# Link diagnostic tools

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## Ltest

Ltest utility allows precise test of a radio link. It is recommended for antenna alignment when installing a new device or for testing of existing radio link.

Ltest can work in standard, alignment and bandwidth modes.

**Standard mode:**

In standard mode Ltest measures signal levels, retries, lost packets and acks.

To start Ltest in this mode:

```
lt rf5.0 <Mac-address of a device on the other side of the radio link>
```

When «*ltest*» command starts it will show you output information that contains testing results. You can see Ltest output below:
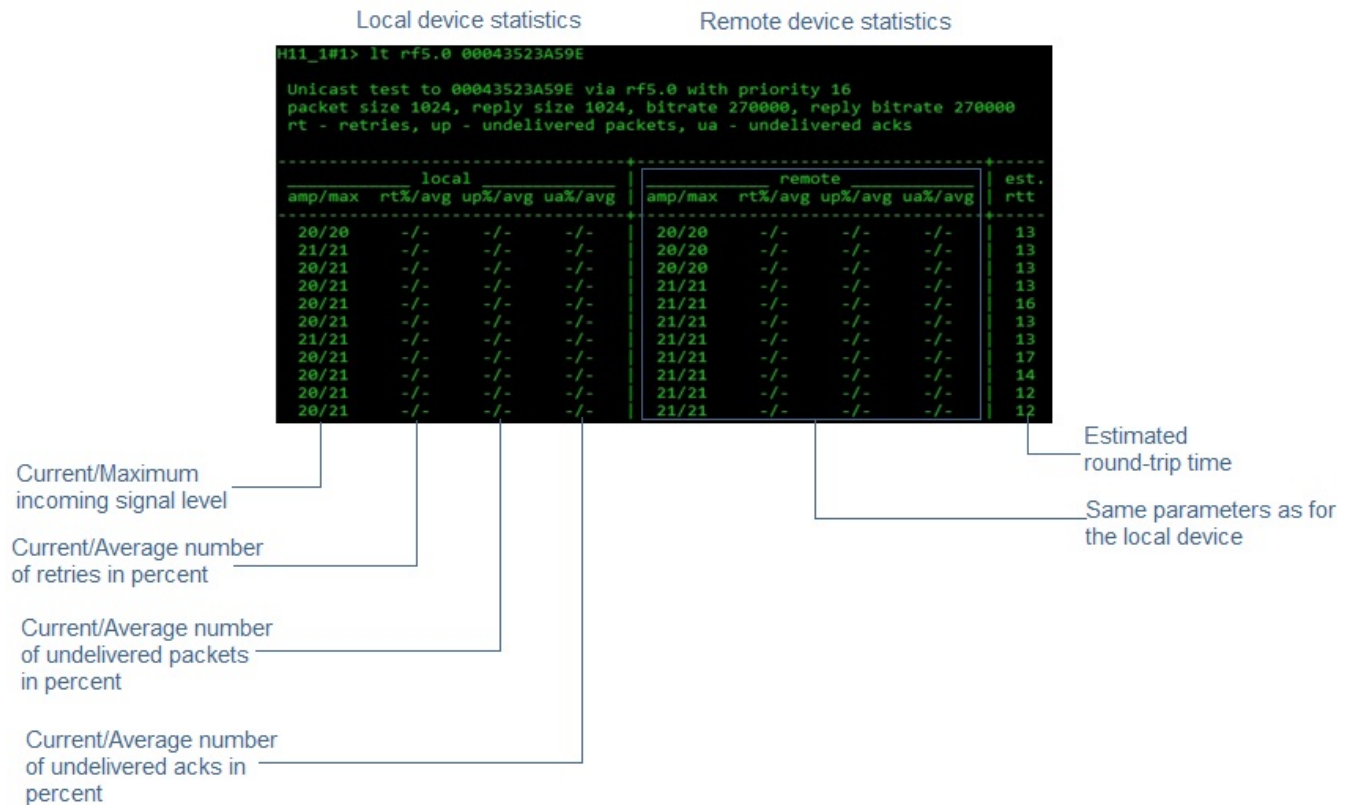
**Figure - ltest output information**

For success radio link establishing the following factors have to be considered:

1. It is recommended to start antenna alignment with searching maximum signal level on a minimal possible bitrate. Afterwards automatic MINT mechanisms will set the most appropriate bitrate if "*autobitrate*" mode will be enabled
2. Current incoming signal level in «amp/max» columns (see "*ltest*" command output) must be between 12 and 40

   When it is more than 40 it is recommended to lower amplifier power.

   If maximal signal level is less than 12 it is recommended to lower bitrate or channel width (for example, from 20MHz to 10MHz on the both sides of the radio link).

   In some cases signal level that is less than 12 may be enough for radio link operation. In this case one has to be guided by such parameters as number of retries, number of undelivered packets and number of undelivered acks. If the number of undelivered packets and the number of undelivered acks is null, the number of retries is small and all these parameters are constant in time then the radio link, most often, will be operating properly.
3. Number of retries value in «rt%» columns must be as close to zero as possible
4. Number of undelivered packets value in «up%» columns must be zero; if this value is not zero then the radio link couldn't be exploited
5. Number of undelivered acks value in «ua%» columns must be zero; if this value is not zero then the radio link couldn't be exploit. If this value is constantly not less then 50 then most probably «*distance*» parameter is set with a wrong value. If radio link distance is more than 20 km then «*long*» mode must be enabled.

ALL described parameters must be observed in the both ("Local" and "Remote") sections of the «*ltest*» command output.

## Alignment mode (for Xm-series only)

The difference of this mode from the standard one is that «ant.amps» column is used instead of «amp/max». «Ant.amps» column indicates signal levels for each of two antennas of a devce divided by ":" correspondingly.

To start Ltest in this mode:

```
lt rf5.0 <Mac-adress> -align [L,R]
```
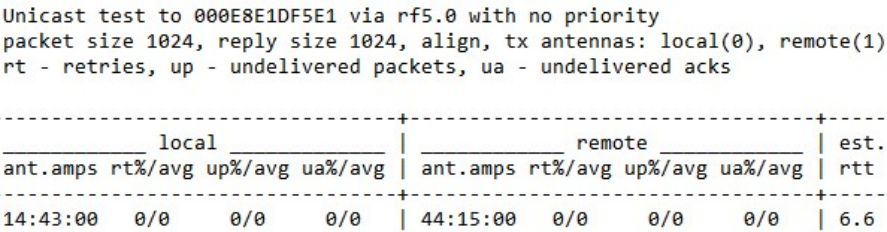
Ltest output in alignment mode:

```
Unicast test to 000E8E1DF5E1 via rf5.0 with no priority
packet size 1024, reply size 1024, align, tx antennas: local(0), remote(1)
rt - retries, up - undelivered packets, ua - undelivered acks

-----------------------------------+-----------------------------------+-----
_____ local _____ | _____ remote _____ | est.
ant.amps rt%/avg up%/avg ua%/avg | ant.amps rt%/avg up%/avg ua%/avg | rtt
-----------------------------------+-----------------------------------+-----
14:43:00    0/0      0/0     0/0 | 44:15:00    0/0      0/0     0/0 | 6.6
```

**Figure - Ltest output in alignment mode**

## Bandwidth mode (Bandwidth meter)

Bandwidth meter is used to test the following radio link characteristics: throughput in kilobits per second, packets per second, number of retries and errors.

Use the following «*ltest*» command options for testing:

- "*-tu [seconds]*" – Unidirectional test: packets are transmitted only from the current side to the specified address ("*target*" option)
- "*-tb [seconds]*" – Bidirectional test: packets are transmitted in both directions

"*Seconds*" parameter allows setting test period (5 seconds by default). Maximum value is 60 seconds.

To start Ltest in this mode:

```
lt rf5.0 <Mac-adress> -tb
```

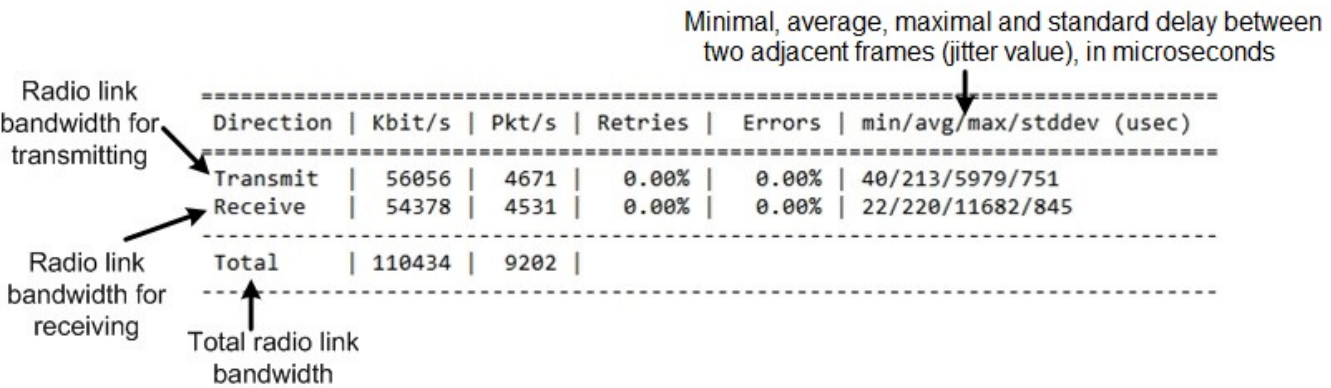"*ltest*" command output in Bandwidth meter mode for "*MINT*" firmware:



**Figure - Ltest output in Bandwidth meter mode for MINT**

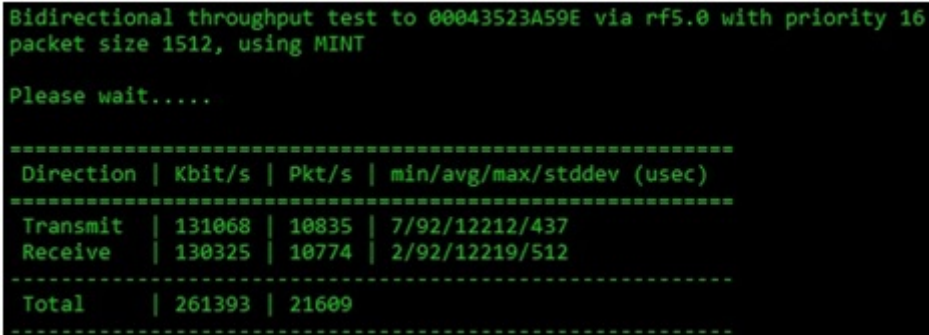"*ltest*" command output in Bandwidth meter mode for "*TDMA*" firmware:



**Figure - Ltest output in Bandwidth meter mode for TDMA**

# Muffer

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# Title

The "*muffer*" module makes it possible to rapidly test the electromagnetic environment, visually estimate the efficiency of the utilization of the air links, reveal sources of interference, and estimate their power.

Several operating regimes of the "*muffer*" module provide for different levels of details in test results.

## Review mode

This regime is enabled by the "*review*" option. It makes possible to have a general estimation of emissions and interference within specified frequency range.

> ⚠ **NOTE**
>
> Normal operation of the radio is not possible in this mode.

This regime can be useful on the first steps of link configuration. One can observe the activity on the selected list of frequencies and make decisions of what frequencies can be used for the link so that the link did not interfere with other sources of signals.

> ⚠ **NOTE**
>
> The scan is performed only for the packets corresponding with the standard of the radio module (802.11a for 5GHz devices and 802.11b for 2.4 GHz devices. Other sources of signals on the scanned frequencies stay unseen.
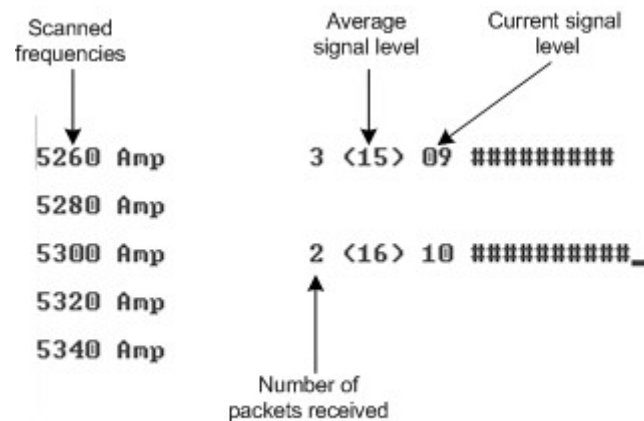


**Figure - Review mode output**

To run the "*review*" mode please type the following command:

```
muffer <IF-NAME> review
```

Once the link is established you can use this mode to review the activity on the configured for frequency for the link. If no activity is observed that means that the signal from the remote side is being broken by the interference sources or by the obstacles on the signal propagation path.

## MAC2 mode

This regime performs MAC-addresses analysis to estimate the number of clients with different MAC addresses and the efficiency of their utilization of the air link. The analysis is carried out for all MAC addresses at the frequency previously specified by "*rfconfig*" command. The "*mac2*" regime checks both data packets and the link-level ACK messages sent by protocol supported devices.

> ⚠ **NOTE**
>
> Normal operation of the radio is not possible in this mode.
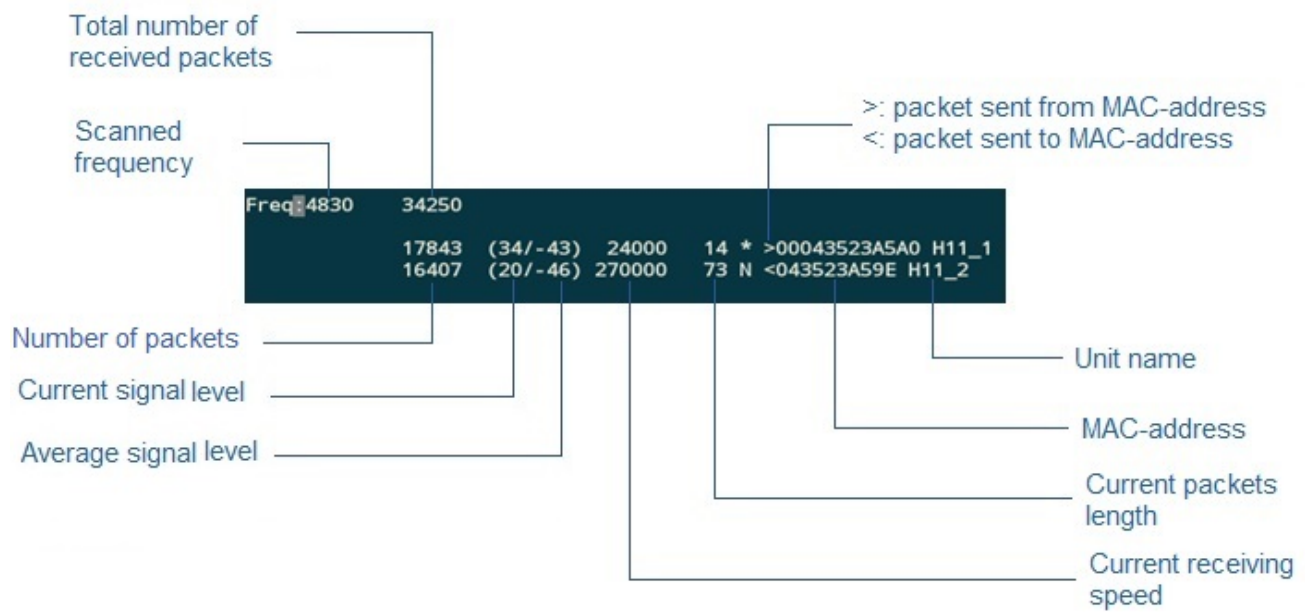
**Figure - MAC2 regime output**

Like in review mode this regime provides with the information about a current activity but on the configured frequency.

To run the "*review"* mode please type the following command:

```
muffer <IF-NAME> mac2
```

## Statistics

The statistics gathering is used for estimating link load intensity and per client. The amount of packets sent and received, and the number of retransmissions is shown for each MAC address participating in the data exchange.
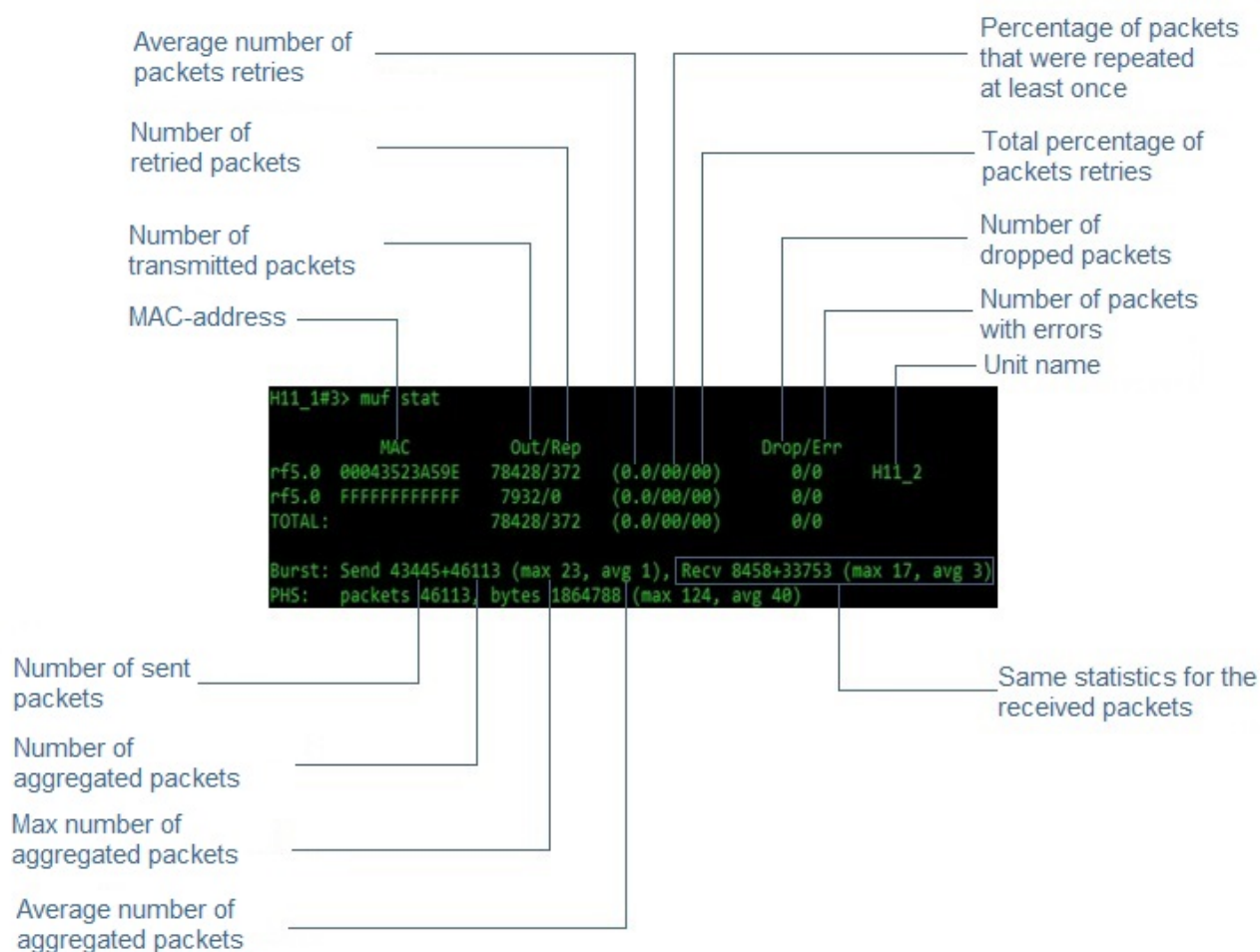
# Title



**Figure - Statistics output**

The following decisions can be made by analyzing the outputted parameters:

- If the number of repeated packets is comparable with total number of packets that means that you might have an interference source on the selected frequency. For normally operating link the percentage of repeated packets should not exceed 10%. It is extremely important to obtain a permanent zero value for the average number of repeats per packet. If the value is not zero that means that the link is NOT working properly and requires further improvement
- If total percentage of repeated packets and the percentage of packets that were repeated at least once are close to each other that might mean that you have got a permanent source of interference. Otherwise, it means that a strong interference source appears from time to time breaking your signal
- Concerning the fact that statistics module outputs the information for each MAC-address separately, you can reveal the problem for some specific unit on the wireless network

The "*muffer stat*" command shows the statistics only from registered devices.

To view "*statistics*" type the following command:

```
muffer stat
```

To reset all counters please type:

```
muffer stat clear
```

## Othet modes of muffer

The "*muffer*" also has the following modes:

- "*mac"* mode. Compared to the "*mac2"* mode this mode does not take link-level ACK messages sent by protocol support devices into account
- "*mynet"* mode performs the radio testing without disturbing radio module's normal operation, but taking into account only packets from within the given network
- "*sid"* mode. The "*sid"* regime allows estimating the number of currently operating subscriber groups having different identifiers (SID), and the efficiency of air links utilization. The analysis is carried out for all network identifiers at the frequency previously specified for the radio module by "*rfconfig"* command.

# Load Meter

Load meter is a powerful tool that allows estimating the load of a system interface specified by interface parameter. By default, the information is displayed on one line and updated every second; the load is measured in kilobytes.

Below picture shows the load meter output for the radio interface outputted in line-by-line mode with one second interval.
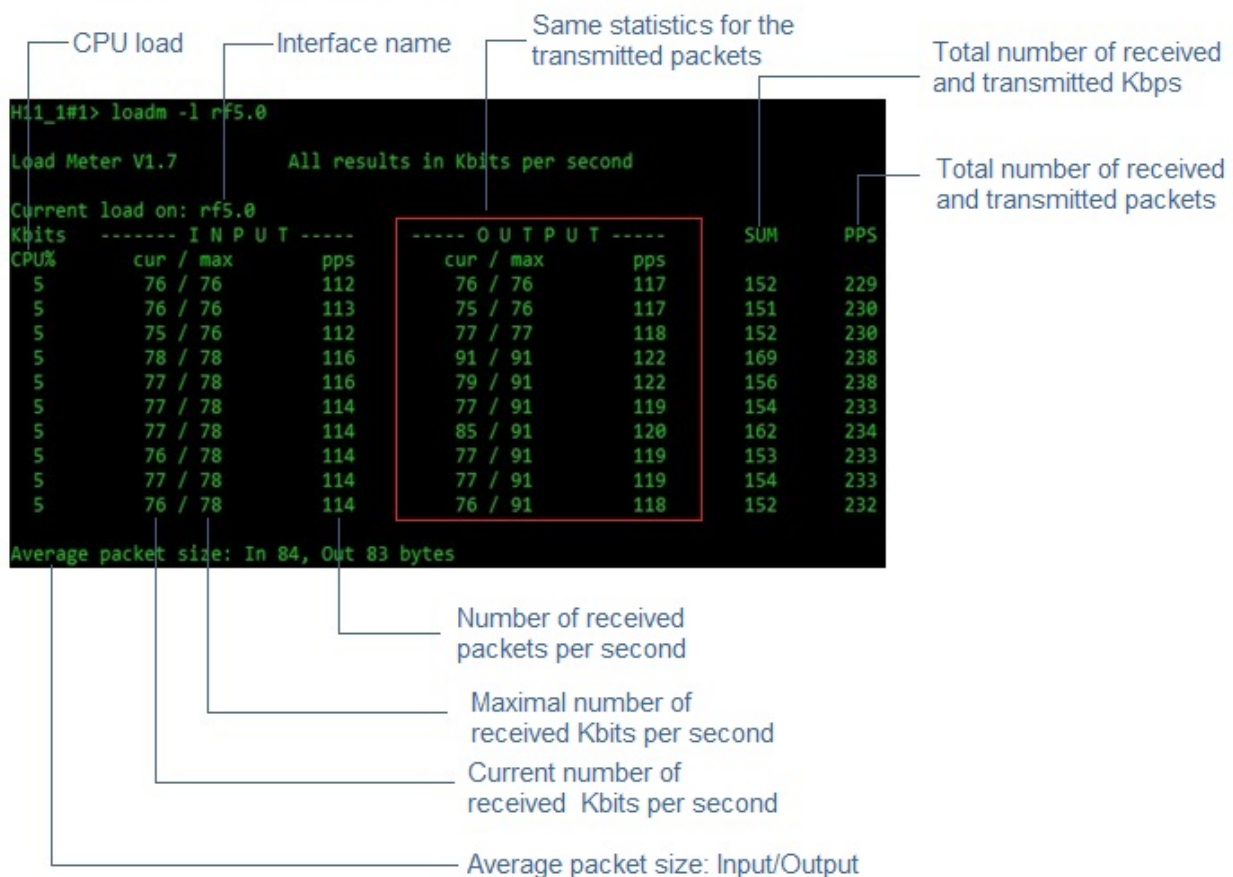


**Figure - "loadm" output**

To run load meter like it is shown above, please type:

```
loadm –l<IF-NAME>
```

# Acquiring interfaces statistics

Interface statistics can be acquired using "*netstat"* module which includes two modes:

- Routing tables output (using "*-r"* parameter with the command)
- Interfaces statistics output (using "*-i"* parameter with the command)

Below picture shows the example of interfaces statistics output.

# Title



**Figure - Interfaces statistics output**