SIMCom_3G_TCPIP_Application Note_V3.70

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Version History

Date	Version	Description of change	Author
2010-08-01	V1.00	New version	songjin
2012-03-29	V2.00	Support multiple TCP/IP connection and multiple TCP server, but only one TCP connection can be called to send data using AT+CIPSEND at the same time. V2.0 application note match to the firmware which built after 2012.03.29, and the built time can be checked by 'AT+BT'. For SIM5320E, it is supported from 1575B08SIM5320E.	mengyadong
2013-04-17	V3.00	Support optimized TCP/IP operation mode. Multiple TCP sockets can send/receive data without interference. From 2013-04-05, the product firmwares built after that support this V3.0 application note. For SIM5320E, it is supported from 1575B11SIM5320E.	songjin
2013-11-15	V3.60	Support UDP transparent mode. Support one socket works on transparent mode using one port(for example USB-MODEM), other sockets work on AT command mode using another port(for example USB-AT). From 2013-11-15, the product firmwares built after that support this V3.6 application note. For SIM5320E, it is supported form 1575B12SIM5320E.	songjin
2014-06-06	V3.70	Rewrite using new document template, add description of supporting both two set of TCP commands, and modify description of + IPCLOSE.	songjin

Scope

This document presents the AT command of TCP/IP operation and application examples. This document can apply to SIMCom 3G modules, including SIM5218/SIM5215/SIM5216/SIM5320/SIM5310/SIM6320/SIM6216 series modules.

1 Introduction

This document presents the AT command of TCP/IP operation for SIMCom 3G modules.

1.1 Features

1. Support multiple sockets(TCP and UDP) send and receive at the same time.
2. Support TCP server, TCP client, UDP socket.
3. Support TCP/UDP transparent mode operation.
4. Support one socket in transparent mode and other sockets in AT command mode..

2 AT commands

Below is the TCPIP associated with AT commands, detailed information please refer to document [1].

Through these AT commands can achieve the following functions.

1) Open/close network.
2) Open TCP client socket, UDP socket.
3) Start TCP server socket and accept incoming client socket
4) Do transparent mode operation

Command	Description
AT+NETOPEN	Open network
AT+NETCLOSE	Close network
AT+NETDORM	Enter or leave dormancy state
AT+IPADDR	Get the IP address
AT+CIPHEAD	Add an IP header when receiving data
AT+CIPSRIP	Show remote IP address and port
AT+CIPCCFG	Configure parameters of sockets
AT+CIPSENDMODE	Set sending mode
AT+CIPMODE	Set TCP/UDP operation mode(TM or normal AT command mode)
AT+CIPDNSSET	Set DNS query parameters
AT+CIPTIMEOUT	Set TCP/UDP timeout parameters
AT+SERVERSTART	Start a TCP server
AT+SERVERSTOP	Stop a TCP server
AT+CIPOPEN	Open a TCP/UDP socket, and connect to server if it is TCP socket.
AT+CIPCLOSE	Close the socket.
AT+CIPSEND	Send data using TCP/UDP socket
AT+CIPRXGET	Retrieve data cached in received buffer.
AT+CDNSGIP	Resolve IP address using domain name through DNS server.
AT+CDNSGHNAME	Resolve domain name using IP address through DNS server
AT+CIPSTAT	Statistics total bytes of data sent and total bytes of data received.
AT+CTCPFIN	Configure TCP FIN to be compatible with 4-step TCP close flow.
AT+CTPCKA	Enable or disable TCP KEEP ALIVE function.

3 Examples

There are some examples to explain how to use these commands.

In the "Grammar" columns of following tables, input of AT commands are in black , module return values are in blue.

3.1 Network Environment

TCPIP application is based on GPRS network; so, ensure GPRS network is available before TCPIP setup. Following are the recommended steps.

Grammar	Description
AT+CSQ +CSQ: 23,0 OK	Check CSQ
AT+CREG? +CREG: 0,1 OK	Check CREG state.
AT+CPSI? +CPSI: GSM,Online,460-00 0x1816,63905,81 EGSM 900,-68,0,31-31 OK	Check network information.
AT+CGREG? +CGREG: 0,1 OK	Check CGREG state.

3.2 Open/close network

Grammar	Description
For WCDMA Module(e.g. SIM5320): AT+CGSOCKCONT=1,"IP","CMNET" OK AT+CSOCKSETPN=1 OK *For CDMA/EVDO Module(e.g. SIM6320/SIM6216):* AT+CSOCKAUTHNV=1	Set APN. *Note, usually CSOCKAUTH and CSOCKSETPN parameter are kept default if not care about.* Set User/Password

OK AT+CSOCKAUTH=,,"card","card" OK	
AT+CIPMODE=0 OK	This command must be set before network open if want to select command mode or data mode. '0' is to select command mode as default, and '1' is to select data mode.
AT+NETOPEN OK +NETOPEN: 0	Open network. Currently SIMCom 3G modules support both new TCP/IP command set and old TCP/IP command set. When the AT+NETOPEN is called with parameters(like AT+NETOPEN="TCP"), the TCP/IP V2.0 command set will be used(TCPIP Application Note for WCDMA Solution V2.0.doc); If the AT+NETOPEN is called without parameters, the new command set will be used(per this application note). The two command set are quite different, but they are supported at the same time. The old V2.0 application note is only used to be compatible with old developed applications, for new application, the AT commands are recommended to be used per this application note.
AT+IPADDR +IPADDR: 10.113.43.157 OK	Get the local IP address
AT+NETCLOSE OK +NETCLOSE: 0	Close network. All opened sockets must be closed before calling this command.

3.3 Command Mode(Non-transparent mode)

Command mode is sometimes called non-transparent mode, which is default configured by module. Multiple sockets are available under this mode.

3.3.1 TCP Client

Grammar	Description
For WCDMA Module(e.g. SIM5320): AT+CGSOCKCONT=1,"IP","CMNET" OK AT+CSOCKSETPN=1 OK *For CDMA/EVDO Module(e.g. SIM6320/SIM6216):* AT+CSOCKAUTHNV=1 OK AT+CSOCKAUTH=,,"card","card" OK	Set APN. Set User/Password
AT+CIPMODE=0 OK	Set TCP/IP module to use command mode.
AT+NETOPEN OK +NETOPEN: 0	Open network.
AT+CIPOPEN=0,"TCP","116.236.221.75",8011 OK +CIPOPEN: 0,0	Open TCP connection. Both IP address and domain name are supported
AT+CIPSEND=0,5 >HELLO OK +CIPSEND: 0,5,5	Send data of 5 bytes.
AT+CIPSEND=0, >HELLO<Ctrl+Z> OK +CIPSEND: 0,5,5	Send data using <Ctrl+Z> to commit. The second parameter is empty means using <Ctrl+Z> to check the end Note: When the <cnfSendLength> in +CIPSEND URC is not equal to <reqSendLength>, it usually means the TCP socket cannot work correctly further.
AT+CIPCLOSE=0 OK	Close the socket

+CIPCLOSE: 0,0	

Note: if connection closed by remote server, following URC will return:
+IPCLOSE: 0,1
Here, the meaning of second parameter in this URC is following,
0 - Closed by local, active
1 - Closed by remote, passive
2 – Closed for sending timeout

3.3.2 UDP Socket

One socket could communicate with multiple UDP channels.

Grammar	Description
For WCDMA Module(e.g. SIM5320): AT+CGSOCKCONT=1,"IP","CMNET" OK AT+CSOCKSETPN=1 OK *For CDMA/EVDO Module(e.g. SIM6320/SIM6216):* AT+CSOCKAUTHNV=1 OK AT+CSOCKAUTH=,,"card","card" OK	Set APN. Set User/Password
AT+CIPMODE=0 OK	Set TCP/IP module to use command mode.
AT+NETOPEN OK +NETOPEN: 0	Open network.
AT+CIPOPEN=0,"UDP",,,9000 +CIPOPEN: 0,0 OK	Open an UDP socket. Here 9000 is local port
AT+CIPSEND=0,5,"16.236.221.75",9015 >hello OK +CIPSEND: 0,5,5	Send data of 5 bytes to 16.236.221.75:9015.
AT+CIPSEND=0,,"16.236.221.75",8058 >12345<Ctrl+Z> OK	Send data using <Ctrl+Z> to commit. The second parameter is empty means using <Ctrl+Z> to check the end

+CIPSEND: 0,5,5	
AT+CIPCLOSE=0 +CIPCLOSE: 0,0 OK	Close the socket

3.3.3 TCP Server

Module supports 4 sockets to listen

Grammar	Description
For WCDMA Module(e.g. SIM5320): AT+CGSOCKCONT=1,"IP","CMNET" OK AT+CSOCKSETPN=1 OK *For CDMA/EVDO Module(e.g. SIM6320/SIM6216):* AT+CSOCKAUTHNV=1 OK AT+CSOCKAUTH=,,"card","card" OK	Set APN. Set User/Password
AT+CIPMODE=0 OK	Set TCP/IP module to use command mode.
AT+NETOPEN OK +NETOPEN: 0	Open network.
AT+SERVERSTART=8080,0 OK	Start TCP server<0> listening on 8080 port.
AT+SERVERSTART=9090,1 OK	Start TCP server<1> listening on 9090 port.
AT+SERVERSTART=7070,2 OK	Start TCP server<2> listening on 7070 port.
AT+SERVERSTART=6060,3 OK	Start TCP server<3> listening on 6060 port.
+CLIENT: 0,1,192.168.108.5:57202	If a socket is accepted, the URC will be reported.
AT+CIPOPEN? +CIPOPEN: 0,"TCP","192.168.108.5",57202,1 +CIPOPEN: 1 +CIPOPEN: 2 +CIPOPEN: 3	Check accepted sockets For +CIPOPEN: 0,"TCP","192.168.108.5",57202,1 , last parameter of 1 indicates this is an accepted socket, this server index is 1

+CIPOPEN: 4 +CIPOPEN: 5 +CIPOPEN: 6 +CIPOPEN: 7 +CIPOPEN: 8 +CIPOPEN: 9 OK	
AT+CIPSEND=0,5 >HELLO OK +CIPSEND: 0,5,5	Send data to client
AT+CIPCLOSE=0 OK +CIPCLOSE: 0,0	Close accepted socket of index 0.
AT+SERVERSTOP=0 +SERVERSTOP: 0,0 OK	Stop TCP server<0>
AT+SERVERSTOP=1 +SERVERSTOP: 1,0 OK	Stop TCP server<1>
AT+SERVERSTOP=2 +SERVERSTOP: 2,0 OK	Stop TCP server<2>
AT+SERVERSTOP=3 +SERVERSTOP: 3,0 OK	Stop TCP server<3>

Note, we can check connection status with command AT+CIPOPEN. If some socket needs to close, please issue command AT+CIPCLOSE=<linked_num>

3.3.4 Connection Status Checking

Grammar	Description
AT+CIPOPEN? +CIPOPEN: 0 +CIPOPEN: 1 +CIPOPEN: 2 +CIPOPEN: 3 +CIPOPEN: 4 +CIPOPEN: 5	Check currently opened sockets.

+CIPOPEN: 6 +CIPOPEN: 7 +CIPOPEN: 8 +CIPOPEN: 9 OK	
AT+CIPOPEN=0,"TCP","116.236.221.75",8011 OK +CIPOPEN: 0,0	Create an TCP socket and connect to 116.236.221.75:8011
AT+CIPOPEN? +CIPOPEN: 0,"TCP","116.236.221.75",8011,-1 +CIPOPEN: 1 +CIPOPEN: 2 +CIPOPEN: 3 +CIPOPEN: 4 +CIPOPEN: 5 +CIPOPEN: 6 +CIPOPEN: 7 +CIPOPEN: 8 +CIPOPEN: 9 OK	Check currently opened sockets.

3.3.5 Retrieve Data

3.3.5.1 Receive Data Automatically

Command AT+CIPHEAD is used to show IP head (data length) information, and command AT+CIPSRIP is used to show remote IP address and port once data received.

Grammar	Description
For WCDMA Module(e.g. SIM5320): AT+CGSOCKCONT=1,"IP","CMNET" OK AT+CSOCKSETPN=1 OK *For CDMA/EVDO Module(e.g. SIM6320/SIM6216):* AT+CSOCKAUTHNV=1 OK AT+CSOCKAUTH=,,"card","card"	Set APN. Set User/Password

OK	
AT+CIPMODE=0 OK	Set TCP/IP module to use command mode.
AT+NETOPEN OK +NETOPEN: 0	Open network.
AT+CIPHEAD=1 OK	Add “+IPD” header
AT+CIPSRIP=0 OK	Do not show “RECV FROM” header
AT+CIPOPEN=0,"TCP","116.236.221.75",8011 OK +CIPOPEN: 0,0	Open TCP connection.
AT+CIPSEND=0,5 >11111 OK +CIPSEND: 0,5,5	Send data.
+IPD13 hello from pc	Here, remote data is coming
AT+CIPSRIP=1 OK	Show “RECV FROM” header
RECV FROM:116.236.221.75:8011 +IPD15 hello from pc 2	Here, remote data is coming
AT+CIPCLOSE=0 OK +CIPCLOSE: 0,0	Close socket

3.3.5.2 Retrieve Data Manually

Grammar	Description
For WCDMA Module(e.g. SIM5320): AT+CGSOCKCONT=1,"IP","CMNET" OK AT+CSOCKSETPN=1 OK	Set APN.

For CDMA/EVDO Module(e.g. SIM6320/SIM6216): AT+CSOCKAUTHNV=1 OK AT+CSOCKAUTH=,,"card","card" OK	Set User/Password
AT+CIPMODE=0 OK	Set TCP/IP module to use command mode.
AT+NETOPEN OK +NETOPEN: 0	Open network.
AT+CIPHEAD=0 OK	Hide "+IPD" header
AT+CIPSRIP=1 OK	Show "RECV FROM" header.
AT+CIPRXGET=1 OK	Set module to cache received data. This only needs to be set once.
RECV FROM:116.236.221.75:8011	Here, remote data is coming
AT+CIPRXGET=2,1,1024 +CIPRXGET: 2,1,15,0 hello from pc 2 OK	Use AT command to retrieve the cached received data.

3.4 Data Mode(Transparent mode)

Currently, only one socket can be used for transparent mode, either TCP client or TCP server or UDP socket.

Command AT+CIPCCFG could be configured several parameters for data transmission under transparent mode. Before using data mode, the AT+CIPMODE=1 must be called first.

Note: In transparent mode, the first server(TCP server<0>) and the first client socket(<link_num> = 0) are used for transparent mode operation. Other servers(TCP server<1-3>) and other client sockets(<link_num> = 1-9) are still used in command mode.

3.4.1 TCP Client

Grammar	Description
For WCDMA Module(e.g. SIM5320): AT+CGSOCKCONT=1,"IP","CMNET" OK	Set APN.

AT+CSOCKSETPN=1 OK *For CDMA/EVDO Module(e.g. SIM6320/SIM6216):* AT+CSOCKAUTHNV=1 OK AT+CSOCKAUTH=,,"card","card" OK	Set User/Password
AT+CIPMODE=1 OK	Set TCP/IP module to use transparent mode.
AT+NETOPEN OK +NETOPEN: 0	Open network.
AT+CIPOPEN=0,"TCP","116.236.221.75",8011 CONNECT 115200	Connect to TCP server. only <link_num>=0 is allowed to operate with transparent mode.
+++ OK	Sequence of +++ to quit data mode
AT+CIPCLOSE=0 OK CLOSED +CIPCLOSE: 0,0	Close socket.
AT+NETCLOSE OK +NETCLOSE: 0	Close network

3.4.2 TCP Server

Grammar	Description
For WCDMA Module(e.g. SIM5320): AT+CGSOCKCONT=1,"IP","CMNET" OK AT+CSOCKSETPN=1 OK *For CDMA/EVDO Module(e.g. SIM6320/SIM6216):* AT+CSOCKAUTHNV=1 OK	Set APN. Set User/Password

AT+CSOCKAUTH=,,"card","card" OK	
AT+CIPMODE=1 OK	Set TCP/IP module to use transparent mode.
ATS0=7 OK	ATS0 should be configured for TCP server application
AT+NETOPEN OK +NETOPEN: 0	Open network.
AT+SERVERSTART=8080, 0. OK	Start TCP server<0>. Only TCP server<0> is allowed to operate with transparent mode
+CLIENT: 0,0,192.168.108.5:57202 CONNECT 115200	If a socket is accepted, the URC will be reported. Only <link_num> 0 can be used for transparent mode operation.
+++ OK	Sequence of +++ to quit data mode
AT+CIPCLOSE=0 OK CLOSED +CIPCLOSE: 0,0	Close socket.
AT+SERVERSTOP=0 +SERVERSTOP: 0,0 OK	Stop TCP server<0>
AT+NETCLOSE OK +NETCLOSE: 0	Close network

3.4.3 UDP Socket

Grammar	Description
For WCDMA Module(e.g. SIM5320): AT+CGSOCKCONT=1,"IP","CMNET" OK AT+CSOCKSETPN=1 OK	Set APN.

For CDMA/EVDO Module(e.g. SIM6320/SIM6216): AT+CSOCKAUTHNV=1 OK AT+CSOCKAUTH=,,"card","card" OK	Set User/Password
AT+CIPMODE=1 OK	Set TCP/IP module to use transparent mode.
ATS0=7 OK	ATS0 should be configured for TCP server application
AT+NETOPEN OK +NETOPEN: 0	Open network.
AT+CIPOPEN=0,"UDP","116.236.221.75",8011,8080 CONNECT 115200	Create an UDP socket and set it only send data to 116.236.221.75:8011
+++ OK	Sequence of +++ to quit data mode
AT+CIPCLOSE=0 OK CLOSED +CIPCLOSE: 0,0	Close socket.
AT+SERVERSTOP=0 +SERVERSTOP: 0,0 OK	Stop TCP server<0>
AT+NETCLOSE OK +NETCLOSE: 0	Close network

Note, the factors which influence data rate are following:

AT&E1 the data rate should be the serial connection rate;

AT&E0 the data rate is the wireless connection speed (based on QOS, refer to command AT+CGSOCKQREQ/AT+CGSOCKEQREQ/AT+CGSOCKQMIN/AT+CGSOCKEQMIN).

3.4.4 Switch Between Data Mode and Command Mode

Hardware flow control is recommended.

Currently, USB->modem port, USB->AT port and UART port all support hardware flow control.

Software switching: escape sequence +++. Please take care, this is a complete command, do

not separate each character, also take care that the time delay before and after this sequence should be more than 1000 milliseconds, the interval of each character should not more than 900 milliseconds.

Hardware switching: DTR pin could be used to trigger data mode and command mode changed. Command AT&D1 should be configured before application.

3.4.5 Stop Data Mode when socket closed passively

When the socket used for transparent mode is closed by the remote, the transparent mode will stopped automatically and enter command mode, and the DCD pin will be pulled to high level. The +IPCLOSE and CLOSED URC will be reported also.

3.5 External Information

3.5.1 TCP Retransmission Information

Each sending TCP packet needs to get a TCP ACK packet from peer socket. If the TCP ACK packet is not got in time, the module shall resend the same packet. The waiting for TCP ACK packet interval is <ESTIMATED_ROUND_TRIP_TIME>*2(n-1) seconds, while n is the retry times. Also for a packet sending, the total trying send time is 2 minutes. For example:

1. Send the TCP packet, here as a sample, the module measures <ESTIMATED_ROUND_TRIP_TIME> as 3 seconds. In runtime, each retransmission would use the latest measured <ESTIMATED_ROUND_TRIP_TIME> value in the following steps.
2. Wait 3 seconds, and if TCP ACK packet is not got, resend the packet
3. Wait another 6 seconds, and if TCP ACK packet is not got, resend the packet
4. Wait another 12 seconds, and if TCP ACK packet is not got, resend the packet
5. Wait another 24 seconds, and if TCP ACK packet is not got, resend the packet
6. Wait another 48 seconds, and if TCP ACK packet is not got, resend the packet
7. Wait another 27 seconds, and if TCP ACK packet is not got, regards socket sending failure and close the socket. (Here only 27 seconds waiting is because that the total trying time is 2 minutes).
8. If the TCP ACK packet is got within the previous steps, the packet is regarded as sending successfully.

User can modify the total allowed retrying send times by set the first parameter of AT+CIPCCFG. For example, if AT+CIPCCFG=3, then the packet sending should be as following:

1. Send the TCP packet, here as a sample, the module measures <ESTIMATED_ROUND_TRIP_TIME> as 3 seconds. In runtime, each retransmission would use the latest measured <ESTIMATED_ROUND_TRIP_TIME> value in the following steps.
2. Wait 3 seconds, and if TCP ACK packet is not got, resend the packet
3. Wait another 6 seconds, and if TCP ACK packet is not got, resend the packet
4. Wait another 12 seconds, and if TCP ACK packet is not got, resend the packet
5. Wait another 24 seconds, and if TCP ACK packet is not got, regards socket sending failure and

close the socket

6. If the TCP ACK packet is got within the previous steps, the packet is regarded as sending successfully.

User also can modify the minimum waiting interval by setting the 7th parameter of AT+CIPCCFG. For example, if AT+CIPCCFG=,,,,,,10000, then the packet sending interval should be should be as following:

1. Send the TCP packet, here as a sample, the module measures <ESTIMATED_ROUND_TRIP_TIME> as 3 seconds. In runtime, each retransmission would use the latest measured <ESTIMATED_ROUND_TRIP_TIME> value in the following steps.
2. Wait MAX(10, $3*2^{(n-1)}$) = 10 seconds, and if TCP ACK packet is not got, resend the packet
3. Wait another MAX(10, $3*2^{(n-1)}$) = 10 seconds, and if TCP ACK packet is not got, resend the packet
4. Wait another MAX(10, $3*2^{(n-1)}$) = 12 seconds, and if TCP ACK packet is not got, regards socket sending failure and close the socket
5. Wait another MAX(10, $3*2^{(n-1)}$) = 24 seconds, and if TCP ACK packet is not got, resend the packet
6. Wait another MAX(10, $3*2^{(n-1)}$) = 48 seconds, and if TCP ACK packet is not got, resend the packet
7. Wait another 16 seconds, and if TCP ACK packet is not got, regards socket sending failure and close the socket. (Here only 16 seconds waiting is because that the total trying time is 2 minutes).
8. If the TCP ACK packet is got within the previous steps, the packet is regarded as sending successfully.

The two parameters can be used together and they may affect AT+CIPOPEN/AT+CIPSEND/AT+CIPCLOSE.

According to our experience, the AT+CIPCCFG can be set to following value to obtain stable TCP transfer:

Grammar	Description
AT+CIPCCFG=10,,,,,,10000 OK	Set TCP retransmission parameters to obtain stable transfer.

3.5.2 Set TCP Timeout Parameters

User can set the maximum timeout value for AT+NETOPEN, AT+CIPOPEN and AT+CIPSEND using AT+CIPTIMEOUT command:

AT+CIPTIMEOUT=<netopen_timeout>,<connect_timeout>,<send_timeout>,

Grammar	Description
AT+CIPTIMEOUT=40000, 30000, 25000 OK	Set timeout value.

3.5.3 Set DNS Timeout Parameters

User can set the maximum timeout value for DNS query using AT+CIPDNSSET command: AT+CIPDNSSET=<max_net_retries>,<net_timeout>,<max_query_retries>.

The timeout value for performing DNS query is <net_open_time> + 3000ms + 1000ms*<dns_query_retry_counter>. Here <net_open_time> is the time for opening PS network. <dns_query_retry_counter> is the retry counter for sending DNS query using UDP packet. By default, the maximum DNS query time is long, so the AT+CIPDNSSET=0,30000,5 is recommended to be used, for this setting, the maximum timeout value is 63 seconds.

Grammar	Description
AT+CIPDNSSET=0, 30000, 5 OK	Set DNS timeout value.

3.5.4 Force to Send FIN Packet When Closing TCP Socket

By default, when the module calls AT+CIPCLOSE in PS network dormancy state, It will close the socket immediately without notifying peer socket. User can set AT+CNVW=1341,0,”01”, this will force the AT+CIPCLOSE to send FIN packet to peer socket even in PS network dormancy state. This setting only needs to be performed once, and it will take effect from next power cycle.

Grammar	Description
AT+CCNVW=1341,0,”01” OK	Set to send FIN packet when closing socket even in network dormancy state.

3.5.5 Use TCP/UDP socket and voice call together

Currently GSM/CDMA/EVDO modes cannot use TCP and voice call together, when using voice call; the TCP/UDP transfer shall be suspended. So when using voice call in the three modes, don’t transfer data using TCP/UDP.

Appendix

A Related Documents

SN	Document name	Remark
[1]	SIMCOM_SIM5320_ATC_EN_V2.01.doc	

B Terms and Abbreviations

Abbreviation	Description
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
IP	Internet Protocol
TM	Transparent mode

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