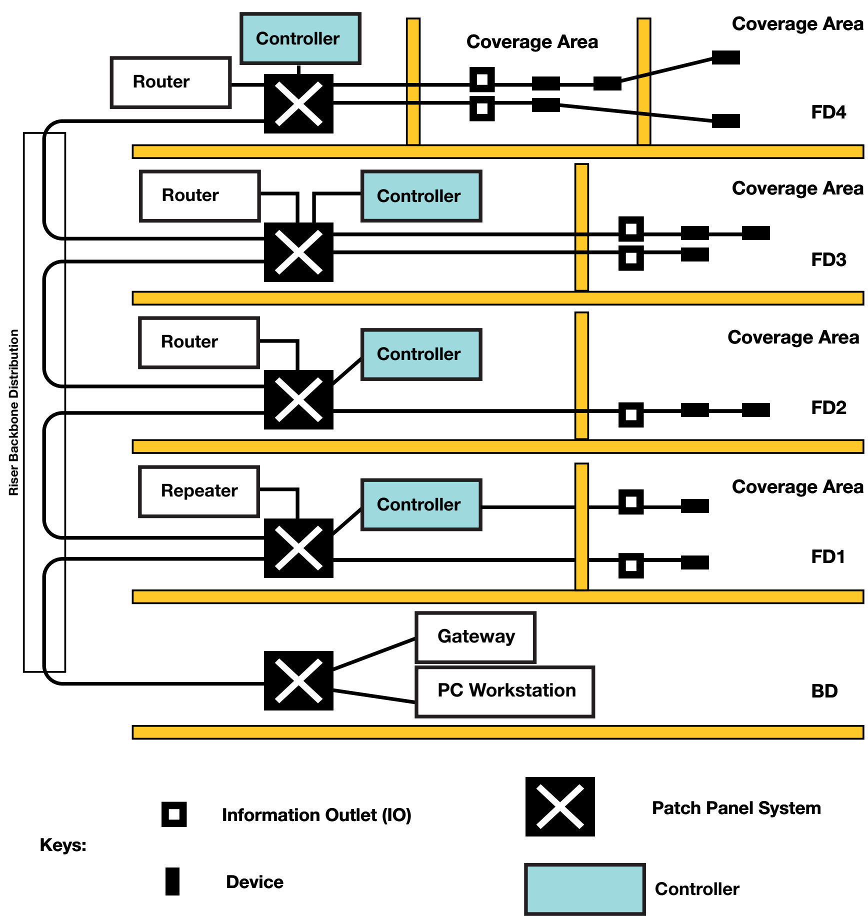
Centralization of controllers is recommended in implementing device densities and wiring. However, when this is not possible, controllers (that is, FTT-10A intelligent nodes) are installed in the coverage area for the device (for example, temperature sensors, dampers, etc.) it operates. Three controller branches are shown in Figure 3: (1) at left – 3 chained nodes, (2) in the center – 4 chained nodes; (3) at right – two chained nodes. The workstation is connected to the bus by the patch panel. Branches one, two and three are administered (as chained branches or bridged branches) in the BD.

3.1.3 Distributed Star Topology

An example of distributed star topology using repeaters and routers is shown in Figure 4. When there are multiple floors and each floor has a large number of controllers, the star topology is a convenient way to centralize control of the BAS. The bus is routed through the backbone cabling and each FD has controllers that support endpoint devices and other controllers on its floor. There is a star wiring configuration administered by the patch panel in the FD on each floor. If the FTT-10A channel segment distance and node count are at the maximum, repeaters are added in the FD to extend the capacity of the network. This is illustrated in Figure 4 at FD1, where the coverage area or number of nodes on the floor requires more than one segment.

When network capacity is reached (for example, due to traffic engineering, network partitioning, etc.), routers are used to communicate between two networks. Routers may be placed in any of the IBIS subsystems (BD, FD, campus, etc.) and count as a node on each of the channel segments it connects. See Figure 4 example.

Figure 4: Example of Distributed Controllers and Repeaters



3.2 FT-10A Cabling Topologies & Parameters

3.2.1 Point-to-Point Wiring and Daisy Chaining

Basic point-to-point wiring is illustrated in Figure 5. The recommendation for maximum horizontal distance (from cross-connect to the IO) is 90 meters. The point-to-point wiring may include a daisy chain of devices in the coverage area. This is illustrated in Figure 6.

Figure 5: Point-to-Point Wiring of Devices

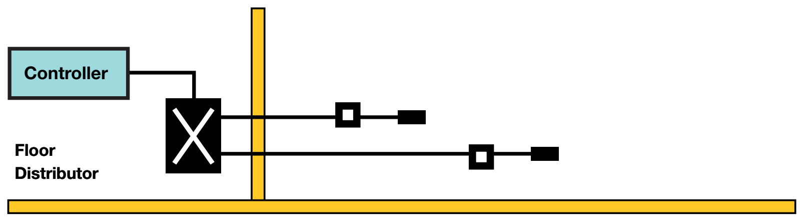
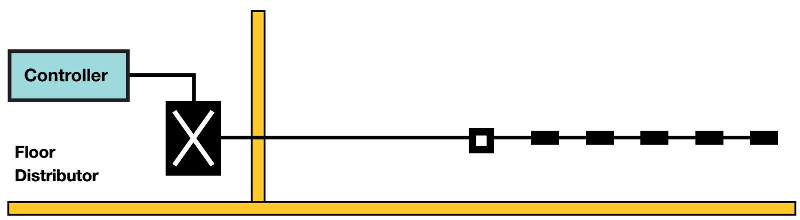


Figure 6: Point-to-Point Wiring and Daisy Chaining of Devices



3.2.2 FTT-10A Star Wiring

Basic star wiring is illustrated in Figure 7. The branches may have a single device or a chain of devices. There are two methods of forming a physical star cabling configuration. The first method is to bridge the branches together at the cross connect in the FD/TR (This is referred to as Chained Device connections in the CommScope IBIS General Design Guidelines for BAS documentation or Multipoint Bus in TIA/EIA-862). This is illustrated in Figure 8. The second method is to chain the branches in the FD/TR on the cross connect. In this method, each branch is serially connected to the other branches to form a bus (This is referred to as Chained Branches in the CommScope IBIS General Design Guidelines for BAS documentation or Chained Connections in TIA/EIA-862). This is illustrated in Figure 9.

Figure 7: Basic Star Wiring Configuration

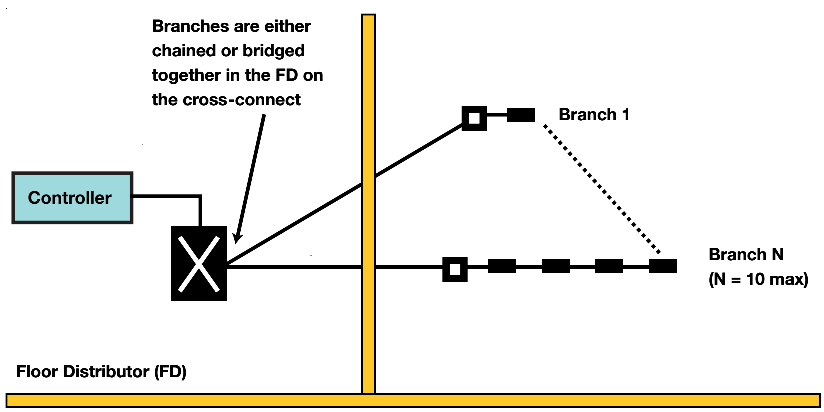


Figure 8: Bridged or Multipoint Bus Configuration

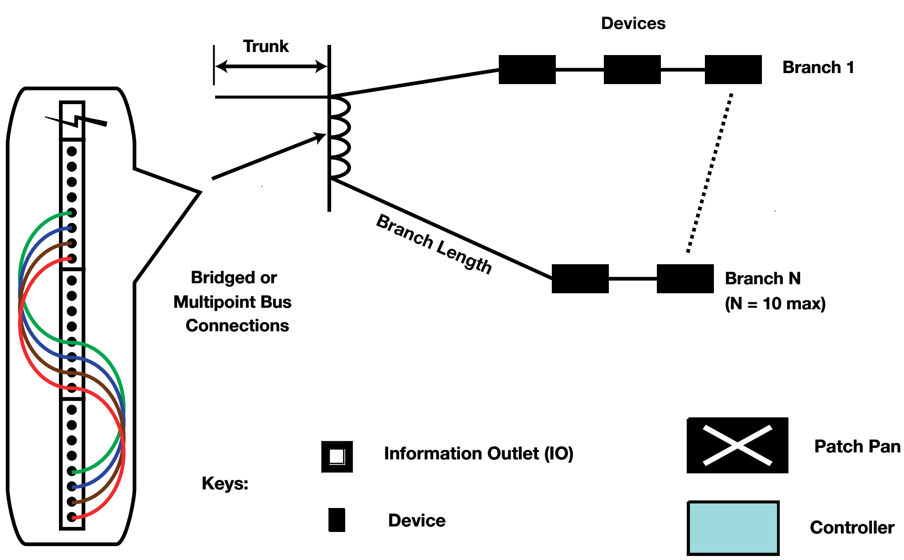
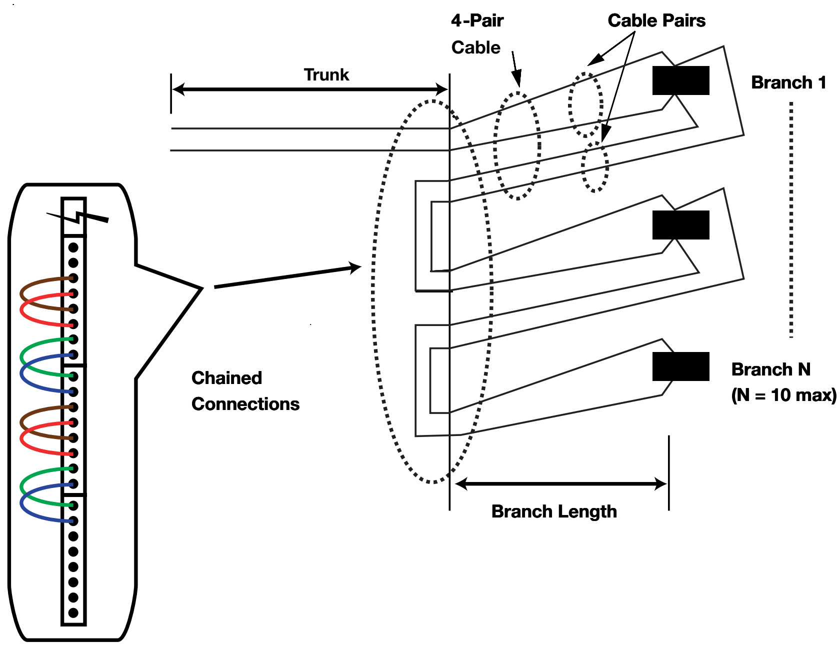


Figure 9: Chained Branches (Chained Connections) Configuration



3.2.2.1 FTT-10A Chained Branches

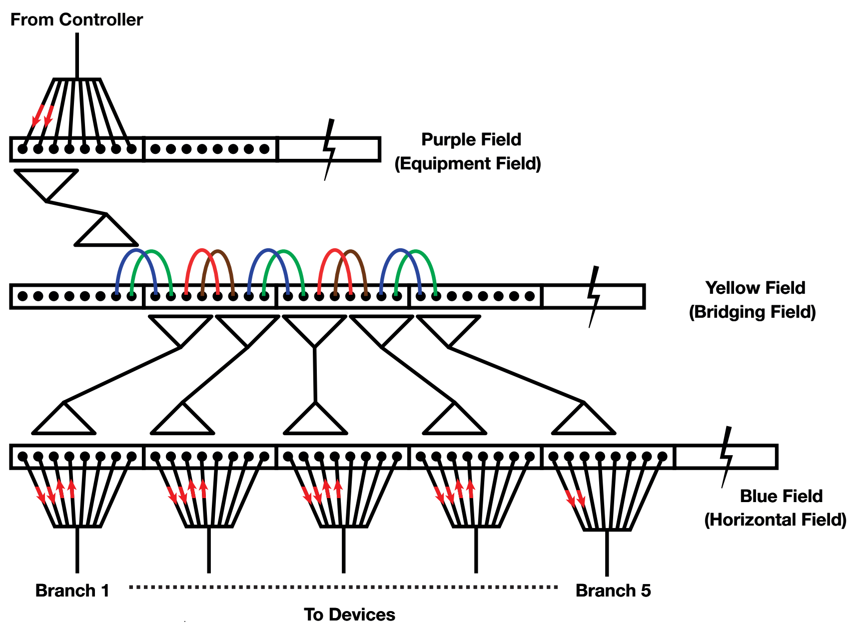
The following requirements must be applied to FTT-10A chained branch circuits:

1. Doubly terminated bus.
2. Total maximum cabling distance = 500 m (1640 ft) of 4-pair SYSTIMAX PowerSUM / GSXL/GSX10D cabling. This is equivalent to 900 m (2953 ft) of electrical length. The implementation of chained branches requires two pairs per 4-pair cable except for the last branch).
3. Maximum number of 100 m (328 ft) branches = 5.
4. Maximum number of devices = 64.
5. Maximum node-to-node distance = 500 m (1640 ft). This is equivalent to 900 m (2953 ft) of electrical length.
6. Minimum node-to-node distance = 0 m (0 ft).

The maximum length bus runs from the FD/TR cross-connect, where it is terminated, down pair 1 of the first branch cabling, loops back at the branch end and runs back up pair 2 in the same branch cabling to the FD/TR. Pair 2 of the first branch cabling is connected to pair 1 of the second branch cabling. The bus continues similarly down pair 1 of the second branch cabling and back on pair 2. This continues for the third, and fourth branch cabling, and finally runs down pair 1 of the fifth branch cabling, where it is terminated at the end. This creates a doubly-terminated bus with an electrical length of 900 meters on five 100 meter cabling branches. This is illustrated in Figure 10.

Note: The electrical length of each of the first four cabling is the length of pair 1 plus the length of pair 2. Since only one pair is used in the fifth branch, its electrical length is the length of pair 1.

Figure 10: FTT-10A Chained Branches Configuration



3.2.2.2 FTT-10A Bridged (Multipoint Bus) Branches

The following requirements must be applied to FTT-10A bridged branch circuits:

1. Singly terminated bus.
2. Total maximum cabling distance = 450 m (1476 ft)
3. Maximum number of 100 m (328 ft) branches = 4
4. Maximum number of devices = 64
5. Maximum node-to-node distance = 250 m (820 ft)
6. Minimum node-to-node distance = 0 m (0 ft)

3.2.3 FTT-10A Remote Star Wiring

The remote star wiring is the same as the star except that the controller is placed on a different floor or a location different than the FD/TR. This topology provides two points of administration: one administration in the BD/ER and one point of administration in the FD/TR. This allows greater flexibility in port assignment for changes and future technology upgrades. The trunk distance must be considered in the overall cabling distance. See Figure 11.

The rules for remote star wiring are the same as the star wiring with the following exceptions:

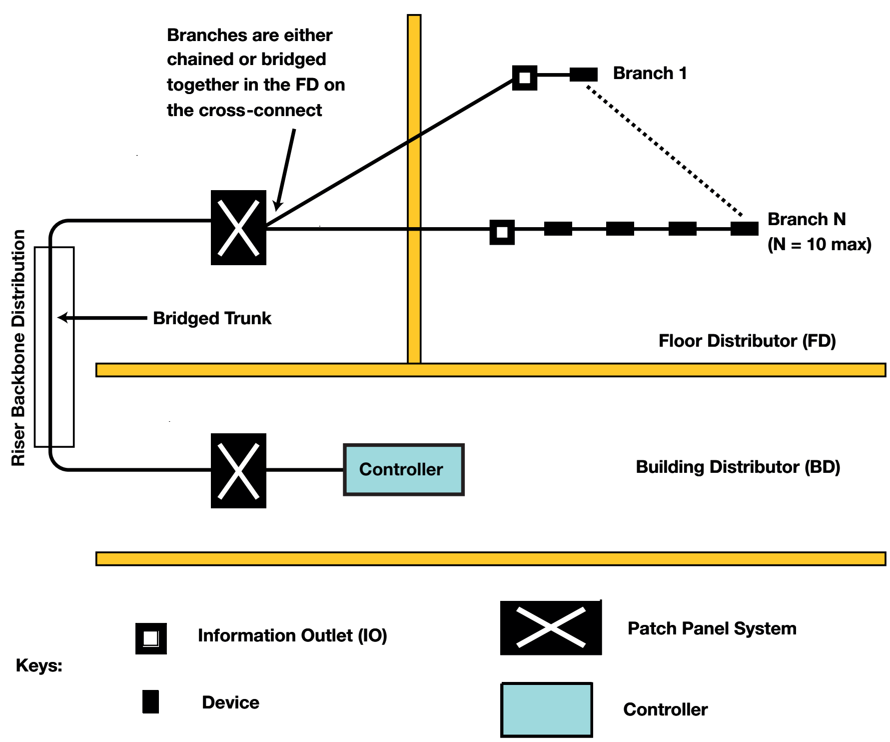
1. The length of the bridge trunk (see Figure 11) is subtracted from the total cabling length and the remaining cabling length is used to implement the chained branches.
2. If the bridge trunk length is less than a single branch length maximum (that is, 100 m [328 ft]), then the total branch count is the same as the star configuration but the last branch length is shorter by the trunk length.
3. If the trunk length is equal to or greater than a maximum branch length, the number of branches are reduced accordingly.

3.3 Shared Sheath Configuration

The signal of a FTT-10A communications bus shares a cable with itself. In the implementation of chained branches, FTT-10A signals share the same sheath.

The FTT-10A bus can share the same sheath as 10BASE-T and 100BASE-T signals.

Figure 11: Remote Star Wiring Configuration



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