

## **SW-4901 Gigabit Ethernet Controller 1.00**

### **Network supervisor and device controller software for the Gigabit system**

This software was designed for programming and controlling the devices and networks, which use the Gigabit Ethernet Controller module. This software can configure all the TS Sender and IP Receiver units in the CW-49xx product family (SW-4941, -44 ASI – IP Converters, CW-4971, -72, -73, -74, -75,-76 Demodulator quads etc.).

After the CW-Net system, CableWorld Ltd elaborated a new and very efficient instruction set for the Gigabit system. The SW-4901 Gigabit Ethernet Controller software uses this new instruction set for sending out commands. The CW-4901 Gigabit Ethernet Controller module can operate with the old and the new instruction set, the compatibility is nearly 100% until the user disables the compatibility by program. Moreover the programming can be locked. When the Lock function is ‘On’ the device replies only the ACK messages and does not accept any programming instructions. Beside the 1000Base-T networks the Gigabit modules can be operated from the 10Base-T and 100Base-T environment as well, but the 10Base-T mode was not tested in the course of fabrication. When the required data rate makes it possible, the use of the 100Base-T mode is more favourable for reliability and lifetime than of the 1000Base-T. The mode selector circuitry of the Gigabit Ethernet Controller works in ‘Forced Slave’ mode, so the current mode is determined by the external unit (PC, switch, etc.), what is connected to the device.

### **Instruction manual**

#### **1. Task of the software**

Development of digital television technology requires the Transport Stream transmission over IP network as well. The Gigabit system developed by CableWorld Ltd allows the TS transmission over IP network beside the device control. The speciality of the solution is that the transmission is common no separate networks for the device control and TS transmission are needed.

The use of the Gigabit system is easier for users who know the CW-Net system. So we suggest for new partners studying the descriptions CW-Net.pdf and Using CW-Net.pdf which are available for downloading from the [www.cableworld.hu](http://www.cableworld.hu) web site. The software was designed for the Windows system, the development and test happen in Windows XP Professional environment and we suggest our customers to use this version.

CableWorld Ltd delivers the CW-4901 Gigabit Ethernet Controller module for design engineers and device manufacturers in board format as well. We suggest this software to partners who develop own software or device for controlling the operation and the construction of commands. The detailed description of the module and the instruction set are free accessible in the 4901k\_m.pdf file.

The transmission of TS in IP environment requires skills both in computer studies and digital television technology for the user. The most important information for TS transmission over IP network is summarized in our publication ‘Transport Stream Managing over IP’.

## 2. Establishing the CW-Net and the Gigabit CW-Net

The CW-Net can be built of the components of the widely used 100 MBit/s Ethernet networks. The simplest system can be established by connecting the computer's Ethernet socket with that of one of the CableWorld devices' through a category 5 cross-wired cable.

Connecting more than one device can be made through a switch or some other component of similar function, but in this case all devices must have different IP addresses. CableWorld Ltd. delivers its products with the 10.123.13.101 IP address, which must be changed to different addresses each at putting them in operation. For doing this, first connect the computer with a straight (not cross-wired) cable to the switch, and then connect the first device with a straight cable. Set the IP address of the device, and then continue this procedure with all devices.

In the CW-Net network the computer has to be set to a fix IP address (e.g.: 10.123.13.201) and to 100 MBit/s full duplex operation mode. In Windows XP environment, for setting the computer's IP address, select following options: My Computer – Control Panel – Network Connections – Local Area Connection – (mouse right click) Properties – Internet Protocol (TCP/IP). The offered (255.0.0.0) Subnet mask should be accepted. Here, on the upper side of the General page also the setting of the network handling device is offered (Configure > Advanced). After clicking the "Settings" button, click the "Link Speed/Duplex Mode" line in the "Special" page and then in the roll down menu select the "100Mbps/Full Duplex" mode. In most cases auto mode is applicable, too.

When selecting the switch type, consider that for transmitting simple instructions e.g. setting IP addresses any switch type may work, but the fast transport stream can only be transmitted by industrial versions.

Most of the switches store the data of the device connected to their port for a few minutes. Therefore in case of changing the IP address (or removing the cable to another port) the device looks inaccessible, as using CableWorld's Auto-MAC setting the MAC address changes as well. This effect ceases when the switch refreshes its MAC table.

In 100Base-T networks the straight and crossover cables are used as mentioned above. In 1000Base-T networks straight cables are used always and all the 8 wires of the UTP cable are applied. Short parts in the Gigabit networks can operate with CAT5 cables but in professional systems and long distance transmissions CAT6 cables must be used. The No.34 issue of the 'CableWorld hírek' technical magazine gives detailed description on the technical solutions used in Ethernet networks.

When connecting to Gigabit networks the setting of the computer should be modified as well. For long time connection at the gigabit output of a switch choose '1000Base-T/Full Duplex Mode'. When the connection changes frequently, on experimentation and development use 'Auto' mode.

In multicast mode choosing the switch and setting-up the network requires special considerations, since many devices are not suitable for the perfect managing of multicast transmission.

## 3. Installing the software

The SW-4901 software is free available for our customers, anyone can download it from our web site. Installing is made in the usual way, with running setup.exe. After installing, the software is started with clicking the icon on the desktop.

Generally the settings are stored in the CW4901a.ini file. The complicated settings of the gigabit systems require regular saving and loading. Therefore the software supports the user in easy modification of the 'ini' file by a text editor. The 'Settings' subdirectory is used for saving the user's settings. Here the structure of the MySettings.ini file is the same as of the CW-4901a.ini file. While running the software the user can download and save own settings without limitation.

We suggest the regular use of the 'ini' file and data storing in the 'ini' file especially for operators and installers of large systems who must load in the devices a number of settings.

#### **4. General Device Controller**

On running the software, the General Device Controller graphic user interface (GUI) panel appears on the screen. This platform can be used for querying the device parameters and the network and modifying the IP addresses.

##### **IP Address**

The software always communicates with the device whose IP address is seen in the IP Address box. An arbitrary IP address can be typed in, then the last byte can be changed by steps. On clicking the pull-down list the prepared IP addresses appear in the box. On checking 'Use CW-Net' the automatic circuitry prohibits leaving the CW-Net range.

##### **Use CW-Net (10.123.13. xxx)**

In the learning phase not really skilled users should remain within the 10.123.13 .xxx range of the CW-Net system. Skilled users can work in any IP address range. When this box is checked the IP addresses will be written back automatically to the range of the CW-Net system, that is the leaving is prohibited.

##### **IP Address List**

The software allows the user to work with a prepared IP address list, instead of toiling with setting the addresses. The address list can be given in the CW4901a.ini file as follows:

Open the ini file by any text editor and look up the following part in the text:

```
[IP Address List]
Number of Items=10
IP Address 1=192.168.1.101
IP Address 2=10.123.13.90
IP Address 3=10.123.13.91
IP Address 4=10.123.13.93
IP Address 5=10.123.13.70
IP Address 6=10.123.13.102
IP Address 7=192.168.1.100
IP Address 8=192.168.1.101
IP Address 9=230.255.1.45
IP Address 10=255.255.255.255
```

Type the number of items of the required list in the second line then type in your list according to the original format.

##### **Communication Port Number**

The Gigabit Ethernet Controller ranges the incoming messages according to the port number after MAC filtering. Very important rule: The communication message must not arrive at the reserved and programmed port range of the transport stream. Because the Port Filter will not pass these messages to the message processor unit (IP Manager).

The Gigabit Ethernet Controller automatically extends the range reserved for the transport stream with the individual values that are programmed to any of its IP receivers accidentally or intentionally (if these values are out of range). We suggest the use of 56000...56999 range for communication. The software allows using the range set in the Network Setup Platform.

The Gigabit Ethernet Controller must not get a high-speed transport stream at its communication port even accidentally, because it causes the overload of the slow message processor circuitry. In case of overload some messages will be lost or the command will be executed hard, after multiple repetitions.

## **Query**

On clicking 'Query' the device parameters at the preset IP address will be queried. The most important data from the device answer will be displayed. The 'Query' message will be given out in the new format of the Gigabit Ethernet Controller so the former devices of the CW-Net system will not reply!

## **IP Address Replacer**

The software communicates always with the device at the preset IP address. To change the IP address type the new IP address in the box and push the 'Replace IP Address' button. Before accomplishing the change the software asks for verification. The IP address of the 'lost' device can be restored by message spreading (255.255.255.255) instruction 'Replace IP'. This time the IP address of all devices will be restored, which receive the instruction. Use this instruction with careful considerations!

**Reset** - General device Reset over IP network.

On pushing this button all the circuits in the device get an electronic Reset signal. The Reset time is 5 sec. During Reset the network connection breaks, too. This break cannot be seen through a switch by PC.

## **Settings Save as**

Perfect setting of many parameters requires careful work. Settings can be saved in an 'ini' file named by the user with the function 'Settings Save as ...'. In large systems user should save the settings of devices in separate 'ini' files.

Remember, the modifications can be made directly in the ini file as well. Beside the file name also the Project Name in the ini file can be used for identifying the settings. When the settings should be saved apart from the current IP address, rewrite the 4<sup>th</sup> byte of the IP address to 0 (Up-Down IP-4=0) in the ini file.

## **Load My Ini File**

The prepared settings of the user can be load by the 'Load My Ini File' button. This load actualizes the settings of every platform and does not change the current IP address if Up-Down IP-4=0 is set in the ini file.

## **Auto Search**

The Auto Search mode addresses the devices by the values 1 ... 255 of the 4<sup>th</sup> byte of the IP address. On receiving the reply it displays the name and IP address of the device. Without reply to the Gigabit addressing the former CW-Net command will be sent out as well. So the software indicates the presence of the devices of the former CW-Net system as well. The Gigabit devices are distinguished by 'G' on the display. The Auto Search can be held up by the 'Stop' button any time.

## 5. Network Setup

When connecting to the computer network the Gigabit Ethernet Controller behaves as an intelligent device, it starts communication with the system like a computer. The user's job is to supervise and control this communication on demand.

### Query

This is a duplicate of the Query button with invariant operation mentioned earlier. It is repeated in this platform so you should not go back to the former platform for Query.

### User defined Communication Port Interval User defined Transport Stream Port Interval

The speciality of CableWorld solution is that their devices can receive device control instructions and transport streams in a common network so the user need not build two parallel networks. The built in Gigabit Ethernet Controller in the devices ranges the incoming messages according to the port number, after MAC filtering. In the course of signal processing the Port range reserved for the transport stream has the primary role. The values written in the boxes for 'Lower Limit' and 'Upper Limit' will be programmed to device. We suggest the use of 56000...56999 range but it can be different. Remember, the Gigabit Ethernet Controller automatically extends the range reserved for the transport stream with the individual values that are programmed to any of its IP receivers accidentally or intentionally.

Very important rule: The communication message must not arrive at the reserved and programmed port range of the transport stream. Because the Port Filter will guide these messages to the TS processor so the IP Manager cannot receive them. We suggest the use of 56000...56999 range for communication. The Communication Port Interval set in the Network Setup Platform has effect only on the device controller instructions of the SW-4901 software. The software does not allow the user sending instructions to device outside this range. The course of ranging the messages is shown in Figure 1.

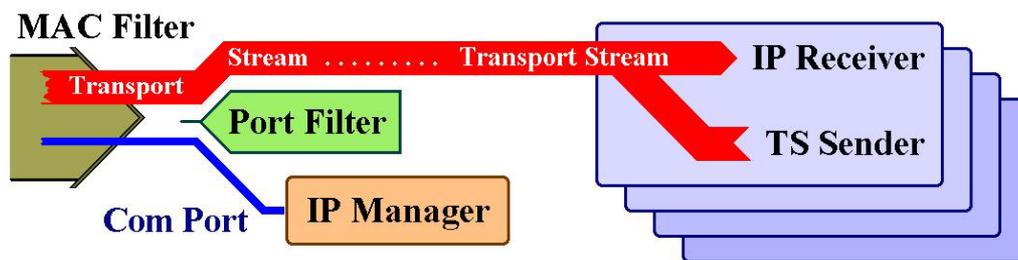


Figure 1

The course of ranging the incoming messages at the input of the Gigabit Ethernet Controller  
The transport stream transmission occurs within the TS Port interval.

**Important rule: The device control commands and the transport streams must be located in different port ranges! These ranges must not have common parts. The port numbers of the instructions and the transport streams must not be mixed!**

## Network Parameters from Device

By pushing the Query button all the parameters of the device will be read out. The 'Network Parameters' display shows the most important parameters for the network setting.

## New Network Parameters

The control panel allows changing the values of the Network Mask, the Default Gateway, the Gateway Mode and the ARP Repetition Time. In small networks without Gateway, set 'No Gateway' mode to switch off the search function of the Gigabit Ethernet Controller. In Normal mode the Gigabit Ethernet Controller queries the MAC Address to the Gateway IP address in order to apply it when necessary. It repeats the querying instruction until receives the reply.

The Gigabit Ethernet Controller sends messages for refreshing the MAC table of the switch according to the value of the ARP Repetition Time. Set a small value, e.g. half of the preset time in the switch. In digital systems operating in constant set-up for a long time (e.g. head-ends), set long lifetime (3...10 minutes or longer) for the switch MAC table.

## 6. IP Receiver Platform

The Gigabit Ethernet Controller is made in two versions. The 4I version (4 × Input) is capable of receiving four different transport streams and packing them to four different IP addresses by its four TS Sender units. At the same time its one additional transport stream receiver is capable of receiving and sending UDP/IP packets over IP.

The 4O version (4 × Output) comprises four IP receivers, is capable of receiving four data streams from the IP network and sending out them in parallel format at its transport stream outputs.  
(Note: In the course of development complex versions are expected as well, but these are not discussed here.)

The IP Receiver Platform can configure the reception parameters of the four receivers. The controls of the four receivers are uniform but their programming happens separately. The software reads out the default parameters of the IP Receivers from the CW4901a.ini file. When the user wants to work with prepared settings, loads his owns. The parameters of the receiver modules can be seen in the ini file as follows:

```
[IP Receiver_1]
Multicast Mode=1
Multicast IP=239.123.13.100
TS Port=58100
Receiver On=1
NCO(Hz)=5100000
Packet Format=2
Continuous Clk=1
NP Remover=1
NP Inserter=2
```

## Receiver Mode

The IP Receiver can be programmed to unicast and multicast mode. After setting the mode the boxes of the unnecessary data go grey. In the ini file the unicast mode can be set as Multicast Mode=0, the multicast mode as Multicast Mode=1.

The main characteristic of the unicast mode is that only one receiver can access the data stream of the IP network. In multicast mode many receiver can receive the same data stream simultaneously.

### **Receiver IP Address**

In Multicast mode type the IP address of the data stream to be received in the box. In Unicast mode the software writes the preset IP address (Device IP Address) in the box.

In case of any data may be written, the box goes yellow at the start of typing. The data processing starts by pushing 'Enter'. The software processes the entered data and writes back the interpreted and improved, new data in the box.

### **TS Port**

Type the port number of the data stream to be received in the box. For easy memorizing in our examples the TS Port number is connected with the IP address (e.g. Multicast IP Address: 239.123.13.110 Port: 58110), but you may be different.

### **Receiver On/Off**

The Gigabit Ethernet Controller comprises four Receivers their operations can be switched on/off separately. In the ini file the line 'Receiver On=1' sets the On position, the line 'Receiver On=0' sets Off.

### **NCO Frequency**

The Gigabit Ethernet Controller comprises four NCO (Numerically Controlled Oscillator) circuits. The oscillator frequency is determined by the value written in the box. This value can be given by the line 'NCO(Hz)=5100000' of the ini file. The operation range of the NCO is 120 Hz ... 62,5 MHz.

The NCO uses the signal of the 125 MHz crystal oscillator of the Ethernet controller for generating the output signal. Those values derived from the 125 MHz through dividing by an integer are jitter-free, the intermediate values have 8 ns jitter. The larger number can be found to divide the preset frequency value without remainder, the smaller the jitter will be.

At the transport stream output the output bytes will be obtained by the frequency of the NCO (in Hz), that is the NCO directly provides the clock signal of the parallel output. When the Null Packet Inserter circuitry is 'On', a null packet sequence appears at the TS output even without input signal. The data rate expressed in bit/s is the eightfold of the NCO frequency.

### **TS Clock**

In the pull down list 'Gated' or 'Continuous' can be chosen. In the ini file the continuous clock signal can be chosen by the line 'Continuous Clk=1'. When the TS is taken from the IP network, the Null Packet Inserter must be switched on for generating a continuous output signal. The Inserter fills in the empty intervals with null packets.

## Packet Format

In the pull-down list the user can set the packet format to the fixed values of 188 or 204 bytes/packet. In 'Auto' mode the output signal format is determined by the input format.

In the ini file the line 'Packet Format=1' determines the setting. In the pull down list the data must be given by the line number. Important note: Give 0 for the first line as shown in Figure 2.

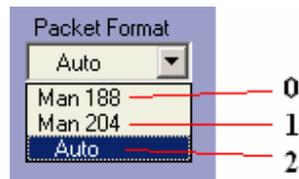


Figure 2

Explanation of identifiers for the lines of the pull-down list

## Null Packet Remover

The Null Packet Remover can remove the null packets from the transport stream arriving from the IP network. Switch on by the line 'NP Remover=1' in the ini file.

## Null Packet Inserter + TSP Flag

The pull-down list comprises the four combinations of the operating state bits from the Null packet Inserter and the Transport Error Indicator. The setting from the ini file is made by the identifiers as explained in Figure 2. (e.g. NP Inserter=2)

In lack of data the Null Packet Inserter can fill null packets in the transport stream for maintaining continuity.

When the TSP Flag is 'On' the IP Receiver is watching the value of the Transport Error Indicator bit in the incoming packets, and in case of '1' discards the whole packet.

## Load to Device

The user's settings are loaded to device when pushing the 'Load to Device' button. In every case only one IP Receiver is programmed the settings of the three others remain unchanged. The loadings will be saved in every case. The meaning of the LED colour beside the button is as follows:

Green: Successful load

Yellow: Settings changed, without load

Blue: Read back data

Grey: Neutral state, no data

## IGMP Report Time

When receiving Multicast data stream the IP Receiver indicates continuously for the switch, that still needs the data stream. The 'IGMP Report Time' can set the repetition time of these signals. The value can be  $(1 \dots 255) \times 0.4$  sec, the signals can be switched off by setting '0' value. This parameter is common for the four IP Receivers, programming any of them will set the current value. In the ini file the line 'IGMP Report Time=15 ( $15 \times 0.4 = 6$  sec)' sets this.

## Read Settings from Device

On pushing this button the software reads out the settings of the four IP Receivers from the device and displays on the screen. The read out data are distinguished by the green colour of the boxes from the user's settings.

## Load my ini

Prepared settings can be loaded quickly by this button. We especially suggest the use of the ini file it can be modified easily by any text editor (e.g. XP-Accessories\Notepad).

## 7. TS Sender Platform

The Gigabit Ethernet Controller comprises four independent TS Sender units, which are capable of sending four transport streams to the IP network. The four TS Senders can be programmed separately. Configuration from the ini file and the course of querying the settings are the same as of the IP Receiver, so those details are not described here.

## Sending Mode

In the pull-down list determining the mode of sending the transport stream the following settings can be chosen:

- **Send TS to Me** – Send TS to our computer. In this mode the TS Sender takes the MAC address of our PC out from the query message and using this starts composing and sending UDP /IP packets.
- **Send TS to Broadcast** – In this mode TS Sender starts sending UDP /IP packets unconditionally to everyone after the Send TS command.
- **Send TS to IP** – The TS Sender sends ARP messages for getting the MAC address of the addressee. Sending the TS starts only after receiving the reply. When sending to other network the ARP messages are sent to the router.
- **Send TS to Multicast** – Sending the TS starts unconditionally with the preset parameters. The software makes the MAC address automatically.
- **Send TS to Manual Address** – In this mode the user can send the TS to the IP network unconditionally, in optional configuration.

## UDP Packet Format

When choosing 'IPTV' the UDP packet contains only the data of the transport stream. When choosing CW-Net format, after the data contents auxiliary data of 32 bytes are transmitted as well. The 32-byte supplement contains packet counter, time base with resolution of 40ns, etc. for professional applications. The detailed description of the supplementary data is available in the CW-Net.pdf file.

## TS Packet Format

The length of the TS packets in the UDP packet can be set to 188 or 204 byte. The TS packets always start with a synchron byte (h47).

## **UDP Size**

The number of TS packets in the UDP packet can be set between 1 and 7. In IP TV systems the  $7 \times 188 = 1316$  Byte data packet is the most current size.

## **CW-Net Data Size**

In case of CW-Net format the TS data stream gets into the UDP packet without check and its size can be set here. This mode allows transmitting the data streams of any kind (not DVB transport stream). In its measuring systems CableWorld Ltd uses the size  $7 \times 204 = 1428$  bytes. The 32-byte supplement is added to this size.

## **Data Valid**

The Gigabit Ethernet Controller allows the Data Valid signal standardized in the DVB system be effective as well. In the ASI transmission there is no Data Valid signal, choose the 'Disable' setting. The Data Valid signal may be required at special demodulators.

## **Null Packet Remover + TSP Flag**

In order to decrease the IP data rate the user can remove the null packets and the packets marked faulty by the Transmission Error Indicator from the transport stream. In the IP TV systems the null packets are removed, switch on the Remover! In case of transparent transmission these two units must be switched off.

## **IP Address**

The user's job is giving the IP address associated with the transport stream according to the application.

## **MAC Address**

Except for a few special applications the MAC address is determined by the software.

## **Port**

One of the most important parameters is the Port Number, determines which processor unit will get the UDP package for processing.

Remember, in the CableWorld system the port number must be in the range reserved for the TS transmission.

## **Send TS – Always Send TS – Donot Send TS**

The settings for the TS Sender will be programmed to device by pushing the 'Send TS' button. The settings will be alive until the power off. The settings are saved by the 'Always Send TS' button and at power on or after the Reset instruction the device starts in this mode. The instruction 'Donot Send TS' stops sending the TS.

## Read Settings from Device

On pushing this button the software reads out the settings of the four TS Senders and displays on the screen. The read out data are distinguished by the green colour of the boxes from the user's settings. The read back data line gives information about the working conditions of the four TS Senders as well.

## Load my ini

Prepared settings can be loaded quickly by this button. We especially suggest the use of the ini file, it can be modified easily by any text editor (e.g. XP-Accessories\Notepad).

## 8. Schematic Diagram

Transmitting the transport stream over IP network is a new challenge for the experts needs a new attitude and has many pitfalls. For demonstrating the processes and for easier orientation the schematic diagram of the Gigabit Ethernet Controller and the course of signal processing are shown on the software control panel and in Figure 3 as well.

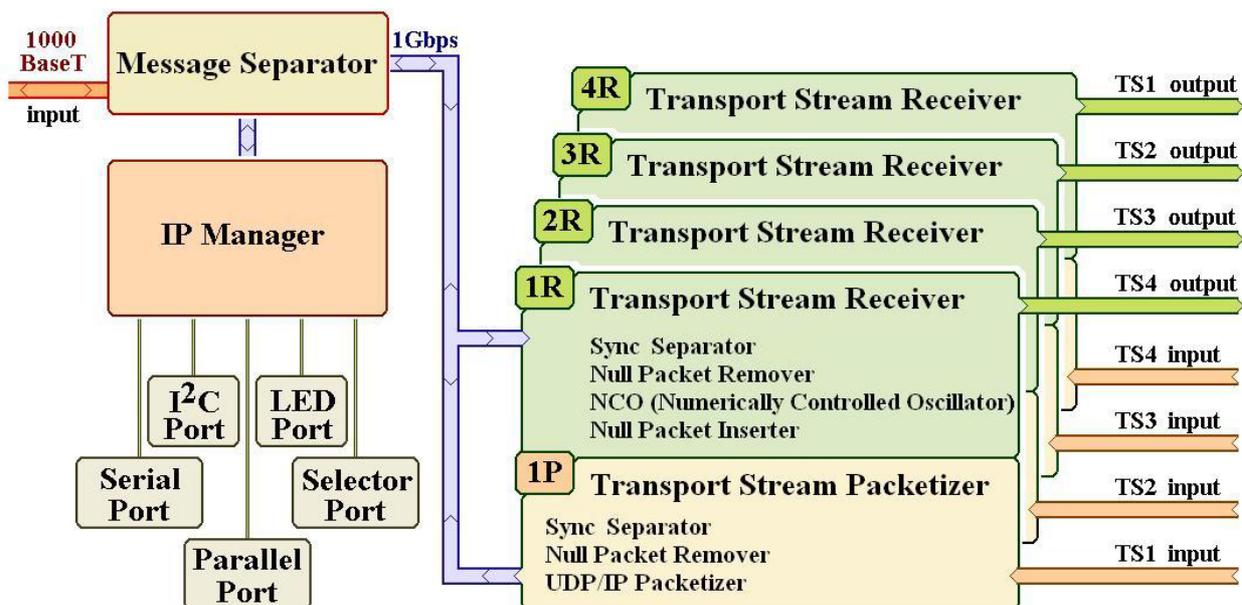


Figure 3

The schematic diagram of the Gigabit Ethernet Controller and the course of signal processing.

## 9. Special Settings

CableWorld Ltd delivers the Gigabit Ethernet Controller module in board format, too for firms developing and manufacturing devices. On page 'Special Settings' we put some controls for the sake of design engineers, in general applications this functions are not necessary. The system development is continuous so the number and the mode of the special settings published here can change in time. Briefly the 1.00 version comprises the special settings as follows:

- **Device Type** – Type number setting only for manufacturers and design engineers! On pushing the ‘Send Message’ button the type number in the box will be programmed to the device at the preset IP address. .
- **Device Serial Number** – Possible setting for the device serial number. Important to know, that in the former CW-Net system the serial number was a two-byte variable, in the Gigabit system it is a four-byte. The former CW-Net software reads the last two bytes only.
- **User Network Identifier** – Users can make their own system individual by typing a 15-byte variable in the box. In the Ethernet analyzer after the inscription ‘DDToIP’ (Digital Data Transmission over IP) the User Network Identifier appears.
- **Primary MAC** - The Gigabit Ethernet Controller can be given an individual MAC address as well. In the CableWorld devices a kind of CableWorld automatic MAC address is used. Users who possess their own MAC address can program it to device.
- **Secondary MAC** - Reserved MAC address for later developments.
- **CW-Net Compatibility** – When ‘On’ is programmed the Gigabit Ethernet Controller executes the instructions of the former 100 Mbit system. In ‘Off’ position the commands starting with the ‘CW-Net’ identifier are discarded and only the commands starting with ‘DDToIP’ are executed.
- **Locked** – Programming the device can be prohibited by the key written in the box.
- **Unlocked** – When the key written in the box is the same as the key used for lock, the lock can be lifted.
- **SNMP and Trap Messages** – Under development

The number of reprogramming events of the device parameters and settings is greater than 1 000 000.

## 10. Comments, further information

We are pleased to receive (at [cableworld@cableworld.hu](mailto:cableworld@cableworld.hu)) comments and remarks pertaining to our products and software and we take the included suggestions and ideas into consideration at further developments. At the same address we are ready to provide further information about the application of the products.