

# Quick Update on Network Stack Parallelism



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# The Big Picture

TCP/IP MPSAFE since FreeBSD 5.3

6.x, 7.x, and 8.x non-trivially lower overhead,  
improve lock granularity, greater parallelism

Improving highly concurrent workloads

Many cores, many threads

BIND9/nsd/memcached (UDP)

Apache (TCP)

MySQL/PostgreSQL (Local Sockets, TCP)

# UDP: Problems

BIND9, nsd, memcached

One(ish) sockets per process, many threads

Tens/hundreds of thousands of simultaneous clients

TCP neither feasible nor desirable

Very high contention on a number of locks

pcbinfo for input path

inpcb during input and output processing

receive socket buffer lock for thread receive

Excessive overhead from socket buffer routines

# UDP Solutions

Motivates two locking improvements

- Read-write locks for pcbinfo and inpcb

  - Read lock most common paths

- Reduction of socket layer overhead

  - sosend\_dgram, soreceive\_dgram

UDP itself no longer a source of contention in these workloads – significant performance win

Still contention sources in receive socket buffer, routing locks, ifnet transmit queue locks

# TCP Problems

Apache, MySQL, PostgreSQL

Server: one listen socket, many data sockets spread over many threads or processes

Client: many simultaneous unrelated sockets

Very high contention on several locks

pcbinfo for input path and user state transition paths

inpcb contention during send/receive

socket buffer contention

# TCP Solutions

Improvements in lock granularity, primitives

sblock now optimized sx lock

Read-write locking for pcbinfo and inpcb

Primarily pcbinfo, not inpcb, due to complex per-TCP state

Somewhat complicated because cannot tell a priori from header flags if global state transition will be triggered when looking up connection

Decompose pcbinfo lock into connection groups

Reduce necessarily exclusive access to globals

inpcb lock, socket buffer send/receive, routing,  
ifnet transmit queue locks remain significant

# Stack Parallelism

## Direct dispatch vs. netisr

Exploring multiple netisrs to improve loopback performance, but direct dispatch remains win

## Multiple input queues

10gbps cards/drivers support 4+ input queues, represented as (n) ithreads balanced with RSS

## Multiple output queues

Kip has prototype in Perforce, some discussion of ordering issues

Need to align stack, driver, card flow logic

# The Plan

Convert inpcb/pcbinfo mutex to rwlock in 8.x, 7.x

Move to read locking wherever possible in UDP for pcbinfo and inpcb in 8.x, 7.x

Move to input path read locking of pcbinfo in TCP input path where possible in 7.x, 7.x

Prototype connection group decomposition of pcbinfo in 8.x, MFC may be possible

Retain non-loopback direct dispatch default

Use parallel netisr for loopback, IPSEC, etc