concurrent

Intel e1000e Linux Driver Special characteristic of an InterruptThrottleRate Parameter

Version	Date	Description			
	Issue		Author	Check	App
Version	Date	Description			
	Issue		Author	Check	App
Version	Date 2011/11/21	Description			
1	Issue Professional Service		Author T.Oshima	Check	App

Title	No	Version
Intel e1000e Linux Driver Special characteristic of an InterruptThrottleRate parameter	PSG-20111118-1	2
		Pages 1/18

Abstract.

The parameter of 10 exists and it is known for the e1000e device driver (1.2.7. k2.0) used by RedHawk 6.0 (kernel 2.6.36.4) that a performance will change.
In this paper, I clarify the special characteristic of the InterruptThrottleRate parameter (I call the following ITR) which restricts the interrupt Numbers of the second bits which I generate by a receiving packet.

InterruptThrottleRate parameter

The InterruptThrottleRate parameter which can control the numbers of times of an interrupt of the second bit which an adaptor generates by a receiving packet exists in an e1000e driver.

1.2.7. In k2.0, InterruptThrottleRate can carry out a Contains-messages-which-match Set Value.

0,1,3,4,100～100000 （Default Value: 3）

0: **off**
1: **dynamic,**
3: **dynamic conservative**
4: **simplified balancing**
100～100000: **Interrupts Number (Hz)**

The driver has a mode of three which adjusts InterruptThrottleRate to a Dynamic based on receiving traffic. （1 ,3 or 4 ）

An algorithm classifies each space character of receiving traffic into a Classes, and it adjusts the numbers of times of a reception so that it may become a best in the type of the traffic.

The Classeses defined are "Bulk traffic", "Low latency", and "Lowest latency", and are the following classes.

The algorithm classifies the incoming traffic every interval into classes. Once the class is determined, the InterruptThrottleRate value is adjusted to suit that traffic type the best. There are three classes defined:
"Bulk traffic", for large amounts of packets of normal size; "Low latency", for small amounts of traffic and/or a significant percentage of small packets; and "Lowest latency", for almost completely small packets or minimal traffic.

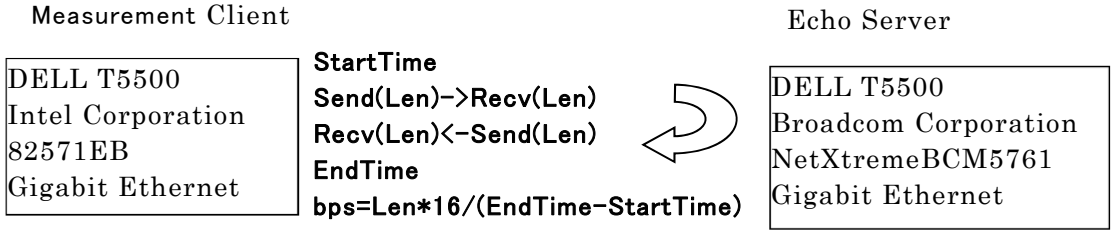
Test method

Test 1 UDP unicast.

I connect two sets of iHawk systems to a direct with a crossing cable, and I measure the transceiver time 10000 times, changing a transmitting sizes by UDP message, and calculate the mean time.

I perform a measurement by a client-side, and transmit to the repeat packets, every echo server of the sizes of an any, and an echo server echoes back a receiving packet as it is to a client-side.

At this time, a measurement client uses Intel/e 1000e and uses Broadcom for an echo server.

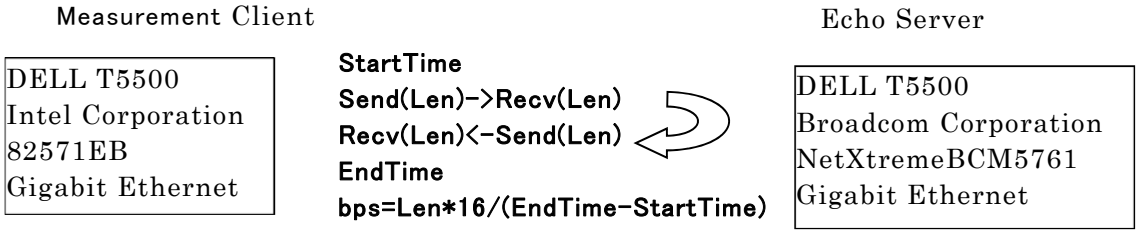


Test 2 TCP unicast

I connect two sets of iHawk systems to a direct with a crossing cable, and I measure the transceiver time 10000 times, changing a transmitting sizes by TCP message, and calculate the mean time.

I perform a measurement by a client-side, and transmit to the repeat packets, every echo server of the sizes of an any, and an echo server echoes back a receiving packet as it is to a client-side.

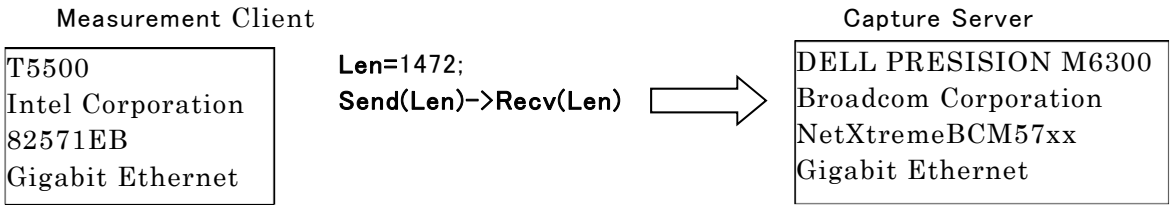
At this time, a measurement client uses Intel/e 1000e and uses Broadcom for an echo server.



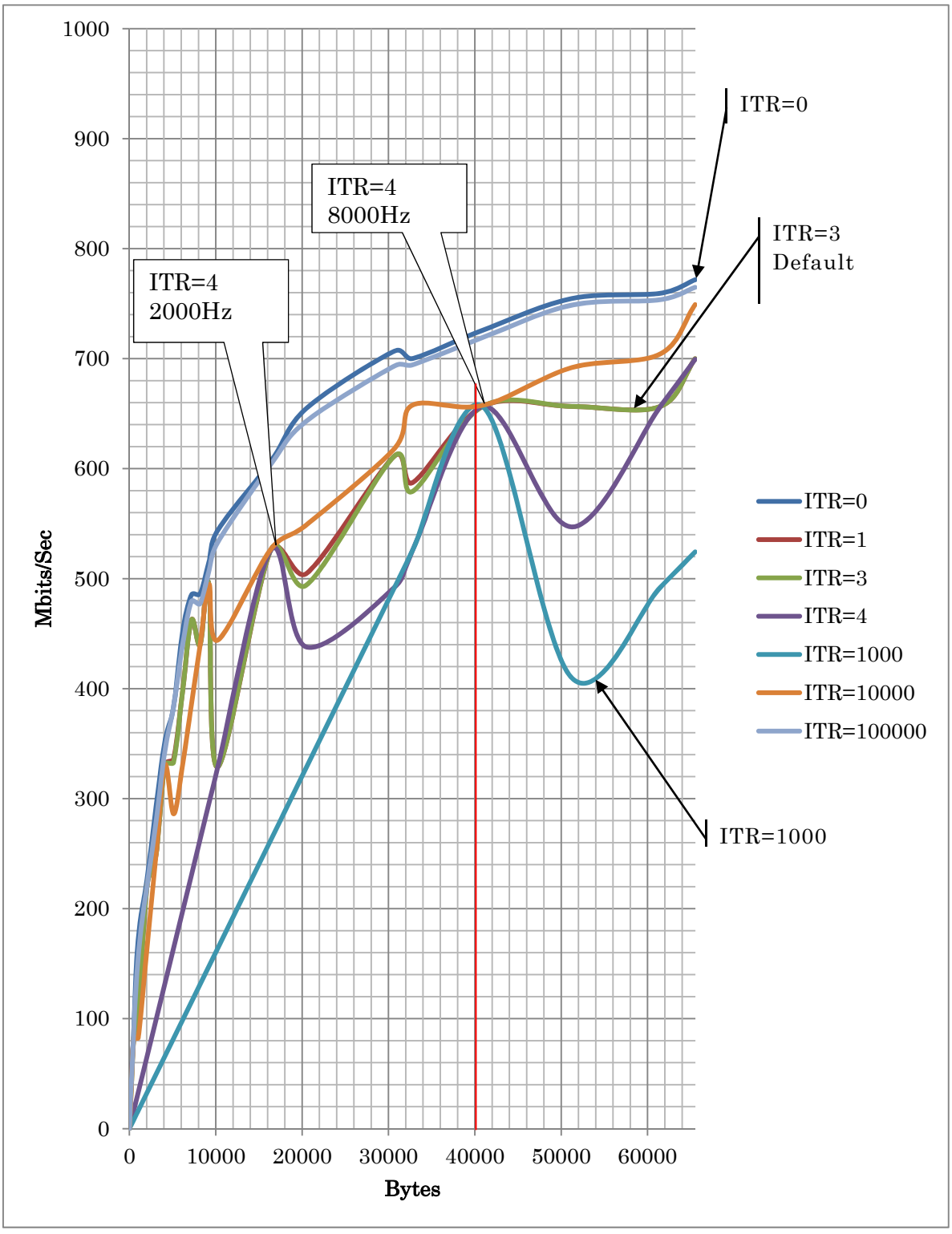
Test3 UDP Broadcast

A program is only a Sending. I measure the sending-out timing of an On The Network. In addition, 1472 bytes becomes a frames maximum length of a physical layer.

I used Astec-Eyes for the capture program. (http://www.asteceyes.com/ENGLISH/)



The result of test1 (UDP unicast: half-duplex)

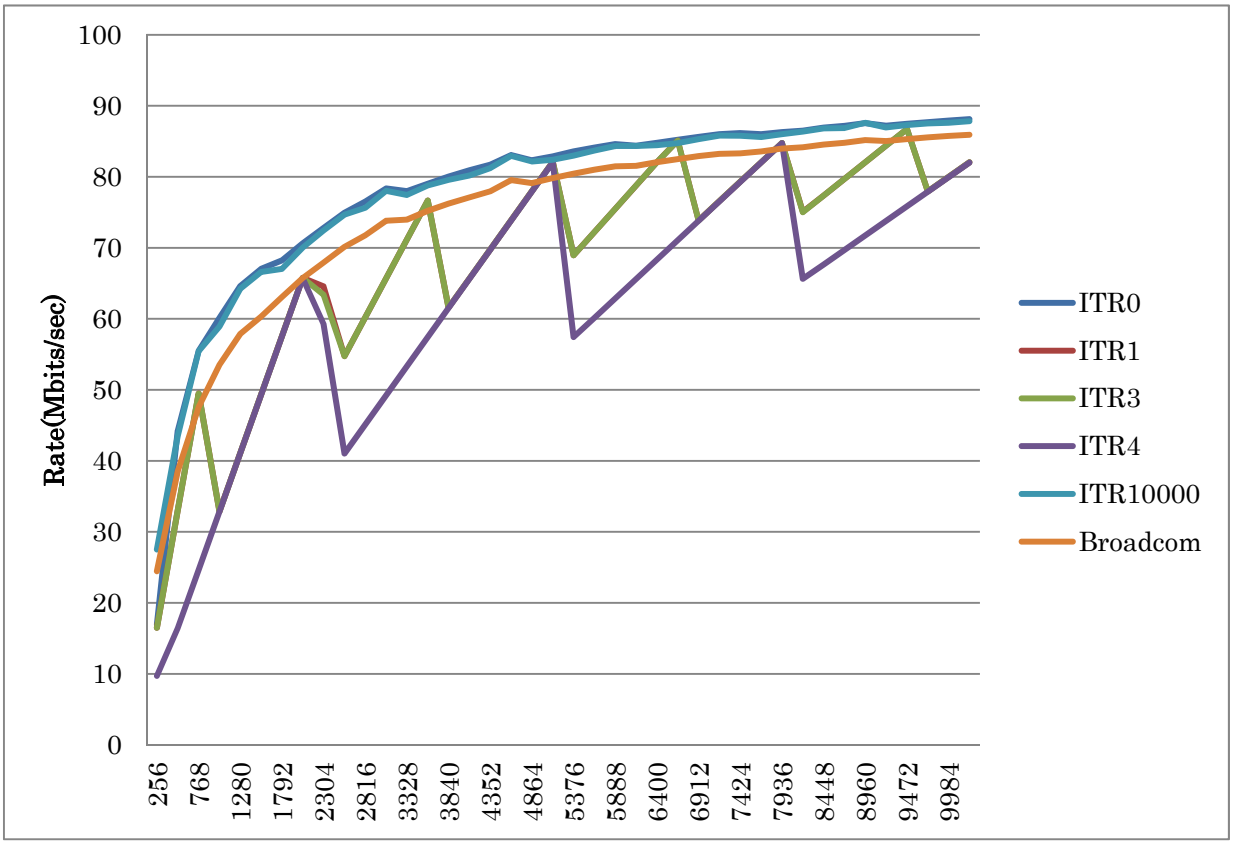


n ITR=zero and default ITR=three, I can understand carrying out maximum 40% receiving performance reduction so that clearly also from the above-mentioned graphs. Moreover, since a performance will deteriorate rapidly if the is equal to which that it is near about 40 K byte can also understand, and this threshold level are exceeded, receiving ITR=1000, i.e., a 1kHz interrupt restriction, needs sufficient examination for a setups of InterruptThrottleRate. In this test, at the is equal to and UDP

which are using basic-programming-system=Length/Time, in order for there not to be a sliding window and DelayedACK, note that the Rate of a halfduplex communication is measured.

	Intel Corporation 82571EB Gigabit EthernetTransfer Speed (Mbits/Sec)						
Length	ITR=0	ITR=1	ITR=3	ITR=4	ITR=1000	ITR=10000	ITR=100000
2	0.445663	0.382572	0.348723	0.258305	0.032025	0.323423	0.404999
4	0.892073	0.77235	0.70339	0.141199	0.064102	0.651809	0.817768
8	1.781683	1.543725	1.427716	0.256791	0.128201	1.303484	1.635693
16	3.56003	3.086654	2.885752	0.513591	0.256402	2.607257	3.270395
32	7.050438	6.166713	5.883353	1.027169	0.512801	5.214301	6.540131
64	13.83737	12.33311	10.85892	2.054366	1.025608	10.42784	13.07769
128	26.92293	24.6646	20.84139	4.108666	2.051238	20.84014	26.11139
256	50.61077	49.1882	41.67964	8.217369	4.1025	41.66972	46.42407
512	91.47952	83.36098	83.35953	16.43445	8.205053	83.35148	89.77731
1024	173.4247	110.5933	110.5788	32.86979	16.41002	82.70287	157.8855
2048	226.7988	221.0206	221.0182	65.74389	32.82117	165.3903	221.1074
3072	291.3125	248.0967	248.0854	98.61468	49.2316	248.0859	277.8257
4096	351.5137	330.7917	330.7787	131.4866	65.64192	330.7772	342.8074
5120	383.5102	336.2146	333.0571	164.3654	82.0533	286.1853	383.8227
6144	450.8901	396.4216	396.2313	197.2365	98.46375	329.9357	439.3302
7168	484.999	462.2186	462.1682	230.1122	114.8746	384.9114	479.0485
8192	486.3491	439.9238	439.7418	262.983	131.2859	439.8981	477.3324
9216	515.2482	494.3788	494.3414	295.8481	147.696	494.9076	506.9542
10240	544.117	328.9062	328.8973	328.7335	164.1069	444.0793	533.1537
16384	606.6036	526.2272	526.2021	525.9484	262.5739	526.7969	603.9892
20480	654.6596	504.5338	494.0084	437.8894	328.2176	548.7808	643.133
30720	706.9754	611.7206	611.6741	492.3353	492.3422	618.5514	693.4426
32768	700.0705	587.1763	579.2037	525.1538	525.1467	657.7288	694.2891
40960	725.9821	656.7748	656.7788	656.4529	656.0693	657.5389	719.3018
51200	754.5919	656.582	656.5789	546.9639	409.9492	691.7988	748.6166
61440	759.3838	656.444	656.4326	656.0687	491.8033	704.133	753.5389
65507	771.7102	699.9059	699.9042	699.3769	524.3528	749.0866	764.781

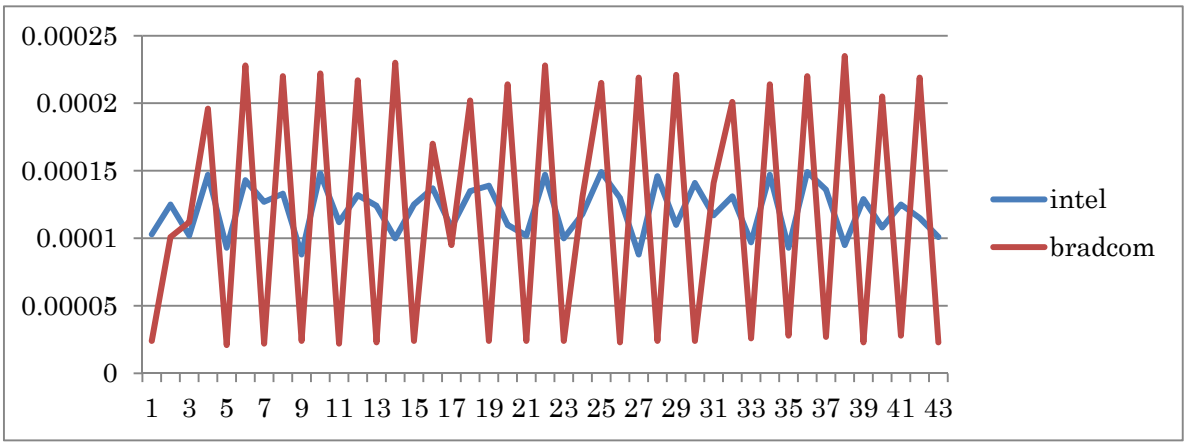
The UDP redirection result at the time of making it link to below by 100.00Mbits/Sec as reference data is shown.
Here, I can understand that the is equal to and performance inequality which also show the data of Broadcom for the Compare are the same as the tendency of a certain is equal to and an ITR=zero If You are.



The following displays jitter of the transmitting space character at the time of a 64Kbytes redirection as a default parameter.
When it compares with Broadcom, and that jitter of intel is small can understand, however the total is searched for, the value of the way of broadcom is a Small. (Namely, transmitting Time Short) This is clear also from a transmission-rate-UDP transfer size graphs.

Intel totaltime	Bradcom total time
0.005205	0.005114

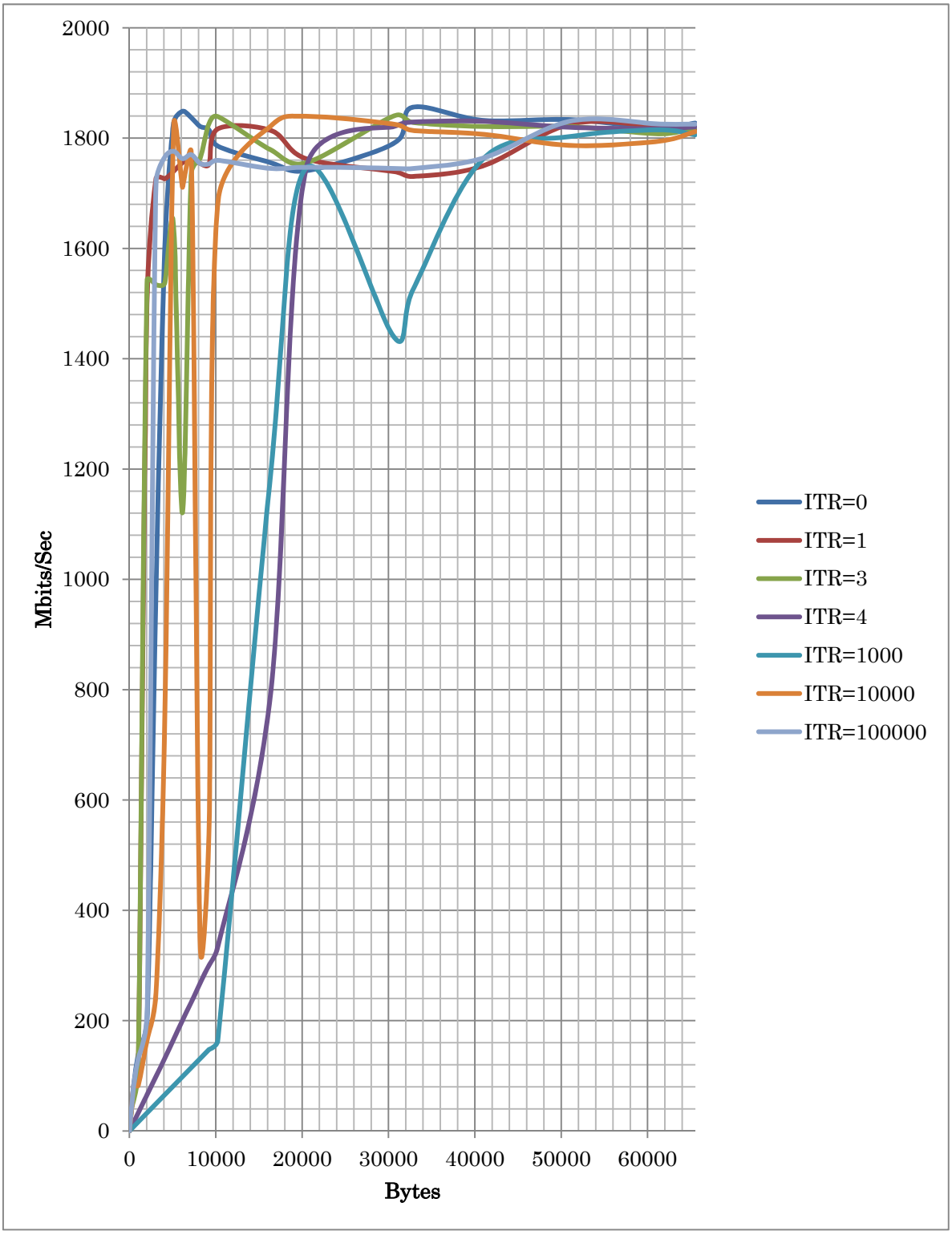
The jitter time at the time of a Continuous Sending　(Intel/ITR=3)



	Intel Corporation 82571EB Gigabit Ethernet (Mbits/Sec)					Broadcom Corporation NetXtreme BCM5761 Gigabit Ethernet(Mbits/Sec)
Length	ITR0	ITR1	ITR3	ITR4	ITR10000	Broadcom
256	16.9674	16.4922	16.49235	9.708307	27.51581	24.45411
512	44.23792	32.98685	32.98897	16.43402	43.50932	38.52117
768	55.51161	49.48384	49.47324	24.65147	55.43941	47.57609
1024	60.15921	32.89418	32.89101	32.86467	58.90783	53.51725
1280	64.62678	41.11101	41.10985	41.08594	64.23397	57.87698
1536	67.03746	49.32381	49.33237	49.29675	66.59999	60.31472
1792	68.2278	57.54407	57.53704	57.50872	67.01961	63.05549
2048	70.6366	65.76419	65.76482	65.72311	70.01744	65.73954
2304	72.78924	64.57396	63.4049	59.27608	72.42791	67.911
2560	74.94909	54.75501	54.75459	41.02572	74.66686	70.13655
2816	76.50701	60.23016	60.22309	45.12645	75.64286	71.75188
3072	78.36484	65.7052	65.70331	49.22868	78.02235	73.81533
3328	77.97153	71.17345	71.16791	53.33181	77.44544	73.96251
3584	79.01536	76.65117	76.64858	57.43342	78.77742	75.19904
3840	80.02711	61.57851	61.56721	61.53652	79.55971	76.22007
4096	80.92414	65.67061	65.6692	65.63817	80.1968	77.10481
4352	81.72227	69.77187	69.77459	69.74202	81.22963	77.9516
4608	83.07812	73.87911	73.87748	73.84302	82.93492	79.54405
4864	82.32886	77.97795	77.97973	77.93833	82.1399	79.1185
5120	82.88283	82.08238	82.08295	82.03977	82.39776	79.80375
5376	83.60062	68.94054	68.93471	57.41837	82.98157	80.42927
5632	84.12014	72.21587	72.21811	60.13803	83.67871	80.99922
5888	84.59796	75.50041	75.50017	62.87197	84.33846	81.46523
6144	84.37777	78.78123	78.7831	65.60578	84.33033	81.5493
6400	84.79246	82.06206	82.06214	68.339	84.44519	82.0533
6656	85.20769	85.09571	85.11399	71.07303	84.75218	82.49404
6912	85.61047	73.84632	73.84348	73.80641	85.29808	82.90762
7168	85.99587	76.57891	76.57643	76.54017	85.8026	83.23947
7424	86.16799	79.31274	79.31194	79.26785	85.7858	83.29252
7680	86.01533	82.04483	82.04753	82.00673	85.5895	83.56122
7936	86.30098	84.77394	84.77375	84.7347	86.00405	83.9791
8192	86.50314	75.06367	75.00759	65.63918	86.36874	84.15515
8448	86.92805	77.34743	77.34842	67.63777	86.81895	84.54815
8704	87.18176	79.6922	79.69001	69.68816	86.85779	84.78911
8960	87.5629	82.03391	82.03402	71.73695	87.61442	85.16634
9216	87.20295	84.37553	84.37677	73.78675	86.94799	85.03961
9472	87.46169	86.72042	86.72047	75.83651	87.28582	85.31675
9728	87.6876	77.92899	77.92749	77.88622	87.51507	85.55258
9984	87.92208	79.97765	79.9777	79.93574	87.61378	85.75162
10240	88.12813	82.0275	82.02733	81.98313	87.8205	85.92413

Intel(Sec)	Bradcom(Sec)
0.000103	0.000024
0.000125	0.000101
0.000102	0.000112
0.000147	0.000196
0.000093	0.000021
0.000143	0.000228
0.000127	0.000022
0.000133	0.00022
0.000088	0.000024
0.000148	0.000222
0.000112	0.000022
0.000132	0.000217
0.000124	0.000023
0.0001	0.00023
0.000125	0.000024
0.000137	0.00017
0.000108	0.000095
0.000135	0.000202
0.000139	0.000024
0.00011	0.000214
0.000102	0.000024
0.000147	0.000228
0.0001	0.000024
0.000118	0.000131
0.000149	0.000215
0.00013	0.000023
0.000088	0.000219
0.000146	0.000024
0.00011	0.000221
0.000141	0.000024
0.000117	0.000141
0.000131	0.000201
0.000097	0.000026
0.000147	0.000214
0.000093	0.000028
0.000149	0.00022
0.000136	0.000027
0.000095	0.000235
0.000129	0.000023
0.000108	0.000205
0.000125	0.000028
0.000115	0.000219
0.000101	0.000023

The result of test 2 (TCP unicast: full-duplex)



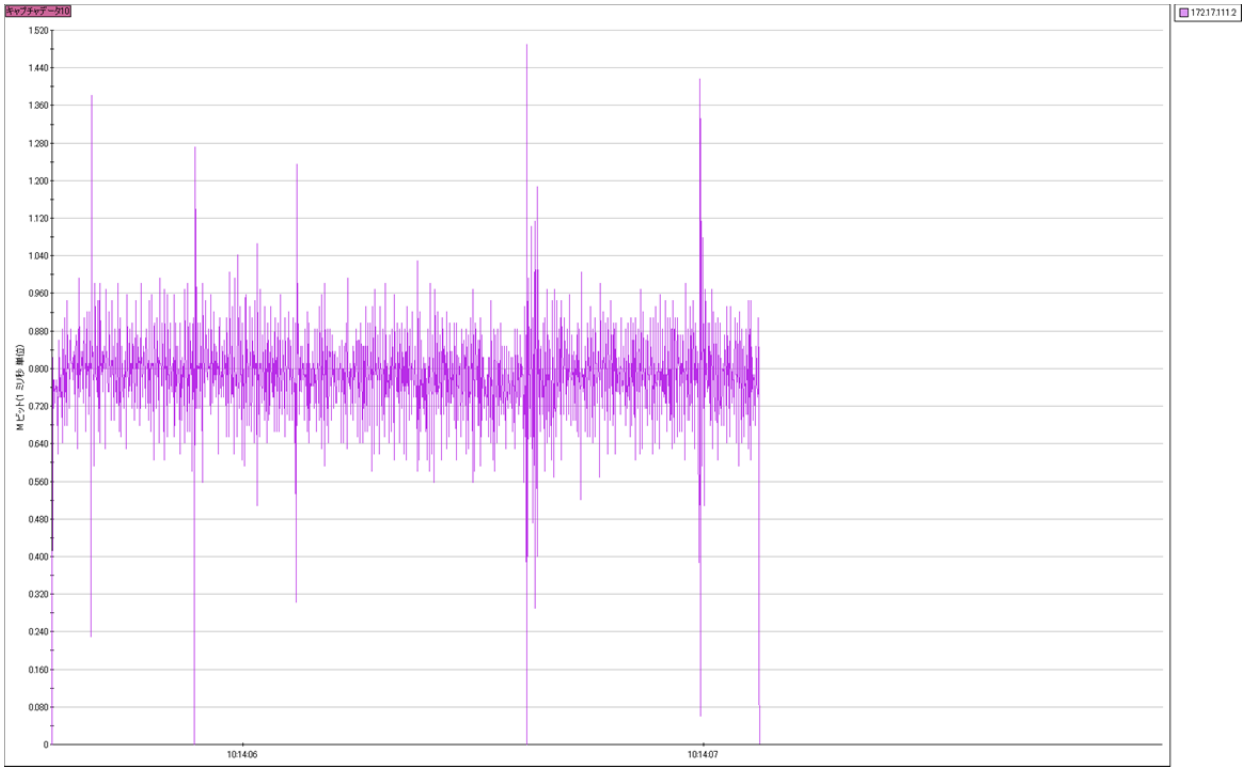
In an exam program, since the amount of send-receives / time is used and the Rate of a full-duplex transmission is measured, be careful of the Dot Screen that the upper is 2.0GBits/Sec. If it says from a result and a packet size will be below TwentyK, ITR=zero shows the performance with sufficient ITR=fourth by more than it.

	Intel Corporation 82571EB Gigabit Ethernet 転送速度(Mbits/Sec)						
Length	ITR=0	ITR=1	ITR=3	ITR=4	ITR=1000	ITR=10000	ITR=100000
2	0.392392	0.392562	0.325785	0.12647	0.032052	0.325734	0.363132
4	0.782312	0.777854	0.651663	0.128411	0.064104	0.651227	0.726243
8	1.56694	1.552846	1.303278	0.256808	0.128203	1.302377	1.452397
16	3.09738	2.974703	2.606585	0.513611	0.256405	2.604593	2.902889
32	6.147374	5.811571	5.213515	1.027249	0.51281	5.210136	5.803423
64	12.16617	11.44435	10.42614	2.054377	1.025625	10.42055	11.58401
128	23.74798	22.52441	20.84943	4.108895	2.051253	20.84287	23.11815
256	44.70264	43.43888	41.68168	8.217524	4.102553	41.67646	43.70521
512	84.89498	63.81365	56.97253	16.43497	8.2051	83.30664	84.91557
1024	138.5681	110.5373	110.562	32.87044	16.4103	82.68659	131.7549
2048	203.6252	1506.055	1542.612	65.74286	32.82137	165.4096	210.6821
3072	974.3314	1726.34	1533.8	98.62324	49.23451	248.1096	1717.274
4096	1598.704	1726.203	1537.271	131.493	65.64696	744.3475	1765.598
5120	1827.698	1739.751	1643.406	166.2111	82.05789	1820.525	1776.178
6144	1848.619	1755.479	1120.908	200.5862	98.47057	1710.643	1762.681
7168	1836.974	1762.744	1736.145	233.4183	114.8825	1772.168	1769.95
8192	1821.18	1754.143	1763.315	268.1716	131.29	339.2365	1753.885
9216	1814.903	1752.443	1826.259	300.6274	147.7021	540.3937	1752.976
10240	1785.531	1816.726	1838.899	333.8434	164.1105	1682.847	1759.677
16384	1755.401	1813.815	1778.345	797.1355	1196.25	1821.866	1744.823
20480	1740.806	1762.513	1755.282	1746.592	1745.858	1839.415	1747.303
30720	1791.417	1739.104	1840.787	1821.26	1437.386	1825.057	1745.214
32768	1855.773	1730.417	1828.552	1828.98	1522.715	1813.904	1744.798
40960	1832.078	1749.624	1820.879	1830.3	1762.688	1806.925	1763.646
51200	1833.47	1825.872	1820.733	1819.396	1803.092	1786.5	1831.184
61440	1817.766	1820.327	1807.633	1817.083	1814.945	1794.55	1825.384
65507	1827.222	1816.341	1819.187	1820.362	1805.853	1811.484	1825.35

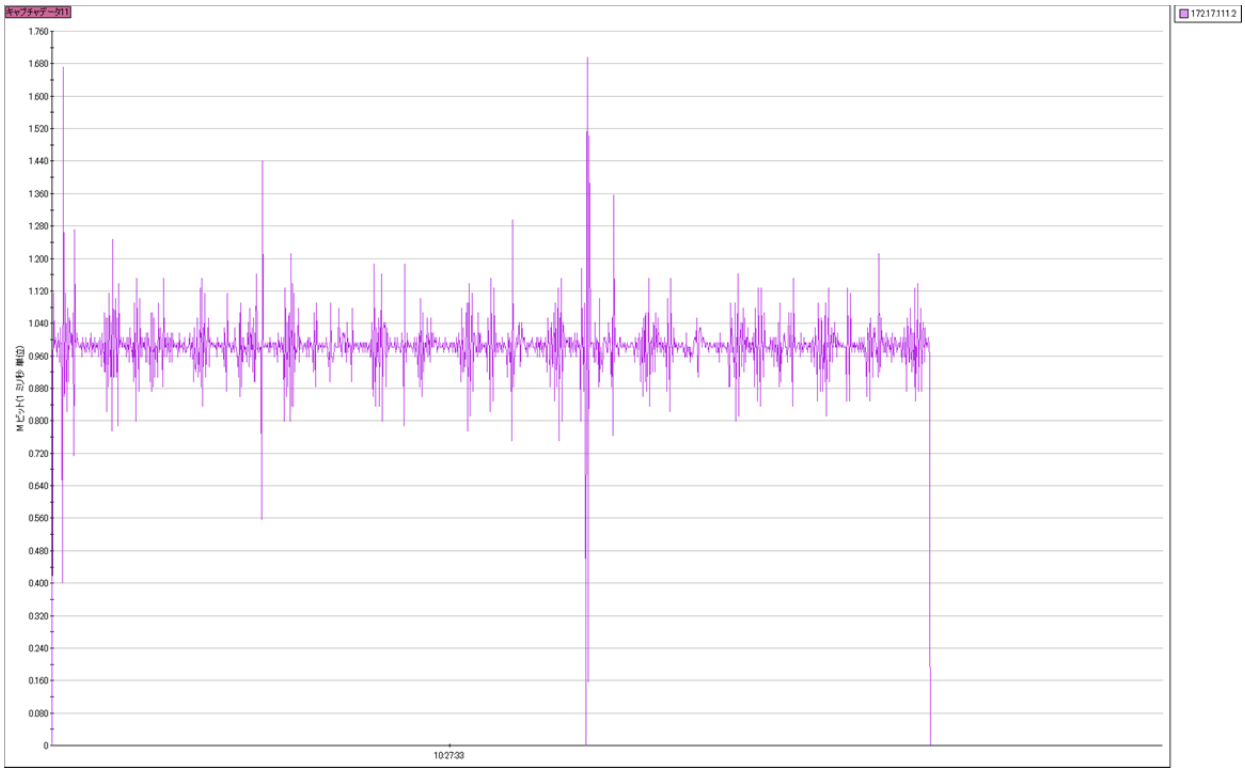
The result of test 3 (UDP broadcast).

Below, the result of test 3 is shown. A time-axis expresses the amount of data per first millisecond by Bits/Sec.

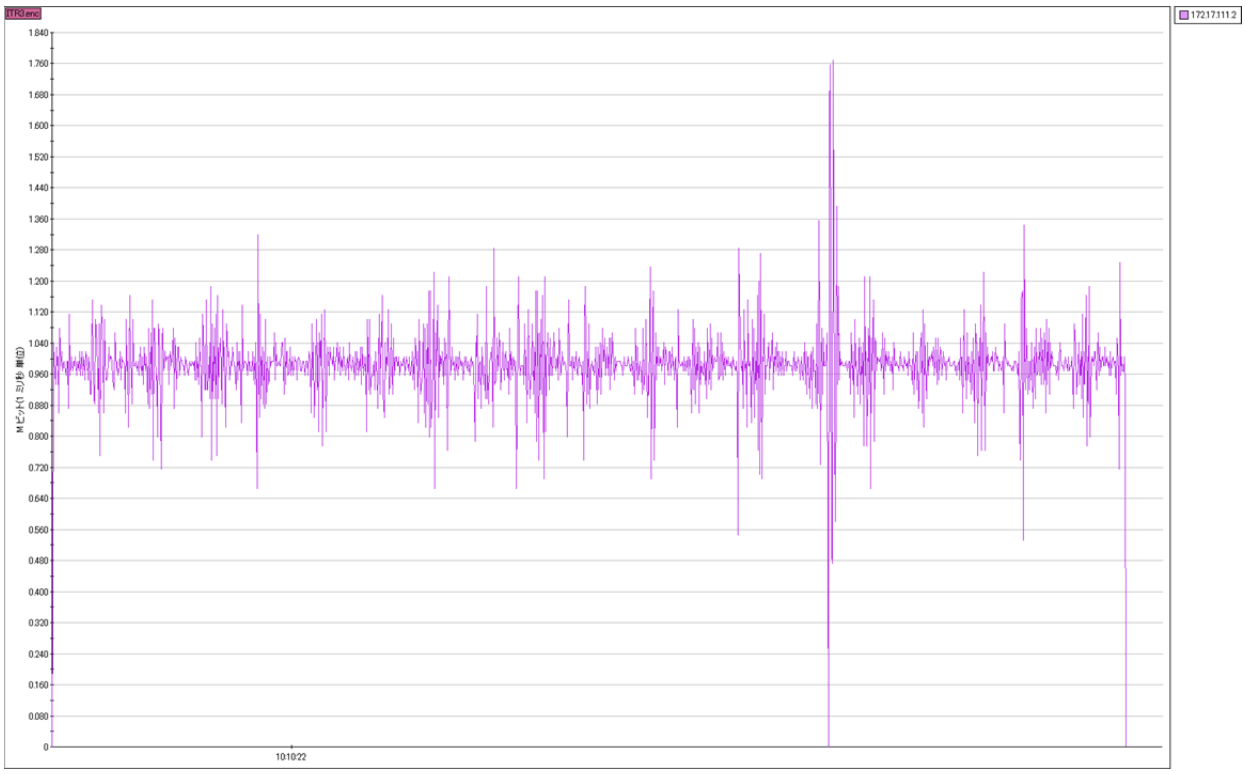
ITU=0



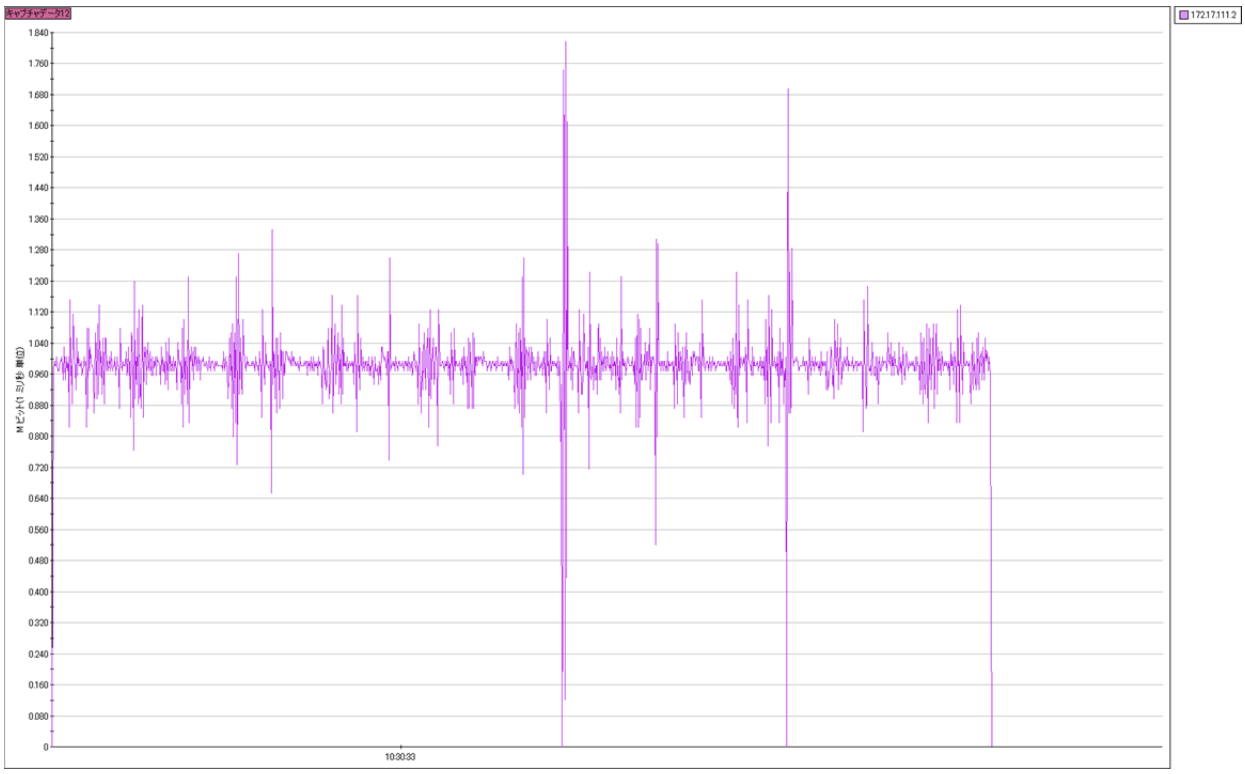
ITU=1



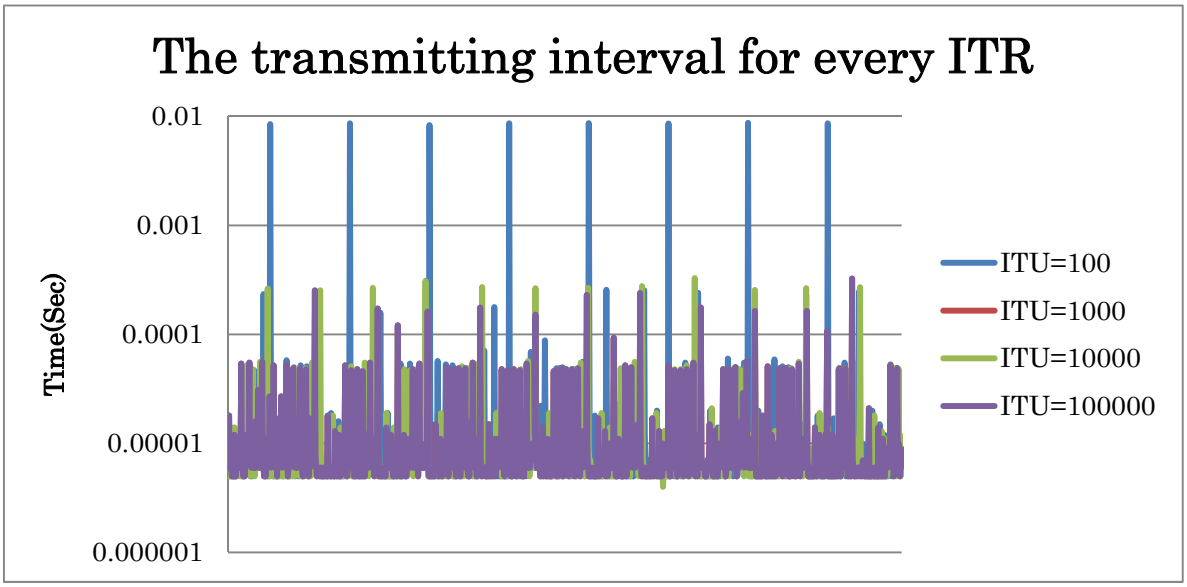
ITU=3


ITR3.enc
172.17.111.2
1.840
1.760
1.680
1.600
1.520
1.440
1.360
1.280
1.200
1.120
1.040
0.960
0.880
0.800
0.720
0.640
0.560
0.480
0.400
0.320
0.240
0.160
0.080
0
10:10:22

ITU=4


キャプチャデータ12
172.17.111.2
1.840
1.760
1.680
1.600
1.520
1.440
1.360
1.280
1.200
1.120
1.040
0.960
0.880
0.800
0.720
0.640
0.560
0.480
0.400
0.320
0.240
0.160
0.080
0
10:30:33

If its attention is paid to the time-axis of a graphs, he can understand that the times to the termination of a redirection differ, and I can read that it is as high as this Time Short thing in Burst nature.
A data with this late Controls effective in the following is shown.
The ordinate of a graphs is a transmitting time between packets, and is shown by the Logs Scale type.
In an ITU100.00 If You are, I can read easily that the bandwidth restriction has occurred in about 10 ms (100.00Hz).



Summary

From the exam result, it became clear in the real-time use that setting to ITR=0 was desirable.
In addition, in order to set this parameter to a ramp-up period, I add the following lineses to modules.conf.

```
alias eth0 e1000e
alias eth1 e1000e
alias eth2 e1000e
alias eth3 e1000e
options e1000e InterruptThrottleRate=0,0,0,0
```

In addition, when a the port will be two or more sheets, it is necessary to divide a parameter with a comma.

The further description of a parameter

Linux* Driver for Intel(R) Network Connection
==========
Intel Gigabit Linux driver.

Contents
========
- Identifying Your Adapter
- Command Line Parameters
- Additional Configurations
- Support

Identifying Your Adapter
==========
The e1000e driver supports all PCI Express Intel(R) Gigabit Network
Connections, except those that are 82575, 82576 and 82580-based*.
* NOTE: The Intel(R) PRO/1000 P Dual Port Server Adapter is supported by the e1000 driver, not the e1000e driver due to the 82546 part being used behind a PCI Express bridge.
For more information on how to identify your adapter, go to the Adapter & Driver ID Guide at:
http://support.intel.com/support/go/network/adapter/idguide.htm
For the latest Intel network drivers for Linux, refer to the following website. In the search field, enter your adapter name or type, or use the networking link on the left to search for your adapter:
http://support.intel.com/support/go/network/adapter/home.htm

Command Line Parameters
==========
The default value for each parameter is generally the recommended setting, unless otherwise noted.
NOTES: For more information about the InterruptThrottleRate, RxIntDelay, TxIntDelay, RxAbsIntDelay, and TxAbsIntDelay parameters, see the application note at:
http://www.intel.com/design/network/applnots/ap450.htm

InterruptThrottleRate

Valid Range: 0,1,3,4,100-100000 (0=off, 1=dynamic, 3=dynamic conservative,
4=simplified balancing)
Default Value: 3

The driver can limit the amount of interrupts per second that the adapter will generate for incoming packets. It does this by writing a value to the adapter that is based on the maximum amount of interrupts that the adapter will generate per second.

Setting InterruptThrottleRate to a value greater or equal to 100 will program the adapter to send out a maximum of that many interrupts per second, even if more packets have come in. This reduces interrupt load on the system and can lower CPU utilization under heavy load, but will increase latency as packets are not processed as quickly.

The driver has two adaptive modes (setting 1 or 3) in which it dynamically adjusts the InterruptThrottleRate value based on the traffic that it receives. After determining the type of incoming traffic in the last timeframe, it will adjust the InterruptThrottleRate to an appropriate value
for that traffic.

The algorithm classifies the incoming traffic every interval into classes. Once the class is determined, the InterruptThrottleRate value is adjusted to suit that traffic type the best. There are three classes defined: "Bulk traffic", for large amounts of packets of normal size; "Low latency", for small amounts of traffic and/or a significant percentage of small packets; and "Lowest latency", for almost completely small packets or minimal traffic.

In dynamic conservative mode, the InterruptThrottleRate value is set to 4000 for traffic that falls in class "Bulk traffic". If traffic falls in the "Low latency" or "Lowest latency" class, the InterruptThrottleRate is increased stepwise to 20000. This default mode is suitable for most applications.

For situations where low latency is vital such as cluster or grid computing, the algorithm can reduce latency even more when InterruptThrottleRate is set to mode 1. In this mode, which operates the same as mode 3, the InterruptThrottleRate will be increased stepwise to 70000 for traffic in class "Lowest latency".

In simplified mode the interrupt rate is based on the ratio of Tx and Rx traffic. If the bytes per second rate is approximately equal the interrupt rate will drop as low as 2000 interrupts per second. If the traffic is mostly transmit or mostly receive, the interrupt rate could be as high as 8000.

Setting InterruptThrottleRate to 0 turns off any interrupt moderation and may improve small packet latency, but is generally not suitable for bulk throughput traffic.

NOTE: InterruptThrottleRate takes precedence over the TxAbsIntDelay and RxAbsIntDelay parameters. In other words, minimizing the receive and/or transmit absolute delays does not force the controller to generate more interrupts than what the Interrupt Throttle Rate allows.

NOTE: When e1000e is loaded with default settings and multiple adapters are in use simultaneously, the CPU utilization may increase non-linearly. In order to limit the CPU utilization without impacting the overall throughput, we recommend that you load the driver as follows:

modprobe e1000e InterruptThrottleRate=3000,3000,3000

This sets the InterruptThrottleRate to 3000 interrupts/sec for the first, second, and third instances of the driver. The range of 2000 to 3000 interrupts per second works on a majority of systems and is a good starting point, but the optimal value will be platform-specific. If CPU utilization is not a concern, use RX_POLLING (NAPI) and default driver settings.

RxIntDelay

Valid Range: 0-65535 (0=off)
Default Value: 0

This value delays the generation of receive interrupts in units of 1.024 microseconds. Receive interrupt reduction can improve CPU efficiency if properly tuned for specific network traffic. Increasing this value adds extra latency to frame reception and can end up decreasing the throughput of TCP traffic. If the system is reporting dropped receives, this value may be set too high, causing the driver to run out of available receive descriptors.

CAUTION: When setting RxIntDelay to a value other than 0, adapters may hang (stop transmitting) under certain network conditions. If this occurs a NETDEV WATCHDOG message is logged in the system event log. In addition, the controller is automatically reset, restoring the network connection. To eliminate the potential for the hang ensure that RxIntDelay is set to 0.

RxAbsIntDelay

Valid Range: 0-65535 (0=off)
Default Value: 8

This value, in units of 1.024 microseconds, limits the delay in which a receive interrupt is generated. Useful only if RxIntDelay is non-zero, this value ensures that an interrupt is generated after the initial packet is received within the set amount of time. Proper tuning, along with RxIntDelay, may improve traffic throughput in specific network conditions.

TxIntDelay

Valid Range: 0-65535 (0=off)
Default Value: 8

This value delays the generation of transmit interrupts in units of 1.024 microseconds. Transmit interrupt reduction can improve CPU efficiency if properly tuned for specific network traffic. If the
system is reporting dropped transmits, this value may be set too high causing the driver to run out of available transmit descriptors.

TxAbsIntDelay

Valid Range: 0-65535 (0=off)
Default Value: 32

This value, in units of 1.024 microseconds, limits the delay in which a transmit interrupt is generated. Useful only if TxIntDelay is non-zero, this value ensures that an interrupt is generated after the initial packet is sent on the wire within the set amount of time. Proper tuning, along with TxIntDelay, may improve traffic throughput in specific network conditions.

Copybreak

Valid Range: 0-xxxxxxx (0=off)
Default Value: 256

Driver copies all packets below or equaling this size to a fresh Rx buffer before handing it up the stack.

This parameter is different than other parameters, in that it is a single (not 1,1,1 etc.) parameter applied to all driver instances and it is also available during runtime at /sys/module/e1000e/parameters/copybreak

SmartPowerDownEnable

Valid Range: 0-1
Default Value: 0 (disabled)

Allows PHY to turn off in lower power states. The user can set this parameter in supported chipsets.

KumeranLockLoss

Valid Range: 0-1

Default Value: 1 (enabled)

This workaround skips resetting the PHY at shutdown for the initial silicon releases of ICH8 systems.

IntMode

Valid Range: 0-2 (0=legacy, 1=MSI, 2=MSI-X)
Default Value: 2

Allows changing the interrupt mode at module load time, without requiring a recompile. If the driver load fails to enable a specific interrupt mode, the driver will try other interrupt modes, from least to most compatible. The interrupt order is MSI-X, MSI, Legacy. If specifying MSI (IntMode=1) interrupts, only MSI and Legacy will be attempted.

CrcStripping

Valid Range: 0-1
Default Value: 1 (enabled)

Strip the CRC from received packets before sending up the network stack. If you have a machine with a BMC enabled but cannot receive IPMI traffic after loading or enabling the driver, try disabling this feature.

WriteProtectNVM

Valid Range: 0-1
Default Value: 1 (enabled)

Set the hardware to ignore all write/erase cycles to the GbE region in the ICHx NVM (non-volatile memory). This feature can be disabled by the WriteProtectNVM module parameter (enabled by default) only after a hardware reset, but the machine must be power cycled before trying to enable writes.

Note: the kernel boot option iomem=relaxed may need to be set if the kernel config option CONFIG_STRICT_DEVMEM=y, if the root user wants to write the NVM from user space via ethtool.

Additional Configurations
==========

Jumbo Frames

Jumbo Frames support is enabled by changing the MTU to a value larger than the default of 1500. Use the ifconfig command to increase the MTU size.
For example:

ifconfig eth<x> mtu 9000 up

This setting is not saved across reboots.
Notes:
- The maximum MTU setting for Jumbo Frames is 9216. This value coincides with the maximum Jumbo Frames size of 9234 bytes.
- Using Jumbo Frames at 10 or 100 Mbps is not supported and may result in poor performance or loss of link.
- Some adapters limit Jumbo Frames sized packets to a maximum of 4096 bytes and some adapters do not support Jumbo Frames.

Ethtool

The driver utilizes the ethtool interface for driver configuration and diagnostics, as well as displaying statistical information. We strongly recommend downloading the latest version of Ethtool at:

http://sourceforge.net/projects/gkernel.

Speed and Duplex

Speed and Duplex are configured through the Ethtool* utility. For instructions, refer to the Ethtool man page.

Enabling Wake on LAN* (WoL)

WoL is configured through the Ethtool* utility. For instructions on enabling WoL with Ethtool, refer to the Ethtool man page.

WoL will be enabled on the system during the next shut down or reboot.
For this driver version, in order to enable WoL, the e1000e driver must be loaded when shutting down or rebooting the system.

In most cases Wake On LAN is only supported on port A for multiple port adapters. To verify if a port supports Wake on LAN run ethtool eth<X>.

Support
=======

For general information, go to the Intel support website at:

www.intel.com/support/

or the Intel Wired Networking project hosted by Sourceforge at:

http://sourceforge.net/projects/e1000

If an issue is identified with the released source code on the supported kernel with a supported adapter, email the specific information related to the issue to e1000-devel@lists.sf.net