

BGAN and IP data connections

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I.0. Introduction

I.1. About this guide

This document explains how IP data connections operate on the BGAN network, and explains how each terminal manages IP data connections.

It is intended for first time end-users, Distribution Partners, Service Providers and anyone who wants to use a BGAN terminal to connect to the BGAN network and use network services. A previous knowledge of satellite communications is useful, but not essential.

This document covers the following topics:

- **BGAN and IP data connections** – introduces Standard IP and Streaming IP, connections designed to meet all your IP data requirements.
- **BGAN and PDP contexts** – provides an overview of PDP contexts. A PDP context provides essential information about your data connections to the BGAN network.
- **BGAN and IP addressing** – explains how the HNS 9201 and Explorer 500 allocate IP addresses. (The Nera WorldPro 1000 does not allocate IP addresses.)
- **Using TCP/IP and UDP/IP** – gives recommendations on the use of applications based on TCP/IP and UDP/IP, and provides tips on how to maximize performance.

I.2. Terminology

The following terms are used in this document. A brief explanation of each is given.

- **QoS** – Quality of Service (QoS) specifies a guaranteed throughput rate for data. On the BGAN terminal, you have the choice of transferring data at rates of up to 256kbps, depending on the terminal.
- **PDP context** – A Packet Data Protocol (PDP) context transfers information about your data connections between the BGAN terminal and the BGAN network. The PDP context defines connection aspects such as routing, QoS and security. The BGAN terminal opens a primary PDP context or a secondary PDP context, depending on the IP data connection type. Refer to **BGAN and PDP contexts** for details.
- **Traffic Flow Template** – A Traffic Flow Template (TFT) is a series of filters that allows traffic that passes the filters to be routed on a particular PDP context, and given a different QoS to traffic on other PDP contexts. TFTs enable the terminal to have more than one PDP context open simultaneously.

I.3. Other sources of information

- This is one of a series of PDF documents that make up the BGAN Solutions Guide. The Solutions Guide is designed to help you make the most of your BGAN terminal. Other documents in the series are available for download from www.inmarsat.com/bgan. Click on **BGAN support**, then click on **How to guides**.

This Web site also gives further information on the BGAN service, including Industry solutions.



2.0. BGAN and IP data connections

BGAN supports two types of IP data connection, designed to meet the full range of your IP data requirements. They are:

- Standard IP.
- Streaming IP.

NOTE: Refer to the **Getting Started** guide for the specific **BGAN** terminal for information on opening and closing an IP data connection.

2.1. Standard IP

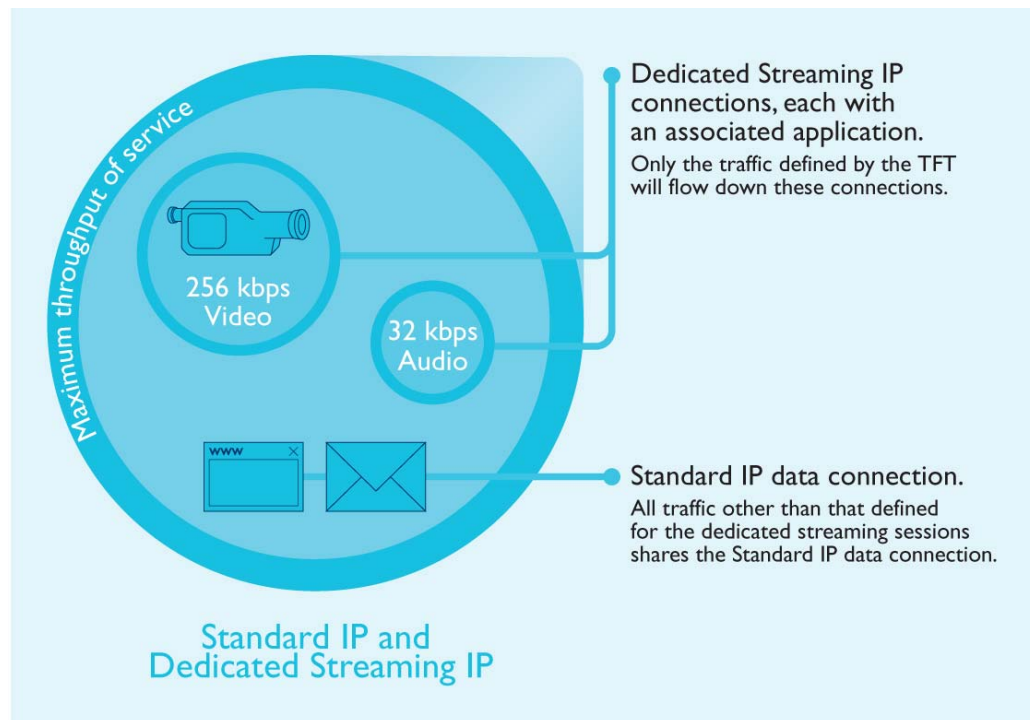
The diagram features a large light blue circle with a darker blue border. Inside the circle, the text "Up to 492kbps best effort" is centered. The words "Maximum throughput of service" are written along the inner curve of the top-left portion of the circle's border. Below the circle, the text "Standard IP" is centered. To the right of the circle, a bullet point states: "• The Standard IP connection is shared with other terminal users."

A **Standard IP** data connection is pre-configured on the BGAN terminal.

- It offers data rates of up to 492kbps (depending on the terminal) over a best effort, shared connection.
 - Standard IP is best suited to typical office applications, such as Internet browsing, e-mail and FTP.
 - You can configure BGAN LaunchPad to open a Standard IP connection by default when you register with the BGAN network, or you can open a Standard IP connection manually after registration. The default setting depends on the BGAN terminal you are using.
 - Refer to your BGAN Service Provider for details on how you are charged for a standard IP connection.
-

TIP: There may be a minimum charge when an IP data connection is open, and data may be transferred across the connection even if you are not actively using an application (for example, your computer may be receiving automatic updates). If you do not want to incur these charges, you can switch off automatic connection using **BGAN LaunchPad**, or close the data connection after registration.

2.2. Streaming IP



Streaming IP is optimized for use with audio and video applications, such as Streambox, Win Media and QuickTime. You can configure your own **Streaming IP** data connections on the BGAN terminal, and open two or more streaming IP connections in addition to the standard IP connection.

In the diagram above, a standard IP connection is open, and is being shared by terminal users for IP data applications such as Internet and e-mail services. In addition, two dedicated streaming IP sessions are open. The first, at 32kbps, is being used exclusively for an audio streaming application. The second, at 256kbps, is being used exclusively for a video streaming application.

NOTE: **BGAN LaunchPad** is supplied with a number of pre-configured streaming IP data connections, which you can use as an alternative to the standard IP connection. Note that, as with the standard IP connection, all terminal traffic is shared on a pre-configured streaming IP connection. To maximize the performance of streaming IP, Inmarsat recommends that you configure and use your own dedicated streaming IP connections.

- Streaming connections are available at one of the following data rates:
 - 32kbps streaming.
 - 64kbps streaming.
 - 128kbps streaming (HNS 920I and Explorer 500 only).
 - 256kbps streaming (HNS 920I only).
- Streaming IP is optimized for use with UDP applications, such as video and audio.
- The Quality of Service (QoS) is consistent and guaranteed. However, observed throughput may be slower than the rate you select because of overheads, such as the packet header size of the application you are using. In addition, any interconnect with terrestrial networks may impact throughput.

BGAN and QoS

- To guarantee the Quality of Service (QoS), Inmarsat provides QoS on the **satellite interfaces**, and supports QoS in the BGAN network. The Quality of Service is negotiated between the terminal and the BGAN Core Network when you open a data connection.
 - To ensure a consistent data rate **across the connection**, you must ensure that end-to-end QoS is supported for the desired data rate. To ensure end-to-end QoS, a dedicated streaming connection must be in place between your BGAN Service Provider and your corporate headquarters, including any terrestrial interconnect.
- Inmarsat recommends that you configure each streaming IP connection that you require using BGAN LaunchPad. In BGAN LaunchPad, these customized streaming IP connections are called dedicated streaming IP connections.
 - You must assign a dedicated streaming IP connection to a specific application, such as Win Media. You do this by selecting a traffic flow template (TFT) when you configure the connection. This ensures that the application does not share the connection with any other traffic.
 - The standard IP connection must be open before you can open a dedicated streaming IP connection. This is because a dedicated streaming IP connection uses the routing information of the standard IP connection. (Note that you can open one of the pre-configured streaming IP connections as an alternative to the standard IP connection.)
 - One or more dedicated streaming IP connections can be open in addition to the standard IP connection. The maximum number depends on the terminal (refer to **BGAN and PDP contexts** on page 7 for details).
 - You can configure as many dedicated streaming IP connections as you require.
 - Refer to your BGAN Service Provider for details on how you are charged for a streaming IP connection.
-



3.0. BGAN and PDP contexts

3.1. About PDP contexts

The BGAN network manages resources using Packet Data Protocol (PDP) contexts.

When you open an IP data connection, a PDP context is opened automatically. This PDP context must be established in the BGAN terminal and BGAN/UMTS core network for you to be able to transfer data across the network. A PDP context defines connection aspects such as routing, Quality of Service (QoS), security and billing between the terminal and network.

When you first open a PDP context, the terminal requests sufficient radio resources (that is, power and bandwidth) to support the context activation procedure. Once the resources are allocated, the terminal sends the activate PDP context request to the BGAN/UMTS core network. This request includes key information about the BGAN terminal, for example:

- the PDP address (which may be, for example, an IP address).
- the PDP type (that is, static or dynamic address).
- the QoS requested for this context – standard or streaming at the selected data rate.
- the Access Point Name (APN) of the external network to which connectivity is requested.
- your SIM card's identity number (IMSI).
- any necessary IP configuration parameters (for example, security settings).

On receiving the Activate PDP Context message, the UMTS/BGAN network checks your subscription record to establish whether the request is valid. If the request is valid, a virtual connection is established between the terminal and the UMTS/BGAN core network and data transfer can then take place between the terminal and the external data network.



Traffic Flow Template

Each dedicated streaming connection is associated with a Traffic Flow Template (TFT). A TFT, also called an Application Template, enables the BGAN network to filter packets received from an external network into the correct PDP context. When incoming data arrives at an access point in the core network, a packet classifier will make a PDP context selection based on the Traffic Flow Template and map the incoming data packets to the PDP context with the correct QoS attributes. The use of a Traffic Flow Template allows multiple PDP contexts to be associated with the same PDP address. (The PDP address conforms to the network layer service used, and may be, for example, an IP address).

BGAN LaunchPad supports the following pre-configured TFTs, any one of which can be selected when you configure a dedicated streaming connection to ensure that the defined traffic has its own dedicated connection:

- FTP
- QuickLink
- QuickTime
- Real Media
- Streambox
- WinMedia

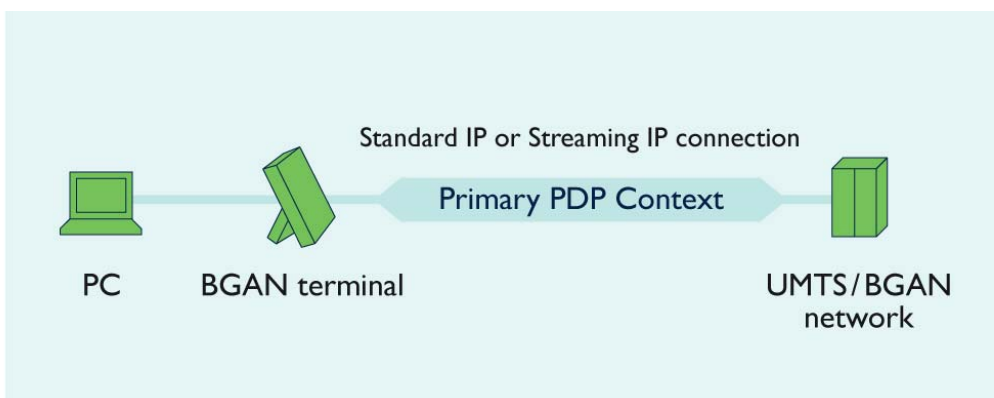
If you want to define your own TFT for another application, contact your Service Provider for assistance.

NOTE: The use of TFTs requires careful consideration. A document describing the factors to consider will be available in Q2 2006.

3.2. BGAN and PDP contexts

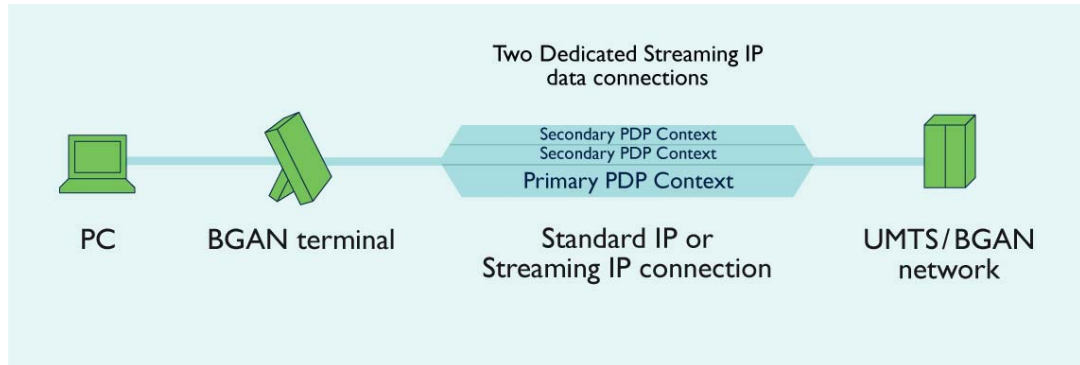
The BGAN terminal creates a PDP context for each IP data connection that you open to send or receive traffic over the BGAN network. These contexts can either be primary or secondary.

If you open the **standard** IP data connection or one of the pre-configured **streaming** IP data connections in BGAN LaunchPad, the BGAN terminal opens a **primary PDP context**, as shown below. Primary contexts can each connect to a different APN and each get a public IP address.





If you open a **dedicated streaming IP** data connection, allocated to a particular application, the BGAN terminal opens a **secondary PDP context**, specifically for this connection, as shown below:



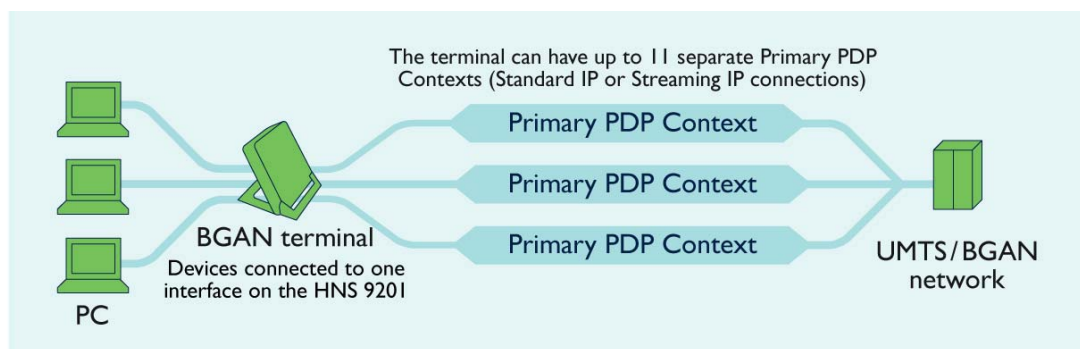
A secondary context is always associated with the primary PDP context open on the interface and shares the APN and IP address with the primary context. However, the secondary PDP context can have a different QoS from that of the primary PDP context.

Each terminal has a different method of managing PDP contexts and supports different combinations of primary and secondary PDP contexts.

3.3. PDP Contexts on the HNS 9201

The HNS 9201 supports up to 11 PDP contexts simultaneously. Contexts can be primary or secondary, but a primary PDP context must always be open before you can open a secondary PDP context.

For example, up to 11 users can connect to the terminal across all interfaces and each can open a primary PDP context. In the diagram below, three users are connected, each with a primary PDP context.



In this scenario:

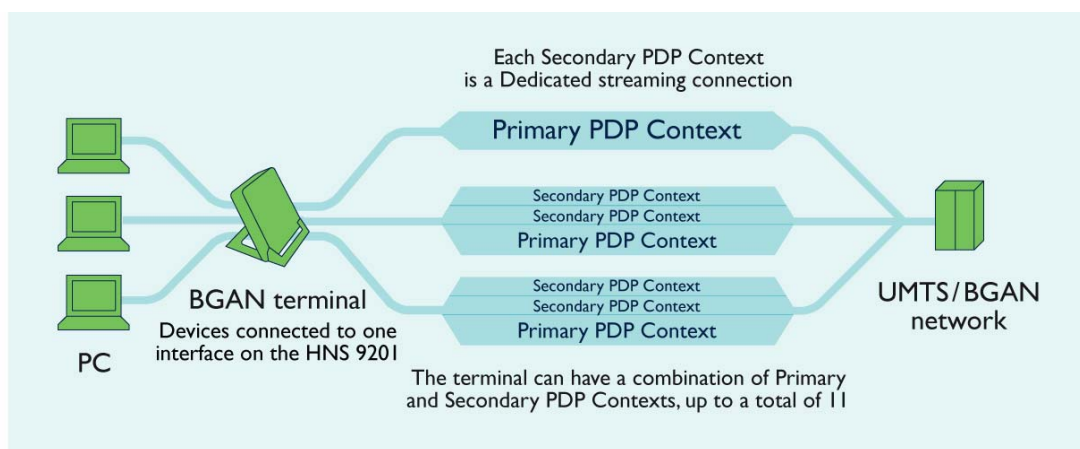
- Each primary PDP context has its own public IP address, can use a different APN, and can have its own Quality of Service.
- Each primary PDP context must be managed using a separate session of BGAN LaunchPad. Each user has the experience of being the only user connected to the terminal, although each user can view the other open connections on the terminal



An alternative example is shown in the diagram below. In this scenario, seven PDP contexts are open, and there are three users connected to the terminal.

- User 1 has a primary PDP context open. All their traffic is running down one standard or streaming connection.
- Users 2 and 3 each have one primary PDP context open, and two secondary PDP contexts open. The secondary PDP contexts are dedicated streaming IP connections, each assigned to a particular application.

This scenario would only be used with lower Quality of Service dedicated streaming connections, due to the demands on terminal capacity.



In this scenario:

- Each secondary PDP context shares its routing profile including the APN and IP address with the primary PDP context, but can have a different QoS.
- Users who open a secondary PDP context must be connected to the same interface as that operating the primary PDP context.

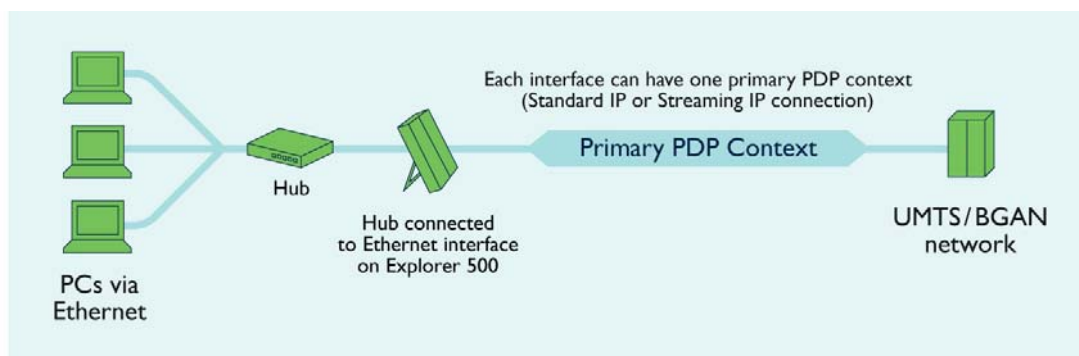
3.4. PDP contexts on the Explorer 500

The Explorer 500 can open one primary PDP context on the LAN interface and one primary PDP context on the USB interface. If more than one user is connected to a single interface, for example the LAN interface, all users connected to that interface must share the same primary PDP context. This differs from the HNS 9201, where each user on a single interface can have their own primary PDP context.

For this reason, Inmarsat recommends that only one session of BGAN LaunchPad should be open per interface. This user controls the terminal's data connections for each user connected to the interface. If a secondary PDP context is required, use the computer running BGAN LaunchPad to open this connection. This secondary PDP context can also be shared by all users connected to the interface.



In the diagram below, three users are connected to the LAN interface of the terminal through a Hub. There is only one primary PDP context open between the terminal and the network.

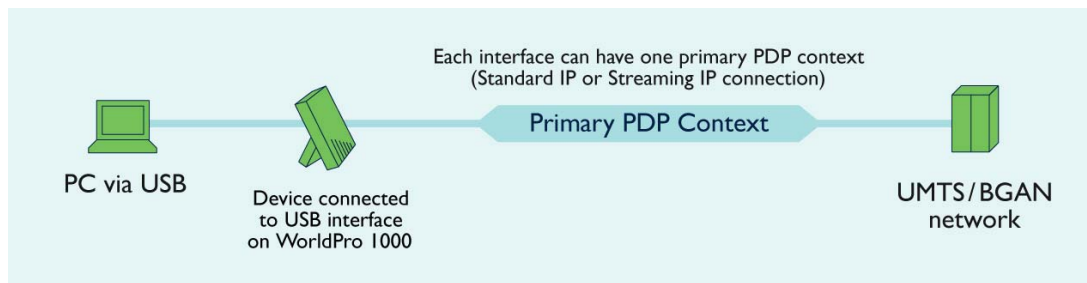


In addition, up to seven Bluetooth-enabled IP data devices can be connected to the terminal's in-built Bluetooth modem,

3.5. PDP contexts on the WorldPro 1000

The WorldPro 1000 can open one primary PDP context on the USB interface. If a secondary PDP context is required, use the same computer to open this interface.

In the diagram below, one user is connected to the USB interface of the terminal. There is only one primary PDP context open between the terminal and the network.



In addition, up to four Bluetooth-enabled IP data devices can be connected to the terminal's in-built Bluetooth modem.

3.6. Summary

The following tables show how many primary and secondary PDP contexts are available on each terminal. Note the following:

- The figures shown are all subject to availability of network resources.
- The total QoS requested can not exceed the capacity of the terminal. For example, on the HNS 9201 the maximum capacity is 492kbps. Therefore, if you request ten 32kbps dedicated streaming connections, the maximum remaining capacity is 172kbps.



HNS 9201

	Ethernet	WLAN	USB
IP data, single-user	1 Primary PDP context. 1 or more Secondary PDP contexts.	1 Primary PDP context. 1 or more Secondary PDP contexts.	1 Primary PDP context. 1 or more Secondary PDP contexts.
IP data, multi-user	1 1 simultaneous PDP contexts, at least one of which must be primary.		

Explorer 500

	Ethernet	Bluetooth	USB
IP data, single-user	1 x Primary PDP context. 1 or more Secondary PDP contexts.	1 x Primary PDP context. 1 or more Secondary PDP contexts.	1 x Primary PDP context. 1 or more Secondary PDP contexts.
IP data, multi-user	<ul style="list-style-type: none"> 1 1 simultaneous PDP contexts, at least one of which must be primary. Maximum 1 Primary PDP context per interface, shared by all users connected to the interface (NAT mode). One or more Secondary PDP contexts per Primary PDP context (NAT mode). 		

WorldPro 1000

	Bluetooth	USB
IP data, single-user	1 Primary PDP context. 1 or more Secondary PDP contexts.	1 Primary PDP context. 1 or more Secondary PDP contexts.
IP data, multi-user	<ul style="list-style-type: none"> 1 1 simultaneous PDP contexts, at least one of which must be primary. Maximum 1 Primary PDP context per interface, shared by all users connected to the interface. One or more Secondary PDP contexts per Primary PDP context. 	



4.0. BGAN and IP addressing

The BGAN terminal obtains a public IP address when it connects to the BGAN network. Each of the computers connected to the terminal obtains a private IP address, either direct from the terminal's NAT functionality or from a router connected to the terminal.

The HNS 9201 and Explorer 500 each has a different method of managing IP addressing (the WorldPro 1000 does not have an Ethernet interface).

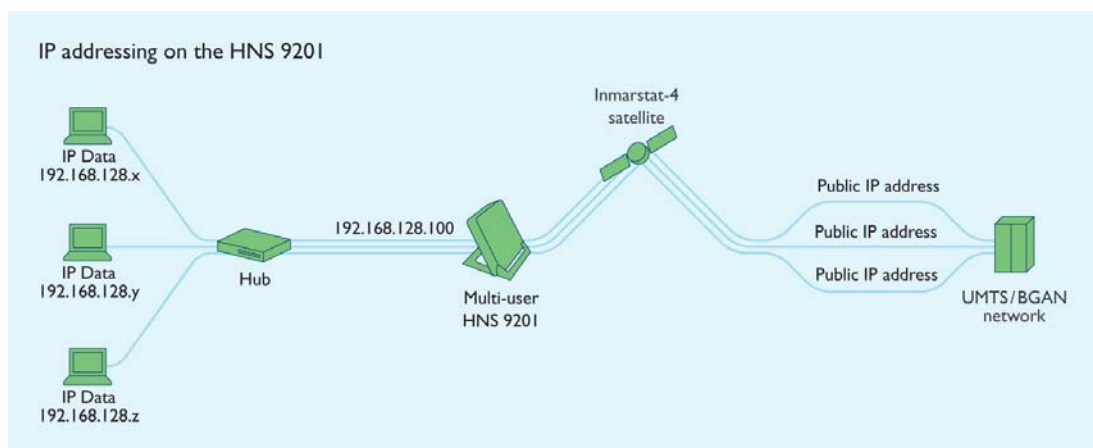
4.1. IP addressing on the HNS 9201

The DHCP server in the terminal dynamically allocates an IP address to each user connected to the Ethernet or WLAN interface, up to a maximum of 11 users. The DHCP server then maps the IP address to a network address for full Network Address Translation (NAT) and Port Address Translation (PAT). Each user can therefore open a separate data connection from the terminal.

In normal operation, the terminal dynamically allocates IP addresses to the **connected devices**. (Alternatively, you can manually configure the IP addresses using your operating system's administrative tools.) The default IP address of the terminal is 192.168.128.100, and the allocated address is in the range 192.168.128.101 to 192.168.128.254. For details, refer to "Getting Started with the HNS 9201", available for download from www.inmarsat.com/bgan.

The public IP address of the **terminal** is allocated by your BGAN Service Provider and can be either static or dynamic. Dynamic configuration is carried out automatically. If you want to allocate the static IP address provided by your BGAN Service Provider for a particular data connection, use BGAN LaunchPad to edit the routing options for the data connection. Refer to "BGAN LaunchPad Help" for details.

The following diagram illustrates how each private IP address allocated by the terminal corresponds to a public IP address on the network, enabling each user to have the experience of being the only user connected to the terminal.



4.2. IP addressing on the Explorer 500

The Thrane & Thrane Explorer 500 offers you the choice of using the terminal in NAT mode or Modem mode. The two modes allocate IP addresses differently, and give differing levels of management control to connected users.



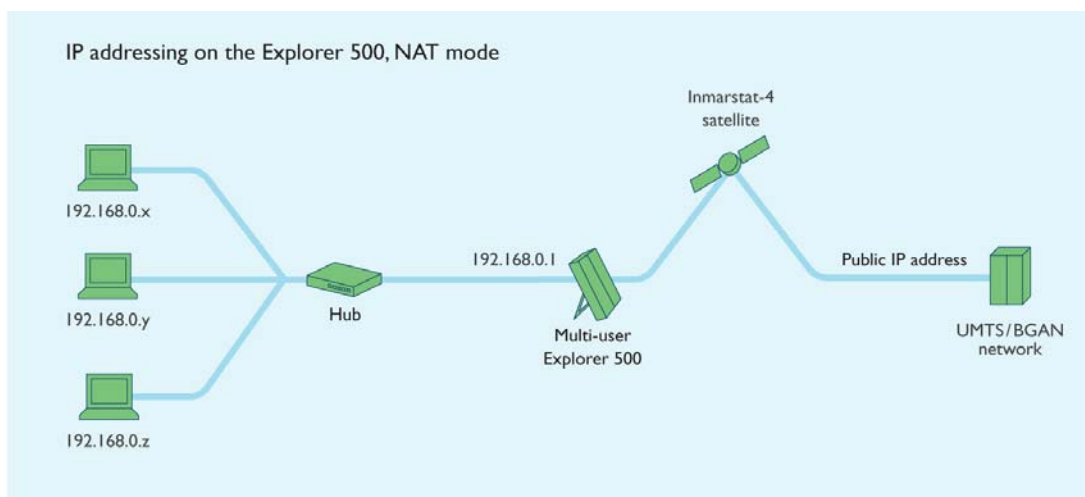
NAT mode

In **NAT** mode, the terminal dynamically allocates IP addresses to the **connected devices**. (Alternatively, you can manually configure the IP addresses using your operating system's administrative tools.) The default IP address of the terminal is 192.168.0.1, and the allocated addresses use the format 192.168.0.x. For details, refer to "Getting Started with the Explorer™ 500", available for download from www.inmarsat.com/bgan.

The public IP address of the **terminal** is allocated by your BGAN Service Provider and can be either static or dynamic. Dynamic configuration is carried out automatically. If you want to allocate the static IP address provided by your BGAN Service Provider for a particular data connection, use BGAN LaunchPad to edit the routing options for the data connection. Refer to "BGAN LaunchPad Help" for details.

If multiple users are connected to the Ethernet interface, the terminal allocates a private IP address to each device connected to it from its pool of private IP addresses.

The following diagram illustrates how multiple private IP addresses allocated by the terminal correspond to one public IP address on the network. Therefore each user must share the Standard or Streaming IP connection.



Modem mode

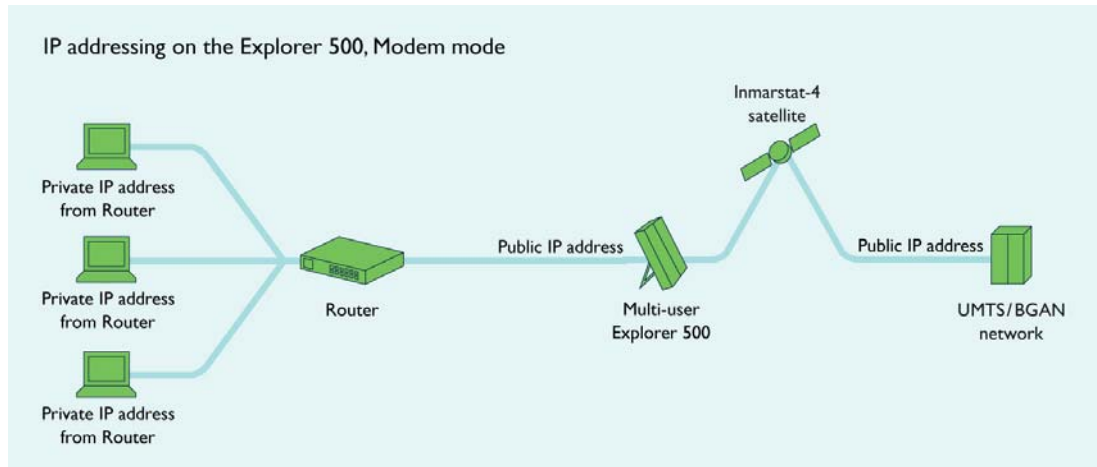
In **Modem** mode, the terminal does not allocate IP addresses to the **connected devices**.

The public IP address is allocated by your BGAN Service Provider to the **connected device**, which may be a computer if a single user is connected to the terminal, or a router if multiple users are connected to the terminal's LAN interface. Only one public IP address is allocated. If the terminal is connected to a router, the router can allocate private IP addresses to connected devices from its own pool of IP addresses.

NOTE: The terminal may temporarily allocate an IP address to the connected device whilst it is waiting for a public IP address to be allocated. It may take several seconds for the change to occur. This is normal behaviour.



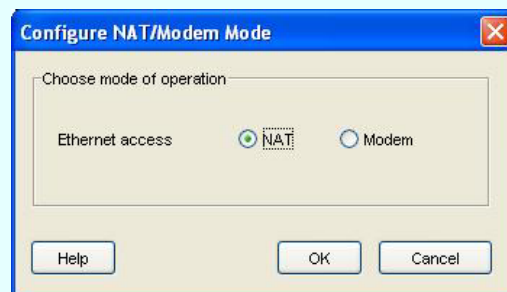
The following diagram illustrates how multiple private IP addresses allocated by the router correspond to one public IP address. If multiple users are connected to the Ethernet interface over a router, only one user can request a Standard or IP connection.



Selecting NAT mode or Modem mode

You can set the Explorer 500 to operate in NAT mode or Modem mode using BGAN LaunchPad. To do this:

1. Select **Terminal > NAT Mode** from the BGAN LaunchPad main menu. The Configure NAT/Modem Mode screen is displayed, as shown below:



2. Select either **NAT** or **Modem**, and click on **OK**.



5.0. Using TCP/IP and UDP/IP

This section gives recommendations for the use of applications based TCP/IP and UDP/IP, over the BGAN network, provides information on the performance of each protocol on a streaming IP data connection, and recommends how to configure your data connections and applications to maximize performance.

5.1. Recommendations

- Use a **Standard IP** data connection for **TCP** applications, for example e-mail and FTP.
- Use a **Streaming IP** data connection for **UDP** applications, for example video streaming and audio streaming.

5.2. About TCP/IP

TCP traffic is better suited to a Standard IP data connection.

TCP (Transmission Control Protocol) is used for normal Internet traffic and applications such as Web browsers, FTP and so on, where data delivery must be guaranteed. TCP/IP requires packet re-transmission, that is the re-sending of dropped or lost packets to ensure that all data is transmitted.

Packet retransmission is a standard feature on all networks running applications over TCP/IP. One result of this is the reduction in perceived IP throughput rates as the protocol waits for the re-transmission of dropped or lost packets. In addition, TCP/IP applications throttle their rate of packet transmission based on the capacity of the link. For these reasons, TCP is best suited to an IP connection optimized for packet re-transmission, and ideally with as large a capacity possible. Inmarsat recommends the **Standard IP** connection, with data rates of up to 492kbps, for TCP-based applications traffic over the BGAN network.

The characteristics of TCP/IP traffic are not as well suited to the **Streaming IP** connections available on the BGAN network. Each Streaming IP connection is a dedicated connection designed for a single IP packet stream at a fixed rate of throughput (up to 256kbps). The Streaming IP connection is better suited to time-critical applications, where rapid transmission of data is more important than dropped or lost packets. Such applications are better suited to the UDP protocol.

Should you decide to use **TCP/IP applications** over an **IP Streaming** data connection, you may experience the following:

- In the from-mobile direction, a typical 10-15% reduction in throughput due to network signalling and application overheads, plus a further 10-15% reduction based on TCP packet retransmission. The achieved IP throughput could therefore be up to 30% less than the desired Streaming rate.
- In the to-mobile direction, the affect on performance could be the same as the from-mobile direction. In addition, there is the risk of further dropped packets should data burst at a rate higher than the capacity of the connection. In this scenario, packets are repeatedly lost and re-transmitted until the BGAN link has the capacity to forward them to their destination. This may cause a further 10% reduction in throughput.

5.3. About UDP/IP

UDP traffic is better suited to a Streaming IP data connection.

UDP (User Datagram Protocol) is used for applications such as video streaming or audio streaming, where lost packets don't need to be retransmitted and speed takes precedence. Unlike TCP/IP, any

dropped or lost packets are ignored and compensated for or replaced by the application. This application intelligence optimizes transmission speeds, and is particularly effective on non-contended connections, such as **Streaming IP** connections on the BGAN network.

UDP applications throttle their transmission rate according to the capacity of the connection, but they do not retransmit packets. The achieved data rate is therefore much closer to the desired connection rate.

Inmarsat particularly recommends **Streaming IP** connections for live video and audio applications, which are better suited to the UDP protocol. Examples of such applications are Streambox and QuickLink.

5.4. Optimization and Tips

- Make sure that **end-to-end QoS** is supported for the required data rate.

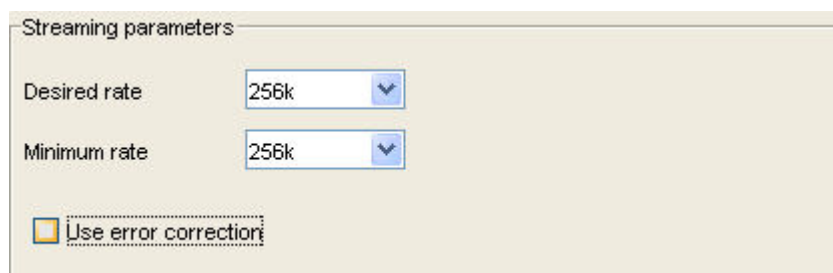
This is particularly important for UDP-based applications running over Streaming IP connections on BGAN. To maintain throughput and quality it is important that QoS is maintained across the terrestrial 'last mile' link as well as the satellite interface.

If you want to use BGAN for live video and audio streaming traffic using UDP-based applications, Inmarsat recommends that you investigate and implement 'last mile' routing arrangements which guarantee end-to-end QoS. Your BGAN Service Provider can provide details of available interconnect options.

- In BGAN LaunchPad, always **set the Minimum data rate to the same as the Desired data rate**. This ensures that you are always allocated the data rate that you require.

To set the Minimum rate and the Desired rate to the same value, do the following in BGAN LaunchPad for each data connection:

1. Select the **Data** tab, and right-click on the connection you want to edit.
2. Select **Edit**. The Connection Icon Setup dialog box displays.
3. Select the **Connection** tab.
4. Select the same data rate in each drop down box (shown below), and click on **OK**.



Streaming parameters

Desired rate: 256k

Minimum rate: 256k

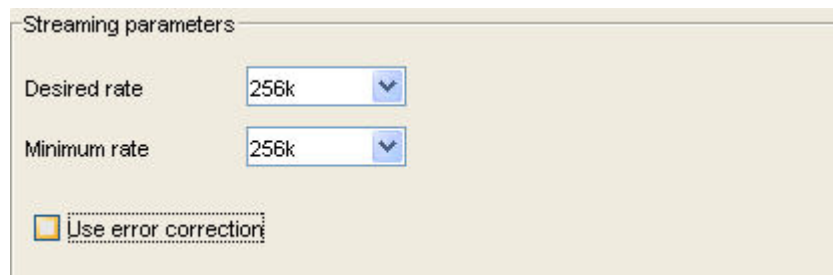
Use error correction



- Turn **error correction off**. Error correction is not required by either protocol, because:
 - UDP does not require re-transmission.
 - TCP has re-transmission built-in.

To turn error correction off, do the following in BGAN LaunchPad for each data connection:

1. Select the **Data** tab, and right-click on the connection you want to edit.
2. Select **Edit**. The Connection Icon Setup dialog box displays.
3. Select the **Connection** tab.
4. Uncheck the Error correction check box (shown below), and click on **OK**.



- Make sure that you read the documentation supplied with your application for advice on maximizing performance.