



DT-6XXX

LOOP TEST NETWORKING

IP-LTCN APPLICATION

USER'S MANUAL



RELEASE 14 VERSION 1

BUILD 14.1

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1 FORWARD

The Mechanized Loop Test operations system has been around since what can seem like the dawn of time. It provides a necessary testing function in the maintenance of end user loop facilities. The Mechanized Loop Test operations system has been continually updated to support an 'up to date' set of loop elements.

The communications between the Mechanized Loop Test operations system contain components that have become manufacturer discontinued. As such, the communications path between the Mechanized Loop Test operations system and the loop test equipment is at risk.

The IP-LTCN application will be described as a replacement for all existing communications environments.

The IP-LTCN application is an Internet Protocol replacement that has been designed to be used in conjunction with the Tollgrade LoopCare product. Support and feature request issues should be addressed directly to the author of this document.

2 GLOSSARY

BNS	Broadband Networking System
BX.25	Bell System X.25 Protocol Specification.
CO	Central Office
CODEC	Coder/Decoder
COLO	Central Office Co-Location
DCN	Loop Test System Data Communications Network
DCTU	Directly Connected Test Unit
DK	Datakit
DMN	Digital Measurement Node
DMU	Digital Measurement Unit
IP	Internet Protocol
LCN	Loop Test System Communications Network
LMOS	Loop Maintenance Operations System
LoopCare	The new name for the Mechanized Loop Test Operations System.
LTCN	Loop Test System TCP/IP Communications Network
LTS	Loop Test System
MLT	Mechanized Loop Test Operations System
NE	Network Element
OS	Operations System
OSS	Operations Support System
RFC	Request For Comments (Internet Specifications)
SNMP	Simple Network Management Protocol



TCP	Transport Control Protocol
TCP/IP	Transport Control Protocol over the Internet Protocol
UMI	Universal Mediation Interface (Datakit/BNS interface module)
URP	Universal Receiver Protocol



3 SUGGESTED REFERENCE

The following documents are resident at <http://www.datatekcorp.com> under the documentation button.

<u>Document</u>	<u>Scope</u>
DT-6xxx Platform User's Manual.	Describes the DT-6xxx Embedded Network Processor infrastructure and command set. This includes configuration information, hardware specifications, and SNMP MIB support. The DT-6xxx is the infrastructure on which the Mechanized Loop Test communications applications reside.
DT-4000 User's Manual.	Describes the DT-4000 multi-protocol access device. The DT-4000 implements special functions enabled by the IP-LTCN to interface with LTS and DCTU interfaces.
DT-4180 User's Manual	Describes the DT-4180 access device. The DT-4180 implements special functions enabled by the IP-LTCN to interface with LTS and DCTU interfaces.
DT-4216, DT-4232, DT-4280 User's Manual	Describes the DT-42xx series of access devices. The DT-42xx implements the special functions enabled by the IP-LTCN to interface with LTS and DCTU interfaces.
DT-6xxx Redundant Operation White Paper.	Describes the method of operating the DT-6xxx in a 1+1 sparing configuration.



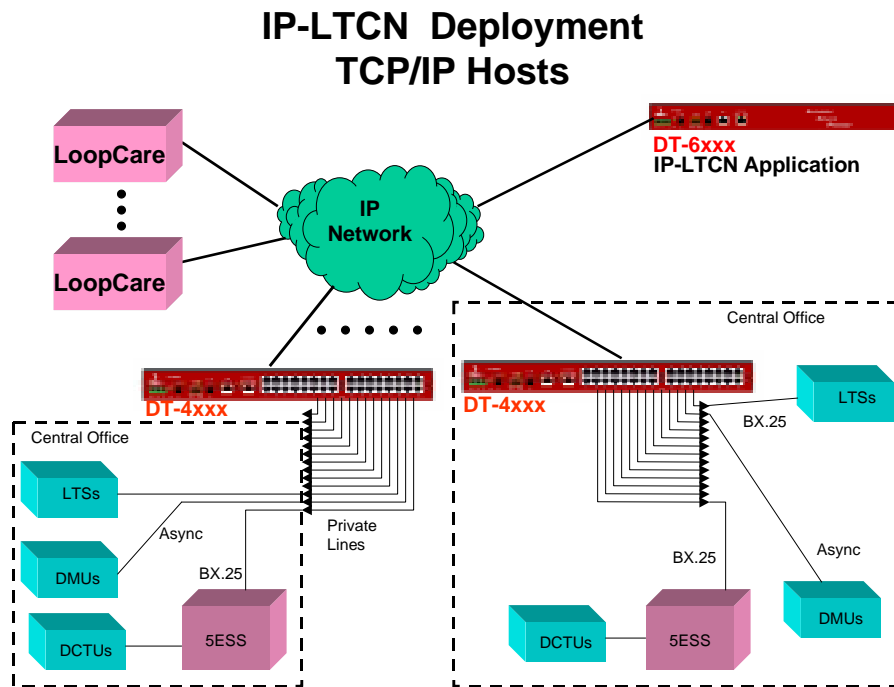
4 THE IP-LTCN MIGRATION SOLUTION

The IP-LTCN application is a migration solution for all variants of the Loop Test Communications Environments. It is designed to be used in conjunction with an Internet Protocol conversion of the Tollgrade LoopCare product. The LoopCare product is the evolution of the Lucent Technologies MLT operations system.

The IP-LTCN can replace a DCN in its entirety. This eliminates a maintenance risk since the DCN is manufacturer discontinued, with a consequential shortage of spare parts. A side benefit is that the IP-LTCN will free up the 120 square feet of conditioned floor space taken up by the DCN.

The IP-LTCN supports an enhanced TCP/IP interface to the LoopCare host. This allows connectivity with the LoopCare hosts using an IP infrastructure. The new LoopCare hosts do not have either a BX.25 interface to communicate with a DCN, nor a fiber interface to communicate with a BNS node. Instead, the LoopCare hosts have implemented a direct TCP/IP interface to the IP-LTCN application.

The following diagram shows this arrangement:



In the diagram above, the asynchronous DMUs would be accessed directly by the LoopCare OS host. The LoopCare OS host would establish a TCP connection with the DT-4xxx port to which the DMU is attached. Data exchange would proceed using RFC 854 encapsulation as normal.

The LTS connections (and DCTU connections via the 5ESS) would be exactly the same as in the LCN or DCN cases. That is, the LTS link is connected to the DT-4xxx port. The DT-4xxx port is configured to originate a TCP connection to the IP-LTCN at the TCP port number corresponding to the LTS identification.

The OS host connections to the IP-LTCN are done directly using TCP/IP. This is done at the designated TCP port number for this type of interface. See the interface section of this document for more details. The host protocol suite is fully supported. Status information of the LTS connections will be available if the MLT OS host desires.



5 REDUNDANCY & RELIABILITY ISSUES

The Loop Test operation requires a very high reliability. Each solution provides some form of protection. However, the IP-LTCN is superior in all regards.

The DCN approach to this type of reliability was in having the ability of multiple “A” cabinets access an LTS on a single “B” cabinet. The MLT host would then be attached to two “A” cabinets. If a BX.25 link from the host to the “A” cabinet would fail, test operations would proceed on the alternate connection. If an “A” cabinet would fail, the alternate “A” cabinet would still be attached to the host and could proceed with the test operations. However, if a “B” cabinet should fail; then all the LTS connections would not be protected. An engineer would need to re-cable the LTS links to another “B” cabinet manually.

The LCN approach to this type of reliability was hinged on the DKAP making the outbound calls to the SAM endpoints on the BNS network. Should the DKAP fail, then all connections would be torn down. A new DKAP would then be brought into service manually. The MLT host would then reconfigure the DKAP and establish new calls to the LTS endpoints on the SAM. Note that this is a manual operation since the address groups for the DKAP to which the MLT OS hosts make the call need to be unique to a single DKAP channel sets. Consequently, they cannot be pooled reliably. Consult the BNS documentation for more information.

The IP-LTCN application relies on the DT-6xxx redundancy infrastructure for its reliability. The DT-6xxx infrastructure provides 100% reliability through a 1+1 spare arrangement. Should a DT-6xxx fail, the spare would immediately take over automatically. The spare would become the active DT-6xxx in the set, and assume the public IP address of the set. It should be noted that the application interfaces do not need to change, or even be made aware, of the duplex nature of the DT-6xxx redundancy. The IP-LTCN implements both the “A” and “B” cabinets of the DCN, and all interface paths of the LCN. Consequently, the IP-LTCN is the most reliable solution possible for the loop test environment. Consult the DT-6xxx redundancy documentation for more information. Redundancy is optional. It is not required by the IP-LTCN application.



6 IP-LTCN INTERFACES

The TCP port numbers associated with a DT-6xxx application are normally referenced by which **instance** the application is installed. The IP-LTCN is different in that premise because of the large number of distinct TCP port numbers, the need to simplify administration, and engineering configurations.

The IP-LTCN application may only be installed on **instance #1** of the DT-6xxx. Installing on any other instance will result in a periodic alarm after which the IP-LTCN will proceed to sleep perpetually. Consult the DT-6xxx infrastructure manual for information on how to install an application.

The TCP Numbers associated with the IP-LTCN application (using **instance #1** as required) are as follows:

Set	#Channels	TCP Port#	Usage
OA&M	1	10001	Configuration and administration of the IP-LTCN application. This is the standard configuration TCP port number for instance #1. The general formula is 10,000 + instance#. Connections to this TCP port are made via a Telnet client.
Host	20	30001 - 30020	These are the host data port connections. They are maintained as separate TCP port numbers so that every LoopCare OS host may be configured uniquely. In that manner, access is always guaranteed for a particular host.



Control	20	31001 - 31020	Each of these TCP ports reports status, and provides a mechanized control interface to a host. This interface is documented as an appendix to this document. All of the control connections are equivalent. They are maintained as separate TCP ports so that each one may be configured uniquely.
LTS	768	40000 + LTS ID	There are a total of 768 TCP ports reserved for LTS connections. These are from 40,001 through 40,768 and correspond to LTS ID 1 through 768 inclusive. This is identical to a physical mapping on a DCN "B" cabinet. BX.25 from the LTS connections are terminated by the IP-LTCN on these connections.

An example of how these circuits are used follows:

The IP-LTCN would be assigned to instance #1 on the DT-6xxx. Once done, the IP-LTCN will listen for inbound TCP connections on all of the TCP port numbers specified above.

Each DT-4xxx port on which an LTS is connected then originates a TCP call to the IP-LTCN application at its LTS identification TCP port number (40,001 to 40,768). The IP-LTCN will then establish and terminate the BX.25 protocol to the LTS on these connections.



A TCP/IP LoopCare OS host responsible for control functions, including address upload, would attach any of the TCP port numbers between 31,001 and 31,020. This connection is optional, and not required for the proper operation of the IP-LTCN.

Any TCP/IP LoopCare OS host may also make a connection to the IP-LTCN at TCP port numbers 30,001 to 30,020.

No correspondence exists between the TCP ports used for host interfaces, and the TCP ports used for control interfaces. All control interfaces are equivalent to each other. All host interfaces are equivalent to each other. The multitude of each type is to allow for simultaneous access for different hosts.

Once both the LoopCare OS host and LTS endpoints have established connections; the IP-LTCN can emulate the DCN/LCN functions as needed.



7 IP-LTCN APPLICATION COMMAND SET

7.1 INPUT CONVENTIONS

All parameters may be given on the command line. Parameters of the form **name=<value>** may be given in any order.

For several complex commands, listed below, missing parameters, or corrections of errors in given parameters, of the form **name=<value>** are collected by prompting the console user. The user responds to a prompt for the **name** by typing the required **<value>** followed by *newline*. Defaults are supplied in some cases, so the user need only enter *newline*.

Commands may be entered in upper or lower case.

Parameters of the form **name=value** may use upper or lower case for **name**.

Default values, if any, are shown in parenthesis as part of the prompt.

Case is not preserved for values.

Backspace erases one character.

7.2 LOGIN

Syntax: login PASSWD=<password>

The login command is used to allow access to the other configuration commands.

The login command is only visible when the application is in the *logged out* (i.e. secure) mode. The unit enters this mode whenever a *logout* command is issued or when the Telnet to the application instance OA&M TCP port is interrupted for any reason.

The password is not echo-suppressed. The password consists of up to seven alphanumeric characters. Special characters are not allowed.

The default password is "initial". If no password is given, the IP-LTCN will prompt for a password. In the prompted mode, the password is not echoed. Instead an asterisk is echoed for each character.



7.3 LOGOUT

Syntax: logout

The logout command is only allowed if the console user is logged *in*. It uses no arguments. It will set the console to the logged *out* mode.

7.4 EXIT

Syntax: exit

The exit command is only allowed if the console user is logged *in*. It uses no arguments. It will set the console to the logged *out* mode, and drop the telnet connection. It is useful where a daisy chain of telnet connections are used to negotiate a firewall network.

7.5 CHANGE PASSWORD

Syntax: chgpas *PASSWD*=<old> *NEWPASS*=<new> *CONFIRM*=<new>

The chgpas command is used to change a user password on the system console. The command is only allowed if the user is logged *in*.

All three parameters must be given on the same line as the command. None of those entries are echo-suppressed.

If the current password is valid, and the two entries for the new password match, the password is changed to the new value.

7.6 HELP

Syntax: help [?] [Command]

The help command is always visible. The help command displays the currently allowed commands for the mode that the unit is currently entered. The alternate command for help is a question mark.

7.7 VERSION

Syntax: ver

The version command is only visible when the application is *logged in*. The command has no arguments. It displays the current software and database revisions of the application.

7.8 DISPLAY OF MEASUREMENTS

Syntax: dmeas [ALL | CTL <RANGE> | OS <RANGE> | LTS <RANGE>

The **dmeas** command is only visible when the application is logged in. The command is used to display the current measurements on any of the interfaces.

The **dmeas** command may display the measurements for a single interface, or all of the interfaces. Where the value of **<RANGE>** is specified, the identifier may be a single numeric (e.g. the number '3'), a numeric range (e.g. '1-3'), or the value 'ALL' to indicate the entire allowed numeric range.

The **LTS <RANGE>** option will display the measurement information for the LTS connection to the IP-LTCN. The **<RANGE>** may have values between 1 and 768 inclusive to match the LoopCare OS numbering scheme.

The **CTL <RANGE>** option will display the measurement information for the IP-LTCN mechanized control interfaces. The values in the **<RANGE>** are 1 through 20 inclusive that correspond one for one to the TCP port numbers 31,001 through 31,020 inclusive. There is no requirement that these interfaces be attached in any particular order.

The **OS <RANGE>** option will display the measurement information for the Operations System interface to the IP-LTCN application. The values in the **<RANGE>** are 1 through 20 inclusive that correspond one for one to the TCP port numbers 30,001 through 30,020 inclusive. The Operations System hosts are not required to attach these interfaces in any order.

When measurements are displayed via the **dmeas** command, and more than a single entity has been specified; only non-zero entries are actually displayed.

7.9 DISPLAYING CURRENT CONNECTIONS

Syntax: dc



The **dconn** command is used to display all of the current connections into the IP-LTCN application. This includes all of the LTS, Control Interface, and Operations System native connections.

Please note that the command does not require any arguments. The command will issue a report that shows the connection peer for each active connection.

7.10 SNOOPING ON BX.25 TRAFFIC

Syntax: snoop [OFF | OS <#> | LTS <#>]

The IP-LTCN application has a diagnostic ability to snoop on any of interfaces which carry user data. This is done with the **snoop** command. All output is directed to the OA&M connection.

If the command is invoked with no arguments, it produces a report of all active snooper configurations.

If the command is invoked with the **OFF** option, all of the active snooper configurations are disabled.

If the command is invoked with the **LTS <#>** option, the LTS interface specified is snooped. The <#> is in the range of 1 to 768 to be compatible with the LoopCare OS numbering scheme. Output is displayed on the OA&M session. Please note that this could be extensive for a moderately busy BX.25 line. Both BX.25 and session data are displayed. The session data messages are decoded.

If the command is invoked with the **OS <#>** option, the OS interface specified is snooped. The <#> is in the range of 1 to 20 inclusive and correspond to host interfaces on TCP ports 30,001 through 30,020. The OS interface does not have a BX.25 protocol present, but frame data is decoded and displayed on the OA&M session. Please note that this could become rather voluminous for even a lightly loaded OS interface.

7.11 CLEAR MEASUREMENTS

Syntax: clr



The measurements displayed with the **dmeas** command are aggregated until cleared. The **clear** command will set all measurements to zero. The command has no arguments.

7.12 VERIFY CONFIGURATION

Syntax: **vfy**

The configuration of the IP-LTCN application is displayed with the **vfy** command. The command has no arguments.

7.13 PROMPT LABELS

Syntax: **label ["Double Quoted String" | NONE]**

The **label** command is used to give the command console a unique prompt. The command is visible only when logged into the **IP-LTCN** administrative console. If the **label** command is invoked without arguments, the current configuration of the label is displayed. If the argument to the **label** command is the word 'none', any current label is set to a null value. If the argument to the **label** command is a double quoted string, the contents of the string becomes the application console prompt label. A console label may be up to 31 characters in length.

7.14 APPLICATION COMMENTS

Syntax: **comment [L1="Any Comment"]** **[L2="Any Comment"]** **[L3="Any Comment"]**

The IP-LTCN application may have comments which are displayed with the *verify configuration* command. Up to three lines of comments are available. Each line may have a comment up to 64 characters in length. Each comment is double quoted to allow for spaces to be embedded. A comment with no characters (i.e. "") is used to delete a comment which is not desired. It is not necessary to delete prior to adding a new comment. The new comment shall replace the existing comment at the line specified.



8 IP-LTCN MEASUREMENTS

This section itemizes the measurements available using the *display measurements* (**dmeas**) command.

The base measurements are always displayed, and the error and exception counters are only displayed if nonzero.

The BX.25 measurements available are as follows:

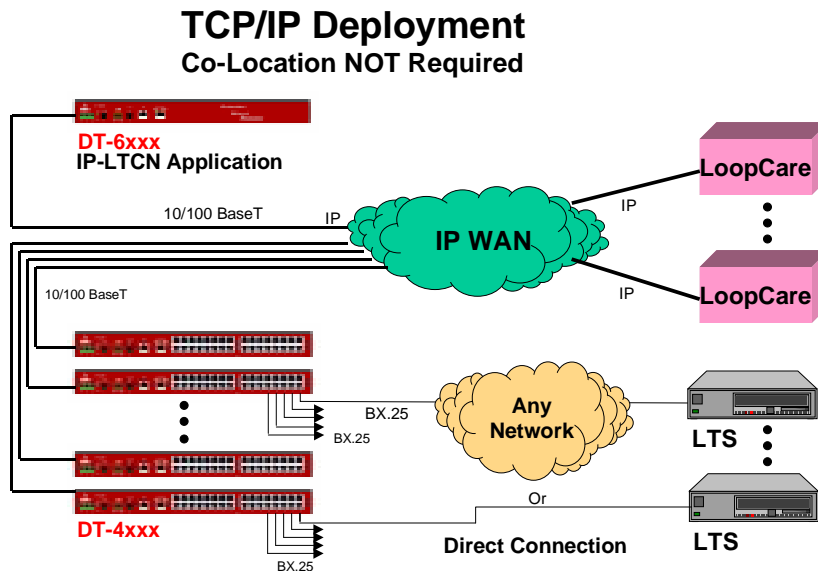
Measurement Description	Type
Number of LAPB Frames Received	Base
Number of LAPB Frames Transmitted	Base
Number of LAPB Bytes Received	Base
Number of LAPB Bytes Transmitted	Base
Number of Invalid Frames Received.	Exception
Number of Frames Ignored when Link is not Inactive.	Exception

9 THE INSTALLATION COOKBOOK

This section is a series of installation instructions for the deployment of the IP-LTCN application.

The TCP/IP capable LoopCare host uses the OS native protocol TCP ports on the IP-LTCN application to make their connection. A connection to a Control TCP port is not required, but may be used by the LoopCare host to acquire link status information for the attached LTS endpoints.

Consider the following connectivity diagram:



In the diagram above, none of the components are required to be located with each other. The communications between components is via the IP infrastructure. The LoopCare OS hosts communicate directly with the IP-LTCN using TCP/IP and the protocol suite. It should be noted that this configuration is exceptionally economical both in terms of equipment and facility expenses. A typical deployment would have one DT-6xxx and eight DT-4xxxs.



Given the above, the deployment could be as follows:

1. Install each DT-6xxx by assigning an IP address, gateway address (if any), and the IP-LTCN application on instance #1. These are done by the **ipaddr <ip_address>**, the **gateway <ip_address>**, and the **app 1 type=ip_ltcn** commands on the DT-6xxx system console. It will be necessary to reboot the DT-6xxx following the IP address configuration. This step may be staged in advance of the deployment.
2. Configure the DT-4xxx ports so that they initiate a TCP call to the IP-LTCN application at the TCP port appropriate for its function. The following assumes external clocking via a modem set such as a 202T.

Port <#> type=ORIG Dest=<DT-6xxx IP Address> dport=<40000+LTS#>

Port <#> prot=HDLC pap=ON dxe=DTE clk=norm enc=nrz

Rs <#>

The cable adapter is a SYNC DTE with a DB-25 Male. This attaches to the cable of the 202T modem to the Network Element. The <40000+LTS#> is for LTS ports in this configuration. The OS connections are native TCP/IP. That is, the LTS port picks a unique TCP number associated with its LTS identifier. For an LTS identifier of 333, the TCP port is 40333 or 40000 + the LTS identification. The <#> is the DT-4xxx port number being configured. Since the “permanently active” option is configured, the TCP call will be immediately set up. Doing a “display connections” command (dc) on either the DT-4xxx or the IP-LTCN OA&M session will show the LTS connection at this time. The clock option normally defaults to ‘normal’ operation, and the encoding normally defaults to NRZ. However, making the specification is not harmful.

3. No further configuration is required.



10 KNOWLEDGE BASE

This section is a random collection of information that may be relevant during the deployment of the IP-LTCN application. In order to avoid duplication and potential for error, much of the information in this section has been moved to their respective User's Manuals.

10.1 SPECIFIC MODEM INFORMATION

Information about the configuration of specific modem sets are now exclusively covered in the DT-4000 User's Manual, the DT-42xx User's Manual, and the DT-4180 User's manual. In the Build #20 version of the DT-4000 User's Manual, it is on page 58 under section 15 "Cabling". In the Build #3 version of the DT-4180 User's Manual, it is on page 50 and section 14.

10.2 CABLING, ADAPTERS, AND PATCH PANELS

Consult the DT-4000 User's manual for Build #20 or higher, the DT-42xx User's manual Build #1.0 or higher, or the DT-4180 User's manual Build #3 or higher. These manuals cover the DT-9116 Intelligent Patch Panel, and the various wiring adapters.

10.3 ISOCHRONOUS LTS CONNECTIONS

This section is covered in the appropriate DT-4xxx User's manual under the heading "Synchronous Protocols with Recovered Clocks". In the DT-4000 build #20 manual, this is section 16 on page 67. A similar section is covered in the DT-4180 User's manual.

11 INTERFACE DEFINITION

The intent of this section is to define the interfaces used by the IP-LTCN application for reference during troubleshooting activity in the field. The interfaces may be monitored both within the IP-LTCN application, and by external means such as a LAN sniffer or a serial line protocol analyzer on the DT-4xxx port.

The interfaces are partitioned by the TCP port on which they interface. There are three types of interfaces. These are the IP-LTCN control interface, a TCP/IP host interface, and a BX.25 LTS interface.

11.1 CONTROL INTERFACE

The control interfaces to the IP-LTCN accept a connection on TCP ports 31,001 through 31,020 inclusive. Each of the control interfaces are equivalent to each other. The intent of the interface is to provide a mechanized means for a host to acquire information about the operation of the IP-LTCN application. Configuration of the IP-LTCN application is not performed on the control interface.

11.2 HOST INTERFACE

The host interface to the IP-LTCN accepts a connection at TCP port between 30,001 and 30020 inclusive. Each TCP port has a hunt group of exactly one. They are maintained unique to prevent a rogue host from locking out its partner.

The host interface provides the means by which messages may be sent to an LTS and responses directed to the originating host. Spurious messages from an LTS are sent to all connected hosts simultaneously. Duplication of spurious messages is prevented by the IP-LTCN.

11.3 LTS INTERFACE

The LTS interface to the IP-LTCN accepts a connection at TCP port between 40,001 and 40,768 inclusive. Each TCP port has a hunt group of exactly one. They are maintained unique to provide an exact mapping to a particular LTS. Exactly one DT-4xxx (e.g. DT-4000, DT-4180, DT-4216, DT-4232, DT-4280) port may make a connection to



an IP-LTCN TCP port for a particular LTS ID. The DT-4xxx provides “B” cabinet functions for the IP-LTCN.



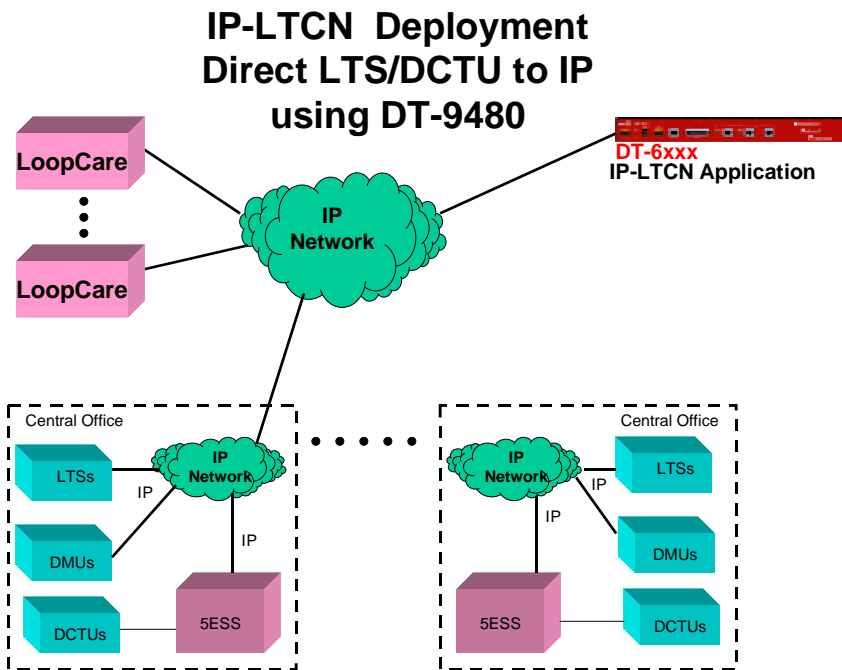
12 TAIL CIRCUITS

The IP-LTCN has several deployment options. Many RBOCs will chose to implement a “DCN Drop-In” where the IP-LTCN is dropped in place of an existing DCN. When this occurs, a “tail circuit” will exist for some period of time. This section details the tail circuit deployment. Because of the unique nature of the LTS and DCTU endpoints; special care must be used in the selection of the tail circuit transport.

In the sections below, several options for tail circuits are presented. Any of these can be used interchangeably. In addition, an improper scenario is presented. This last incorrect scenario is certain to present a failure situation because of timing issues. Consequently, it is specifically not supported by the IP-LTCN.

12.1 OPTION 1 – MAKE THE LTS/DCTU IP NETWORK CAPABLE

This option is simply where the LTS or DCTU is made IP network capable. This is done with a DT-9480 network adapter. A connectivity diagram of this solution is as follows:

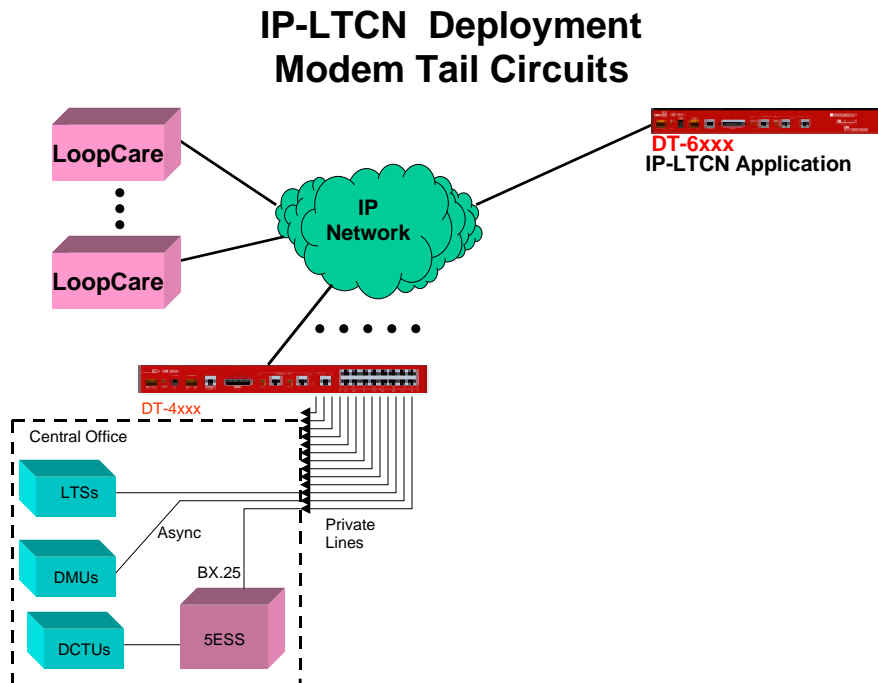


When the LTS or DCTU is made IP network capable with a DT-9480 adapter, there is no mediation equipment of any kind required. It is an easy and clean method of eliminating the tail circuit.



12.2 OPTION 2 – USE A MODEM TAIL CIRCUIT

This option is really nothing more than the status quo after the DCN has been initially replaced. The DT-4xxx mediates to a BX.25 connection. These are then distributed by modem tail circuits to the LTS or DCTU.



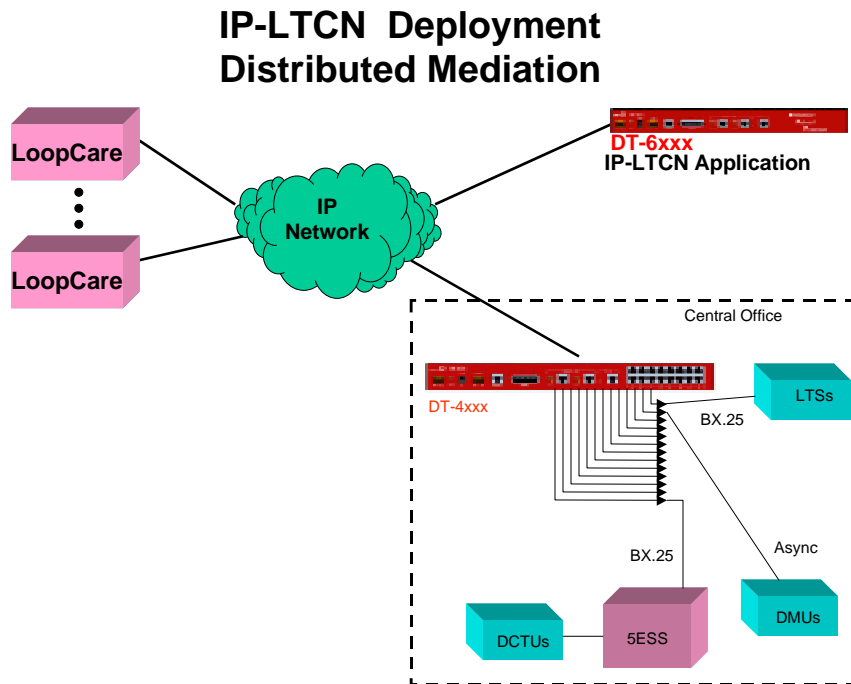
The diagram above has such a configuration. The DT-4xxx series works in conjunction with the DT-6xxx IP-LTCN to handle the IP to BX.25 mediation in a manner suitable for the LTS and/or DCTU. Since the modem circuits are constant latency, they can be distributed remotely.

This option has on-going costs of maintaining the tail circuits; but is otherwise trouble free.



12.3 OPTION 3 – USE A MEDIATION DEVICE IN THE CENTRAL OFFICE

One of the most common approaches is to distribute the DT-4xxx mediation devices to the central offices. The DT-4xxx mediation devices support other systems such as SCC connections and E2A telemetry and are shared with IP-LTCN usage. A diagram of that deployment is as follows:



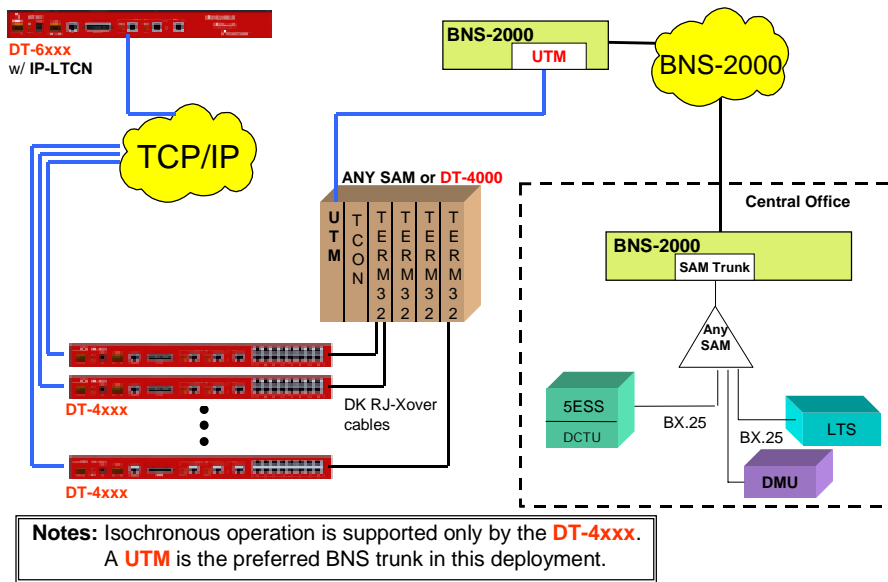
In the above diagram, it can be noted that any port may support one or any protocol. Several operations systems can share a single mediation device and reduce the overall cost of deployment considerably. The DT-4xxx mediation device insures the proper timing and presentation of the interface to the LTS and DCTU using local (B)X.25 or isochronous cabling at the Central Office.



12.4 OPTION 4 – USING AN EXISTING DATAKIT NETWORK

Another common approach is to use an existing Datakit network for distribution of the LTS/DCTU circuits. This only works because the Datakit network is connection oriented and has a constant latency. Consequently, the timing functions of the DT-4xxx LTCN interface are preserved within the Datakit network. Typically, a SAM is used at either endpoint. Consider the following diagram:

Tail Circuit Distribution Via Datakit/BNS



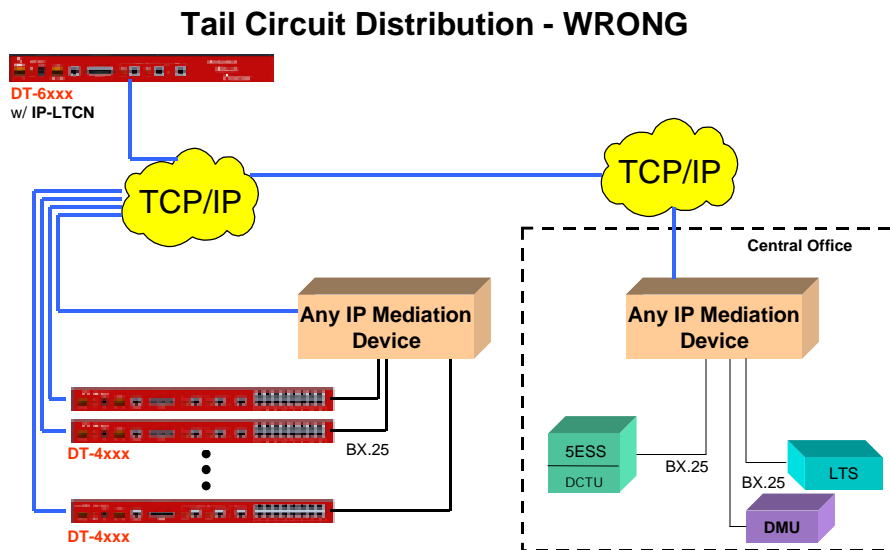
In the diagram above, the mediation occurs at the DT-4xxx interface. The BNS network then transports the BX.25 preserving both the format and the timing. Isochronous connections must be connected directly to a DT-4xxx device since the BNS network and the SAM in particular cannot support that protocol.



12.5 WHAT NOT TO DO WITH TAIL CIRCUITS

As explained in the previous section, the distribution of LTS/DCTU connections does work with the Datakit/BNS network. It does so because Datakit/BNS is a connection oriented network with constant paths and constant delays. Both of these assumptions are not true with an IP based network. There is considerable logic in the DT-4xxx to account for the anomalies in the IP network between the DT-6xxx and the DT-4xxx. The LTS and DCTU are not tolerant of these anomalies. Once the frames have been transmitted by the DT-4xxx, there is no additional protection. Performing additional transport of these frames with an IP network **is certain to fail** at some time. The failure can and will lock the LTS so that it must be manually restarted. This is a known failure mode that occurs even when DT-4xxx are used in the second hop.

Consider the following diagram of **what not to do**:



In the diagram above, the frames are transported across the IP WAN by the Mediation device. However, timing is not preserved and packet loss can occur. Consequently, this scenario will fail and is specifically not supported by the IP-LTCN. Note that even if the



IP mediation device were another DT-4xxx device, the logic to preserve the LTS/DCTU integrity only operates between the IP-LTCN and the initial DT-4xxx. Consequently, even that scenario will fail. **It cannot be overly stressed that this deployment should be avoided.**



13 HARDWARE WARRANTY

The warranty period for the DT-6xxx hardware on which this application is resident shall be ninety (90) days from the date of delivery of the hardware unless extended warranty coverage has been purchased at additional charge without lapse in coverage. Replacements and repairs of the hardware are guaranteed for the longer of the remaining original warranty period or thirty (30) days.

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