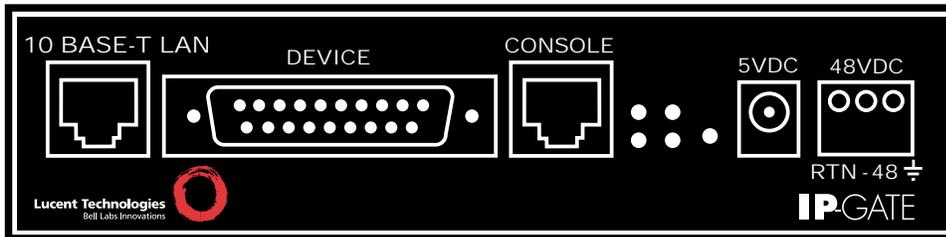


Lucent Technologies
Bell Labs Innovations



IP-GATE

S E R I E S 2 0 0 0

Inter-Networking Interface User's Manual

Version 2.0

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IMPORTANT SAFETY INSTRUCTIONS



The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the product.

When installing, operating, or maintaining this equipment, basic safety precautions should always be followed to reduce the risk of fire, electric shock, and injury to persons, including the following:

- Read and understand all instructions.
- Follow all warnings and instructions marked on this product.
- For information on proper mounting instructions, consult the User's Manual provided with this product.
- This product should only be operated from the type of power source indicated in the User's Manual.
- This unit is intended to be powered from either –48 V dc or AC voltage sources. See User's Manual before connecting to the power source.
- The –48 V dc input terminals are only provided for installations in Restricted Access Areas locations.
- Do not use this product near water, for example, in a wet basement.
- Never touch uninsulated wiring or terminals carrying direct current or leave this wiring exposed. Protect and tape wiring and terminals to avoid risk of fire, electric shock, and injury to service personnel.
- To reduce the risk of electrical shock, do not disassemble this product. Service should be performed by trained personnel only. Opening or removing covers and/or circuit boards may expose you to dangerous voltages or other risks. Incorrect re-assembly can cause electric shock when the unit is subsequently used.

For a unit intended to be powered from –48 V dc voltage sources, read and understand the following:

- This equipment must be provided with a readily accessible disconnect device as part of the building installation.
- Ensure that there is no exposed wire when the input power cables are connected to the unit.
- Installation must include an independent frame ground drop to building ground. Refer to User's Manual.



This symbol is marked on the unit, adjacent to the ground (earth) area for the connection of the ground (earth) conductor.

- This Equipment is to be Installed Only in Restricted Access Areas on Business and Customer Premises Applications in Accordance with Articles 110-16, 110-17, and 110-18 of the National Electrical Code, ANSI/NFPA No. 70. Other Installations Exempt from the Enforcement of the National Electrical Code May Be Engineered According to the Accepted Practices of the Local Telecommunications Utility.

For a unit equipped with an AC Wall Plug-In Unit, read and understand the following:

- Use only the Sceptre, Model SA-0515A5U-2 or SINO American Electronic, Model SA10-0515U (Globtek, Model TR9KA1500LCP-S) Wall Plug-In Unit shipped with this product.
- Unplug this product from the wall outlet before cleaning. Do not use liquid cleaners or aerosol cleaners. Use a damp cloth for cleaning.
- Do not staple or otherwise attach the power supply cord to the building surfaces.
- Do not overload wall outlets and extension cords as this can result in the risk of fire or electric shock.
- The socket outlet shall be installed near the equipment and shall be readily accessible.
- The Wall Plug-In unit may be equipped with a three-wire grounding type plug, a plug having a third (grounding) pin. This plug is intended to fit only into a grounding type power outlet. Do not defeat the safety purpose of the grounding type plug.
- Do not allow anything to rest on the power cord. Do not locate this product where the cord may be abused by persons walking on it.

Unplug this product from the wall outlet and refer servicing to qualified service personnel under the following conditions:

- When the power supply cord or plug is damaged or frayed.
- If liquid has been spilled into the product.
- If the product has been exposed to rain or water.
- If the product does not operate normally by following the operating instructions. Adjust only those controls that are covered by the operating instructions because improper adjustment of other controls may result in damage and will often require extensive work by qualified technician to restore the product to normal operation.
- If the product has been dropped or the cabinet has been damaged.
- If the product exhibits a distinct change in performance.

OVERVIEW

THE HIGHLY SECURE IP SOLUTION

The demand for faster connections and increased bandwidth is driving the worldwide migration to Internet Protocol (IP) networks. A network service provider may be concerned that current IP Local Area Network needs will compromise data security by having mission critical data (e.g. email) traverse public IP networks. With the Internet Protocol Gateway (IP-GATE) from the Lucent Technologies BNS-2000 Family of Products, existing IP Local Area Network needs are satisfied by sending IP based traffic over a secure (e.g. BNS, HDLC compatible) Wide Area Network.

The IP-GATE is an intelligent gateway that allows IP based traffic from a LAN segment to be transported across a WAN. Its principal application is for widely distributed, high reliability, or high security IP based networking. The IP-GATE is not a bridge. It makes intelligent decisions about what is to be routed, and what is not to be routed on the WAN. The IP-GATE is also not a router in the classical sense. It needs little configuration and does not rely on classical routing protocols. As such, it is not subject to "Routing Flap" failures that are prevalent today. The principal intent is for a high reliability, secure IP network via a WAN infrastructure.

INTERFACE SUPPORT

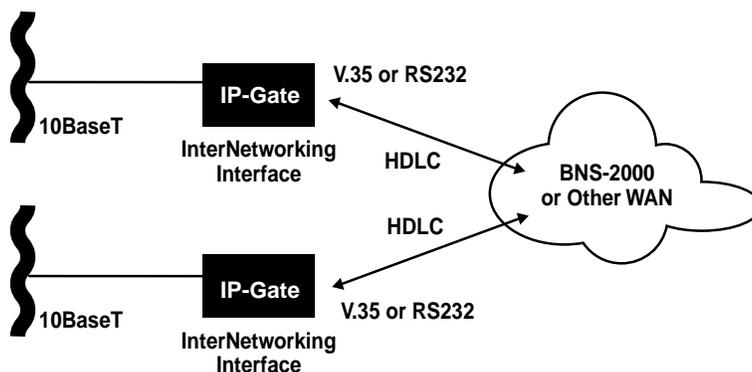
The IP-GATE supports both RS232-C and V.35 interfaces to the WAN. The LAN segment interface is 10BaseT via a standard RJ45. The interface to the WAN may be configured from 9600 baud through E1 inclusive. Line encoding of NRZ, NRZI, and inverted NRZI are supported.

IP-GATE WITH IP-FANOUT

The "Datakit® Applications Processor (DKAP)" runs the IP-FANOUT application. The IP-FANOUT application performs a distribution function so that the IP PDUs from a central home site (e.g. with a mail server) are sent to multiple remote sites. Each remote site is connected back to the home site on a distinct circuit on the WAN. The IP-GATE works by building prioritized routing tables. Traffic that is not destined to locations on the local LAN segment is then routed through the WAN network. The IP-GATE was designed in conjunction with the IP-FANOUT application to handle worldwide gateway functionality. Because the IP-GATE is a solution for secure, high-availability networking, routers are not used.

Contact your Lucent Technologies account representative to learn more about IP-FANOUT.

The following diagram depicts the typical usage of an IP-GATE:



BUILT-IN FLEXIBILITY

The compact IP-GATE is available in both stand-alone and rack-mount versions to fit your space and configuration requirements. The IP-GATE is available as either a 115V AC, 220V AC or 48V DC powered unit.

SMART NETWORK MANAGEMENT

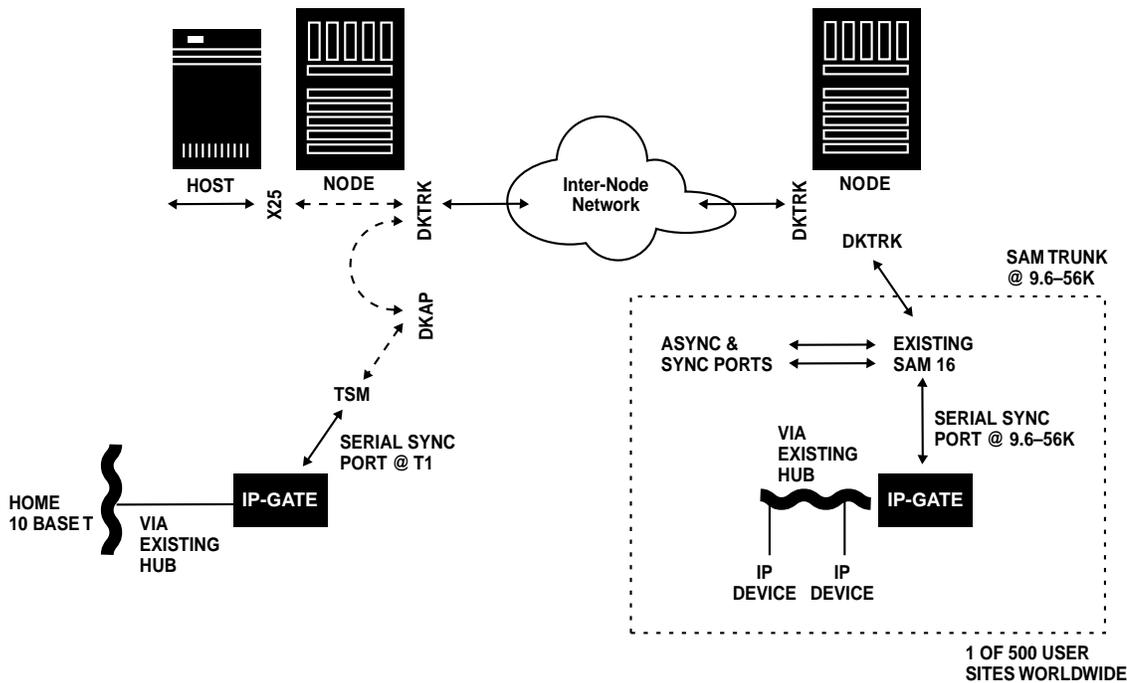
You can manage an IP-GATE via its Console port from a terminal, PC, dial-up modem, or BNS asynchronous connection. Network administrators can access the IP-GATE console port via the StarKeeper® II NMS as well. Finally, the IP-DSU is another network element that the StarKeeper® II NMS can administer, manage and maintain.

FIELD SOFTWARE UPGRADES

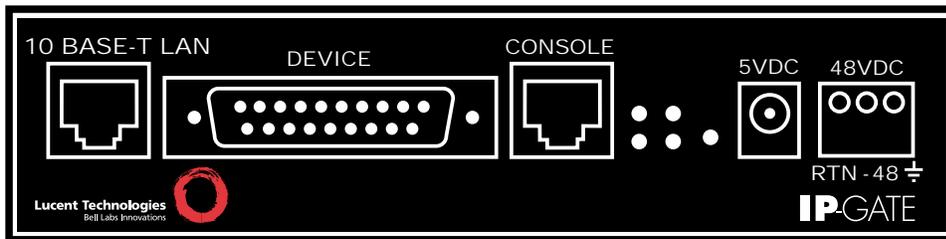
Field software updates, which can occur from a remote location, take place while the IP-DSU is in service and transporting data. As new features and enhancements come out, you can upgrade the IP-DSU software just by upgrading to a new software release using the serial RS232-C console connection to the IP-DSU.

NETWORKING SOLUTIONS FOR THE FUTURE

The IP-GATE reflects the innovation and quality you expect from Lucent Technologies. It's flexible and affordable. It allows one network instead of two to be built. It offers ease of migration. It allows new technologies and traditional products to coexist on the same network without interrupting service, thus preserving the value of your investment. ■



Stand-Alone IP-GATE



DEVICE INTERFACE

Through a DB25, RS530 connector the IP-GATE supports two, software selectable, device interfaces: V.35 and RS232-C for connection to the WAN. The connector is female in gender and electrically presents a data communication equipment (DCE) interface.

For V.35, a DB25 to V.35 adapter is available. V.35 is a 34-pin electrical interface.

The IP-GATE DB25, RS530 connector supports RS232-C directly.

10BASE-T LAN INTERFACE

This interface requires a standard RJ45 terminated category 5, twisted pair, and data cable. It connects to a 10BaseT hub or router on the local LAN segment.

CONSOLE INTERFACE

This interface requires a RJ45 terminated, twisted pair, data cable. It connects as a data terminating equipment (DTE) to an asynchronous device and uses RS232-C signaling. Connection to the IP-GATE console is required for any IP-GATE administration or StarKeeper® II NMS alarm collection. Otherwise, the console can be disconnected during normal operation.

RACK-MOUNT PANEL

The IP-GATE rack-mount panel contains twelve slots to accommodate that number of IP-GATE units. Each rack-mount panel fits in a 19 inch or 23 inch EIA standard equipment rack (use extension ears when mounting in a 23-inch rack). The rack-mount panel supports 1 inch, 1.75 inch and 2 inch spacing between vertical rail, mounting holes. Mounting ears for IP-GATE placements in the rack-mount panel are available.

POWER INTERFACES

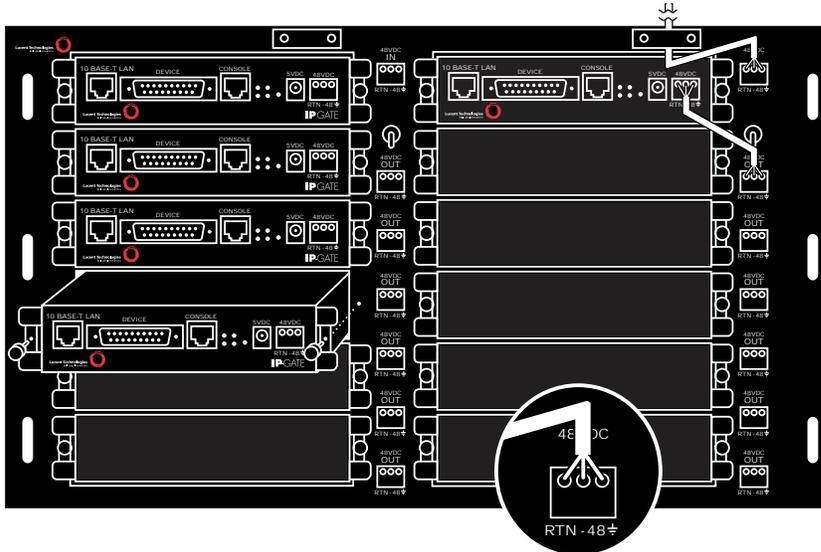
Dual power interfaces are present on the IP-GATE faceplate. A circular interface labeled 5V DC mates with the barrel connector of an AC to DC power transformer for 115/220V AC installations to a standard wall outlet. Alternately, a three position (accepting return, minus and ground, power wires) terminal block labeled 48V DC is commonly used in central office installations.

The IP-GATE is factory configured for either 115V or 220V AC usage. 48V DC operation requires a different jumper setting on the IP-GATE system board. (See Installation section)

STAND-ALONE AC POWER

For this application, a separate AC to DC power supply is available. The power supply has a six-foot long cable that terminates with a barrel connector. The power supply plugs into a standard 115/220V AC outlet. The barrel connector plugs into the circular connector labeled 5V DC on the IP-GATE faceplate.

Rack-Mount IP-GATE



STAND-ALONE DC POWER

The IP-GATE stand-alone unit accepts DC power input directly from a 48V DC power source and connects into the three position (accepting return, minus and ground, power wires) terminal block labeled 48V DC on the IP-GATE faceplate. The terminal block connectors accommodate 10awg to 14awg (American Wire Gauge) wire. A strain relief clamp is available separately for DC wire stabilization.

RACK-MOUNT AC POWER

IP-GATE rack-mount AC power is the same as in the stand-alone IP-GATE. This configuration requires one AC power supply for each IP-GATE unit. However, it is recommended that your equipment rack be outfitted with sufficient power strips to accommodate all of the AC power supplies.

RACK-MOUNT DC POWER

The IP-GATE rack-mount accepts DC power input directly from a 48V DC power source and connects into a main, three position (accepting return, minus and ground, power wires) terminal block labeled 48V DC on the rack-mount panel faceplate. Power from this block is distributed to six terminal blocks, vertically below the main terminal block where each individual terminal block powers a single IP-GATE. Each rack-mount panel accepts two 48V DC power feeds. Twelve IP-GATE units can be powered in this manner

All terminal block connectors accommodate 10 awg to 14 awg wire. A strain relief clamp is available separately for DC wire stabilization. ■

LEDS

The IP-GATE faceplate contains light emitting diodes (LEDs) used to report IP-GATE activity and behavior.

LED Function	LED	Description
Transmit (Tx)	Yellow	10 Base-T Tx Packet Indicator
Receive (Rx)	Yellow	10 Base-T Rx Packet Indicator
Link (LNK)	Green	10 Base-T Link Indicator
Collision (COL)	Red	10 Base-T Collision Indicator
Power (PWR)	Green	Unit Power Indicator

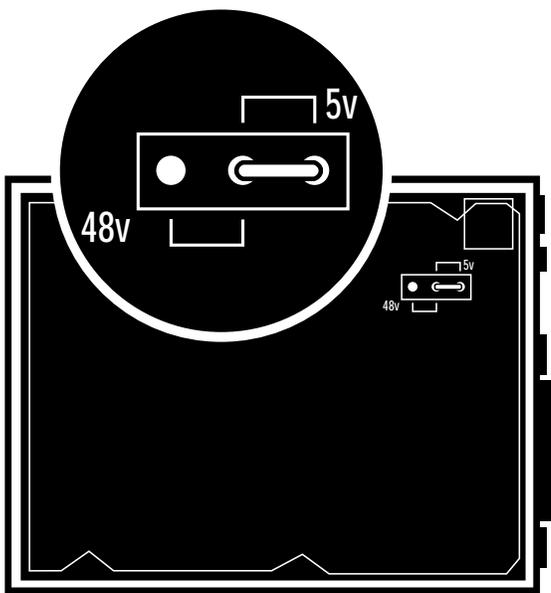
INSTALLATION

EQUIPMENT

Unpack and inspect the IP-GATE units and other components and have on hand a #2 phillips and medium-sized flathead screwdriver.

POWER CONFIGURATION STEPS FOR 48V DC OPERATION

The IP-GATE is factory configured for AC usage. 48V DC operation requires a different jumper setting on the IP-GATE system board. The diagram below shows the factory default setting.



1. Disconnect any power connectors to the IP-GATE.
2. Remove the IP-GATE cover exposing the top portion of the system board.
3. Locate the jumper connector and move the jumper to the 48V setting (see figure).
4. Replace the IP-GATE cover.
5. The IP-GATE is ready for 48V DC operation

STAND-ALONE IP-GATE EQUIPMENT

When stand-alone IP-GATE units are being installed, the following items are needed.

- A minimum of two IP-GATE units.
- For AC operation a power supply for each IP-GATE (DC is directly wired into the unit).
- A V.35 or DB25 (RS232-C) cable for each connection between the IP-GATE and the WAN port. (V.35 requires a DB25 to V.35 adapter)
- An RJ45 terminated, twisted pair, data (RS232-C) cable for each connection between the IP-GATE console port and asynchronous device.
- A category 5, RJ45 terminated twisted pair, data cable for each connection between the IP-GATE and the local 10BaseT LAN hub or router.
- 10BaseT LAN hubs or routers with 10BaseT access to the intranet or internet.
- For DC operation, a strain relief clamp for wire stabilization

RACK-MOUNT IP-GATE EQUIPMENT

When installing IP-GATE units in a rack-mount configuration, it is necessary to gather the items listed above for stand-alone IP-GATE installation, plus the following equipment.

- An EIA standard 19-inch or 23-inch equipment rack with internal, vertical mounting rails. Hole spacing on the vertical, mounting rail may be 1 inch, 1.75 inch or 2 inch. Use the dimensions specifications in the appendix to calculate how high the rack needs to be to support a specified number of rack-mount panels. For example, seven rack-mount panels measuring 10.5 inches each will fit in a data equipment rack with internal mounting rails 75 inches in height. This configuration will support a maximum of 84 IP-GATE units.
- A rack-mount panel for each set of twelve IP-GATE units.
- A pair of mounting ears for each IP-GATE.
- Strain relief clamps for DC wire stabilization.
- Power distribution module(s) (1 for every 6 IP-GATES)

STAND-ALONE INSTALLATION**AC ONLY**

1. Place the IP-GATE in its desired location such as a shelf in a data equipment rack.
2. Plug one end of the RJ45 terminated, category 5 twisted pair, data cable into the IP-GATE 10BaseT LAN interface and the other into a 10BaseT LAN hub or router.
3. Plug one end of the RJ45 terminated, twisted pair, data cable into the IP-GATE console interface and the other into the port of the asynchronous device that will be used to configure or manage the IP-GATE.
4. Plug one end of the V.35 (requires DB25 to V.35 adapter) or RS232-C device cable into the IP-GATE device interface and the other end into the existing WAN port cable or directly into the WAN port.
5. Plug the power supply into a standard 115V AC outlet and the barrel connector stemming from the power supply, into the circular connector on the IP-GATE faceplate labeled 5V DC.

DC ONLY

1. Attach the strain relief bracket to the side of the IP-GATE.
2. Place the IP-GATE in its desired location such as a shelf in a data equipment rack.
3. Plug one end of the RJ45 terminated, category 5 twisted pair, data cable into the IP-GATE 10BaseT LAN interface and the other into a 10BaseT LAN hub or router.
4. Plug one end of the RJ45 terminated, twisted pair, data cable into the IP-GATE console interface and the other into the port of the asynchronous device that will be used to configure or manage the IP-GATE.
5. Plug one end of the V.35 (requires DB25 to V.35 adapter) or RS232-C device cable into the IP-GATE device interface and the other end into the existing WAN port cable or directly into the WAN port.
6. Run your 48 VDC (return, minus and ground) wires from a central source through the strain relief clamp for DC wire stabilization. On the IP-GATE faceplate, attach the return, minus and ground wires to the return, minus and ground connections respectively of the terminal block labeled 48 VDC.
7. Tighten strain relief bracket.

RACK-MOUNT INSTALLATION**AC ONLY**

1. Prepare each IP-GATE for rack mounting by attaching the mounting ears to each side of the IP-GATE.
2. Fasten the twelve-slot rack-mount panel to a 19-inch equipment rack or use extension ears for a 23-inch rack. Slide each IP-GATE with mounting ears into one of the twelve rack-mount panel slots. Secure the IP-GATE to the rack mount panel with screws.
3. For each IP-GATE, plug one end of the RJ45 terminated, category 5, twisted pair, data cable into the IP-GATE 10BaseT LAN interface and the other end into a 10BaseT LAN hub or router.
4. For each IP-GATE, plug one end of the RJ45 terminated, twisted pair, data cable into the IP-GATE console interface and the other end into the asynchronous device.
5. For each IP-GATE, plug one end of the V.35 (requires DB25 to V.35 adapter) or RS232-C device cable into the IP-GATE device interface and the other end into the existing WAN port cable or directly into the WAN port.
6. Plug each IP-GATE power supply into a standard 115V AC outlet and the barrel connector stemming from the power supply, into the circular connector on the IP-GATE faceplate labeled 5V DC.
6. For each IP-GATE, plug one end of the RJ45 terminated, category 5, twisted pair, data cable into the IP-GATE 10BaseT LAN interface and the other end into a 10BaseT LAN hub or router.
7. For each IP-GATE, plug one end of the RJ45 terminated, twisted pair, data cable into the IP-GATE console interface and the other end into the asynchronous device.
8. For each IP-GATE, plug one end of the V.35 (requires DB25 to V.35 adapter) or RS232-C device cable into the IP-GATE device interface and the other end into the existing WAN port cable or directly into the WAN port.
9. Run the 48V DC (return, minus and ground) wires from a central source through the strain relief clamp used for DC wire stabilization. On the rack mount panel, attach the return, minus and ground wires to the return, minus and ground connections to one of the main terminal blocks labeled 48 Vin. Power is distributed to six terminal blocks, vertically below the main terminal block and labeled 48 Vout. Each individual, 48 Vout terminal block below the main, 48 Vin terminal block powers a single IP-GATE. This is accomplished by jumping short, return, minus and ground wires between the panel terminal block and the IP-GATE terminal block. All terminal block connectors accommodate 10 awg to 14 awg wire. Strain relief clamps are used for DC wire stabilization.

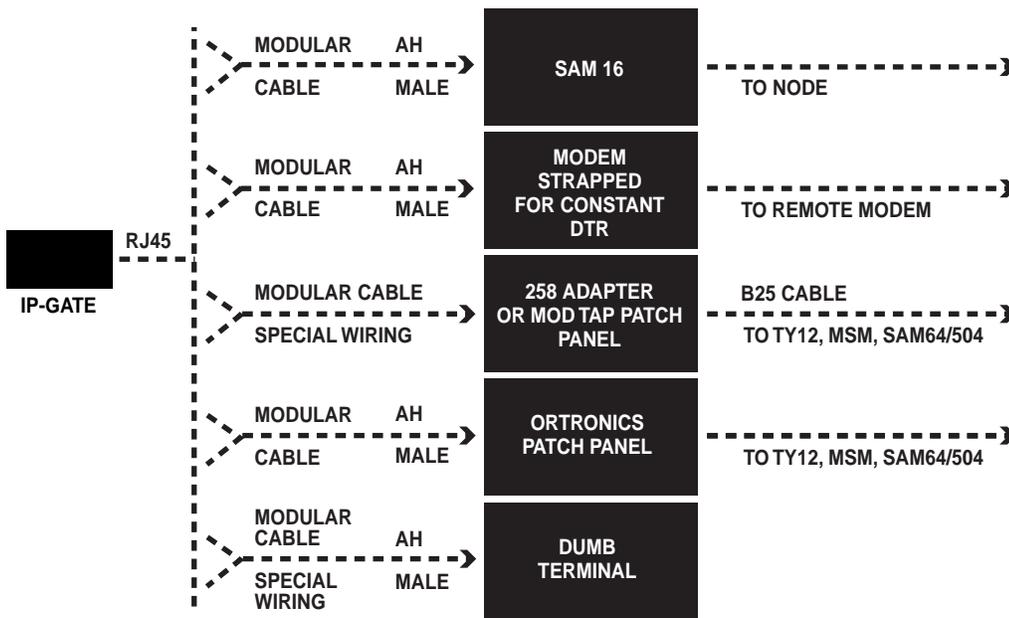
DC ONLY

1. Prepare each IP-GATE for rack mounting by attaching the mounting ears to each side of the IP-GATE.
2. Attach the power distribution panel(s) to the rack-mount plate.
3. Make sure the rack mount panel toggle switches are set to the OFF position.
4. To the rack mount panel faceplate, fasten the strain relief clamp(s).
5. Fasten the twelve-slot rack-mount panel to a 19-inch equipment rack or use extension ears for a 23-inch rack. Slide each IP-GATE with mounting ears into one of the twelve rack-mount panel slots. Secure the IP-GATE to the rack mount panel with screws.
10. Make sure the rack mount panel toggle switches are set to the ON position.

CONSOLE INSTALLATION/CONFIGURATION

The IP-GATE is managed through its console port by a terminal, PC, dial-up modem, or BNS asynchronous connection. Network administrators can access the IP-GATE console port through the StarKeeper® II NMS.

Console cables are available through Lucent and are required for console connection to TY12 and MSM modules, SAM64/504 Multiplexors and connection through an Ortronics distribution patch panel (see figure).



CABLE OR ADAPTER

Straight modular cable
 Modular cable (special wiring)
 AH male connector
 258 adapter

ORDER INFORMATION

ED5P055-31 G(137), G(G)
 Comcode 408198133
 ED5P055-31 G(139)
 ED5P055-31 G(155)

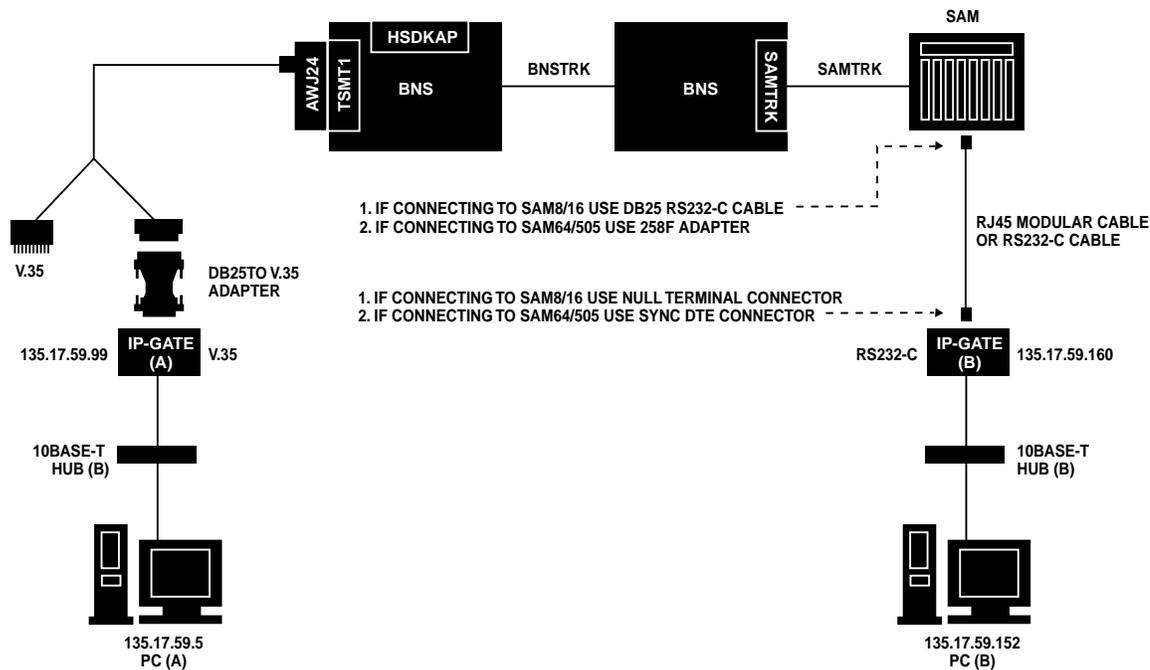
Specific instructions for configuration of SAM, TY12 and MSM asynchronous ports are available in the appropriate BNS-2000 module, reference guide. IP-GATE specific, configuration notes are described herein.

- Configure SAM, TY12 and MSM console connections as 9600 bps with 8 bits and no parity, and use a DCE type cable.
- Configure SAM and MSM console connections as type "host" and as a "pap" (permanently active port).
- Configure TY12 console connections as type "console".

INSTALLATION

BNS NETWORK CONFIGURATION

The diagram below constitutes a typical IP-GATE network configuration *without* the IP-FANOUT feature where the Wide Area Network is comprised of the Lucent Technologies BNS-2000 Family of Products.



CABLE OR ADAPTER	DESCRIPTION	ORDER INFORMATION
HD-2V.35M	50-pin (Male) on TSM side to two V.35 (Male)	ED5P055-31 G(222), G(AS)
DB25 to V.35 Adapter	DB25 (Male) to V.35 (Female)	COMCODE 408181170
258AF Adapter	50-pin (Female) on SAM side to 6 mod sockets for rear connection to SAM64/504	ED5P055-31 G(152)
NULL Terminal Connector	DB25 (Male) to DB25 (Male) for SAM8/16	ED5P055-31 G(208)
DB25 RS232-C Cable		ED5P055-31 G(107)
SYNC DTE-M Adapter	25-pin (Male) on IP-GATE side to modular socket	ED5P055-31 G(149)

IP-GATE/BNS CONFIGURATION NOTES

Configuration of both IP-GATES should be straight-forward. The exception is configuring the routing tables, which can get complex depending on the network configuration. The routing tables are administered using the route command (see Commands section).

NOTE:

- Use a drop route for all IP devices locally attached to the IP-GATE being administered.
- Configure port speed the same as the attached BNS module.

Specific instructions for configuration of the TSM module family or SAM device family is available in the appropriate BNS-2000 module, reference guide.

Specific instructions for configuration of the DKAP/HSDKAP, for the IP-FANOUT application is available in the IP-FANOUT Administration Guide. IP-GATE configuration examples are available in Appendix A.

IP-GATE, BNS and DKAP/HSDKAP specific, configuration notes are described on next page.

CONFIGURATION OF IP-GATE A

<IP-GATE> vc

Current Configuration:

Service State ==> In Service.
 Port Interface ==> V.35 DCE.
 Port Type ==> Generic HDLC Interface.
 Port Speed ==> T1.
 Port Physical Encoding ==> NRZ.
 Data Compression ==> Disabled.
 Local MAC Address ==> 0.96.28.48.56.1
 Local IP Address ==> 135.17.59.99
 Local Subnet Mask ==> 255.255.255.0
 Local Router IP Address ==> 0.0.0.0
 Drop Route [0] ==> 135.17.59.5
 w/Mask 255.255.255.255
 Send Route [1] ==> 135.17.59.0
 w/Mask 0.0.0.0 to DLCI 16
 Loopback Status ==> Loopbacks are
 not Enabled.

CONFIGURATION OF TSM MODULE

- Configure the TSM port as “term” and pap (permanently active port)
- Configure protocol as HDLC
- Configure group as type originate
- Configure a PDD (pre-defined destination) that points to the SAM port of the desired IP-GATE
- Configure the TSM port speed to match the line speed of attached IP-GATE

CONFIGURATION OF IP-GATE B

<IP-GATE> vc

Current Configuration:

Service State ==> In Service.
 Port Interface ==> RS232 DCE.
 Port Type ==> Generic HDLC Interface.
 Port Speed ==> 9600.
 Port Physical Encoding ==> NRZ.
 Data Compression ==> Disabled.
 Local MAC Address ==> 0.19.35.83.58.55
 Local IP Address ==> 135.17.59.160
 Local Subnet Mask ==> 255.255.255.0
 Local Router IP Address ==> 135.17.59.1
 Drop Route [0] ==> 135.17.59.152
 w/Mask 255.255.255.255
 Send Route [1] ==> 135.17.59.0
 w/Mask 0.0.0.0 to DLCI 16
 Loopback Status ==> Loopbacks are
 not Enabled

CONFIGURATION OF SAM DEVICE

- Configure the SAM port as “host”, a dte and pap (permanently active port)
- Configure protocol as HDLC
- Configure group as type receive
- Configure an address for the SAM port attached to the IP-GATE
- Configure the SAM port speed to match the line speed of attached IP-GATE

CONFIGURATION OF DKAP/HSDKAP FOR IP-FANOUT

- Configure module software version as IPGR<#>/IPHSGR<#> where # is the software version number.
- Configure number of module channels to equal the sum of remote sites, the host site, and control channel.
- Configure channel sets 1,2 and 3 as hosts.
- Configure 1 channel per channel set for channel sets 1 and 2.
- Configure channel set 3 for the number of remote sites to be supported

COMMANDS

The following is the complete IP-GATE command set. Except where noted, commands are visible only when the user is logged in to the IP-GATE.

LOGIN

Syntax: `login passwd=<password>`
(default password is: initial)

The `login` command is a security command required for accessing the bulk of the IP-GATE command set. It is only available when the user is logged off the IP-GATE. The password must contain between one and seven alphanumeric characters. The typed password is case insensitive.

LOGOUT

Syntax: `logout`
The `logout` command returns the IP-GATE to its logged out mode thus preventing unauthorized access.

CHANGE PASSWORD

Syntax: `chgpw old=<password> new=<password>`
`confirm=<password>`

The `chgpw` command allows the user to change a previously configured password. The old password is the one currently in effect. The new and confirm passwords should be identical. The password must contain between one and seven alphanumeric characters. The typed password is case insensitive. All arguments are required to complete the command.

LOCAL

Syntax: `local mac=<MAC addr> ipaddr=<IP address>`
`submask=<submask>`

The `local` or `lo` command sets the address of the IP-GATE to facilitate communication with a peer IP-GATE.

The MAC address is a fixed attribute for each unit that should be set only to the value specified at the factory. However, in cases where a spare unit is replacing a failed IP-GATE, configuring the replacement IP-GATE with the same MAC address as the failed unit will eliminate the need for address resolution.

The `ipaddr` is the IP address of this unit. The `submask` is the subnet mask of this unit with a default value of 8 bits (255.255.255.0).

PORT

Syntax: `port phy=<v35 | 232> speed=<speed>`
`enc=<encoding>`

The `port` or `pt` command identifies the BNS trunk I/O board interface used to connect to the IP-GATE. The command consists of four attributes: type, phy, speed and enc.

The speed attribute defaults to 56K rate. It may be changed to another value. The allowed values are T1, 768K, 512K, 256K, 128K, 56K, 38400, 19200, 14400, and 9600.

The `enc` attribute specifies the physical line encoding parameters. It is available for the generic HDLC interface type. It may take on the values of NRZ, INRZ, NRZI, and INRZI. These are physical line encoding parameters.

REMOVE

Syntax: `remove`

The `remove` or `rm` command takes the unit out of service. This command must be performed before any configuration changes can occur. It is only visible when the unit is logged in. The command has no arguments.

RESTORE

Syntax: `restore`

The `restore` or `rs` command returns the IP-GATE to service, and it has no arguments. If any physical attribute was changed on the unit, including the MAC address, the reboot command should be executed after the restore command.

REBOOT

Syntax: `reboot`

The `reboot` command resets the unit, which allows physical attributes to be set, and the command has no arguments. It is only visible when the unit is logged in. After reboot, the console interface returns to the logged-out mode.

ROUTE

Syntax: `route idx=<#> addr=<ip_addr> mask=<netmask> dlci=<dlci> act=<RTE | DROP | DEL>`

The `route` command is only visible when the unit is logged in. The command has arguments that are not all required. The command takes the following form.

The routing table has eight entries and these are indexed 0-7 with the `idx=<number>` argument. These routing entries have precedence. Entry 0 is evaluated before entry 1, and so on.

The `addr=<ip_addr>` and `mask=<netmask>` form the address range in the domain of this routing entry.

The `act=<action>` argument specifies what action is to be performed if the address match is satisfied. A value of `RTE` causes the PDU to be routed, and a value of `DROP` causes the PDU to be explicitly dropped. If the entire table does not produce a match, the PDU is implicitly dropped and produces an error count and exception entry. A value of `DEL` will delete a routing table entry. Finally, if the action was `RTE`, the `DLCI=<dlci>` specifies which DLCI is to be used in the WAN. The default is the number 16. This is only of issue when the WAN used is frame relay.

VERIFY CONFIGURATION

Syntax: `vcfg`

The `vcfg` or `vc` command displays the current configuration of the unit and is only visible when the unit is logged in. The command has no arguments.

Sample Output:

`<IP-GATE> vcfg`

Current Configuration:

Service State ==> In Service.
 Port Interface ==> V.35 DCE.
 Port Type ==> Generic HDLC Interface.
 Port Speed ==> 56K.
 Port Physical Encoding ==> NRZ.
 Local MAC Address ==> 0.96.28.48.56.1
 Local IP Address ==> 135.17.59.99
 Local Subnet Mask ==> 255.255.255.0
 Local Router IP Address ==> 0.0.0.0

Drop Route [0] ==> 135.17.59.5
 w/Mask 255.255.255.255
 Send Route [1] ==> 135.17.59.0
 w/Mask 0.0.0.0 to DLCI 16
 Loopback Status ==> Loopbacks are not enabled.

DISPLAY LOG

Syntax: `dlog`

The `dlog` command displays the exception logs. The exception log provides details about the last 32 errors counted. Only some errors have exception entries. An example follows:

`<IP-GATE> dlog`
 M Display Exception Log

Chronological Log Entries:

SA: 135.22.94.137 DA: 135.22.94.1
 10BaseT->Wan routing drop
 SA: 135.22.94.149 DA: 135.22.94.1
 10BaseT->Wan routing drop
 SA: 135.22.94.41 DA: 135.22.94.1
 10BaseT->Wan routing drop
 SA: 135.22.94.36 DA: 135.22.94.1
 10BaseT->Wan routing drop
 SA: 135.22.94.58 DA: 135.22.94.1
 10BaseT->Wan routing drop
 SA: 135.22.94.36 DA: 135.22.94.101
 10BaseT->Wan routing drop
 SA: 135.22.94.117 DA: 135.22.94.1
 10BaseT->Wan routing drop
 SA: 135.22.94.131 DA: 135.22.94.1
 10BaseT->Wan routing drop
 SA: 135.22.94.36 DA: 135.22.94.124
 10BaseT->Wan routing drop
 SA: 135.22.94.116 DA: 135.22.94.36
 10BaseT->Wan routing drop
 SA: 135.22.94.36 DA: 135.22.94.51
 10BaseT->Wan routing drop
 SA: 135.22.94.114 DA: 135.22.94.1
 10BaseT->Wan routing drop

`<IP-GATE>`

In the preceding example, these exceptions were caused because the source devices were broadcasting on the LAN segment at the MAC layer. This is legal operation on the LAN segment but would create needless traffic on the WAN. The IP-GATE filters this traffic at the IP layer. Since the routing table had no match for these addresses, they were implicitly dropped which increments error counters and produces an exception in the log.

DISPLAY MEASUREMENTS

Syntax: **dmeas**

The **dmeas** or **dm** command displays the current measurements of the unit and is only visible when the user is logged in. The command has no arguments.

Sample Output:

<IP-GATE> **dmeas**

M Display Measurements

Current Measurements:

Number of Ethernet Packets Received ==> 30411
 Number of Ethernet Packets Transmitted ==> 5137
 Number of Device Frames Received ==> 5136
 Number of Device Frames Transmitted ==> 30410

<IP-GATE>

The base measurements, shown above, are always displayed whether zero or nonzero while error counters are only displayed if they become nonzero.

LIST OF IP-GATE MEASUREMENTS

BASE MEASUREMENTS

- ____ Ethernet Packets Received
- ____ Ethernet Packets Transmitted
- ____ WAN Frames Received
- ____ WAN Frames Transmitted

ERROR COUNTERS

- ____ Ethernet Discards (Resource)
- ____ WAN Port Discards (Resource)
- ____ Late Collisions (Ethernet Tx)
- ____ Underrun (Ethernet Tx)
- ____ Retry Limit Exceeded (Ethernet Tx)
- ____ Carrier Sense Lost (Ethernet Tx)
- ____ Frame Collisions (Ethernet Rx)
- ____ Rx Overruns (Ethernet Rx)
- ____ Rx CRC Errors (Ethernet Rx)
- ____ Short Frame Errors (Ethernet Rx)
- ____ Non-Aligned Frame Errors (Ethernet Rx)
- ____ Frame Length Violations (Ethernet Rx)
- ____ Frames aborted by CTS lost (Port Tx)
- ____ Frames Underrun (Port Tx) Frames aborted by CD lost (Port Rx)
- ____ Rx Overruns (Port Rx)
- ____ Rx CRC Errors (Port Rx)
- ____ Rx Aborts (Port Rx)
- ____ Rx Parity Errors (Port Rx)
- ____ Non-Aligned Frame Errors (Port Rx)
- ____ Frame Length Violations (Port Rx)
- ____ Frame DPLL Errors (Port Rx)
- ____ Unsupported Protocol Frames Received
- ____ Rx frames w/IP Header Checksum Errors
- ____ Rx Frames w/ICMP Checksum Errors
- ____ 10BaseT->WAN frames dropped due to Routing.
- ____ WAN->10BaseT frames dropped due to Routing.

CLEAR

Syntax: **clear <MEAS| LOGS>**

The **clear** or **clr** command is only visible when the unit is logged in. The command has a single argument. When that argument is MEAS, the measurement and error counters are set to zero. When the argument is LOGS, the exception logs are cleared.

LOOPBACK

Syntax: **loopback [off | port]**

The **loopback** command enables or disables loopbacks. The command has a single argument indicating which type of loopback command is requested: port, or off. The command is only visible when the user is logged in.

The port option enables a DEVICE loopback. It is the equivalent of a local loopback between two modems. Any data arriving from the device is sent back to the device until loopbacks are cancelled.

The off option disables any loopback that may be in effect. Loopback options are cumulative until an off is specified. If a network loopback was enabled, and subsequently, a device loopback was enabled, the net effect is the same as if both were enabled. Using the off option disables all loopbacks.

Loopbacks are transient conditions. A loopback may only be specified while the unit is in-service, and does not survive a reset. Should the unit be reset for any reason (power outage, manual reset, etc.), the IP-GATE will revert to a normal no loopback mode of operation.

The following table reflects new alarm types generated by the IP-GATE. Alarms are visible at the console and by StarKeeper® II NMS.

ALARM TEXT	SEVERITY	NOTES
NONE	N/A	Cold Start trap alarm generated when the unit starts up
Tx Error on 10BaseT. Check Physical Connection.	Major	Problem with 10BaseT physical connection
Insufficient Buffers for Frame Relay LMI Status Report	Major	Unable to respond to Frame Relay LMI status poll, link may go down.
User Requested Reboot in Progress	Info	Due to manual reboot
Invalid Login Attempt	Minor	Error in login syntax
Invalid Password Change Attempt	Minor	Use of invalid password

HELP

Syntax: **help**

The **help** or **?** command without arguments displays the entire IP-GATE command set and command syntax for the mode (logged out or logged in) the unit is currently in.

Individual command syntax is available when the help command is followed by the command name.

VERSION

Syntax: **ver**

The **version** or **ver** command displays the current software and database revisions of the unit and is only visible when the user is logged in. The command has no arguments.

Sample Output:

```
<IP-GATE> ver M version
IP-GATE - Build 5 made on Wed Jan 28 11:26:33
EST 1999.
Software Version: 1.0.1
DB Version: V.3
```

Troubleshooting an IP-GATE configuration is often a simple correlation of symptom and cause. If armed with a few basic troubleshooting techniques, determining the source of a problem should be easy.

Usually problem indicators can be observed and appropriate actions can be taken to localize a cause. Problem indicators typically include nonzero error counters displayed to the console and the inability to communicate between IP-GATE units. Problems may require the gathering of measurements or running of diagnostic tests from the IP-GATE console as well.

It is recommended that familiarization with the IP-GATE loopback diagnostic command takes place. The loopback command is essential for failed communications between the IP-GATE and the BNS Node. The ping application is used in IP networks to test readability of IP destinations by sending them an ICMP echo request and waiting for a reply. This is essential to testing the IP-GATE 10BaseT port.

StarKeeper® II NMS supports the ping application and can be used to test IP-GATE 10BaseT functionality. From the StarKeeper console you can execute the following.

e.g. `/etc/ping <ip address> [return]`

where <ip address> is the address associated with the IP-GATE LAN port.

Further information on command parameters can be obtained by running the Unix® man command for ping.

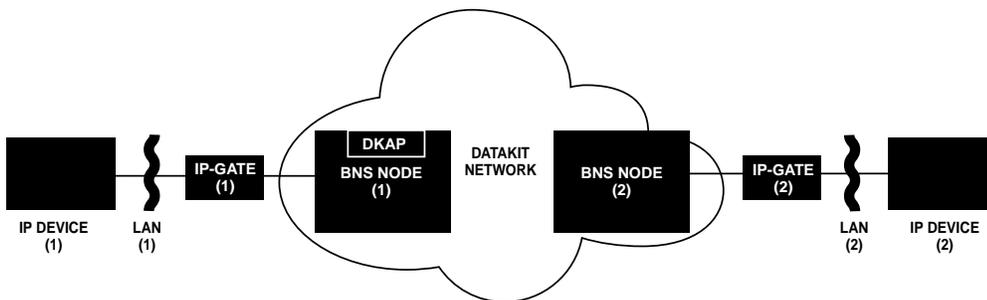
e.g. `man ping [return]`

Installation of faulty hardware is always a possible cause of problems. Having spare parts, including spare cable and an additional IP-GATE, available can significantly reduce start-up time and communication outages.

TROUBLESHOOTING STRATEGY

Consider executing any or all of the following tests to localize the point or points of failure in your IP-GATE network.

With the IP-GATE loopback command and ping application, trace the complete circuit between BNS nodes. Start tracing from either end of the circuit, not the middle. A failed trace test points to the set of interfaces, cables and facilities that make up the failed circuit.



CIRCUIT TRACING STEPS

Step 1: Ping IP-GATE 1 from IP Device 1. If the test passes, move on to step 2. If the test fails, check the physical connection between IP-GATE 1 and IP Device 1.

Step 2: Put IP-GATE 1 into port loopback mode. From BNS Node 1 run diagnostics on the associated module, refer to BNS module reference for diagnostic commands. If the test passes, turn loopback off and move on to step 3. If the test fails, check the cabling between IP-GATE 1 and BNS Node 1. Check that all needed adapters are installed.

Step 3: Check that connectivity has been established between the two BNS endpoints by using the display connection command. Verify that the BNS PDD is in "talking" state. If the IP-FANOUT application is being used the two endpoints are the port connected to IP-GATE 1 and the DKAP module. Otherwise the two endpoints are the port connected to IP-GATE 1 and the port connected to IP-GATE 2. If test passes, if using IP-FANOUT application move on to step 4, else move onto step 5. If test fails, check that all addressing information is correct. Also check module status of associated modules.

Step 4: Check that connectivity has been established between the DKAP and port connected to IP-GATE 2 by using the display connection command. Verify that the BNS PDD is in "talking" state. If test passes, move onto step 5. If test fails, check that all addressing information is correct. Also check module status of associated modules.

Step 5: Put IP-GATE 2 into port loopback mode. From BNS Node 2 run diagnostics on the associated module, refer to BNS module reference for diagnostic commands. If the test passes, turn loopback off and move on to step 6. If the test fails, check the cabling between IP-GATE 2 and BNS Node 2. Check that all needed adapters are installed.

Step 6: Ping IP-GATE 2 from IP Device 2. If the test passes, go back to step one and test the circuit again. If the test fails, check the physical connection between IP-GATE 2 and IP Device 2.

The above troubleshooting strategy should help you localize and remedy most of your network problems. However, if problems are still unresolved after these recommended troubleshooting procedures, check application on IP device is running then contact your customer support representative at 1-800-WE2CARE.

SAMPLE CONFIGURATIONS

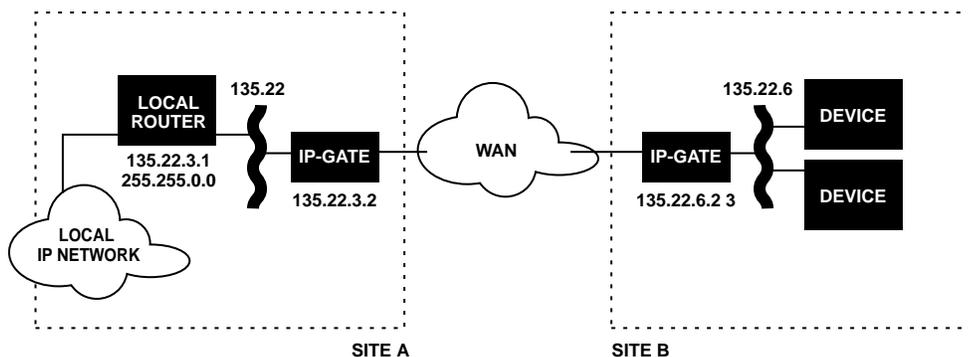
This section presents several distinct scenarios. For each, the network is depicted and a sample configuration of IP-GATE is presented.

There are some common configurations for all. For example, a virgin database defaults to a V.35 physical interface. If the IP-GATE is RS232-C, it will be necessary to change it with the command `port phy=232`. The port speed will need to be set (e.g. `port speed=56k`).

The TSM or SAM port connection to the IP-GATE is configured as HDLC DTE. The port is not permanently active if the IP-FANOUT DKAP application is to be used. This allows configuration changes to be automatically propagated to the IP-FANOUT DKAP application. The balance of the configuration is unique to the situation.

CONNECTING TWO SITES

In this example, two sites are connected via a WAN. One is a home site that has an internal IP network segmented by a router. The other is a branch site where only the LAN segment exists. Consider the following diagram:



The IP-GATE in Site A has two entries in its routing table. They are:

```
route idx=0 addr=135.22.3.0 mask=255.255.255.0 act=drop
route idx=1 addr=135.22.6.0 mask=255.255.255.0 act=rte
route idx=2 addr=135.22.0.0 mask=0.0.0.0 act=drop
```

The Site "A" IP-GATE also has a local router defined: `local rtr=135.22.3.1`. Since we want to be able to ping the IP-GATE unit in Site "A", we gave it an IP address too. `local ipaddr=135.22.3.2`

The IP-GATE in Site "B" has two entries in its route table. They are:

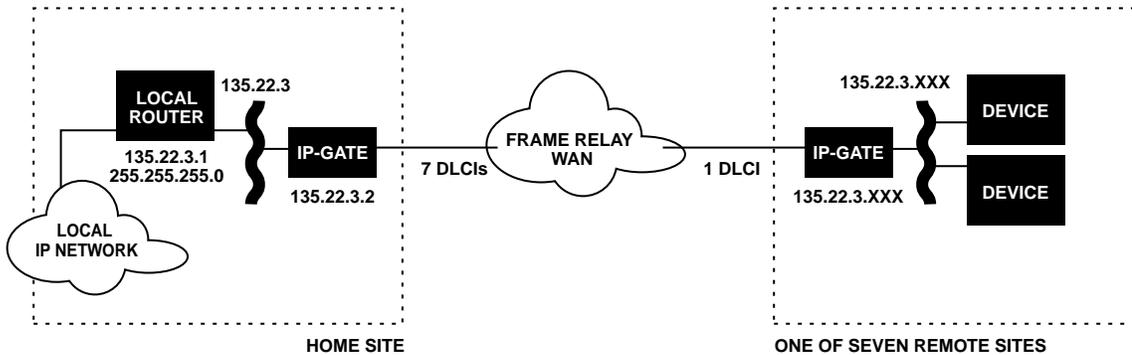
```
route idx=0 addr=135.22.6.0 mask=255.255.255.0 act=drop
route idx=1 addr=135.22.0.0 mask=0.0.0.0 act=rte
```

The site "B" IP-GATE unit also has an IP address so it can be pinged. `local ipaddr=135.22.6.23`

The first condition in either site explicitly drops any datagram that was routed to the local LAN segment by an internal router but is not destined for the remote site. The second is an explicit route of what does exist at the other site.

EIGHT SITE CONNECTION VIA FRAME RELAY

Extending the “two site” example above, suppose the home site had up to seven branch sites. Consider the following diagram:



Each branch site has a share of the 135.22.3 network space. The home network also has a share of that space used by the router interface and the IP-GATE interface. Suppose we gave each site 32 addresses on that space. Then the network mask for all the subnets would be 255.255.255.224. The home net would use addresses 135.22.3.0 through 135.22.3.31. The first remote site would use 135.22.3.32 through 135.22.3.63 and so on. The home site would be set up as follows:

```
Local rtr=135.22.3.1 submask=255.255.255.0 ipaddr=135.22.3.2
Route idx=0 addr=135.22.3.0 mask=255.255.255.224 act=drop
Route idx=1 addr=135.22.3.32 mask=255.255.255.224 dlci=16
Route idx=2 addr=135.22.3.64 mask=255.255.255.224 dlci=17
Route idx=3 addr=135.22.3.96 mask=255.255.255.224 dlci=18
Route idx=4 addr=135.22.3.128 mask=255.255.255.224 dlci=19
Route idx=5 addr=135.22.3.160 mask=255.255.255.224 dlci=20
Route idx=6 addr=135.22.3.192 mask=255.255.255.224 dlci=21
Route idx=7 addr=135.22.3.224 mask=255.255.255.224 dlci=22
```

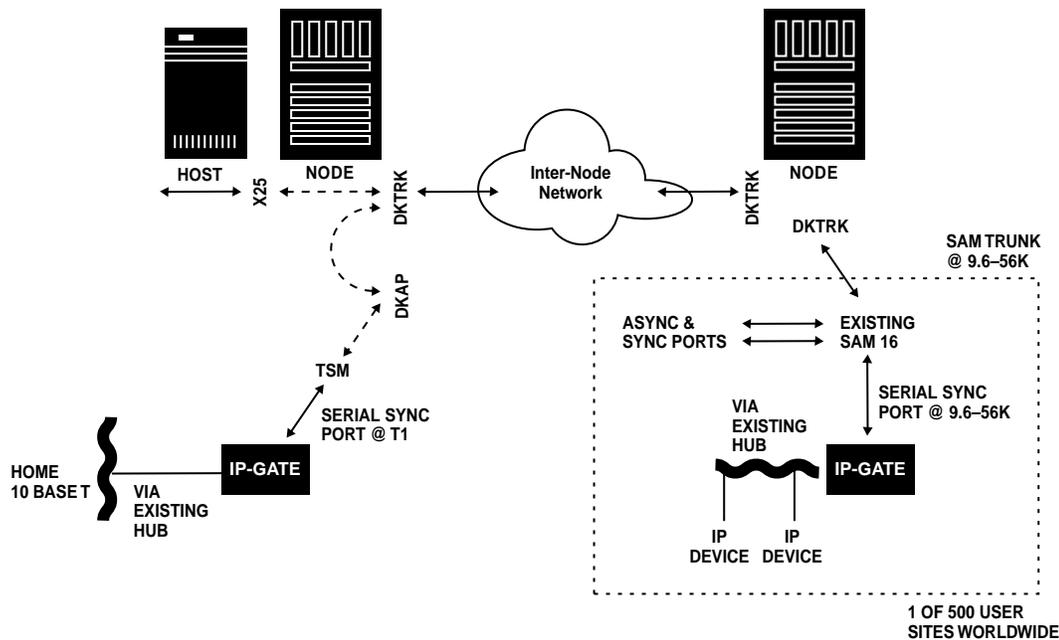
Each remote site would be set up identically except for the actual IP address. Site #1 is as follows:

```
Local ipaddr=135.22.3.34 submask=255.255.255.224
Route idx=0 addr=135.22.3.32 mask=255.255.255.224 act=drop
Route idx=1 addr=135.22.3.0 mask=0.0.0.0 dlci=16 act=rte
```

Each site uses its own address space from the 135.22.3 network. The address in the second route statement (default route) is not important since the network mask allows all bits to be ignored.

500+ SITES TO A HOME NETWORK

It is possible to extend the distribution of branch locations into the thousands. However, this requires the IP-FANOUT DKAP application. The IP-FANOUT DKAP application operates in a manner similar to the one described above. It does not require configuration because it enquires the configuration of the attached IP-GATE devices to build its routing tables. Consider the following diagram first presented during the introduction:



Suppose that each of the remote sites still requires 32 addresses as per our previous example. This example uses the entire 135.22.0.0 class B network space to distribute 2048 sites (1 home site and 2047 remote sites). The DKAP can handle approximately 1023 total due to limitations on that circuit pack.

In this example, the home network uses addresses 135.22.0.0 through 135.22.0.31 for local LAN usage. The local router is assigned 135.22.0.1, and the IP-GATE is 135.22.0.2. The home IP-GATE is configured as follows:

```
Local rtr=135.22.0.1 ipaddr=135.22.0.2 submask=255.255.255.224
Route idx=0 addr=135.22.0.0 mask=255.255.255.224 act=drop
Route idx=1 addr=135.22.0.0 mask=255.255.0.0 act=rte
Route idx=2 addr=135.22.0.0 mask=0.0.0.0 act=drop
```

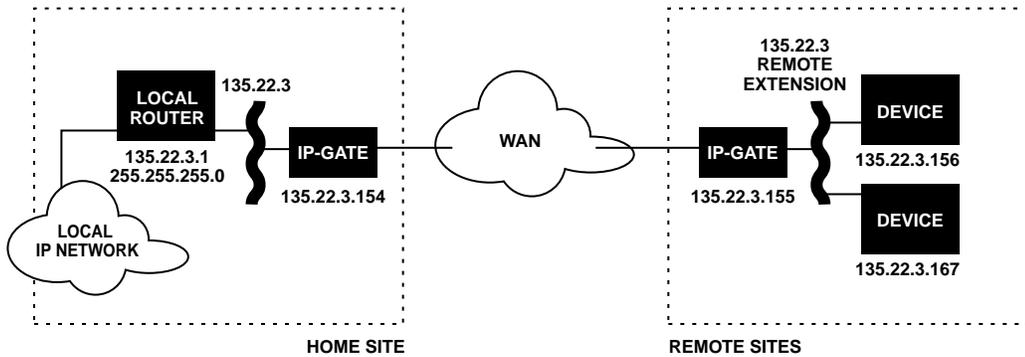
Each remote site has an IP-GATE that is configured with a unique IP address. The first site is assigned address 135.22.0.32 through 135.22.0.63. Its configuration is as follows:

```
Local ipaddr=135.22.0.34 submask=255.255.255.224
Route idx=0 addr=135.22.0.32 mask=255.255.255.224 act=drop
Route idx=1 addr=135.22.0.0 mask=0.0.0.0 act=rte
```

The IP-FANOUT application queries the IP-GATE application for its configuration after the BNS virtual circuit is set up. The routing information provided above is used by the IP-FANOUT to build its routing tables.

“DROP IN” TWO SITE CONFIGURATION

In all the prior examples, the address space was segmented so that each site would “own” its portion of the IP space. This is the approach taken by all IP routers today. However, this is frequently hard to manage and precludes a “Drop In” into an existing network. The IP-GATE is easily configured to not require any address segmentation. Consider the following diagram:



Immediately obvious is that the devices at the remote sites do not have their own subnet. They are present on the host subnet. They continue to use the host subnet router 135.22.3.1 as their “gateway” although they could use the remote IP-GATE 135.22.3.155 if they wished. However, since this is a “Drop In” it is not necessary. In fact, the only reason the IP-GATE units have IP addresses is for ICMP (Ping) purposes.

The home site would be set up as follows:

```
Local rtr=135.22.3.1 ipaddr=135.22.3.154 submask=255.255.255.0
Route idx=0 addr=135.22.3.155 mask=255.255.255.255 act=rte
Route idx=1 addr=135.22.3.156 mask=255.255.255.255 act=rte
Route idx=2 addr=135.22.3.167 mask=255.255.255.255 act=rte
Route idx=3 addr=135.22.3.0 mask=0.0.0.0 act=drop
```

Each remote site would be set up as follows:

```
Local ipaddr=135.22.3.155 submask=255.255.255.0
Route idx=0 addr=135.22.3.156 mask=255.255.255.255 act=drop
Route idx=1 addr=135.22.3.167 mask=255.255.255.255 act=drop
Route idx=2 addr=135.22.3.0 mask=0.0.0.0 act=rte
```

It is worthwhile to note the “exact route” nature of this configuration. From the host network to the remote site, routing is “exact” while the converse direction is “exclusionary”. This minimizes WAN traffic and provides complete connectivity for the remote devices.

“DROP IN” 500+ SITE CONFIGURATION

As can be seen from the Two Site Drop In Configuration above, it is not necessary to plan the IP address space in the remote sites. This section presents the 500+ site configuration presented earlier without sectioning the IP address space among the remote sites.

Suppose it is assumed that all remote sites will use the 135.22.0.0 address space but there is no plan to provide any fixed partitioning at those sites. Because it is necessary to ping the IP-GATE adapters, the home unit is given the address of 135.22.0.2 as in the prior 500+ port example. The home IP-GATE is configured as follows:

```
Local ipaddr=135.22.0.2 submask=255.255.0.0 rtr=135.22.0.1
Route idx=0 addr=135.22.0.1 mask=255.255.255.255 act=drop
Route idx=1 addr=135.22.0.0 mask=255.255.0.0 act=rte
Route idx=2 addr=135.22.0.0 mask=0.0.0.0 act=drop
```

Each of the remote site IP-GATE units is configured with those addresses that appear at that remote site.

Suppose site K had two devices and its IP-GATE. These could be addresses 135.22.16.101, 135.22.167.15, and 135.22.3.155 respectively. These are random examples and any other address within the 135.22 space can be used. The IP-GATE configuration for site K would be as follows:

```
Local ipaddr=135.22.3.155 submask=255.255.0.0
Route idx=0 addr=135.22.16.101 mask=255.255.255.255 act=drop
Route idx=1 addr=135.22.167.15 mask=255.255.255.255 act=drop
Route idx=2 addr=135.22.0.0 mask=255.255.0.0 act=rte
```

The IP-FANOUT DKAP application that would distribute the data to site K from the home site does not require configuration. It acquires its routing information directly from the IP-GATE at site K at virtual circuit setup time. ■

IP-GATE SPECIFICATIONS

DEVICE INTERFACES

CCITT V.35 DEVICE

A standard interface used for interface and trunk modules. The V.35 interface uses a 34-pin connector and operates at data rates up to 2.048Mbps.

EIA RS232-C DEVICE

A standard interface that uses binary data interchange between DTE and DCE. The RS232-C interface uses a 25-pin (DB25) connector and up to 21 signal leads, and operates at data rates from 75 to 19200 bits per second (bps).

The IP-GATE RS232-C device interface has been tested to run at rates up to 56 Kbps.

10BASET LAN

Eight-pin, 10BaseT modular connector for a 10 Mbps baseband CSMA/CD local area network.

EIA RS232-C CONSOLE

A standard interface that uses binary data interchange between DTE and DCE. The RS232-C interface uses an RJ45 connector and operates at 9600 bits per second (bps).

PHYSICAL DIMENSIONS

IP-GATE:

L=6.0" x W=1.4" x D=7.5"

Rack-mount Panel:

L=19" x W=10.5" D=. 125"

Stand-alone AC/DC Power:

L=3.5" x W=1.75" x D=2.5"

Power distribution Panel:

L=10.4" x W=. 8" x D=. 823"

ENVIRONMENTAL OPERATING RANGE

Operating Temperature: 5° to 40°C (41°F to 104°F)

Operating Humidity: 5% to 85%

Altitude: From 60M (197) below sea level to 1800 m (5905 ft.) above sea level

POWER REQUIREMENTS

IP-GATE Operating Voltage:

5V @ 800 mA Nominal

Stand-alone AC to DC power supply:

115V @ 48mA Nominal

115V @ 90 mA Maximum

Stand-alone DC power supply:

48V @ 104 mA Nominal

48V @ 195 mA Maximum

Rack-mount DC (six units):

48V @ 624 mA Nominal

48V @ 1.17 A Maximum

REGULATORY INFORMATION

IP-GATE Stand-Alone

Safety: UL, CSA, VDE, GS

EMC: FCC Part 15B Class A, ICES-003 Class A

European EMC: CE

NEBS

This Class A digital apparatus complies with Canadian ICES-003.

WARRANTY

NOTE:

This equipment has been tested and found to comply with limits for Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

WARNING:

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

SPECIAL ACCESSORIES NOTE:

In order to comply with the limits for Class A, Radio Frequency Devices, Subpart B- Unintentional Radiators (digital devices) Part 15 Rules, the user must use the cables available with this product, a RJ45 terminated shielded console cable and a DB25 to V.35 shielded adapter.

WARRANTY

The warranty for this product is as specified in customer's written agreement with Lucent Technologies Inc. or in Lucent Technologies' order acknowledgment form. If no warranty period is stated therein, the warranty period for hardware shall be one year from the date of delivery, and the warranty for software shall be 90 days from the date of delivery. Replacements and repairs are guaranteed for the longer of the remaining original warranty period or 90 days.

This product is year 2000 compliant.



