|  |  |
| --- | --- |
| 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.**