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了解网络

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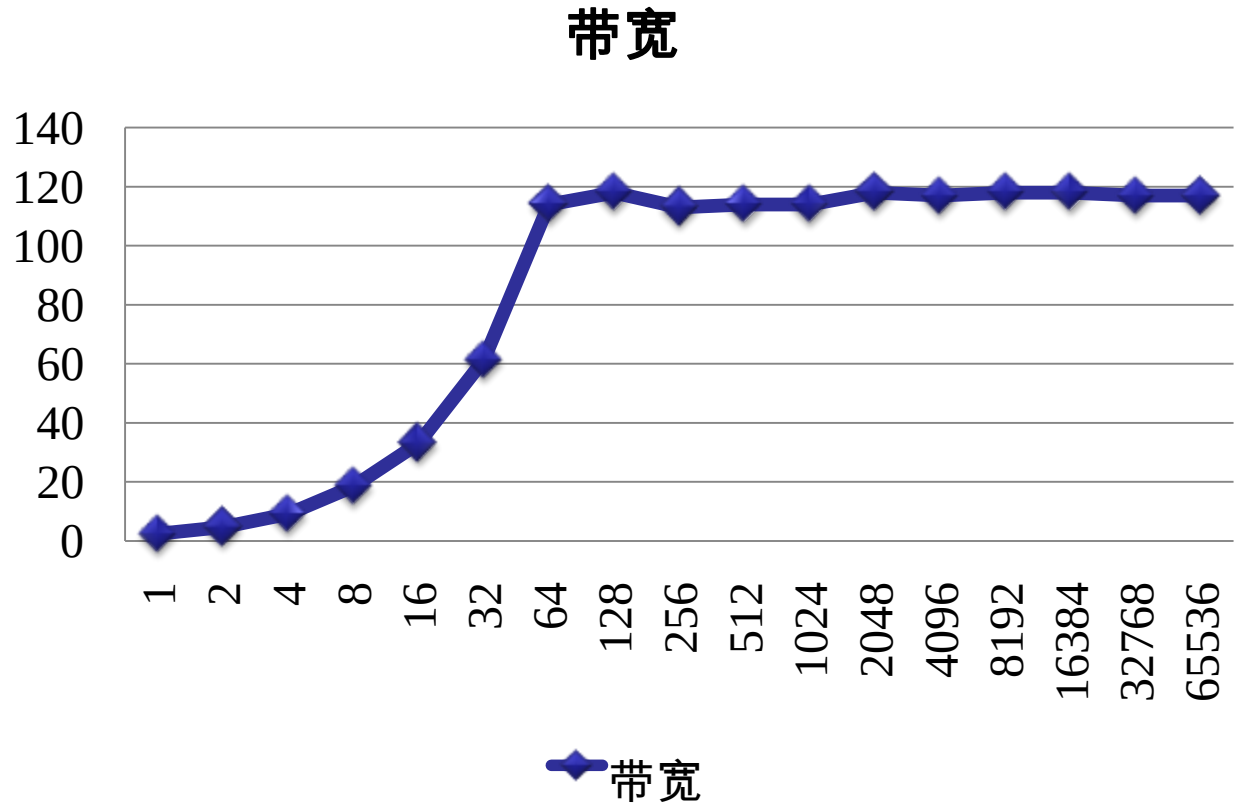
网卡型号

```
$ sudo hwconfig
Chipset:        Intel 82801JIB A0 (ICH10)
Network:        eth0 (bnx2): Broadcom BCM5709 Gigabit,
   4c:b1:6c:8f:4a:bc, 1Gb/s <full-duplex>
Network:        eth1 (bnx2): Broadcom BCM5709 Gigabit,
   4c:b1:6c:8f:4a:bc, no carrier
OS:             RHEL Server 6.2, Linux 2.6.32-
   131.21.1.tb477.el6.x86_64 x86_64, 64-bit
```

TCP/IP Offload Engine(TOE) for increased bi-directional throughput and performance
Integrated iSCSI Host Bus Adapter(HBA) functionality
Receive Side Scaling (RSS)
TCP Segmentation
802.1q VLAN Tagging
Link Aggregation and Load Balancing
Jumbo Frames
iSCSI HBA
IPV6 Checksum

千兆网卡带宽


带宽
140
120
100
80
60
40
20
0
1
2
4
8
16
32
64
128
256
512
1024
2048
4096
8192
16384
32768
65536
带宽

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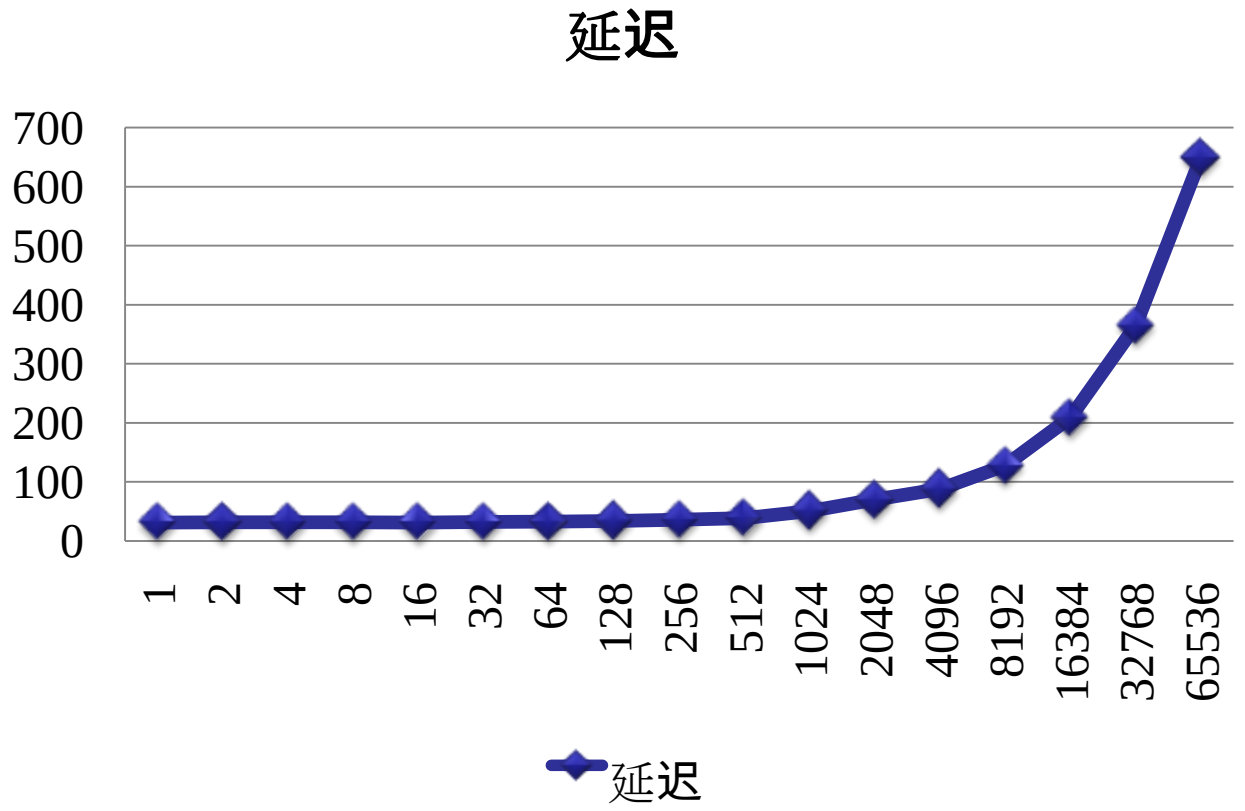
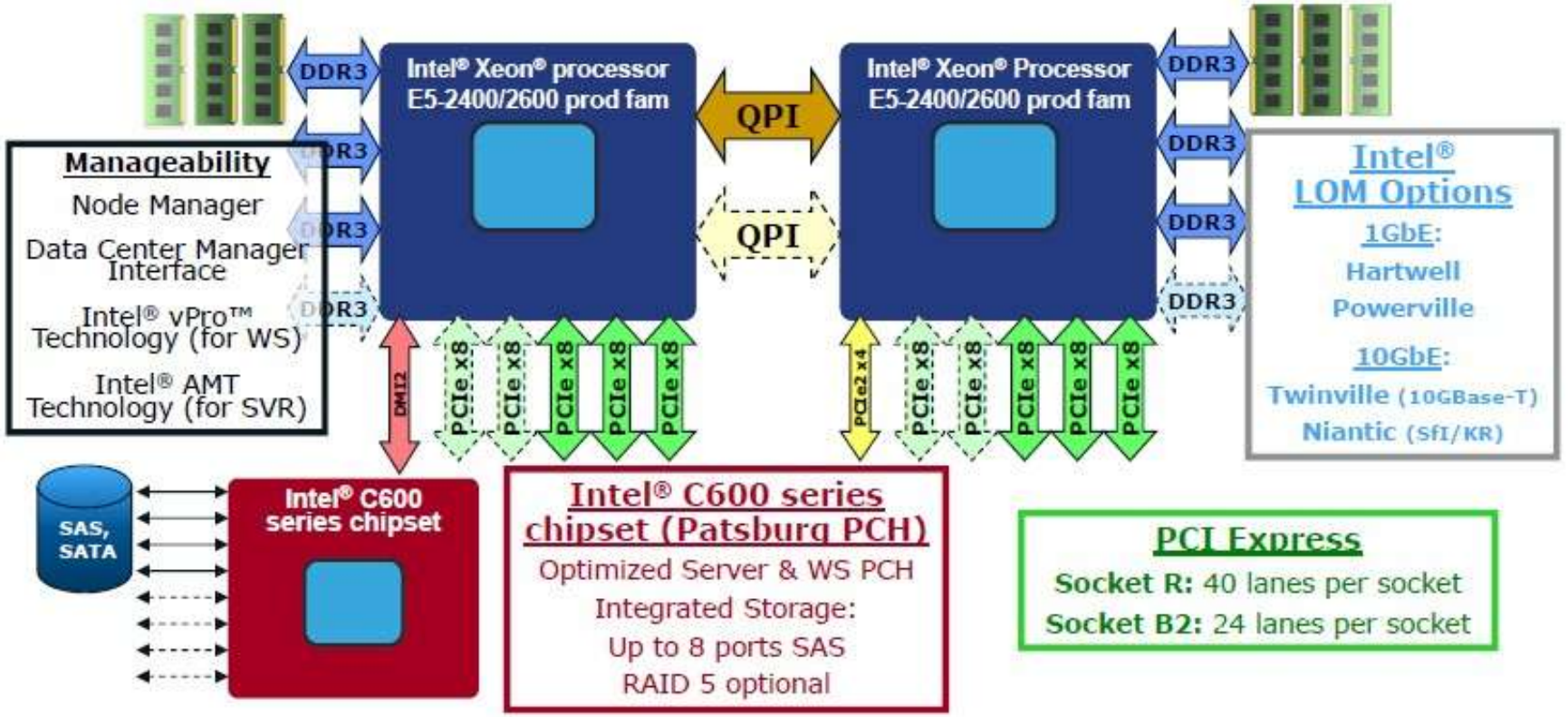
千兆网卡延迟



网卡新趋势(1)


DDR3
Intel® Xeon® processor E5-2400/2600 prod fam
QPI
QPI
Intel® Xeon® Processor E5-2400/2600 prod fam
DDR3
Manageability
Node Manager
Data Center Manager Interface
Intel® vPro™ Technology (for WS)
Intel® AMT Technology (for SVR)
DMI2
PCIe x8
PCIe x8
PCIe x8
PCIe x8
PCIe x8
PCIe2 x4
PCIe x8
PCIe x8
PCIe x8
PCIe x8
PCIe x8
Intel® LOM Options
1GbE:
Hartwell
Powerville
10GbE:
Twinville (10GBase-T)
Niantic (SFI/KR)
SAS, SATA
Intel® C600 series chipset
Intel® C600 series chipset (Patsburg PCH)
Optimized Server & WS PCH
Integrated Storage:
Up to 8 ports SAS
RAID 5 optional
PCI Express
Socket R: 40 lanes per socket
Socket B2: 24 lanes per socket

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网卡新趋势(2)

英特尔® 至强® 处理器 **5500**

英特尔 至强 处理器 5500
- 集成内存控制器
- 英特尔® QuickPath 接口(英特尔® QPI)

英特尔® 至强® 处理器 **E5-2600**

英特尔 至强 处理器 E5-2600
- 英特尔® 集成I/O
- 每个CPU插槽支持多达40条PCIe lane
- 英特尔® Data Direct I/O 技术

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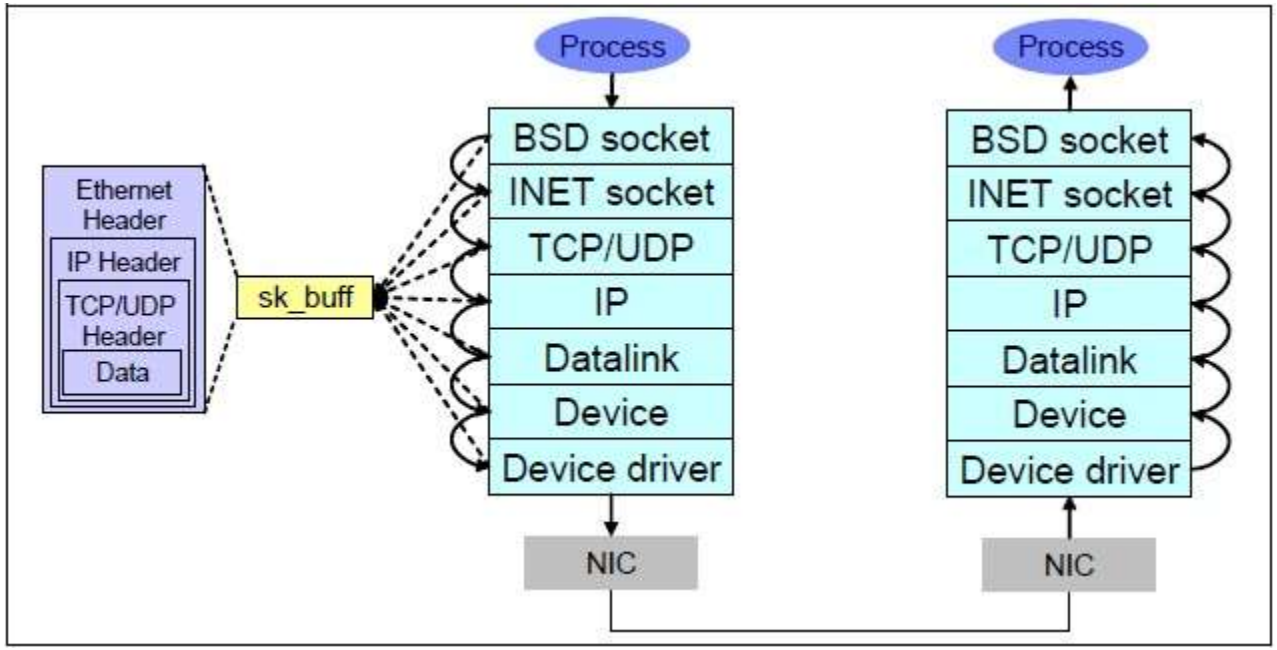
性能必知数字

L1 cache reference	0.5 ns
Branch mispredict	5 ns
L2 cache reference	7 ns
Mutex lock/unlock	25 ns
Main memory reference	100 ns
Compress 1K bytes with Zippy	3,000 ns
Send 2K bytes over 1 Gbps network	20,000 ns
Read 1 MB sequentially from memory	250,000 ns
Round trip within same datacenter	500,000 ns
Disk seek	10,000,000 ns
Read 1 MB sequentially from disk	20,000,000 ns
Send packet CA->Netherlands->CA	150,000,000 ns

Linux网络协议栈


Process
Process
BSD socket
INET socket
TCP/UDP
IP
Datalink
Device
Device driver
BSD socket
INET socket
TCP/UDP
IP
Datalink
Device
Device driver
Ethernet Header
IP Header
TCP/UDP Header
Data
sk_buff
NIC
NIC

微调协议栈

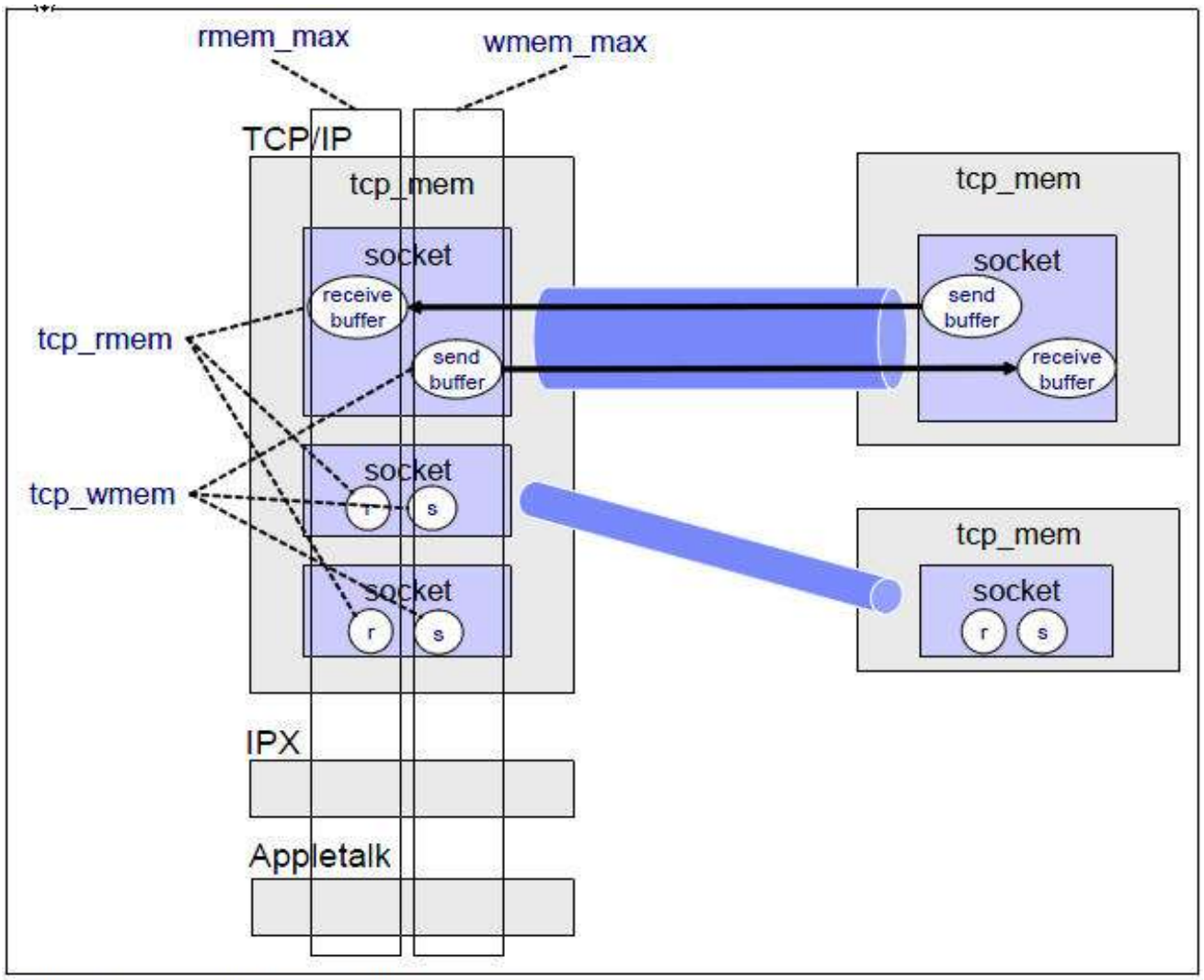


Figure 1-24 socket buffer memory allocation

```
net.ipv4.tcp_fin_timeout = 30
net.ipv4.tcp_keepalive_time = 1200
net.ipv4.tcp_syncookies = 1
net.ipv4.tcp_tw_reuse = 1
net.ipv4.tcp_tw_recycle = 1
net.ipv4.ip_local_port_range = 1024 65000
net.ipv4.tcp_max_syn_backlog = 8192
net.ipv4.tcp_max_tw_buckets = 5000
```

原则： dmesg可以观察到协议栈在抱怨什么，它抱怨什么我们解决什么！

TCP协议栈内存 **不可交换物理内存**

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网卡bonding

```
[chuba@rds064075.sqa.cm4 systemtap-1.6]$ cat /proc/net/bonding/bond0
Ethernet Channel Bonding Driver: v3.6.0 (September 26, 2009)

Bonding Mode: fault-tolerance (active-backup)
Primary Slave: eth0 (primary_reselect always)
Currently Active Slave: eth0
MII Status: up
MII Polling Interval (ms): 100
Up Delay (ms): 0
Down Delay (ms): 0

Slave Interface: eth0
MII Status: up
Link Failure Count: 0
Permanent HW addr: 4c:b1:6c:8f:4a:bc
Slave queue ID: 0

Slave Interface: eth1
MII Status: down
Link Failure Count: 0
Permanent HW addr: 4c:b1:6c:8f:4a:bd
Slave queue ID: 0
```

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中断平衡

```
[root@my174 beam]# dstat
----total-cpu-usage---- -dsk/total- -net/total- ---paging-- ---system--
usr sys idl wai hiq siq| read  writ| recv  send|  in   out | int   csw
  5   1  92   3   0   0|1417k 4532k|   0     0 |  24k   33k|1559    25k
  0   0 100   0   0   0|   0     0 | 420B 1092B|   0     0 |1002   106
  0   0 100   0   0   0|   0     0 | 140B  364B|   0     0 |1003   122
  0   0 100   0   0   0|   0     0 | 140B  364B|   0     0 |1003   108
```

硬中断:

```
yufeng@yufeng-laptop:~$ cat /proc/interrupts
           CPU0       CPU1
  0:    3757785    3774177   IO-APIC-edge      timer
  1:       4053       4013   IO-APIC-edge      i8042
  8:          0          1   IO-APIC-edge      rtc0
  9:       2198       2141   IO-APIC-fasteoi   acpi
```

- irqbalance 智能的均衡硬件中断。
- 手动 [root@linux /]#echo ff > /proc/irq/19/smp_affinity

软中断:

```
yufeng@yufeng-laptop:~$ cat /proc/softirqs
                    CPU0       CPU1
          HI:          0          0
       TIMER:    2821708   13270908
     NET_TX:          1          7
     NET_RX:      60385      57542
      BLOCK:      89454      87914
```

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RPS/RFS 解决softirq平衡

RPS is not automatically switched on, you have to configure it.

echo ffff >/sys/class/net/eth0/queues/rx-0/rps_cpus

Same for RFS if you prefer to use RFS

echo 16384 >/sys/class/net/eth0/queues/rx-0/rps_flow_cn

显著提高软中断的均衡性，大大提高性能。

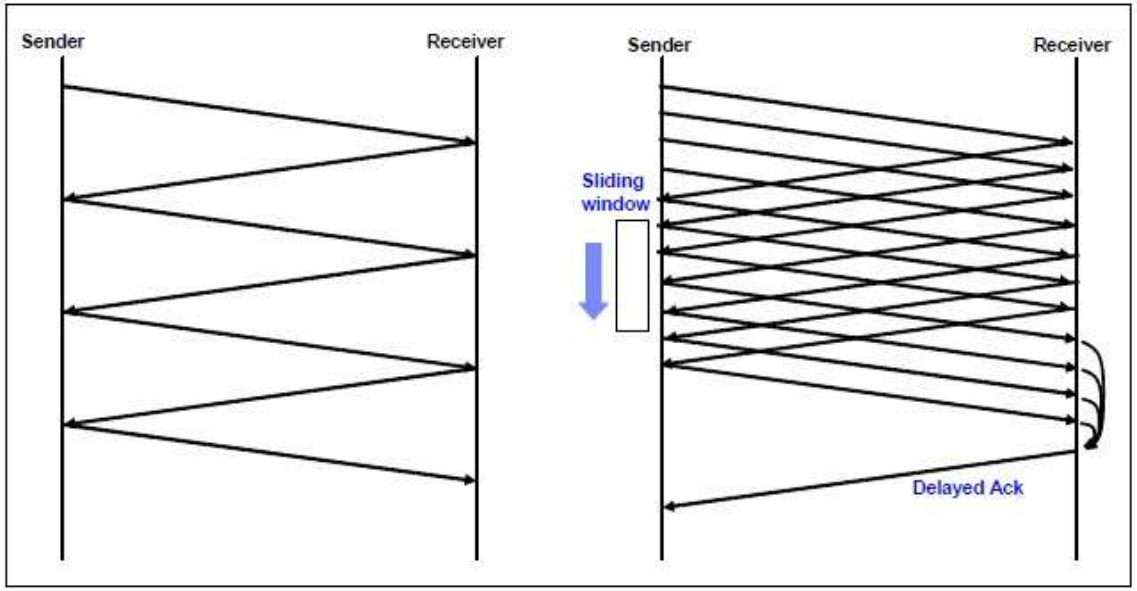
```
e1000e on 8 core Intel
   No RFS or RPS                104K tps at 30% CPU
   No RFS (best RPS config):    290K tps at 63% CPU
   RFS                          303K tps at 61% CPU

RPC testtps       CPU%     50/90/99% usec latency    Latency StdDev
  No RFS/RPS      103K     48%       757/900/3185                4472.35
  RPS only:       174K     73%       415/993/2468                491.66
  RFS             223K     73%       379/651/1382                315.61
```

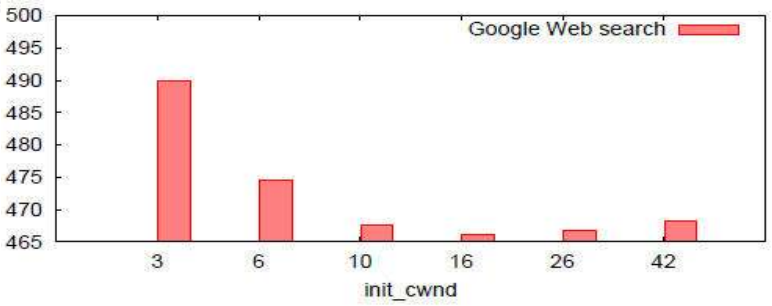
initcwnd调优

通过提高初始拥塞窗口的大小(3)，大大减少短连接的响应时间.

make sure your Linux kernel is 2.6.30 or higher.

ip route change [default via a.b.c.d dev ethX ...] initcwnd 10





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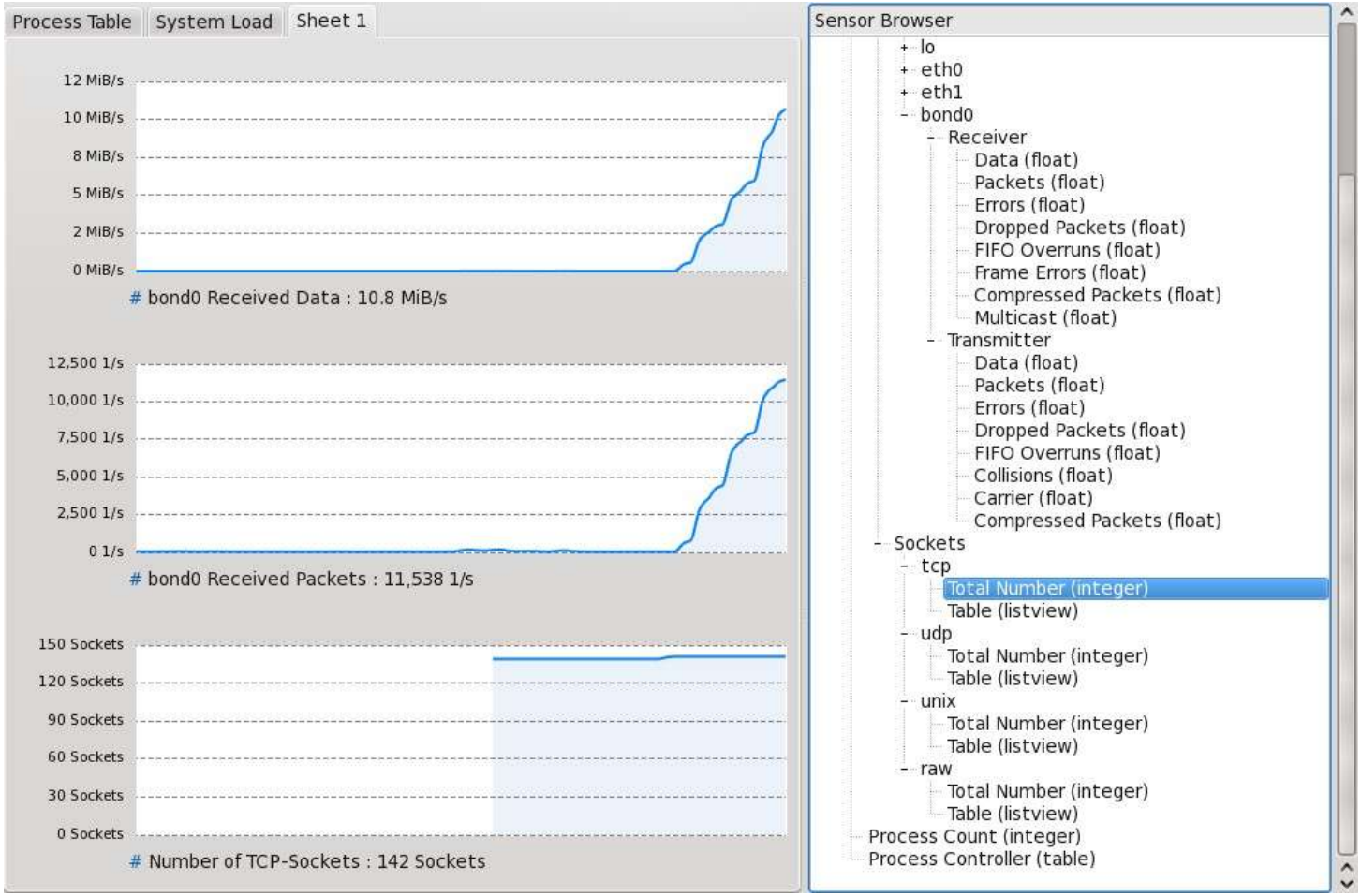
ksysguard观察网络行为



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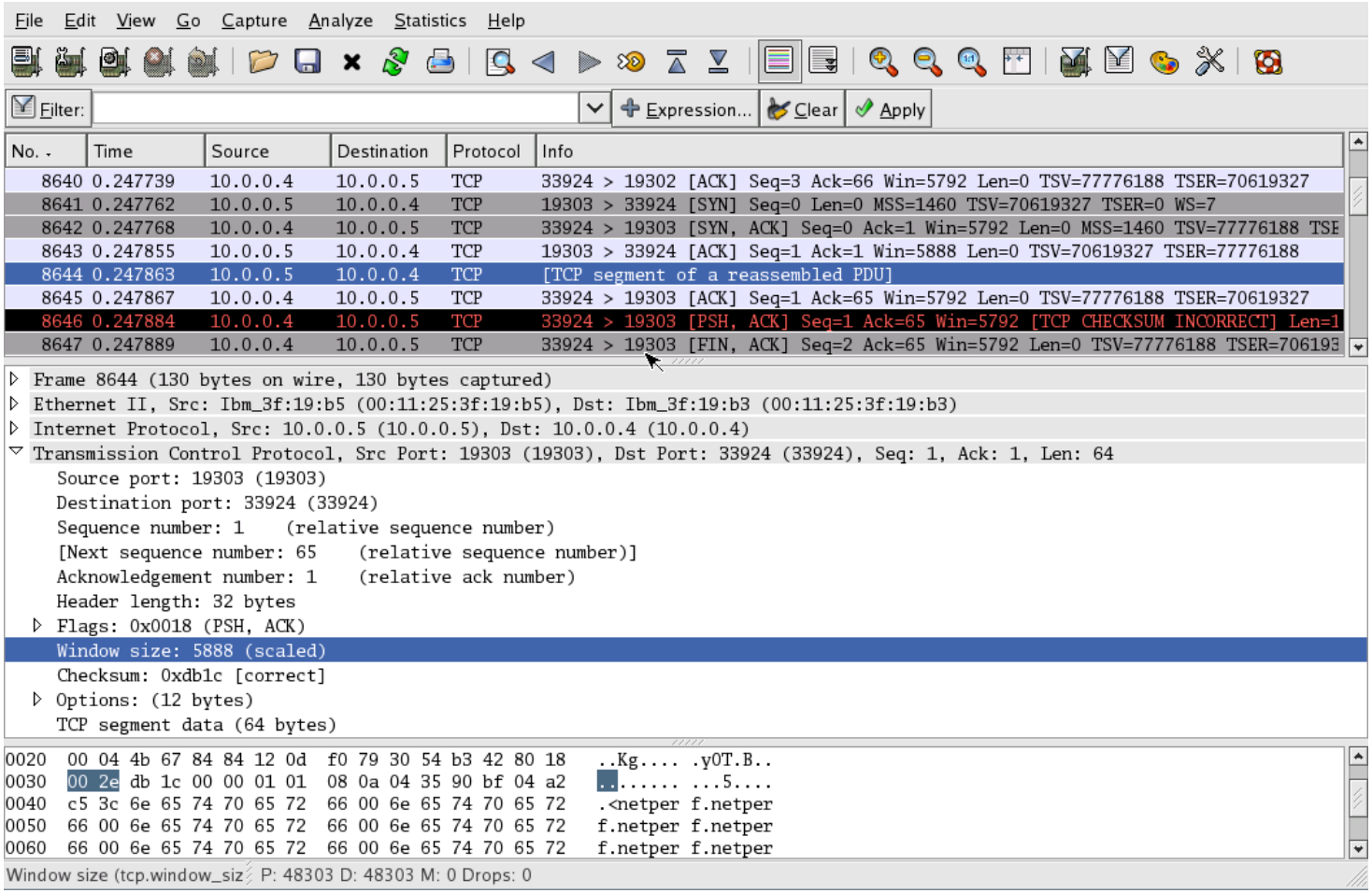
wireshark



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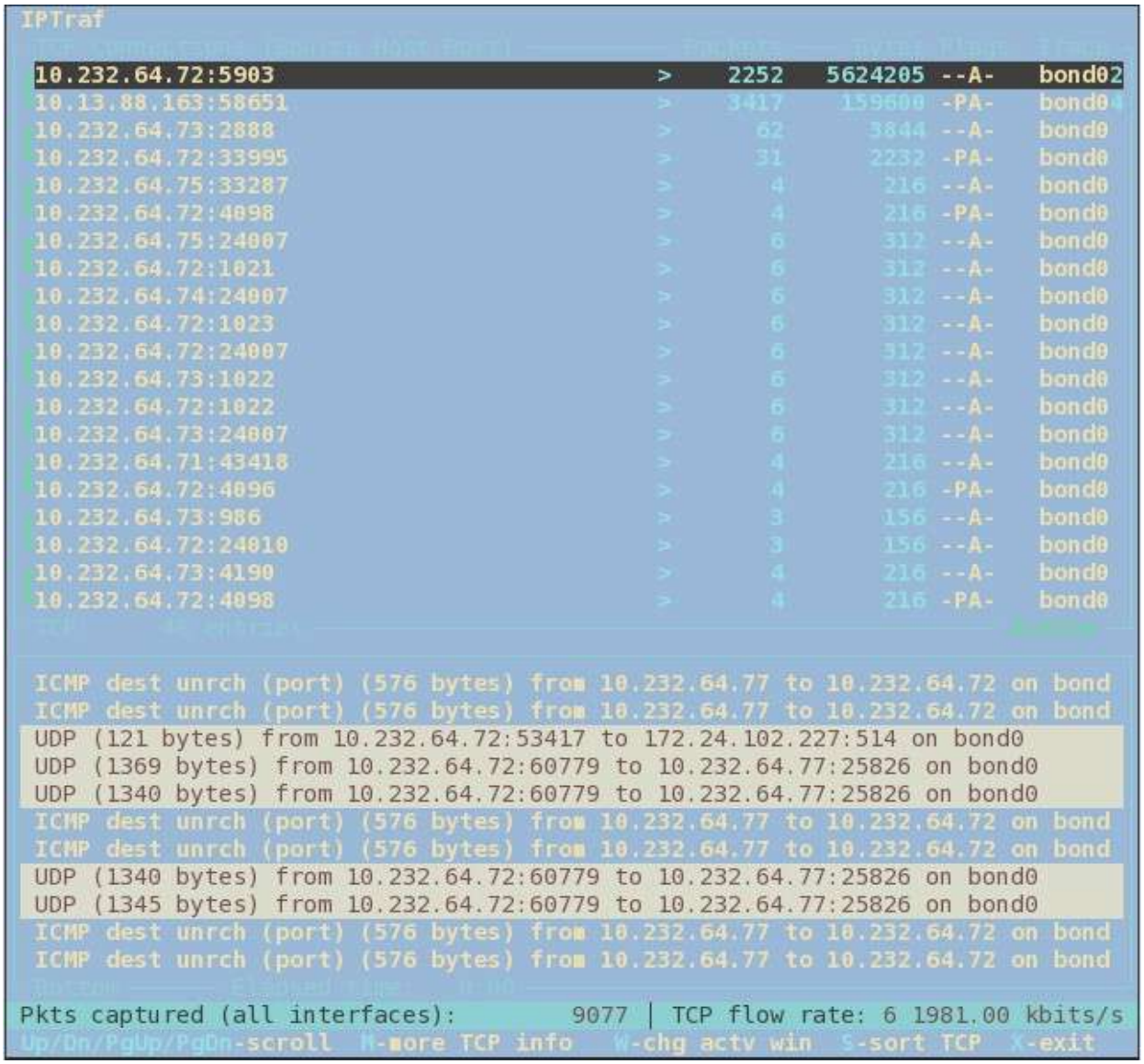
iptraf



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socktop

```
------------------------------ PROCESSES ------------------------------
PID   UID      #SEND    #RECV SEND_KB RECV_KB PROT FAMILY   COMMAND
16468 50920       23       22       0       2 IP   LOCAL    gnome-settings-
6658  50920       23       22       0       2 IP   LOCAL    gnome-settings-
9545  50920       23       22       0       2 IP   LOCAL    gnome-settings-
17365 50920       23       22       0       2 IP   LOCAL    gnome-settings-
7144  50920       23       22       0       2 IP   LOCAL    gnome-settings-
2196  50920       23       22       0       2 IP   LOCAL    gnome-settings-
16431 50920       15       16       2       0 IP   LOCAL    Xvnc
6610  50920       15       16       2       0 IP   LOCAL    Xvnc
9416  50920       15       16       2       0 IP   LOCAL    Xvnc
17306 50920       15       16       2       0 IP   LOCAL    Xvnc
-----------------------------------------------------------------------
```

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网络系统调用代价

```
sudo ./syscalltimes -n qperf -t -u chuba -p `pgrep qperf`
```

System Call	Count	Total ns	Avg ns	Min ns	Max ns
wait4	2	4024520544	2012260272	2009330244	2015190300
read	46095	3485115497	75607	1776	5174715
write	28987	274827544	9481	5401	210723
sendto	2	21129	10564	9158	11971
select	14	5584573	398898	2022	4885391
setsockopt	2	5293	2646	2483	2810
listen	2	24955	12477	8776	16179
fcntl	2	5896	2948	2748	3148
getsockname	6	10325	1720	1140	2688
socket	8	3433358	429169	4825	1959357
recvmsg	4	13792	3448	1342	5976
bind	4	18815	4703	2954	5381
connect	2	26498	13249	8661	17837
ioctl	2	6380	3190	2875	3505
close	10	243409	24340	2087	158796
accept	3	16716181	5572060	353843	10778264
fork	2	178637	89318	76755	101882
rt_sigreturn	2	6677	3338	3033	3644
lseek	4	10511	2627	1437	3363
setitimer	6	9227	1537	1112	2132
times	4	9032	2258	1782	2584

协议栈缺内存引发问题

```
$ sudo stap sk_stream_wait_memory.stp
1218230114875167: python(17631) blocked on full send buffer
1218230114876196: python(17631) recovered from full send buffer
1218230114876271: python(17631) blocked on full send buffer
1218230114876479: python(17631) recovered from full send buffer
```

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丢包观察

```
$ netstat -s|grep drop
    281340 outgoing packets dropped
    77 packets dropped from out-of-order
  queue because of socket buffer overrun
    7 ICMP packets dropped because they were
  out-of-window
```

丢包分析

```
$ sudo dropwatch -l kas
Initalizing kallsymsa db
dropwatch> start
Enabling monitoring...
Kernel monitoring activated.
Issue Ctrl-C to stop monitoring
1 drops at netlink_unicast+251
15 drops at unix_stream_recvmsg+32a
3 drops at unix_stream_connect+1dc
```

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ethtool

```
[chuba@rds064075.sqa.cm4 ~]$ sudo ethtool eth0
Settings for eth0:
        Supported ports: [ TP ]
        Supported link modes:   10baseT/Half 10baseT/Full
                                100baseT/Half 100baseT/Full
                                1000baseT/Full
        Supports auto-negotiation: Yes
        Advertised link modes:  10baseT/Half 10baseT/Full
                                100baseT/Half 100baseT/Full
                                1000baseT/Full
        Advertised pause frame use: No
        Advertised auto-negotiation: Yes
        Speed: 1000Mb/s
        Duplex: Full
        Port: Twisted Pair
        PHYAD: 1
        Transceiver: internal
        Auto-negotiation: on
        MDI-X: Unknown
        Supports Wake-on: g
        Wake-on: d
        Link detected: yes
```

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提问时间

谢谢大家！