Polygon Overlay: Summary of Results

▫ **Map of population distribution** ▫ **Map of a region affected by hurricane Sandy** **Where are the safe rescue shelters?**	**MPI-GIS : 44X speedup processing 600K polygons in 1)USA Detailed Water Bodies and 2)USA Block Group Boundaries within 20 seconds on a 32-node (8 cores each) IBM iDataPlex cluster**
Input: Given two map layers $A = \{a_1, a_2, .. , a_n\}$ and $B = \{b_1, b_2, .. , b_m\}$ where a_i , b_i are polygons represented as (x,y) coordinates of vertices and operator *op* $\in$ {*Union, Intersect, Diff*} Output: C <- *A op B*	Output-Sensitive Algorithms: 1) O(log n) time polygon clipping algorithm using plane sweep method using O(n+k+k') processors 2) O(log n) time algorithm using graph traversal method with O(n+ k) processors in PRAM model

Hadoop Topology Suite

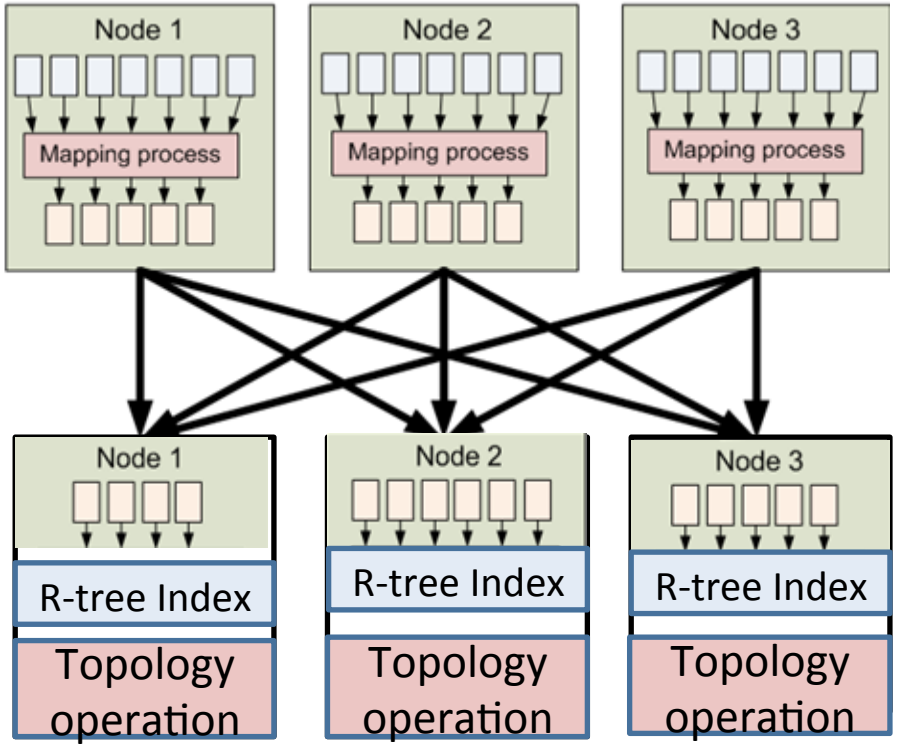
Input Polygons

Emit (cell id, polygon)

Grid-based Shuffle & Exchange

R-tree Query

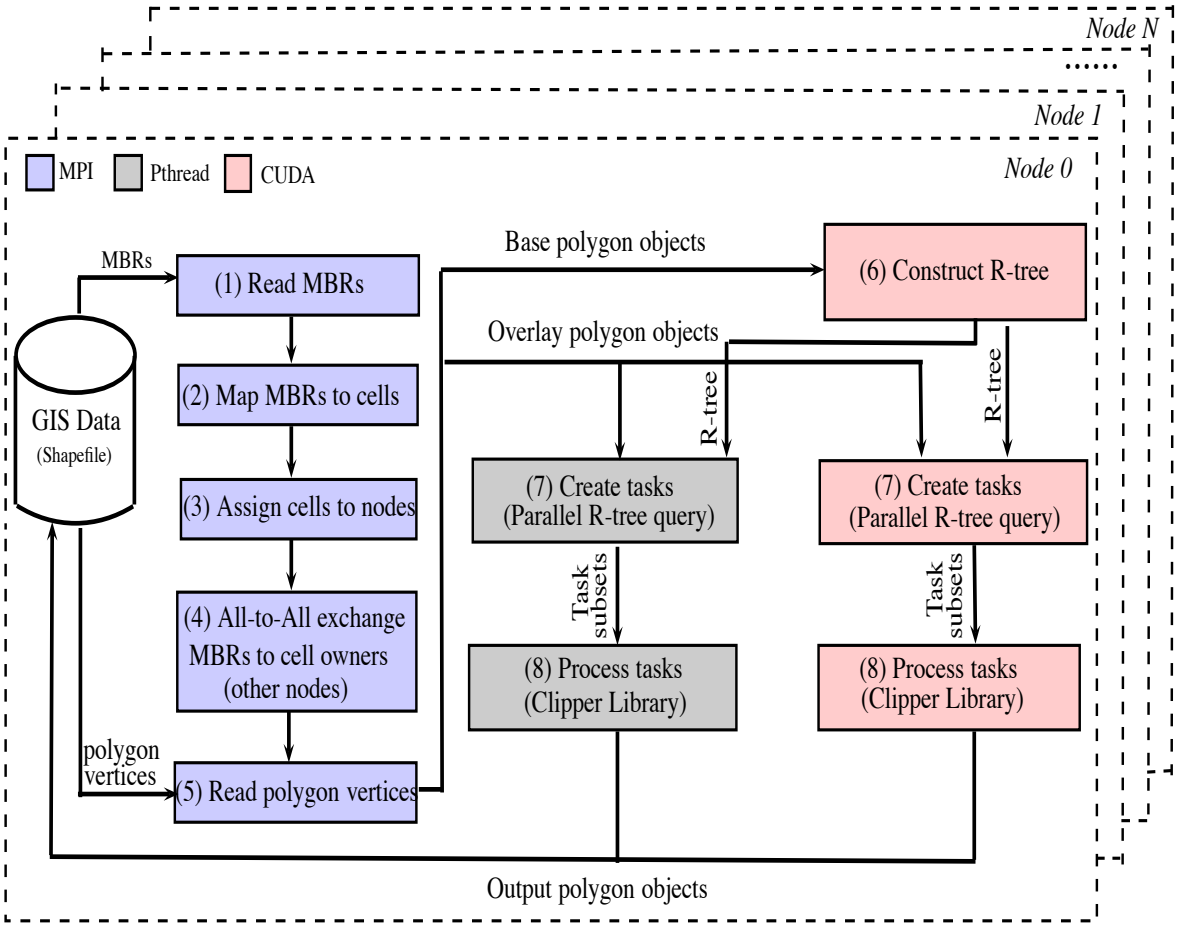
HDFS Storage



Three versions:

1. DistributedCache based with Single Map phase
2. Uniform Grid with Map and Reduce phases
3. Chain of two Map and Reduce phases
4. Scalable, 20 fold relative speedup

Hybrid MPI/GPU Polygon Overlay



Developed CUDA kernels

1) Segment intersection filter and Polygon containment filter

2) Multi-threaded CPU implementation with 30-fold speedup on a 64-core AMD node

3) 10-fold speedup on a nVIDIA GeForce GTX 780 GPU paired with a 12-core Intel Xeon CPU