PAD / PADD Configuration
Whitepaper
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Note: Before performing the instructions in this guide, please ensure that you have the latest firmware version on your router. Visit http://www.netcommwireless.com/products/m2m-wireless to find your device and download the latest firmware.
Introduction

The NetComm NTC-6000 Series Cellular Router running firmware version V1.9.42.x or later supports PAD (Packet Assembler and Disassembler) Mode and PADD (Packet Assembler and Disassembler Daemon).

The NTC-6000 Series Cellular Router PAD Mode or PADD allows the transport of arbitrary asynchronous serial data over a packet switched (IP) cellular network or host computer. Specifically, data received on the router’s V.24 interface (serial port) can be encapsulated into TCP or UDP packets and sent to a remote host. Likewise, data contained in TCP or UDP packets received from a remote host may be forwarded to the router’s V.24 interface (serial port).

The PAD Mode in NTC-6000 Series Cellular Router is generally used with POTS modems to transmit AT commands over a cellular network and the PADD is generally used in the transmission of smart metering or utilities metering data over cellular networks where multiple active sessions are required at the same time for redundancy, backup or system monitoring purposes.

When configured through the browser based configuration interface, PAD Mode can be configured using both the “Data Connection” and “Modem” pages. PADD however is configured using the “PADD” page under the “Services” menu.

The NTC-6000 PAD and PADD features support two modes: the Server Mode where clients make an inbound connection to the router and the Client Mode where the NTC-6000 Cellular Router will make a connection to a remote server. The number of data sessions supported is as follows:

- **PAD - Server Mode**: one active session at a time.
- **PAD - Client Mode**: one active session at a time.
- **PADD – Server Mode**: one active session in ‘Exclusive’ Mode and multiple sessions to the router in ‘Shared’ Mode.
- **PADD – Client Mode**: up to four active sessions at a time
NTC-6000 PAD Mode

The NTC-6000 PAD mode configuration page is located under **Internet Settings > Mobile Broadband > Connection**. The PAD mode parameters are shown as follows:

<table>
<thead>
<tr>
<th>PAD Mode</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote Host</td>
<td>0</td>
</tr>
<tr>
<td>Port</td>
<td>0 (1-65535)</td>
</tr>
<tr>
<td>Local Encoding</td>
<td>Enable, Disable</td>
</tr>
<tr>
<td>PAD Mode</td>
<td>TCP, UDP</td>
</tr>
<tr>
<td>PAD Auto Answer</td>
<td>Enable, Disable</td>
</tr>
</tbody>
</table>

**Remote Host**

In PAD client mode, this is where the cellular router connects to a local or remote host. A local or remote host IP address needs to be specified in the “Remote Host” field. In PAD server mode, this is where a local or remote host connects to the NTC-6000 cellular router. The cellular router will only accept incoming connections from the specified host if an IP address in the field is specified. The IP address specified can be a local or remote IP address. If you specify 0.0.0.0 the router will accept incoming connections from any host.

**Port**

The port field specifies the TCP/UDP port number to use for the PAD session. The range allowed is from 1 – 65535. If not supplied, the protocol from the currently selected profile is used.

**Local Encoding**

This is normally disabled where data is sent without any encapsulation.

**PAD Mode**

This is the used of TCP or UDP protocol for the PAD session.

**PAD Auto Answer**

This radio button serves as the enable / disable switch for configuring PAD – Server mode or PAD – Client Mode. When the “PAD Auto Answer” is enabled, this enables the PAD – Server Mode. It means that the router will accept incoming PAD connections. When the “PAD Auto Answer” is disabled, this enables the PAD – Client Mode. It means the router connects to a remote host. By default, the NTC-6000 Cellular Router is set as a PAD Mode Client where “PAD Auto Answer” set to “Disabled”.

Apart from the PAD mode settings under “WWAN Connection (3G) Connection”, it is important to make sure the “Modem Settings” under “Services” is configured. The default values are shown in Figure 2. The NTC-6000 PAD mode will work under the default Modern Settings.
### Baud Rate

The serial (V.24) port baud rate, the default baud rate is: 115200 bps and the serial line format are 8 data bits, no parity with 1 Stop bit. The other available baud rates are 300bps, 1200bps, 2400bps, 4800bps, 9600bps, 19200bps, 38400bps, 57600bps and 115200bps.

### Inter Character Timeout

The PAD will buffer any bytes received from the serial port until either 512 bytes have been received or no bytes have been received for “Inter Character Timeout” milliseconds. Any bytes in the buffer will then be sent to the remote host.

### ID

When the ID field is not blank (empty) the defined ID will be sent to the remote host as follows:

- For UDP the 1st byte of each datagram sent will be set to the contents of the ID field, data follows immediately after the ID.
- For TCP the ID is transmitted once, immediately after the connection is established.

### Ignore String

When the “Ignore String” field is not blank (empty) the router will strip any character sequence that matches the “Ignore String” from the data stream received from the serial port.

### Connect To

Determines how the router behaves when it receives an “ATD” command on the serial port.

- **Profile:** Connect using “Data Connection Profile”.
- **Circuit:** Establish a circuit switched data connection.
- **Packet:** Connect to cellular packet network in PPP pass through mode.
- **Dial String:** Examine the dialled digits and connect to Profile, Circuit or Packet as appropriate.
**DTR Action**

Determines how the router responds to change of state of the serial port (DTR) Data Terminal Ready line.

- **Ignore**: Take no action.
- **Command**: High to Low transition of DTR causes the router to enter command mode (does not end call).
- **Hangup**: High to Low transition of DTR causes the router to end call and enter command mode.
- **High AutoDial**: Low to High transition of DTR causes the router to dial the Auto Dial Number. High to Low transition of DTR causes the router to end call and enter command mode.
- **Low AutoDial**: High to Low transition of DTR causes the router to dial the Auto Dial Number. Low to High transition of DTR causes the router to end call and enter command mode.
- **Low Pass To AT Port**: When DTR is low, pass all AT commands directly to internal cellular data engine.

**DCD Action**

Determines how the router controls the state of the serial port Data Carrier Detect (DCD) line.

- **Always On**: DCD is always on.
- **Connect On**: DCD is on when a connection is established in response to an ATD command or DTR auto dial.
- **Always Off**: DCD is always off.
- **PPP On**: DCD is on when the router has established a PPP session with the cellular network.

**Flow Control**

- **Off**: Serial port flow control off
- **Hardware**: Serial port uses RTS/CTS flow control

**RI Action**

Determines how the router controls the state of the serial port RI (Ring Indicator) line.

- **Always On**: RI is always on.
- **Incoming Ring**: RI is on when an incoming connection request is received.
- **Always Off**: RI is always off

**Circuit AutoAnswer Rings**

Sets the number of incoming rings after which the router will answer incoming circuit switched data calls. The default value is Off. The other available options are from 1 to 12.

**Auto Dial Number**

Sets the number the router will dial if DTR Auto Dial is enabled and the DTR setting changes state.

**Important Note:**

The PAD Mode parameters may be configured separately for each of the APN connection profiles, however only one single profile can be enabled at one time. Please also note that after a soft reset (reboot) of the cellular router, any active PAD and cellular packet data sessions will be terminated.
The NTC-6000 PAD Daemon

The NTC-6000 Series Cellular Router PAD Daemon runs as a background process whose settings can be accessed with a user controlled web configuration interface. The PADD configuration page is located under “Service > PADD”. The PADD is used usually with multiple connections or when redundant connections are needed. The NTC-6000 PADD has two modes: the PADD Server mode and PADD Client Mode. When PADD is enabled, both the PADD server mode and PADD client mode can be run at the same time.

The NTC-6000 Series Cellular Router PADD Web Configuration page is shown in Figure 3 below. Please note that when the PADD is enabled, the PAD mode in WWAN 3G Connection will be disabled.

Many of the PADD parameters on the configuration page are self-explainatory as shown above in Figure 3. Each of the parameters in Figure 3 are also briefly described below.

- **PAD Daemon**
  Enable or disable the PAD daemon locally using this setting.

- **Debug Level**
  Set the level of system log messages. 0 for off, 1 for basic error messages, 2 for verbose logging.
Baud Rate
The serial (V.24) port baud rate, the default baud rate is: 115200 bps and the serial line format are 8 data bits, no parity with 1 Stop bit. The other available baud rates are 300bps, 1200bps, 2400bps, 4800bps, 9600bps, 19200bps, 38400bps, 57600bps and 115200bps.

Data Bits
The default serial line data bits setting used is 8. Options include 5 – 8 bits.

Stop Bits
The default stop bit setting is set to 1. However the stop bit setting can be set to 2 bits if required.

Parity
Parity is the means to detect transmission errors. An extra data bit is transmitted with each data character, and is arranged in a fashion such that the number of 1 bits in each character, including the parity bit, is always odd or always even. If a byte is received with the wrong number of 1s, then this shows the data must be corrupt. Options include none, odd or even. The default setting is none for no parity checks.

Hardware Flow Control
Used in the hardware handshaking process this field is used to set Data Terminal Ready and Data Set Ready signalling.

Inter-character timeout
The default value is 1 x 100ms. This parameter is used to configure the Inter-Character timeout used by the PAD service when assembling packets for transmission. The PAD will send a packet of data every time the buffer is full (512 Bytes) or if the serial data line is idle for longer than the time specified by this command.

End of Line Character
This field can be used to set an ASCII character as an end of line character.

Start of Line Timestamps
This option is disabled by default (0). Set to 1 for a timestamp with the format of YYYYMMDDHHMMSS.

TCP/IP Server Mode - Port
Enter the port number to use for the TCP/IP server connection.

TCP/IP Server Mode – Incoming connection
‘Exclusive’ mode allows only one single active PAD Server connection only, with further connection attempts refused. ‘Shared’ Mode means multiple connections to the router (PAD Server) are allowed but it will drop the previous active session when a second session connects to the cellular router PADD server.

TCP/IP Client Mode - Mode
Set the TCP/IP Client mode to connect to the first available server or all servers that are available.

TCP/IP Client Mode - Protocol
Select the protocol to use to connect to the remote server or servers.

TCP/IP Client Mode - Remote Servers
Enter the IP address and port number used by the remote servers you wish to connect to.

Network Settings – Remote Server Retry Period
Enter the time in seconds before an attempt is made to reconnect to a remote server if the connection is lost.

Network Settings – TCP Keepalive Probes
Enter the time in seconds when a TCP keepalive ping probe should be sent to the remote address to ascertain whether there is a current connection.

Network Settings – Number of Probe Failures Before Disconnect
Enter the number of ping attempts that will be made before a remote connection is deemed to be disconnected.
NTC-6000 PAD Configuration Examples

NTC-6000 PAD Mode - Server Mode

When configuring PAD mode settings under a particular APN profile, you will need to disable and save the changes then enable the profile with PAD settings. In the following example, the NTC-6000 is configured as a PAD mode server with TCP port number 3000 where it will accept client connection from any host IP address.
Verifying the NTC-6000 PAD Mode Server Connection

The NTC-6000 PAD mode is now running in server mode and is listening on TCP port 3000. Verification of the PAD – Server mode connection to the NTC-6000 Cellular Router, can be made locally or remotely.

Verifying NTC-6000 PAD Mode Server Connection Locally

Connect an RS232 serial cable from the NTC-6000 local serial port, and connect a crossover Ethernet cable from the test laptop to the LAN port of the NTC-6000 Cellular Router.

Open a Hyper Terminal with the following baud rate settings: 115200bps, 8, None, 1, None. Verify the serial connection by typing in the following AT commands: ati (see Figure 7)

Open a telnet client from the test laptop and telnet to the LAN IP address of the NTC-6000 Cellular Router: telnet 192.168.20.1 3000 once the PAD Server session is connected to the router, the hyper terminal will show “Connect 115200”. (See Figure 8)

Once the PAD Mode - Server Mode Connection is up, this means anything that you type in the telnet session will be outputted in the Hyper Terminal session and vice versa. This action simulates a RTU/data logger connected to the NTC-6000 Cellular Router. This behaves like a transparent connection to the serial interface of the NTC-6000 cellular router where any data pass through will be forwarded to the serial port and vice versa. (see Figure 9)
Verifying the NTC-6000 PAD Mode – Server Mode Connection Remotely

To verify PAD Mode – Server Mode remotely, you will need two test laptops and an accessible WAN IP address on the NTC-6000 Cellular router. ‘An accessible WAN IP of the router’ means a public IP address or a WAN IP that you can access from your network (Example: an IP WAN address).

Repeat steps ‘1’ and ‘2’ in mentioned above; open a telnet client from the test laptop at the remote site, telnet to the WAN IP address of the NTC-6000 Cellular Router: telnet 123.209.52.150: 3000. Once the PAD Server session is connected to the router, the hyper terminal will show “Connect 115200”.

Once the PAD Mode - Server Mode connection is up, this means that the input into the telnet session will become the output in the NTC-6000 local hyper terminal session and vice versa. This action simulates a RTU/data logger connected to the NTC-6000 Cellular Router, behaving like a transparent connection to the serial interface of the NTC-6000 cellular router where any data passing through will be forwarded to the serial port and vice versa. (see Figure 11)
NTC-6000 PAD Mode – Client Mode

When configuring the PAD mode settings under a particular APN profile, you will need to disable the APN profile that is currently enabled and save these changes before the profile with PAD settings can be enabled. In the following example, the NTC-6000 is configured as a PAD mode – Client Mode. The router will connect to a remote host with IP address: 123.209.32.203 listening on TCP port number 3000. In this scenario, a Telnet Server is used at the remote host and is listening on TCP port 3000.

The WAN IP address of the remote telnet server is: 123.209.32.203.

**Verifying the NTC-6000 PAD Mode – Client Mode Connection**

The NTC-6000 PAD mode is now running in client mode. To verify its connection, the local IP address, public IP address or IP WAN IP address in the “Remote Host” field can be used. In this test scenario, a public IP address is used in the remote (telnet) host.

Turn on the Telnet Host Server (IP address: 123.209.32.203) listening on TCP port number 3000.

Open a telnet client from the test laptop that is connected to the NTC-6000, and connect to the remote host server: telnet 123.209.32.203:3000. Once the PAD client session is connected to the remote host, the hyper terminal will show “Connect 115200”. (See Figure 11)

Once the PAD Mode Client Mode Connection is up, this means anything that you type in the telnet session will be outputted in the remote host’s Telnet Server window.

The NTC-6000 PAD Mode – Client Mode session is now up and running.
NTC-6000 PADD Configuration Examples

The NTC-6000 PAD Daemon - PAD Server & PAD Clients

The PADD configuration page is located under Services > PADD. The NTC-6000 PADD has two modes: the PADD Server mode and PADD Client Mode. When PADD is enabled, both the PADD server mode and PADD client mode process are running at the same time.

In the following test scenario, the NTC-6000 PADD is configured to accept inbound PAD sessions on TCP port 1516 and the router runs four simultaneous PAD client sessions to the remote host 123.209.138.104 on TCP ports 3000 to 3003.

Note: In an actual implementation environment, different remote hosts or duplicated hosts with different port numbers are usually used to receive the serial data over cellular network (IP) for back up or redundancy purposes.

Figure 15 – NTC-6000 PADD – PAD Server and Client Mode Configuration
Verifying the NTC-6000 PAD Daemon – PAD Server Connection

1. Connect a RS232 serial cable to the NTC-6000 local serial port, and also connect a crossover Ethernet cable from the test laptop to the LAN port of the NTC-6000 Cellular Router.

2. Open a Hyper Terminal with the following Baud Rate settings: 115200bps, 8, None, 1, None.

3. Open a telnet client from the test laptop at the remote side, telnet to the WAN IP address of the NTC-6000 Cellular Router: telnet 123.209.52.150:1516. (See Figure 13 below)

4. Once the PAD Server session is connected to the router, the hyper terminal will show “Connect 115200”. When the PAD Mode - Server Mode connection is up, the input typed into the telnet session will be the output in the NTC-6000 local hyper terminal session and vice versa. (see Figure 17)

The NTC-6000 PADD – PAD Server session is now up and running.
Verifying the NTC-6000 PAD Daemon – Multiple PAD Client Connections

To verify the NTC-6000 PAD Daemon – Multiple PAD Client Connections, a public IP address with different TCP ports (Port 3000 to 3003) is used in the “remote host” field.

1. Turn on the Telnet Host Server (IP address: 123.209.138.104) listening on TCP port number 3000, 3001, 3002 and 3003. (Details on setting up the telnet server are not described in this document.) Please note, in an actual implementation environment, different remote hosts or duplicated hosts with different port numbers are usually used to receive the serial data over a cellular network (IP) for back up or redundancy purposes.

2. Open four telnet clients on the test laptop that is connected to the NTC-6000, and then telnet to the remote host server: telnet 123.209.32.203: 3000 -3003. Once the PAD client session is connected to the remote host. To verify the PAD connection, check that what you typed in the telnet session will become text output on the remote host and vice versa. (See Figure 15)

3. Once the PAD Mode Client Mode Connection is up, this means anything that typed in the telnet session will be outputted in the remote host’s Telnet Server window.

Figure 15 - NTC-6000 telnet to the remote server

Figure 16: NTC-6000 telnet to the remote server
The NTC-6000 PADD – PAD Client mode multiple sessions is now up and running.