
Classroom Setup Guide

The *Telephony Networking v2.1* Classroom Setup Guide is divided into three sections:

1. **Before You Begin** includes courseware update links for instructors, a revision history outlining the revisions made to a coursebook since the last version, an explanation of the requirements for preparing a classroom behind a proxy server, and additional notes that you should consider before you set up the classroom.
2. **Classroom Requirements** list the hardware, software, and network requirements to implement this course.
3. **Setup Instructions** include the configuration requirements for both instructor and student systems and a detailed list of required software installation procedures.

Before You Begin

This section includes courseware update links for instructors, a revision history outlining the revisions made to a coursebook since the last version, an explanation of the requirements for preparing a classroom behind a proxy server, and additional notes that you should consider before you set up the classroom.

Courseware updates

Instructors must download the latest courseware updates from the CTP Certified Web site (www.CTPcertified.com) before teaching the course. Prosoft courseware is updated continually, and the courseware updates provide the most current changes, revisions and notes for this Prosoft courseware.

Courseware updates include feedback from partners, clients and instructors who implement the *Telephony Networking* course. Feedback is reviewed and updates are posted in dynamic documents for both students and instructors. Each updates document correlates with the identical version of the coursebook (e.g., *Telephony Networking v1.0 Update* is designed to be used only with v1.0 of the *Telephony Networking* coursebook). Updates are available for the current version of the coursebooks.

Revision history

Released March 2003 (version 2.1)

This release is considered an errata rollover. The main differences between this *Telephony Networking* version 2.1 course and the previous version (version 2.0 released November 2002) are as follows:

- Expanded or added content in various topic areas, including the European Union Telecommunications Terminal Equipment Directive, the Electromagnetic Compatibility (ECM) Directive 89/336/EEC, the Low Voltage Directive (LVD), the Independent Committee for the Supervision of Standards of Telephone Information Services (ICSTIS), serial cable termination, V communication standards, Link Access Procedure for Modems (LAPM), and the residual current device (RCD).
- Several minor changes have been made to the text and some labs, including corrections of typographical and content errors.

Released December 2002 (version 2.0)

Version 2.0 of *Telephony Networking* includes the addition of standards specific to the United Kingdom, including:

- Material concerning British Telecom (BT) connectors, including BT-431A and 631A.
- Additional material concerning SONET networks, including a discussion of the Synchronous Digital Hierarchy (SDH).
- Discussion of the British Specified Numbering Scheme (SNS).
- Additional information concerning international exchanges and making phone calls.
- Labs concerning BT-style connectors and testing line voltages in the United Kingdom.
- An explanation of a public service integrated network (PISN).
- Material concerning the Digital Private Network Signaling Scheme (DPNSS) and QSIG.
- Material concerning SS7 and ISDN interaction.
- Discussion of earth-start testing in the United Kingdom.
- Addition of the following labs:
 - Lab 1-2: Investigating a local telephone connection, United Kingdom (instructor-led)
 - Lab 2-2: Creating a telephone cable, United Kingdom (instructor-led)
 - Optional Lab 2-1: Reviewing the Specified Numbering Scheme, United Kingdom
 - Optional Lab 2-4: Wiring a line jack unit, United Kingdom (instructor-led)
 - Lab 4-2: Checking local loop voltage, United Kingdom
 - Optional Lab 4-2: Using a butt set on an analog line, United Kingdom
 - Optional Lab 4-5: Using a line tester, United Kingdom
- Correction of existing material concerning Ethernet standards, USOC/RJ-45 and crossover cables.

Preparing the classroom behind a proxy server

Internet access is not required for this course, but it is preferred. If your classroom is behind a proxy server, you may have problems downloading programs during classroom setup and completing certain labs during class. Most proxy servers already allow HTTP traffic. Difficulties may arise when you require additional services, such as e-mail, FTP, and program downloads.

Two suggestions are offered:

1. Talk with the network administrator at the location and make sure that:
 - a. The classroom has proper access to all Internet-related protocols used in the class. Examples include HTTP (TCP/UDP port 80), SSL (TCP/UDP port 443), FTP (TCP/UDP port 20, 21), Telnet (TCP/UDP port 23), POP3 (TCP/UDP port 110), SMTP (TCP/UDP port 25), NNTP (TCP/UDP port 119), and Gopher (TCP/UDP port 70). For certain services, such as FTP, you will need all ports above 1023 (registered ports).
 - b. The IP addresses assigned to the computers in your classroom have permission to access the Internet.
2. Download all the required software (with proper licensing) for the course before you arrive at the site, and place the source files on the instructor's computer. Students can then access all source files from

shares that you create. Perhaps an instructor can create a CD with the required software source files. This will not solve the issues addressed in the first suggestion, but will solve any problems concerning downloads.

Classroom Requirements

This course, *Telephony Networking*, uses computers only for optional labs to access the Internet. However, the other courses in this series (*Data Networking* and *Convergence Technologies*) use Windows 2000 server; if you are teaching this course as part of the CTP series, make the computers available to students when necessary. If you are not teaching this course in a series, it is recommended that you make Internet-ready systems available to your students. As long as students can access the Internet, use a browser and use a media player (e.g., Windows Media Player), they will be able to conduct all optional labs.

Hardware requirements

Computers are not required for this course, but are recommended for Internet research. The course focuses on hands-on labs using telephony equipment (see the *Additional Hardware* section).

The following table summarizes the hardware requirements for this course. Each classroom should be equipped with enough personal computers to accommodate each student and the instructor with his or her own system.

The hardware requirements are similar to the lowest system requirements for Microsoft implementation (Level 1 requirements) except that these specifications require increased hard disk space (8 GB) and RAM (128 MB). This comparison may be helpful for the many training centers that implement *Telephony Networking* and are also CTEC because these centers will be familiar with the Microsoft hardware specifications.

CTP Hardware Specifications	Minimum Requirements
Processor	Intel Pentium II (or equivalent) personal computer with processor speed greater than or equal to 300 MHz
L2 cache	256 KB
Hard disk drive	8-GB hard disk drive
RAM	128 MB
CD-ROM	32X
Network interface card (NIC)	10BaseT or 100BaseTX (10 or 100 Mbps)
Sound card/speakers	Required for instructor's station, optional for student stations
Video adapter	4 MB
Monitor	15-inch monitor
Network hubs	Two 10-port 10BaseT or 100BaseTX (10 or 100 Mbps) hubs
Router	Multi-homed system with three NICs (Windows 2000/NT 4.0 server) <i>(Optional, for Internet access)</i>

Additional instructor hardware (North America)

Instructors require the following hardware to complete the course. For more information on the additional hardware required for this course, see the *Purchasing Telephony Hardware* section in this guide.

- A working analog telephone line for conducting connectivity tests and analyzing concepts such as tip and ring.
- Lineman's test handset (i.e., butt set).
- Tone and probe set.
- Line tester for RJ-45 and RJ-11 connectors.
- Crimper for RJ-11 and RJ-45 connectors.
- Digital multimeter.
- Category 3 station wire bundle: to be used to conduct wire bundle tests using the tone and probe set.
- Category 3 station wire: enough for 3 feet of wire for each student to be used in creating a telephone patch cable using RJ-11 connectors.
- Category 5 plenum cabling: enough for 3 feet of wire for each student.
- Ten RJ-11 connectors for each student.
- Ten RJ-45 connectors for each student.
- A standard RJ-11 wall jack.
- Punchdown tool, with 66 and 110 blade connectors (*optional*)
- Modular breakout adapter (i.e., an adapter that plugs into a standard RJ-11 or RJ-12 phone jack, but allows you to connect each wire to a connector using alligator clips). *Optional*

Additional instructor hardware (United Kingdom)

Instructors require the following hardware to complete the course. For more information on the additional hardware required for this course, see the *Purchasing Telephony Hardware* section in this guide.

- A working analog telephone line for conducting connectivity tests and analyzing concepts such as tip and ring voltage.
- Lineman's test handset (i.e., butt set).
- Tone and probe set.
- Cable (line) tester for RJ-45, and BT-431A/631A connectors.
- Crimper for BT-431A/631A and RJ-45 connectors. You may have to purchase a different crimper for each connector type. The BT-431A houses four wires. The BT-631A houses six wires.
- Category 3 station wire bundle: to be used to conduct wire bundle tests using the tone and probe set.
- Category 3 station wire: enough for at least 1 meter of wire for each student to be used in creating a telephone patch cable using BT-431A/631A connectors.
- Category 5 plenum cabling: enough for at least 1 meter of wire for each student.
- Ten BT-431A or BT-631A connectors for each student. If you want, purchase equal amounts of both types of connectors.
- Ten RJ-45 connectors for each student.

- A screw-type master line jack unit 1. If you do not purchase a screw-type master line jack unit, you will have to obtain a Krone punchdown tool, discussed below. A different type of master line jack unit (e.g., 2 through 5) can be used, if available.
- A screw-type secondary line jack unit 1. If you do not purchase a screw-type master line jack unit, you will have to obtain a Krone punchdown tool, discussed below. A different type of secondary line jack unit (e.g., 2 through 5) can be used, if available.
- Modular breakout adapter (i.e., an adapter that plugs into a standard BT phone line, but allows you to connect each wire to a connector using alligator clips). If you want, you can purchase a “Plug/spade” BT-207A cable. *Optional*
- Krone punchdown tool, for wiring line jack units that are not screw-type. *Optional*

Additional student hardware (North America)

Students require the following hardware to complete the course. For more information on the additional hardware required for this course, see the *Purchasing Telephony Hardware* section in this guide.

- Digital multimeter.
- Ten RJ-11 connectors for each student.
- Ten RJ-45 connectors for each student.
- Category 3 station wire: enough for 3 feet of wire for each student.
- Category 5 plenum cabling: enough for 3 feet of wire for each student.
- Crimper for RJ-11 and RJ-45 connectors.

Additional student hardware (United Kingdom)

Students require the following hardware to complete the course. For more information on the additional hardware required for this course, see the *Purchasing Telephony Hardware* section in this guide.

- Digital multimeter.
- Ten BT-431A or BT-631A connectors for each student. If you want, you can purchase equal numbers of BT-431A and B-631A connectors.
- Ten RJ-45 connectors for each student.
- Category 3 station wire: enough for at least 1 meter of wire for each student.
- Category 5 plenum cabling: enough for at least 1 meter of wire for each student.
- Crimper for BT-431A/BT-631A and RJ-45 connectors. You may have to purchase a crimper for each type of connector.

Software (optional)

Computers are not required for this course, but are recommended for Internet research. The course focuses on hands-on labs using telephony equipment (hardware). The recommended operating system for this course is Microsoft Windows 2000 Server (with a Web browser) because it is used in the two other CTP series courses (*Data Networking* and *Convergence Technologies*).

Networking requirements

Internet connectivity is not required for this course, but it is highly recommended. You will find Internet access useful for technology demonstrations, online experimentation, and further study and research. Obtain TCP/IP configurations using DHCP. If DHCP is not available, contact your network administrator for valid TCP/IP configurations.

Setup Instructions

Use the following procedures to set up the optional computers for class. The instructor and student computers are configured almost identically. The only differences are identified in the specially marked sections titled "Instructor System Only."

System setup

Use the following instructions to set up the classroom systems.

To set up the hardware

Set up the hardware according to the manufacturer's instructions. (Refer to the hardware requirements.)

To set up the software

Before installing Windows 2000, consult the hardware compatibility list (HCL). The HCL for Microsoft 2000 is at www.microsoft.com/hcl/.

To install and configure Windows 2000 Server

1. Start the setup by using the **Windows 2000 Server Setup Disks**, or going to the location of the i386 source files directory (such as on the Windows 2000 Server CD at D:\i386) and entering **winnt**. It is recommended that you use the Windows 2000 Server Setup Disks.
2. Accept the licensing agreement by selecting **F8**.
3. Install Microsoft Windows 2000 Server with the following parameters.

When This Information Is Required	Use
Phase 1	
Partition Location	C:
Partition Size	Depends on the size of your hard drive
Partition File System	NTFS
Location	C:\Winnt
Phase 2	
Regional Settings	Customize for your location.
Name	Your name
Organization	Your organization
CD Key	The CD Key for your copy of Windows 2000 Server
Licensing Modes	Per server
Concurrent Connections	Enter at least the number of student computers in the classroom.

When This Information Is Required	Use
Computer Name	<i>Instructor</i> or <i>StudentX</i> (where <i>X</i> is the assigned student number, such as Student13) <i>Note: If you are teaching where several classrooms are connected, you may encounter name conflicts. If so, add a number or letter to the name. For example, name the instructor computer instructor1 and a student13 computer student13a.</i>
Administrator Password	password (all lowercase)
Windows 2000 Components	Remove Indexing Service
Date and Time Settings	Customize for your location
Network Settings	Custom Settings
Networking Components	Select Internet Protocol (TCP/IP) and click Properties . Select Obtain an IP address automatically . If your network does not use DHCP, you must contact your network administrator to receive your IP configurations. Then select Use the following IP address radio button and manually enter the IP configurations.
Workgroup or Computer Domain	Select No, this computer is not on a network, or is on a network without a domain . In the Workgroup or Computer Domain field, enter Classroom . <i>Note: If you are teaching where several classrooms are connected, you may encounter name conflicts. If so, add a number to the name. For example, name the workgroup Classroom1.</i>
Microsoft Windows 2000 Configure Your Server	After restart, the Configure Your Server window will appear after you log on using the administrator account. Select I will configure this server later and click Next . Deselect the Show this Screen at Startup check box and close the window. The systems will be configured throughout the course labs.

Telephony Labs

Table CS-1 contains instructions to help you prepare for labs designed for North America. Table CS-2 contains instructions to help you prepare for labs designed to be conducted in the United Kingdom. See the *Additional Hardware* requirements for telephony equipment needed to teach this course.

Table CS-1: Preparing for labs (North America)

Lab	Required Tools
Lab 1-1 (North America): Investigating a local telephone connection (instructor led)	A working telephone line with a handset.
Optional Lab 1-1: Viewing telco equipment, North America and the United Kingdom	Access to a server room containing telephony equipment.
Lab 2-1: Creating a telephone cable, North America (instructor-led)	Crimper, 3 feet of cat 3 cable, at least 2 RJ-11 connectors (more, in case mistakes are made). If possible, obtain additional crimpers so that students can follow along as you create a cable.
Optional Lab 2-2: Generating and viewing DTMF tones, North America and the United Kingdom	A standard, Internet-ready PC, with a media player (e.g., Windows Media Player, or WinAmp) and speakers.
Optional Lab 2-3: Studying a phone jack, North America (instructor-led)	A standard telephone wall jack, and a screwdriver to detach a wall plate in order to attach the wall plate, if you want.
Optional Lab 3-1: Wiring an RJ-45, North America and the United Kingdom	Crimper, three feet of Cat 5 cable, at least 2 RJ-45 connectors (more, in case mistakes are made). If possible, obtain additional crimpers so that students can follow along as you create a cable.
Lab 4-1: Checking local loop voltage, North America	A digital voltmeter, a standard, working analog local loop line, and a screwdriver (to detach the wall plate to expose wiring).
Optional Lab 4-1: Using a butt set on an analog line, North America	A screwdriver (to detach the wall plate to expose wiring). A butt set, complete with clips ("bed of nails" clips are recommended).
Optional Lab 4-3: Using a tone and probe kit, North America and the United Kingdom	A tone and probe (i.e., fox and hound). A wire bundle to have students determine where a wire is located. The wire will have to be connected to ground (i.e., earth). You will need two butt sets to use the tone generator's talk battery power.
Optional Lab 4-4: Using a line tester, North America	A line tester (often in two parts, one for each end of the cable) and patch cables that have RJ-11 and RJ-45 endings.
Optional Lab 5-1: Investigating PBX connections, North America and the United Kingdom (instructor-led)	Access to a PBX. You will likely have to obtain permission from a systems administrator. Digital multimeter, to test voltages. Be extremely careful that you do not interrupt telephony service for your company.

Note: You are encouraged to create your own labs. However, make sure that all labs you create correspond to course objectives.

Table CS-2: Preparing for labs (United Kingdom)

Lab	Required Tools
Optional Lab 1-1: Viewing telco equipment, North America and the United Kingdom	A working telephone line with a handset.
Lab 1-2: Investigating a local telephone connection, United Kingdom (instructor-led)	A working telephone line with a handset.

Table CS-2: Preparing for labs (United Kingdom)(cont'd)

Lab	Required Tools
Lab 2-2: Creating a telephone cable, United Kingdom (instructor-led)	Crimper, at least 1 meter of cat 3 cable, at least 2 BT-431A connectors (more, in case mistakes are made). If possible, obtain additional crimpers so that students can follow along as you create a cable.
Optional Lab 2-1: Reviewing the Specified Numbering Scheme, United Kingdom	A standard, Internet-ready PC, with a media player (e.g., Windows Media Player, or WinAmp) and speakers.
Optional Lab 2-2: Generating and viewing DTMF tones, North America and the United Kingdom	A standard, Internet-ready PC, with a media player (e.g., Windows Media Player, or WinAmp) and speakers.
Optional Lab 2-4: Wiring a line jack unit, United Kingdom (instructor-led)	A screw-type type 1 master line jack unit. You will also need a wall connection to wire the line jack unit into. If you do not have a screw-type line jack unit, you will also need a Krone-type IDC tool.
Lab 4-2: Checking local loop voltage, United Kingdom	A digital voltmeter, a standard, working analog local loop line, and a screwdriver (to detach the wall plate to expose wiring).
Optional Lab 4-2: Using a butt set on an analog line, United Kingdom	A screwdriver (to detach the wall plate to expose wiring). A butt set, complete with clips ("bed of nails" clips are recommended).
Optional Lab 4-3: Using a tone and probe kit, North America and the United Kingdom	A tone and probe (i.e., fox and hound). A wire bundle to have students determine where a wire is located. The wire will have to be connected to ground (i.e., earth). You will need two butt sets to use the tone generator's talk battery power.
Optional Lab 4-5: Using a line tester, United Kingdom	A line tester (often in two parts, one for each end of the cable) and patch cables that have BT-431A/631A and RJ-45 endings.
Optional Lab 5-1: Investigating PBX connections, North America and the United Kingdom (instructor-led)	Access to a PBX. You will likely have to obtain permission from a systems administrator. Digital multimeter, to test voltages. Be extremely careful that you do not interrupt telephony service for your company.

Purchasing Telephony Hardware (North America)

Following is a description of the telephony equipment required for the CTP courseware, including pricing at the Home Depot USA hardware store (www.homedepot.com). This additional hardware is beyond the student and instructor computers, and is specific to hands-on telephony fundamentals. The equipment mentioned was used to develop the course, but you can use your own equipment.

- Lineman's test handset, also called a butt set. (e.g., a Harris TS19 with alligator clips, Model number 19800-HD9, SKU #164911).
- Tone and probe set (Harris Pro 2000, Model number 26000-800, SKU #165280).
- Line tester for RJ-45 and RJ-11 connectors (Ideal LinkMaster, Model number 62-200, SKU # 513606).
- Crimper for both RJ-11 and RJ-45 connectors (Ideal Ratchet Telemaster 30696, SKU #388438). Or, you can use the Telephone Installation Kit (Model #33700 and SKU #324978), which is the same thing with 10 RJ-11 and 10 RJ-45 connectors.
- Digital multimeter (for example, the Sperry model number #DM350A, SKU #276539).

- Three feet of standard category 3 station wire for each student to be used in creating a telephone patch cable using RJ-11 connectors. *(Note: The Home Depot Web site is not the best place to obtain this wire. It is expensive. Contact Home Depot directly, or work with another vendor).*
- A category 3 station wire bundle: to be used to conduct wire bundle tests using the tone and probe set. *(Note: The Home Depot Web site is not the best place to obtain this wire. It is expensive. Contact Home Depot directly, or work with another vendor).*
- Category 5 plenum cabling: enough for 3 feet of wire for each student. *(Note: The Home Depot Web site is not the best place to obtain this wire. It is expensive. Contact Home Depot directly, or work with another vendor).*
- A standard RJ-11 wall jack (e.g., an RCA model number TP 247X, SKU # 116059). *(Note: The Home Depot Web site is not the best place to obtain this wire. It is expensive. Contact Home Depot directly, or work with another vendor).*
- Ten RJ-11 connectors for each student. (The Home Depot Web site has only packages with 25 RJ-11s. The model number is 85345, and the SKU # is 324778.) Use 6-position.
- Ten RJ-45 connectors for each student. The Home Depot Web site has only packages of 25 RJ-45 connectors, as of this writing. The model number is 85346, and the SKU # is 324844.
- Optional: Punchdown tool with 66 and 110 blade connectors. Currently, no labs exist on using a punchdown tool, as the classroom is not required to have a 66 or 110 punchdown block present. However, instructors may want to bring one to class, such as standard punchdown tool (the Punchmaster™ II Turn-Lock Punch Down Tool, model number 35485, SKU #279343).

Again, everything listed above is available at Home Depot USA (www.homedepot.com). All prices are standard retail prices. You can also visit www.phonegeeks.com and review prices.

Purchasing Telephony Hardware (United Kingdom)

Following is a description of the telephony equipment required for teaching the CTP courseware in the United Kingdom. This additional hardware is in addition to the student and instructor computers, and is specific to hands-on telephony fundamentals. The equipment mentioned was used to develop the course, but you can use your own equipment.

- Lineman's test handset, also called a butt set (e.g., the Alert 340 Test Butt, model number C00-5052, available from www.millsltd.com).
- Tone and probe set (e.g., the Tone Probe 510/Tone Generator 210 kit, model number 358-2167, available from the RS Components Web site [www.rswww.com]).
- Cable (line) tester for an RJ-45 connector (e.g., Adaptor Test RJ45, model number C00-3115), as well as a cable tester for the BT-431A /631A connectors (e.g., Adaptor Test B.T. Plug, model number C00-1575), all available at www.millsltd.com. The LinkMaster 62-200, available at the RS Components page (www.rswww.com), will work for RJ-45 connectors.
- Crimper for an RJ-45 connector, as well as for the BT-431A/631A connectors (e.g., the B.T. Modular Plug Crimper, model number E72-1018, available at www.millsltd.com). You can also obtain termination tools for BT 431A /631A connectors at RS components (www.rswww.com).
- Modular breakout adapter (i.e., an adapter that plugs into a standard BT phone line, but allows you to connect each wire to a connector using alligator clips). The following modular breakout adapter, available through the Mills Web site (www.millsltd.com), is suitable: Modular Adaptor B.T. Plug, part number C00-1088. If you want, you can purchase a "Plug/spade" BT-207A cable from www.rswww.com. The 4-wire cable part number is 470-156. The 6-wire part number is 470-162.
- Digital multimeter (e.g., the Sperry model number #DM350A).

- At least 1 meter of standard category 3 station wire for each student to be used in creating a telephone patch cable using BT 431A /631A connectors. You could use cord such as the 120-ohm double-screened twisted-pair cable, stock number 342-8041, available at RS Components (www.rswww.com).
- A screw-type master line jack unit 1 (e.g., part number 9LJ1930304, from RS Components, RS stock number 472-512). The RS Components Web page is at www.rswww.com. If you do not purchase a screw-type master line jack unit, you will have to obtain a Krone punchdown tool, discussed below. A different type of master line jack unit (e.g., 2 through 5) can be used, if available.
- A screw-type secondary line jack unit 1 (e.g., part number 9LJ1930306 from RS Components, RS stock number 470-364). The RS Components Web page is at www.rswww.com. If you do not purchase a screw-type master line jack unit, you will have to obtain a Krone punchdown tool, discussed below. A different type of secondary line jack unit (e.g., 2 through 5) can be used, if available.
- A category 3 station wire bundle: to be used to conduct wire bundle tests using the tone and probe set. Wire can be obtained from various places, including RS Components (www.rswww.com).
- Category 5 plenum cabling: enough for at least 1 meter of wire for each student. Wire can be obtained from various places, including RS Components (www.rswww.com).
- Ten BT-431A or BT-631A connectors for each student. If you want, you can obtain equal amounts of each connector. The BT-431A connectors are available at the RS Components Web site (www.rswww.com), as stock number 470-229. The BT-631A connectors are available from the same site as stock number 470-241.
- Ten RJ-45 connectors for each student. Available at various places, including RS Components (www.rswww.com).
- A Krone punchdown tool, if you purchase line jack units that are not screw-in type (e.g., punchdown tool stock number 420-7609 from RS Components). *Optional*