

SerialNET Theory of Operation

Introduction

SerialNET is a mode of operation within Connect One's AT+i™ command set that enables conversion of serial data to TCP/IP packets without any modification of the host device application. iChip SerialNET mode extends a local asynchronous serial link to a TCP or UDP socket across a LAN or Internet. Its main purpose is to allow simple devices, which normally interact over a serial line, to interact in a similar fashion across a network. In order to achieve this, SerialNET mode defines a set of associated operational parameters, which define the nature of the desired network connection. When iChip is put in SerialNET mode, it acts as a router between the device's serial port and the network.

Devices that communicate with a terminal over a serial link fall into three major categories: output only (i.e. printers), input only (i.e. controllers) and interactive (bi-directional communications). The latter are subdivided further into **clients** and **servers**. Generally, clients initiate communications by sending service demands to a server, while servers respond to client demands.

SerialNET mode reacts differently to client or server devices. When a client device initiates communications, SerialNET mode must establish a network connection to a remote server before data may flow between the two systems. On the other hand, when a remote client needs to invoke a device, the remote client first contacts iChip and SerialNET is invoked to create a communication flow to the local server device.

SerialNET mode in iChip includes components to handle both server and client local devices. iChip under SerialNET mode will route full-duplex data between a networked terminal and both types of devices.

SerialNET Mode

iChip's SerialNET mode is established by first defining all related parameters using AT+i commands, followed by a special "Enter SerialNET Mode" AT+i command.

Once in SerialNET mode, no additional AT+i commands may be sent, as the host serial link will be dedicated to raw local-device data. In this mode, auto baud rate is also disabled, since it cannot be guaranteed that the device will issue an 'a' or 'A' as its first character. Thus, a predefined fixed baud rate must be specified before switching over to SerialNET mode.

SerialNET mode will extend across power down, since it is assumed that once acting in this mode, iChip will not normally be connected to an AT+i aware host. SerialNET mode may be terminated by: A) applying power to iChip with the MDSEL signal

pulled low for less than 5 seconds; or, B) issuing the [ESC sequence](#) defined as <half second Delay> followed by “+++” (3 ‘+’ characters) through the serial port.

When one of these occurs, the iChip reboots after terminating SerialNET mode. At this point, iChip reverts to its normal operational mode and again responds to AT+i commands.

Server Devices

Server devices linger until approached by a remote client. The remote client must know the iChip’s IP and Listen port address in order to establish communications.

LAN-based devices and **dial-up devices** linger differently.

While in SerialNET mode, iChip LAN establishes a Listen socket on the port defined in its [LPRT](#) parameter. A remote client terminal may connect to that port. iChip-S or iChip Plus in dialup mode, on the other hand, is offline by default, but waits for a ‘RING’ signal on the modem to trigger it into activity. In this case, the remote client device dials directly to iChip and hangs up after two rings. When contacted, iChip (under SerialNET mode) waits for the ‘RING’ to subside and then dials in to its ISP and connects to the Internet. If the [RRMA](#) parameter contains an Email Address, iChip will issue an Email containing the dynamic IP, assigned by the ISP, and the Listen port defined in LPRT. The syntax of the Email body is:

```
http://<IP addr.> : <port><CR><LF>
```

The http://<IP addr.> portion creates a direct link to iChip’s Web server. If the [AWS](#) parameter was enabled, clicking with the mouse on this link will open the Web browser and display iChip’s home page. The SerialNET link socket may be determined by extracting the <IP addr.> and <port>.

The subject line of the Email is:

```
RING RESPONSE LINK From: iChip-<D/L/S> version: <Firmware version>"
```

The contents of the subject line may be used by the receiving end to filter out this Email. iChip will then listen on the LPRT port for a socket connection. The recipient of the Email may then use the reported IP address and Port to create a link to iChip in SerialNET mode.

If the [RRSV](#) parameter contains a server-name and port, iChip will open a socket to that server and send the “http://<IP addr.> : <port><CR><LF>” data line over the established socket.

Once connected, iChip transfers all arriving data from the local device over the serial link. Device responses are routed back to the initiating client. Data will flow freely between the two systems until a predefined activity termination event is triggered, upon which the remote connection is dropped.

The iChip and iChip Plus MDSEL signal (see iChip and iChip Plus datasheet) may be lowered to GND to emulate the RING event. This is useful for testing and debugging purposes of the SerialNET connection procedure or as a means to cause iChip to activate the Ring-response procedure as a result of some TTL hardware signal.

In a LAN environment, iChip LAN continues to Listen on the Port Server listen socket, while in a dial up environment iChip-S will go offline and wait for another 'RING' trigger.

Client Devices

Client devices initiate communications to a server. When a client device first sends data on its serial link, iChip (in SerialNET mode) buffers the incoming data bytes and attempts to establish a connection to a remote server. Once the connection is established, iChip transmits the buffered data, collected during the connection period. The [MBTB](#) parameter dictates the maximum number of bytes to buffer. If additional bytes are received on the serial port before the connection is established, they will be discarded. iChip / iModem will dial-up the ISP to establish an Internet connection before attempting to open the server socket. iChip LAN closes its Listen socket to avoid remote client devices from connecting during this session.

The remote server's IP and port are part of the SerialNET mode configuration parameters. Once a data connection is established, data can flow freely between the local client device and the remote server. If a connection cannot be obtained, eventually the client device's data will be discarded (similar to the case of a device transmitting serial data without a serial cable connected).

Data continues to flow until a predefined activity termination event is triggered, upon which the remote connection is dropped.

Transmit Packets

Data originating in the local device is buffered, packetized and transmitted to the remote system over the network. Packets are formed as a result of meeting at least one of the following criteria:

1. A predetermined amount of bytes have been received from the local link ([MCBF](#)).
2. The TCP/IP connection MTU was met.
3. A predetermined flush character has been received ([FCHR](#)).
4. A predetermined inactivity timeout event was triggered ([MTTF](#)).

Until one of these events occurs, data is buffered in iChip. When an event occurs, a packet is transmitted. Setting AT+i parameters prior to initiating SerialNET mode configures the event parameters. When a UDP connection is used, data packets are atomic, maintaining their original size. When a TCP connection is used packets may be combined before being actually transmitted. This follows from the stream nature of the TCP protocol.

Data originating in the remote system is routed to the local device as it is made available. Flow control may be governed locally using hardware flow control only.

Completing a SerialNET Session

A SerialNET session is complete when one of the following occurs:

1. The local device transmitted the disconnection string, as defined in the [DSTR](#) parameter.
2. Following an inactivity timeout, as defined in the [IATO](#) parameter.

In a modem environment, iChip will go offline when the SerialNET session is terminated. In a LAN environment, iChip LAN will reopen the SerialNET Listen socket defined in the [LPRT](#) parameter (if it is non-zero), to service future remote-client connections.

SerialNET Failed Connection

If iChip fails to establish a SerialNET connection, SerialNET mode will be deactivated for a delay period defined in the [SNRD](#) parameter.

Local Serial Port Configuration

Prior to entering SerialNET mode, iChip's local serial port may be configured to comply with a wide range of devices by assigning a value to the [SNSI](#) parameter.

Serial port configuration entails settings to:

Baud rate:	2400, 4800, 9600, 19200, 38400 or 56K
Bits/byte:	7 or 8
Parity:	None, Even or Odd
Stop Bit:	Must be 1
Flow Control:	None(0) or Hardware(1)

Activation Command

iChip shall be forced into SerialNET mode by issuing the following command:

[AT+iSNMD](#)

If the minimal SerialNET parameters are defined, the iChip will reply with 'I/OK'.

If iChip was on-line when this command was issued, it will close the Internet session in an orderly manner. This includes closing all open sockets and disconnecting from the ISP in a modem environment.

When iChip boots up in SerialNET mode, it will set the host serial channel to the fixed baud rate and serial interface parameters defined in the [SNSI](#) parameter. iChip LAN will open the SerialNET Listen socket (if it is defined in the [LPRT](#) parameter) and, if defined, launch the Web server.

In an iChip-S dialup environment, the modem is polled for the 'RING' string. If the ring-response destination Email parameter ([RRMA](#)) or ring-response server parameter ([RRSV](#)) contain values, the iChip will wait for the 'RING' strings to subside and connect to the Internet. Once on-line it will send an Email to the RRMA address (if defined) and/or establish a socket to the address in RRSV (if defined). The transmission will contain the dynamic IP address received from the ISP and its Listen port, on which iChip has an open listen socket, ready to serve the remote client.

The iChip will exit SerialNET mode when one of the [Escape procedures](#) is activated (see preceding paragraph). The [BDRF](#) parameter will then govern the iChip's baud rate mode.