1.BIO NIO AIO BIO 10 NIO I/O AIO 1/0 OS BIO NIO BIO NIO BIO Stream NIO channel NIO 1/0 1/0 0 Ю zero-copy IO block Java Reactor Reactor Reactor 2.NIO Buffer Channel Channel Channel flip position limit position 0 clear position 0 capacity limit rewind position 0 DirectByteBuffer Buffer 1/0 JVM heapBuffer Channel 10 Buffer FileChannel read write Selector Selector register Channel open accept SelectionKey SelectableChannel wakeup Selector channel channel

EPollSelectorImpl

EPollArrayWrapper

Selector

Linux

```
native
                epoll
                                 EPollSelectorImpl.
                                                     implRegister
                                                                                  epoll_ctl
                                                       SelectionKey
  epoll
                                                 (fd)
                                            SelectionKey
fdToKey
                 map
fdToKey
                                         Selector
                                                      Channel
         Channel
                                  fdToKey
                                                                        select
Pipe
                                                     sink
                                                                   source
NIO
                        Selector.open()
                                                   Selector ServerSocketChannel.open()
              Channel
                        bind()
                                                                         register()
Channel
                        Selector
                                     select()
3.Netty
                              NIO
                                                     TCP UDP
              socket
                              epoll
                                                  cpu
            NIO
                                 NIO
         decoder/encoder
                                    TCP
                   TCP
                               TCP
       10
                   ByteBuf
                                                       GC
                                   Reactor
                            CAS
            volitale
4.Netty
Netty
           Reactor
boss
              work
                                  boss
                                                                     accept
                                   socket
                                                      NioSocketChannel
  accept
                                                                                   work
                                              write
                                                                    Handler
              work
                                      read
                  1/0
Reactor
                          NIO
                     NIO
                                                                                 TCP
                                 Acceptor
       NIO
                            Ю
                                                                                   NIO
                                  1
                                                        NIO
                Ν
                                                  1
                                                              Acceptor
                  Acceptor
                                                                             SocketChannel
              Reactor
                                                               Sub
```

I/O mainReactor 5.TCP TCP TCP TCP / TCP MSS TCP -TCP >MSS payload MTU 1500 ip FixedLengthFrameDecoder Line Based Frame DecoderDelimiterBasedFrameDecoder Length Field Based Frame Decoder6. CPU Java XML JSON XML XML ms Web browser Ajax Fastjson java json Web Android

Thrift RPC HTTP RPCIDL Avro Hadoop JSON RPC Hadoop Hive Pig MapReduce Protobuf .proto POJO Protobuf XML JSON **RPC** Java C++ python proto protostuff protobuf Jboss marshaling java java.io.Serializable Message pack Hessian remoting onhttp protobuf java Registration kryo Output Input 7. 100ms XML SOAP Mobile app Web browser Ajax JSON JSON JSON XML

Protobuf

Protobuf

Avro

Avro

T

hadoop

Hadoop

Avro

Thrift Avro

Protobuf

Avro

RPC Thrift

Protobuf

protobuf bool double float int32 int64 string bytes enum

message protobuf required: optional:

repeated: 0

protobuf required 0

optional repeated 0 [1,15]

[16,2047] 2

protobuf

required optional repeated

optional repeated

required

.java Builder

UserProto.User.Builder builder =

UserProto.User.newBuilder();builder.build()

Netty ProtobufVarint32FrameDecoder

ProtobufDecoder(UserProto.User.getDefaultInstance()) UserProto.java

ProtobufVarint32LengthFieldPrepender protobuf

32 ProtobufEncoder

StringBuilder ByteBuf copiedBuffer()

8.Netty

Netty ByteBuffer DIRECT BUFFERS Socket

JVM

Buffer Socket ByteBuffer ChannelConfig

ChannelConfig ByteBufAllocator Direct Buffer

CompositeByteBuf ByteBuf ByteBuf,

Buffer Buffer addComponents header

body ByteBuf, ByteBuf CompositeByteBuf

, CompositeByteBuf

FileRegion FileChannel.tranferTo ,

Channel write

byte[] ByteBuf ByteBuffer Netty wrap ByteBuf Selector BUG Selector wakeup CPU 100% Netty select select Selector Ν epoll bug Selector SocketChannel Selector Selector Selector 9.Netty inactive(netty5) : idleStateHandler CPU NIO / ByteBuf;ByteBuf CA Netty SSL V2 V3 TLS SSL CAS volatile 10 AIO Http TCP SO_RCVBUF SO_SNDBUF 128K 256K SO_TCPNODELAY NAGLE 10.NIOEventLoopGroup NioEventLoopGroup(MultithreadEventExecutorGroup) EventExecutor children [], * 2,

EventExecutor NioEventLoopGroup newChild children NioEventLoop SingleThreadEventExecutor NioEventLoop run hasTasks() taskQueue taskQueue selectNow() selector.selectNow() taskQueue select(oldWakenUp) select (oldWakenUp) Nio bug selectCnt selector.select selector.selectNow() epoll bug selector.select(timeoutMillis) selectCnt selectCnt 512 rebuildSelector selector 100% cpu bug rebuildSelector selector old selector openSelector selectionKey old channel cancel selector selector rebuild selectNow ready selectionKey processSelectedKeys 1/0 selectedKeys != null processSelectedKeysOptimized selectedKeys Ю selectkey selectedKeys processSelectedKey processSelectedKey OP_READ OP_WRITE OP_CONNECT fetchFromScheduledTaskQueue runAllTasks 10 scheduledTaskQueue taskQueue taskQueue 64 10 10 10 NioServerSocketChannel NioEventLoop Selector NioEventLoop Selector NioEventLoop Outbound Channel unsafe Outbound tail head Inbound unsafe Channel, Arena Arena Chunk Chunk 2048 Chunk AVL Page page Page Arena 8k poolChunkList PoolSubpage 8k page ByteBuf 4M put /

flip()

zero-copy

AtomicIntegerFieldUpdater

PooledByteBuf

UnpooledHeapByteBuf