

# Novatel Wireless M2M PAD



## Application Note



# General

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# 1

## Introduction

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This document combines the multiple Application Notes that relate to the Novatel Wireless M2M Packet Assembler/Dissassembler (PAD).

The following documents have been combined into this Application Note.

- GSM0000AN011 - Packet/Assembler/Dissassembler (PAD) Configuration and Use
- GSM0000AN012 - Network Transparency Configuration for PAD
- GSM0000AN026 - Using a Terminal Program to Test PAD
- GSM0308AN002 - Novatel Wireless M2M Enabler-III +++/PAD Disconnect

This section gives the user a basic understanding of the Novatel Wireless M2M architecture that addresses the configuration and use of the internal Packet Assembler/Disassembler or PAD.

Novatel Wireless M2M has designed a Packet Assembler/Disassembler (PAD) interface to facilitate connections to platforms that do not have an IP stack. The PAD can be fully automated to provide a network connection upon power up.

# 2

## Configuration And Use

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Overview

Basic PAD Parameters

PAD Parameters (Available in TCP PAD Operation ONLY)

Additional Commands for PAD Operation

Basic UDP PAD Operation

Basic TCP PAD Operation



# Overview

There are many basic serial devices which support legacy applications that could benefit from the ability to use a packet data network like GPRS. The existing devices do not have the processing power or ability to support an IP stack that is required of the device to facilitate communication to the network. The PAD and associated serial interface commands provide an architecture that can be configured for connection to a legacy device. Once configured and connected, the PAD accepts data passed over the serial lines and packages the data for delivery over the network. A PAD is required at the host end to reverse the process. The PAD will accept IP data over the network, parse the data, and pass it to the connected device in the reverse order. TCP and UDP transport protocols are supported in the PAD. The following figure demonstrates the basic architecture.

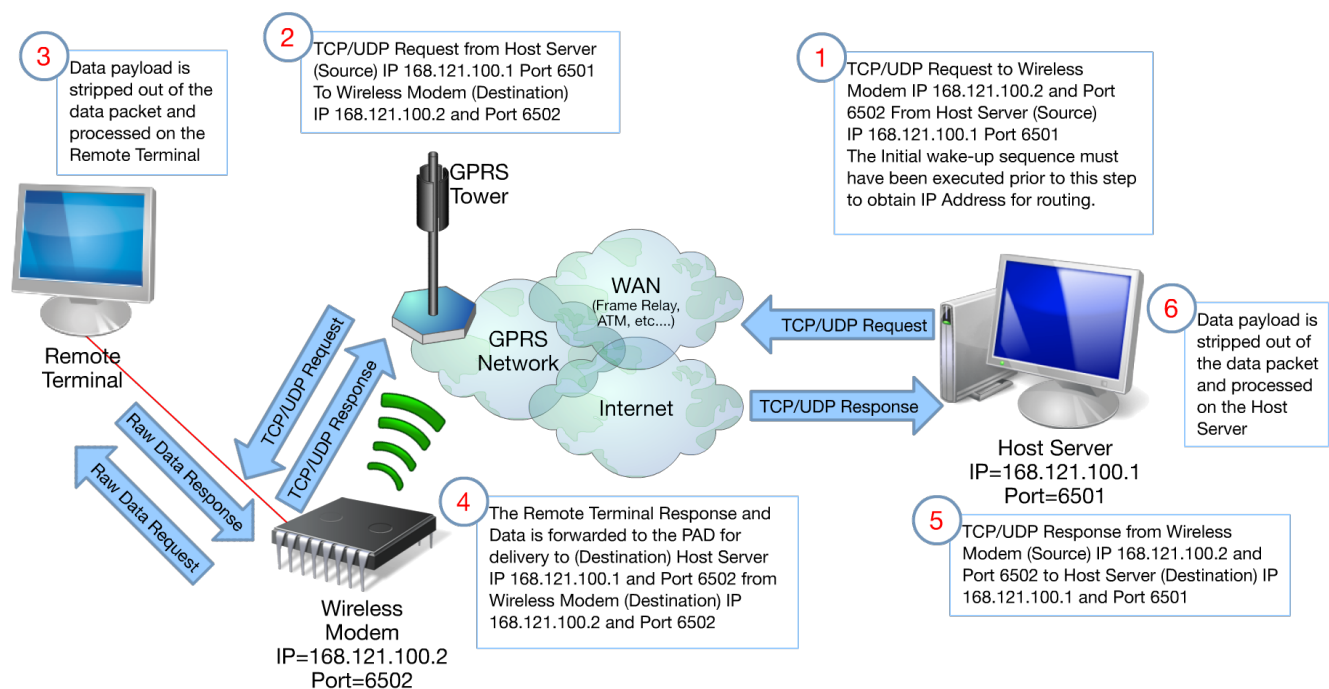


Figure 2-1 PAD Architecture

AT\$HOSTIF	= 1	(Establish a UDP PAD session upon ATD command)
	= 2	(Establish a TCP PAD session upon ATD command)
AT\$PADDST	= *168.121.100.1	(Destination IP address and Port)
	= *6501	
AT\$PADSRC	= 6502	(Source Port)
AT\$PADBLK	= 100	(Amount of data in bytes to be buffered before send-

AT\$PADCMD =	1B	ing) (Bitwise parameter that controls PAD operation features)
AT\$PADFWD =	0D	(Data forwarding character)
AT\$PADTO =	50	(Inter-Character-Timeout. Amount of time before sending data buffer)
AT\$ACTIVE =	1	(Active, client TCP PAD mode of operation) TCP PAD Only
	= 0	(Passive, Server TCP PAD mode of operation) TCP PAD Only
AT\$CONNTO =	50	(TCP PAD Connection Timeout amount of time to attempt TCP PAD connection) TCP PAD Only
AT\$IDLETO =	50	(TCP PAD Idle Timeout, amount of wait before disconnecting the TCP PAD connection) TCP PAD Only

## Basic PAD Parameters

The following commands are used to define the PAD interface and functionality. Please refer to the AT Command Set document for your device for detailed command information and functionality.

### Definitions

Context activation - Used to describe the state where the modem is capable of passing IP Data to the wireless network.

Dial-Up Phone Number (DUPN) - Phone number used to activate data services on the modem. It can be unique for each technology, carrier, and class of service.

Some DUPN Examples

- GPRS/EDGE: ATD\*99#
- CDMA: ATD#777
- UMTS: ATD\*98#

### Destination IP Address And Port (AT\$PADDST)

This parameter provides the destination IP address and port number to be used in communication with a host. The destination IP address is the IP for PAD data. PAD data is sent to and received from this IP. A destination IP address of 0 will allow PAD access from any IP destination, and will cause all locally generated PAD data to be sent to the IP address associated with the last remotely received PAD data. The destination port is the port for PAD

data. PAD data is sent to and received from this port. A destination port of 0 will allow PAD access from any port, and will cause all locally generated PAD data to be sent to the port associated with the last remotely received PAD data.

A value of 0 will allow any IP/port access to the TCP PAD. If populated and in passive server mode (AT\$ACTIVE=0) the TCP PAD will limit access to the IP/port defined.

## Source Port (AT\$PADSRC)

The source port defines the port number provided in the data packet header from the PAD. The source IP address will be the IP address obtained from the network. PAD source port is used as the source port in all outgoing PAD data messages. The remote host must use this port number as the destination port for PAD data sent to the device.



The port number configured using the AT\$UDPAPI command cannot be the same as the one used in the AT\$PADRSC command. An ERROR will be returned by the modem if the same port is used.

## PAD Block Size (AT\$PADBLK)

This parameter defines the size of the PAD data buffer used to trigger the transmission of data based on the amount of data buffered. PAD data will be created at the requested PAD block size (number of bytes) unless an enabled forward character or PAD timeout forces the data to be sent out at a smaller block size. Block size does NOT include the IP or TCP/UDP header size.

## PAD Command Features (AT\$PADCMD)

This command allows for the configuration of various PAD features. The command controls items like forwarding character, backspace, and escape sequence processing.

## PAD Timeout Value (AT\$PADTO)

This command defines the PAD timeout value. Data will be forwarded to the PAD destination even if the PAD block size has not been reached if <pad timeout> period has elapsed since the last PAD character was received from the local host.

## PAD Forwarding Character (AT\$PADFWD)

This command defines the PAD forwarding character. If PAD forward is enabled via AT\$PADCMD, receipt of this character will immediately forward all currently buffered PAD data.

## **PAD Backspace Character (AT\$PADBS)**

This command allows the definition of the PAD backspace character. If PAD edit is enabled via AT\$PADCMD, this character will cause the previous character to be deleted from the PAD output buffer. If the previous character has already been forwarded due to a PAD timeout or receipt of an enabled forward character, receipt of the PAD edit character will have no effect.

## **PAD Parameters (Available In TCP PAD Operation ONLY)**

### **TCP PAD State Operation (AT\$ACTIVE)**

This command determines the active or passive state of the TCP PAD connection. If passive is chosen, the PAD will be in server mode and listen for inbound TCP connection requests. If active is chosen, the PAD will be in client mode and will initiate a connection based on the ATDT command. A value of 0 indicates passive server mode of operation. A value of 1 indicates active client mode of operation. ATDT will be used to initiate the passive server mode functionality. If ATDTxxx.xxx.xxx.xxx/xxxx is used, it will override the passive mode and replace the AT\$PADDST parameters as it does in UDP PAD mode.

### **TCP PAD Connection Timeout Value (AT\$CONNTO)**

This command is used to indicate the amount of time, in seconds, to spend attempting to establish a TCP connection. A value of 0 will indicate infinite connection wait time. This command pertains to client mode operation only. The valid range is 0, 10-3600.

### **TCP PAD Disconnect (AT\$DISC)**

The existing AT\$DISC command is used for API requests to terminate a TCP PAD session. The command checks for AT\$HOSTIF=2 to function as a disconnect request via the API call. This is ONLY functional over the air, as the serial port is occupied processing the PAD interface.

### **TCP PAD Idle Timeout Value (AT\$IDLETO)**

Idle timeout is the length of time, in seconds, a TCP session connection will remain active without the remote connection sending any data. If no communication is received from the remote connection in the specified time, the modem should attempt to close the connection. Default timeout should be two minutes. The valid range is 10 to 86400.

# Additional Commands For PAD Operation

The following commands are necessary for the proper definition of the physical serial port of the Enabler®-G and automated PAD initiation. The serial interface commands allow for proper matching of serial port speed, character framing, and flow control.

## Serial Port Speed (AT+IPR)

This command allows the user to define the port speed from 75 to 115,200.

## Character Framing (AT+ICF)

This command determines the number of data/stop/parity bits that will be used by the serial interface.

## Flow Control (AT+IFC)

This command determines the flow control interface. The parameters include hardware, software, or no flow control.

## Host To Modem Interface (AT\$HOSTIF)

This command configures the desired Host to Modem interface. This parameter determines the behavior of the ATD command. The command allows for automated PAD initiation. When \$HOSTIF is 1, and the appropriate DUPN is used, UDP PAD operation will be invoked. When \$HOSTIF is 2, and the appropriate DUPN is used, TCP PAD operation will be invoked.

## Automated Context Activation (AT\$AREG)

This command controls the ability of the modem to automatically context activate. If the value of this command is a 2, the modem will context activate and enter the mode designated in the AT\$HOSTIF parameter upon power-up. If the AT\$AREG is a 1, the modem will only context activate when the appropriate DUPN is issued.

# Basic UDP PAD Operation

The UDP PAD can be configured to forward data based on several parameters. The UDP PAD can forward data based on a forwarding character as defined by the AT\$PADFWD.

Additionally, the forwarding character can be included or excluded in the data packet using the AT\$PADCMD command. The UDP PAD can forward data based on a timeout value using AT\$PADTO. The data will be forwarded regardless of the AT\$PADFWD and AT\$PADBLK definitions if the timer value expires prior to the other definitions. The UDP PAD can forward data based on data buffer size using the AT\$PADBLK command.

To invoke the UDP PAD, issue the ATD\*99# command while AT\$HOSTIF=1.

Additionally, the UDP PAD can be invoked by using ATDPxxx.xxx.xxx.xxx/xxxx or ATDP"DNS\_Name",xxxx\*; where xxx.xxx.xxx.xxx is the desired destination IP or "DNS\_Name"\* is the desired destination URL and xxxx is the desired destination port number. If this command is used, it will overwrite entries made in the AT\$PADDST command.

\* DNS\_Name supported on software versions 0.7.6 and higher

Local disconnect requests are accomplished via escape sequence (+++), dropping DTR, or connection timeout. Once disconnected the modem will return to AT command mode.

- Escape sequence consists of a one second (or longer) guard time, +++, one second (or longer) guard time. There must be less than a second between each '+' character. Escape sequence detection is controlled with the AT\$PADCMD command.

Proper analysis of terminal device requirements and application timing and control are required to fine-tune the UDP PAD for proper operation. Some experimentation may be required adjusting command settings to gain the best configuration settings for a particular solution. Each terminal device will have unique requirements and time should be spent in testing various configurations.

## Basic TCP PAD Operation

The TCP PAD can be configured to forward data based on several parameters. The TCP PAD can forward data based on a forwarding character as defined by the AT\$PADFWD.

Additionally, the forwarding character can be included or excluded in the data packet using the AT\$PADCMD command. The TCP PAD can forward data based on a timeout value using AT\$PADTO. The data will be forwarded regardless of the AT\$PADFWD and AT\$PADBLK definitions if the timer value expires prior to the other definitions. The TCP PAD can forward data based on data buffer size using the AT\$PADBLK command.

To invoke the TCP PAD, issue the ATD\*99# command while AT\$HOSTIF=2.

Additionally, the TCP PAD can be invoked by using ATDTxxx.xxx.xxx.xxx/xxxx or ATDT"DNS\_Name",xxxx\*; where xxx.xxx.xxx.xxx is the desired destination IP or "DNS\_Name"\* is the desired destination URL and xxxx is the desired destination port number. If this command is used, it will overwrite entries made in the AT\$PADDST command.

Local disconnect requests are accomplished via escape sequence (+++), dropping DTR, or connection timeout. Once disconnected the modem will return to AT command mode.

- Escape sequence consists of a one second (or longer) guard time, +++, one second (or longer) guard time. There must be less than a second between each '+' character. There is no way to disable the escape sequence detection in the TCP PAD.

A remote TCP disconnect request or AT\$IDLETO will return the modem to LISTEN mode when the TCP PAD is configured as AT\$ACTIVE=0.

In server or client mode, CONNECT will echo only after the TCP connection is established and the modem is ready to receive PAD data.

When configured in passive, server mode, LISTEN will echo only when context activation is complete.

Only a single TCP connection is supported at a time. Cannot have connections to multiple TCP hosts simultaneously. Can disconnect one TCP connection and then start a new TCP connection.

Use the UDP API Wakeup/Keep-alive mechanism to have modem report its IP address to remote hosts. This is necessary for a passive modem to inform the remote host of its dynamic IP address.

Proper analysis of terminal device requirements and application timing and control are required to fine-tune the TCP PAD for proper operation. Some experimentation may be required adjusting command settings to gain the best configuration settings for a particular solution. Each terminal device will have unique requirements and time should be spent in testing various configurations.

# 3

## PAD Disconnect

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New AT Command AT\$PADDISC

Background and Reason for New Command

What Happens When AT\$AREG=2 is Set?



# New AT Command AT\$PADDISC

This new AT command performs the following functions:

- Sets the functionality of the +++
- 0 = When +++ is entered tear down PAD and Context activation (default)
- 1 = When +++ is entered Go to command mode, but keep PAD and Context activation active.

## Background And Reason For New Command

This command changes the behavior of entering +++ when connected in a PAD session. On previous products, we would disconnect the PAD session and tear down the current context activation.

This caused issues with attempting to answer incoming voice or data calls and also caused customers to be charged more when activating/deactivating contexts.

This command did not function in accordance with standard serial port or industry standard. To fix this, Novatel Wireless M2M has made the following changes:

- When enabled, +++ will release the serial port into command mode, but will not tear down TCP or Context activation (similar to how CSD works)
- ATO will cause the device to return to data mode and resume the current connection
- ATH will cause the current context activation and PAD session to be disconnected
- Default will be not enabled for backward compatibility
- Enabled with setting AT\$PADDISC=1 (AT\$PADDISC=0 disables)

## What Happens When AT\$AREG=2 Is Set?

When **AT\$AREG=2** is set, and +++ is entered, the modem goes into command mode and waits for user interaction, similar to **AT\$AREG=1**. It does not automatically reconnect. To return to data mode, the ATO command must be used.

If **AT\$AREG=2** is set, +++ is entered, and the user wants to go to command mode, setting **AT\$AREG=1** will disconnect the PAD session and the context activation.

When in **AT\$AREG=2** and in command mode, **ATH** will end the PAD session, but will not deactivate the context activation.

# 4

## Network Transparency Configuration

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Objective

Overview

Authentication Configuration

# Objective

This section provides appropriate configuration settings for the Novatel Wireless M2M modem when used on wireless data networks. Novatel Wireless M2M Modems are able to automate the appropriate requirements when using the PAD such that programmatic and/or manual intervention is not required.

## Overview

Wireless Network Providers may use additional authentication methods when allowing devices to transmit data on their networks.

A network is either transparent or nontransparent in architecture. The transparency determines if the mobile platform is required to provide a username and password to successfully connect to the network. A transparent network will not require a username and password, whereas, a non-transparent network will.

Novatel Wireless M2M has designed a Packet Assembler/Disassembler (PAD) interface to facilitate connections to platforms that do not have an IP stack. The PAD can be fully automated to provide a network connection upon power up. Please see GSM0000AN011 - PAD Configuration and Use for detailed information concerning the PAD. If the PAD is being used on a non-transparent network, it needs to provide a username and password to properly connect. The module will need to provide the authentication protocol required along with the username and password parameters. The following commands provides this capability:

Note: Different technologies require different commands

See the appropriate AT command document for detailed descriptions of these commands.

## Authentication Configuration

### GPRS Configuration

Set the negotiation type with **AT%CGPPP=<pt>**

Set the authentication format and parameters with **AT%CGPCO=<n>,"<authentication format>",<cid>**

### CDMA Configuration

N/A

### UMTS Configuration

Set the configuration with **AT\$QCPDPP=<cid>,<auth\_type>,<auth\_name>,<auth\_pwd>**

## Example

ASCII format for all define contexts, PPP Negotiation: Chap, username: johndoe, password: tornado.

```
AT%CGPPP=2
```

```
AT%CGPCO=1,"johndoe,tornado",0,
```

Or

```
AT$QCPDPP=0,2," johndoe", "tornado"
```

# 5

## Using A Terminal Program To Test PAD

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Equipment Needed

TCP PAD

This section shows the user how to use a terminal program, such as HyperTerminal and to setup a TCP PAD function in the Novatel Wireless M2M Enabler IIG and later products.

A typical application for TCP PAD is point to multipoint connections. These connections have a central server or PC with a dial application and many remote devices connected to a modem. The intent is to transmit the data from the remote device to the central server or PC. In order to accomplish this, the server must dial to the remote modem and establish the connection. The following example will simulate a PAD connection between two PCs. One PC has an Internet connection and the second PC is connected via PAD.

## Equipment Needed

In this example the requirements are:

- An Novatel Wireless, Inc. hardware device
- A notebook or desktop computer with any version of Microsoft Windows that has HyperTerminal or other terminal program
- Mobile terminated SIM card (the following example is not applicable with a mobile originated SIM card)

## TCP PAD

### Modem Configuration

The Novatel Wireless M2M Modem is the one connected to the remote device, in this case connected to a PC. This modem is set to TCP PAD Listen Mode.

Use the appropriate section to configure your modem.

#### GPRS/EDGE:

AT&F (Set All TA Parameters to Factory)

AT+CREG=1 (GSM registration Status)

AT%CGREG=1 (GPRS attach status)

AT+CGDCONT=1,"IP","APN","",0,0 (The word "APN" should be replaced with the actual Access Point Name (APN) provided by the wireless network for your SIM card)

AT%CGPCO=1,"username,password",1 (username and password if needed for the APN)

AT\$HOSTIF=2 (Configure the modem in TCP PAD mode)

AT\$ACTIVE=0 (Modem on LISTEN mode)

AT\$PADDST="0,0,0,0",0 (entry must be left blank to allow an incoming PAD connection)

AT\$PADSRC=500 (PAD source port is used as the source port in all outgoing PAD data messages. The remote host must use this port number as the destination port for PAD data sent to the device)

ATX1 (enable IP reporting)

AT\$AREG=2 (Auto Registration)

AT&W (Save current settings)

## **CDMA:**

AT&F (Set All TA Parameters to Factory)

AT+CREG=1 (GSM registration Status)

AT%CGREG=1 (GPRS attach status)

AT\$HOSTIF=2 (Configure the modem in TCP PAD mode)

AT\$ACTIVE=0 (Modem on LISTEN mode)

AT\$PADDEST="0,0,0,0",0 (entry must be left blank to allow an incoming PAD connection)

AT\$PADSRC=500 (PAD source port is used as the source port in all outgoing PAD data messages. The remote host must use this port number as the destination port for PAD data sent to the device)

ATX1 (enable IP reporting)

AT\$AREG=2 (Auto Registration)

AT&W (Save current settings)

## **UMTS:**

AT&F (Set All TA Parameters to Factory)

AT+CREG=1 (GSM registration Status)

AT+CGREG=1 (GPRS attach status)

AT\$AREG=0 (Turn the Radio off for now)

AT+CGDCONT=1,"IP","APN","",0,0 (The word "APN" should be replaced with the actual Access Point Name (APN) provided by the wireless network for your SIM card)

AT\$QCPDPP= (PPP Negotiation: Chap, username)

AT\$HOSTIF=2 (Configure the modem in TCP PAD mode)

AT\$ACTIVE=0 (Modem on LISTEN mode)

AT\$PADDST="0,0,0,0",0 (entry must be left blank to allow an incoming PAD connection)

AT\$PADSRC=500 (PAD source port is used as the source port in all outgoing PAD data messages. The remote host must use this port number as the destination port for PAD data sent to the device)

ATX1 (Show the IP address for that modem)

AT\$AREG=2 (Auto Registration)

AT&W (Save current settings)

## Listen

When finished configuring the device, power cycle the modem. LISTEN will echo if the context activation is complete as shown in the following figure.

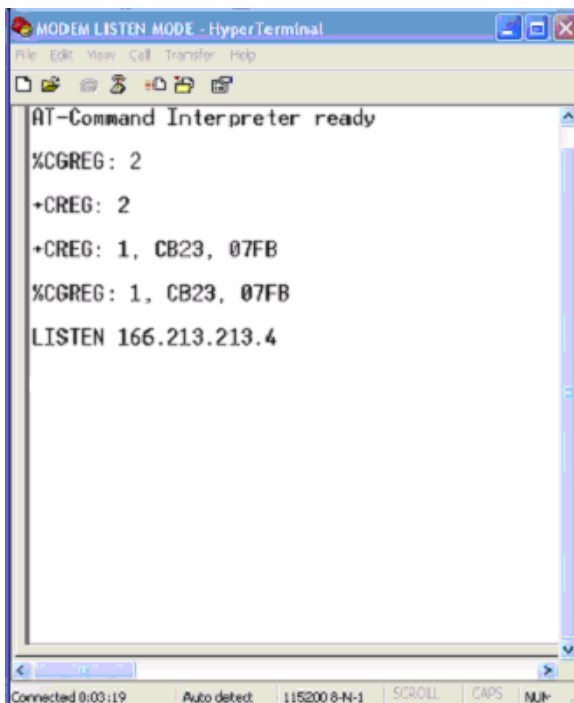


Figure 5-1 LISTEN Echo

## Server Or PC Set Up

Any terminal emulation program may be used to communicate with the modem. HyperTerminal is used for this example.

Start HyperTerminal and create a new session with the following settings:

Connection Description: Enter "PAD TEST" as the connection name





Figure 5-2 New Connection

Connect using: Direct Connect to TCP/IP (Winsock)

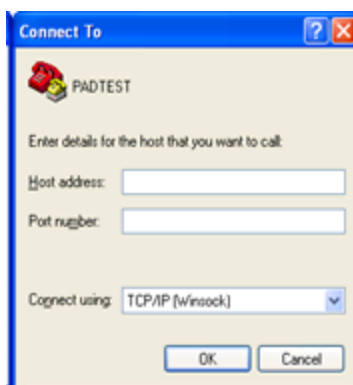


Figure 5-3 PAD Test

Host address: IP remote modem LISTEN xxxx.xxxx.xxxx.xxxx

Port number: The port configured in the AT\$PADSRC remote modem

Click the CALL button, which is the phone, located on the top left side of the HyperTerminal. This will have HyperTerminal start the connection. The process of the connection will be shown at the bottom left of the HyperTerminal window. See “connecting” in the following figure.

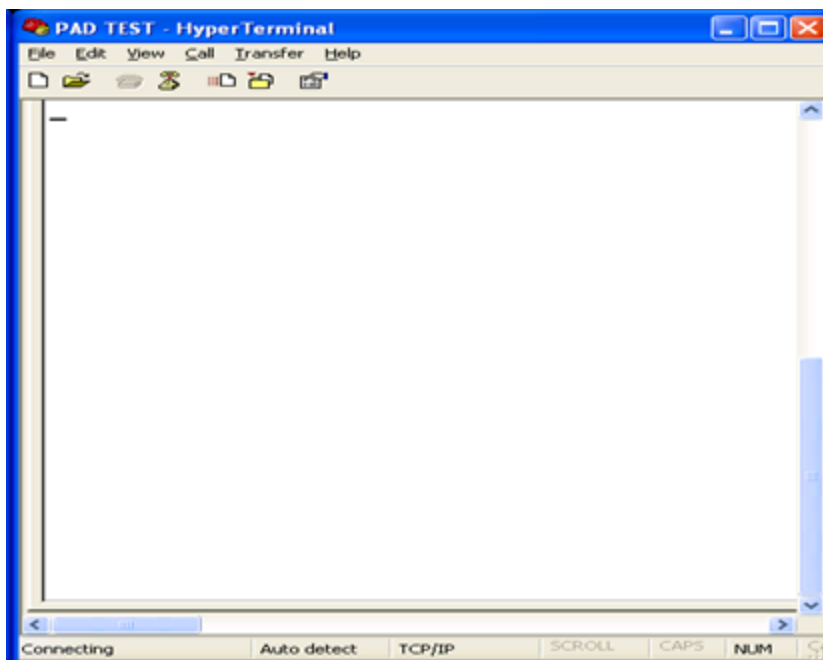


Figure 5-4 Connecting

Once the connection is established to the remote modem, HyperTerminal will show connected at the left bottom side.

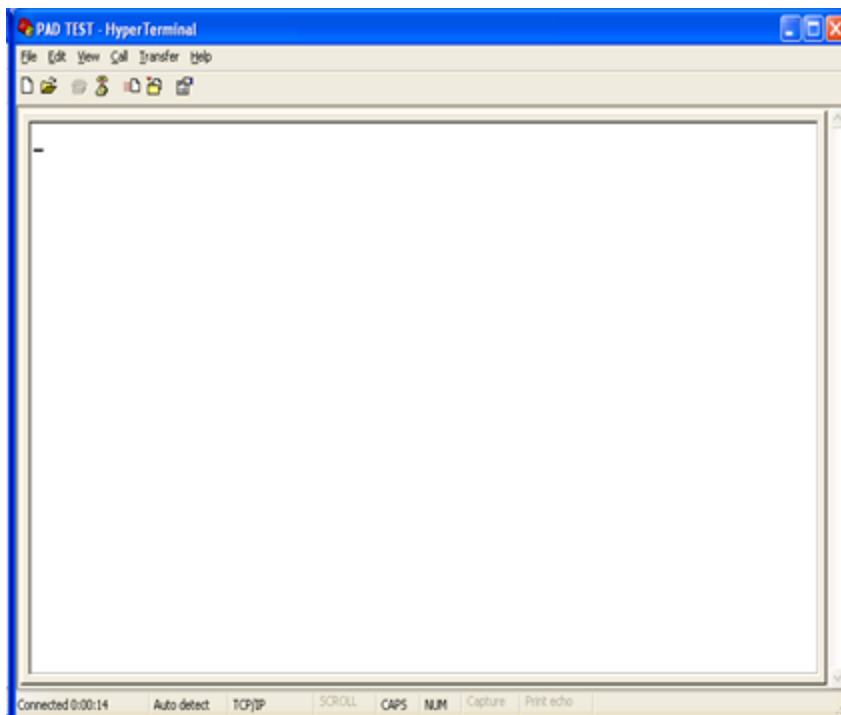
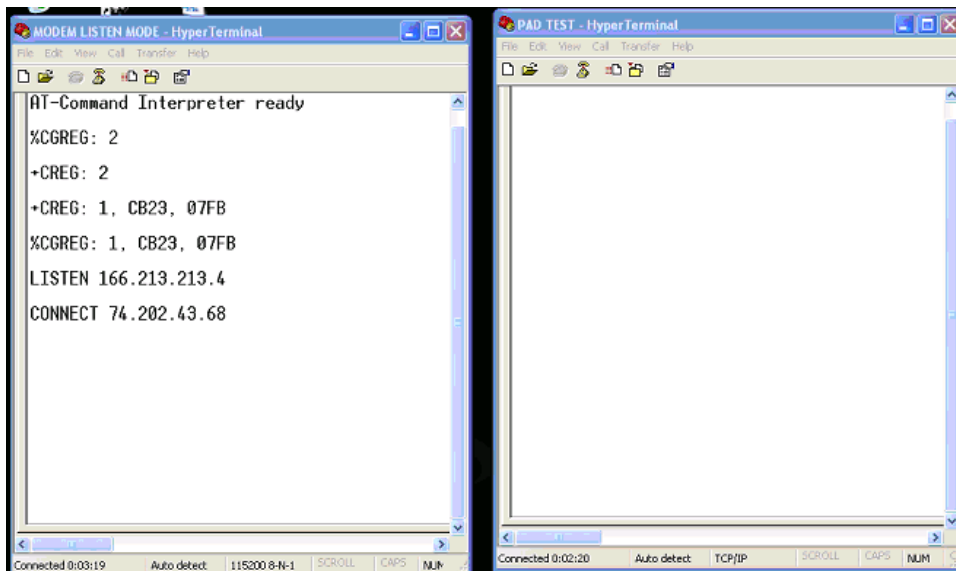


Figure 5-5 Connected

Once the connection is established CONNECT will echo at the remote PC which is configured in LISTEN mode.



When the connection is established, type characters on the PAD TEST window. Those characters will echo at the remote PC (Listen mode) HyperTerminal window.



What is being typed in the PAD TEST window will only echo in the remote window.

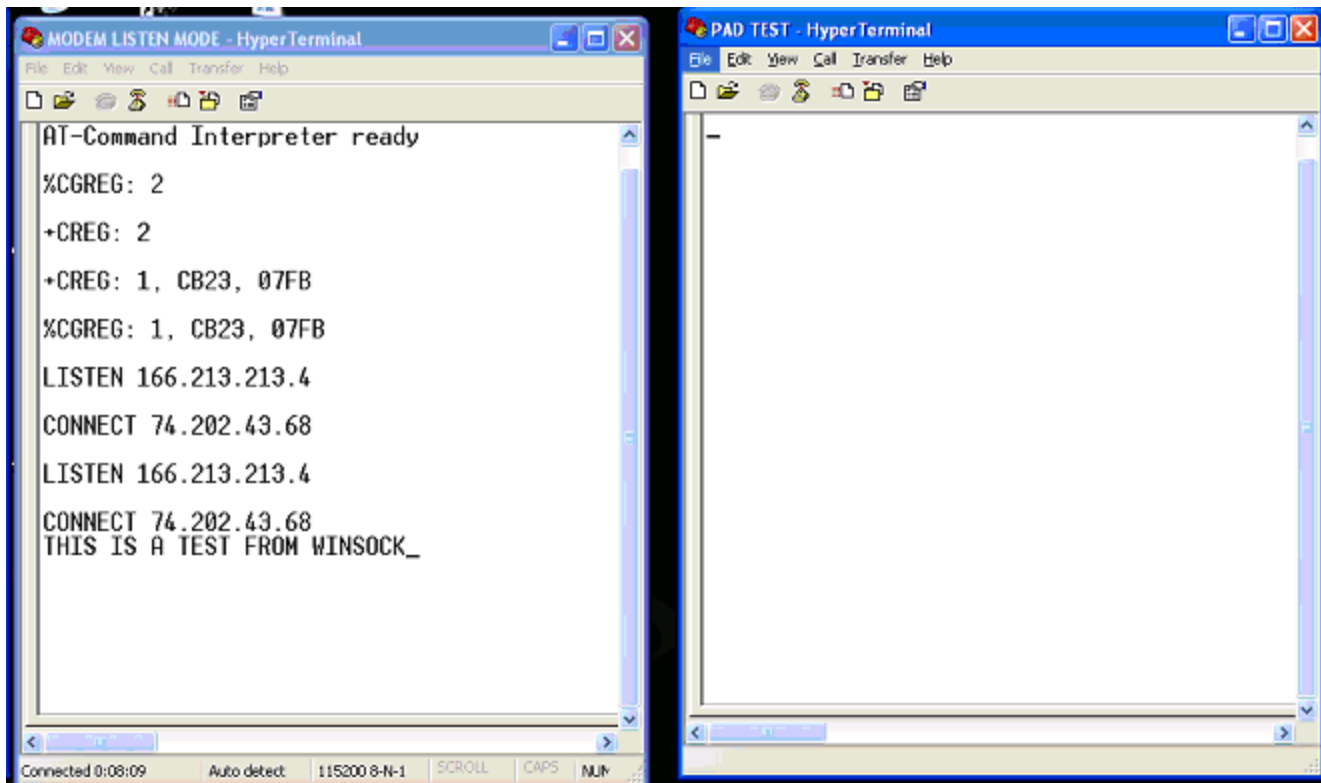


Figure 5-6 Listen Mode

## Troubleshooting

If the modem is trying to connect and you receive a pop-up message in HyperTerminal of “Unable to connect to ...” then it may be because of the following reasons:

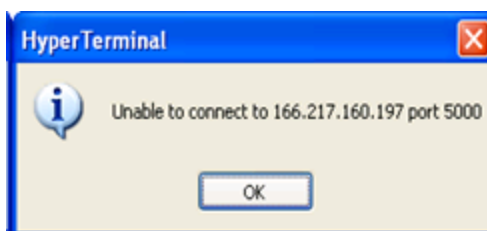


Figure 5-7 Unable to Connect

Other reasons for this could be:

1. No connection to the Internet, verify that the server PC has Internet connectivity.
2. AT\$PADDST is not configured correctly. The correct way is to leave it open for any connection.

AT\$PADDST="0.0.0.0",0

Or

AT\$PADDST="yyyy.yyyy.yyyy.yyyy", zzzz Where xxxx is the IP assigned to the server and zzzz is the port where your server is listening to.

3. AT\$PADSRC does not match the entry for the port in the WINSOCK.
4. The SIM card does not support Mobile Terminated Data.