

0000	Nothing
0001	
0010	
0011	
0100	
0101	Long bcast
0110	medium bcast
0111	Short bcast
1000	Scatter (recursive halving)
1001	Ring gather
1010	Recursive doubling allgather
1011	Gather tree
1100	Uptree reduce
1101	Long reduce recur halving
1110	Short allreduce recur doubling
1111	Long allreduce recur halving

**Short reduce: op=1100**

**Long reduce: op = 1101, then change to 1011**

**Short allreduce: op = 1110**

**Long allreduce: op = 1111, then change to 1010 \***

**Gather: op = 1011**

**Barrier: op = 1011**

**Short allgather: op = 1010**

**Long allgather: op = 1001**

**Scatter: op = 1000**

**Short bcast: op = 0111**

**Medium bcast: op = 0110, then change to 1010 \***

**Long bcast: op = 0101, then change to 1001**

**\*the algorithmic changes for long reduce and long bcast have been implemented in hardware, but the changes for long allreduce and medium broadcast are too currently too complicated due to the switching from recursive halving to recursive doubling. Right now, the simplest option is to have the scatter and gather be two separate software calls by the CPU.**