AToMS
Automatic Tuning Of MPI Software

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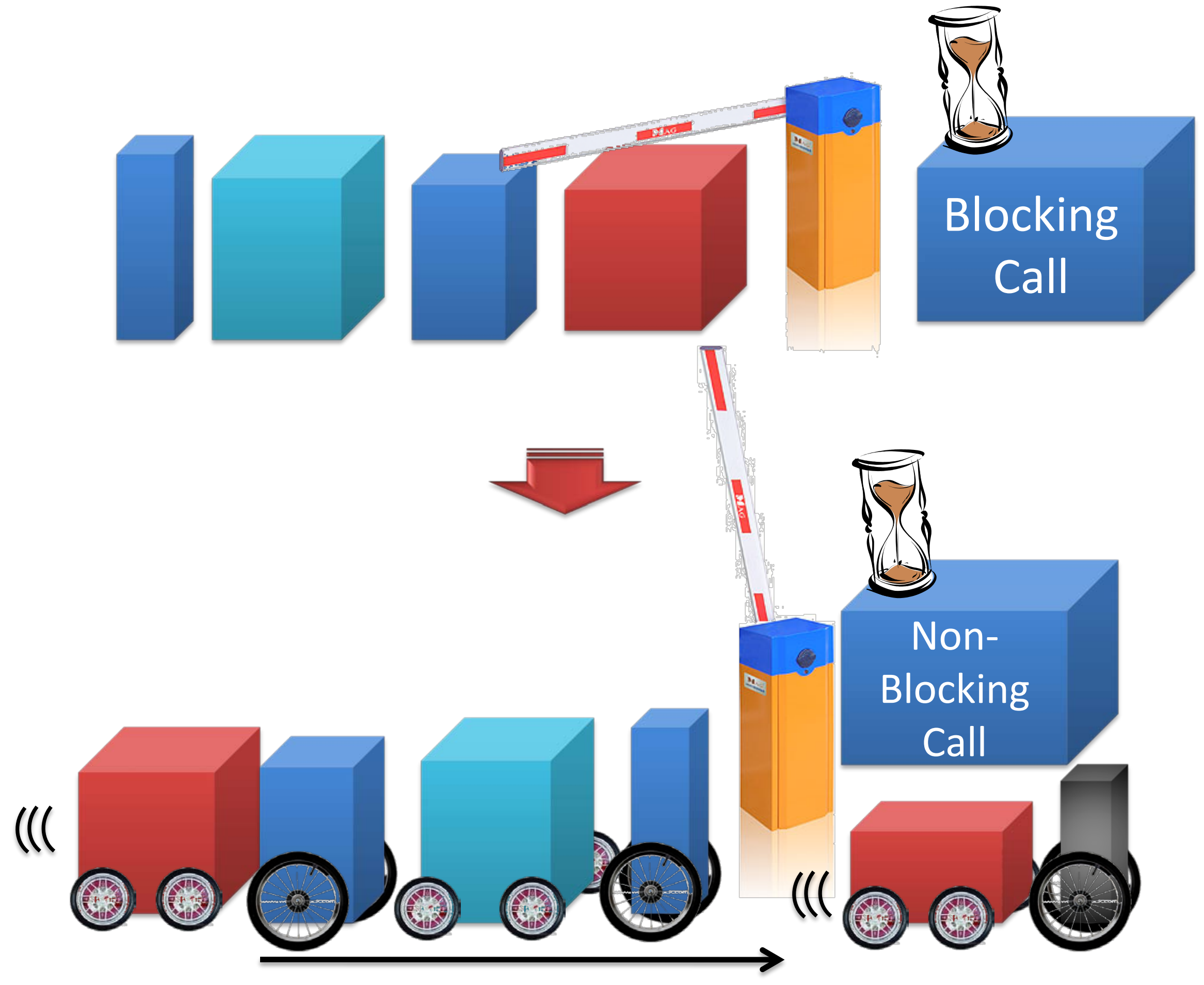
Transformation of Blocking MPI calls to Non-Blocking

•Substitute blocking calls for pairs of non-blocking and waits
•Computation can be done during wait (**overlaps**)
•Communication occurs in background



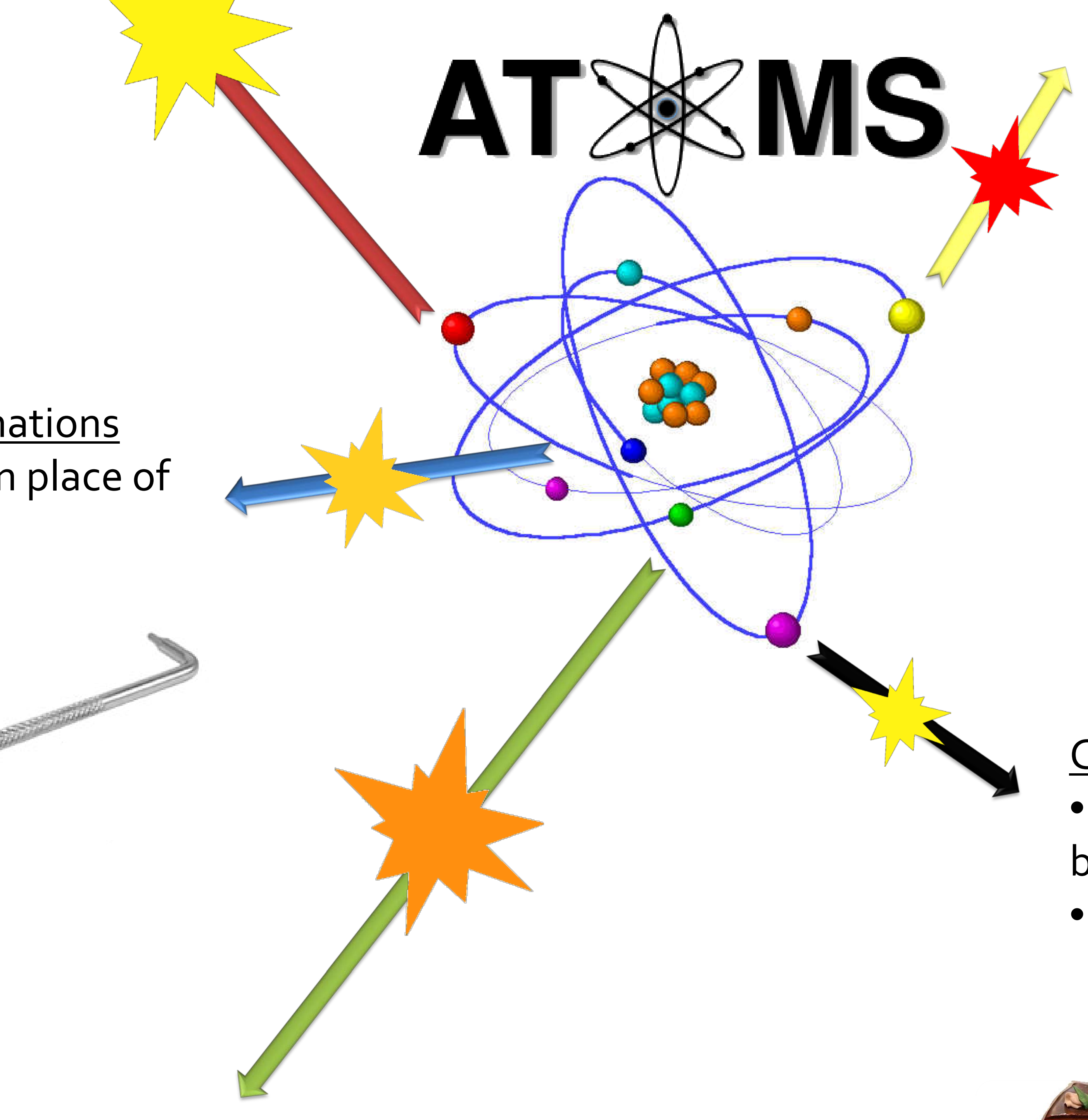
Problem

•Traditional compilers treat MPI (Message Passing Interface) calls as "black boxes"
•Opportunities for optimizing the calls and surrounding code are lost

Solution

•Boost compiler's knowledge of MPI
•Implement compiler transformations, apply to MPI calls in parallel application codes
•Result: optimized transformed code

Our **AToMS** approach provides the transformation in **particles**:

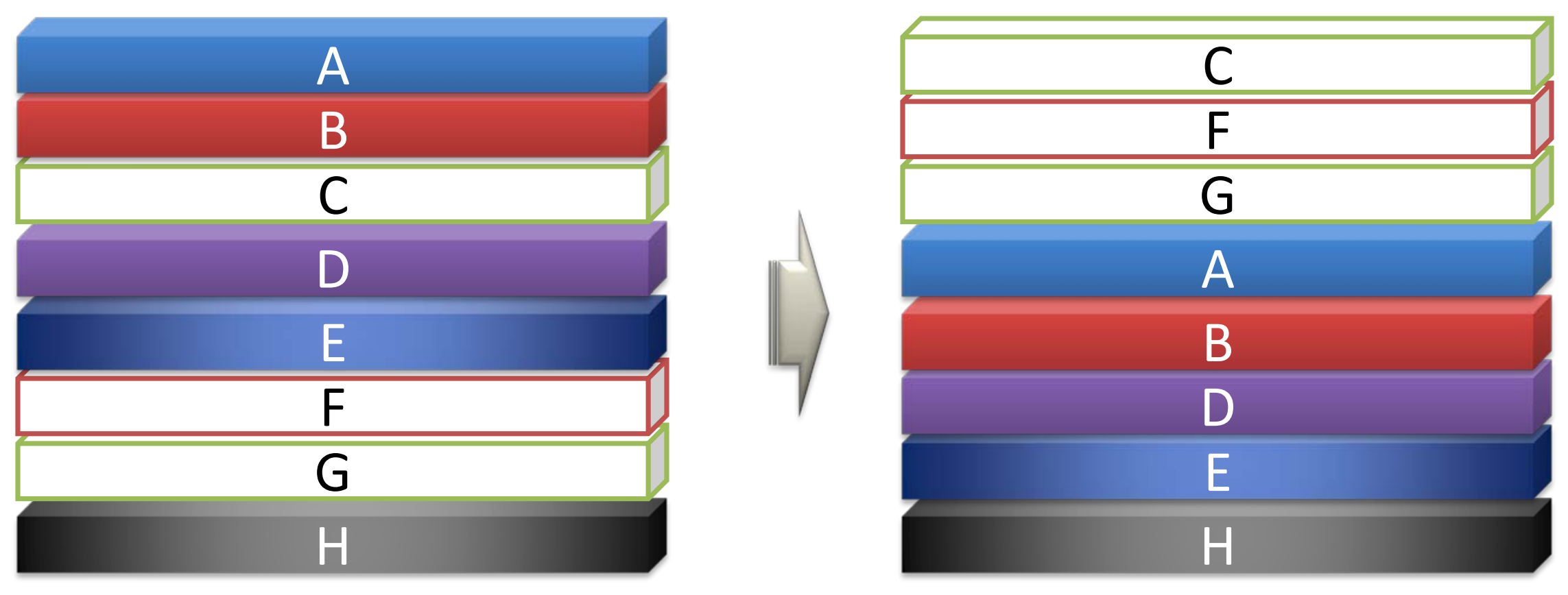


Variable Cloning

•Similar to register renaming
•Data dependencies that impair code motion can be removed by inserting *clones* of dependent variables

Native Data Structure Transformation

•Commonly, MPI data structures mirror native data structures; processes send entire instances of structure to other instances via MPI
•In some cases, users omit unused fields in MPI data structure
•This creates non-contiguous data, forcing analysis for buffer placement
•Optimize by arranging layout of native data structure at compile time
•Put non-transmitted first or after transmitted fields
•Adjust user's logical layout of MPI data structure



C, F, G: Not to be transmitted

Transformed data structure

Communication Library Specific Transformations

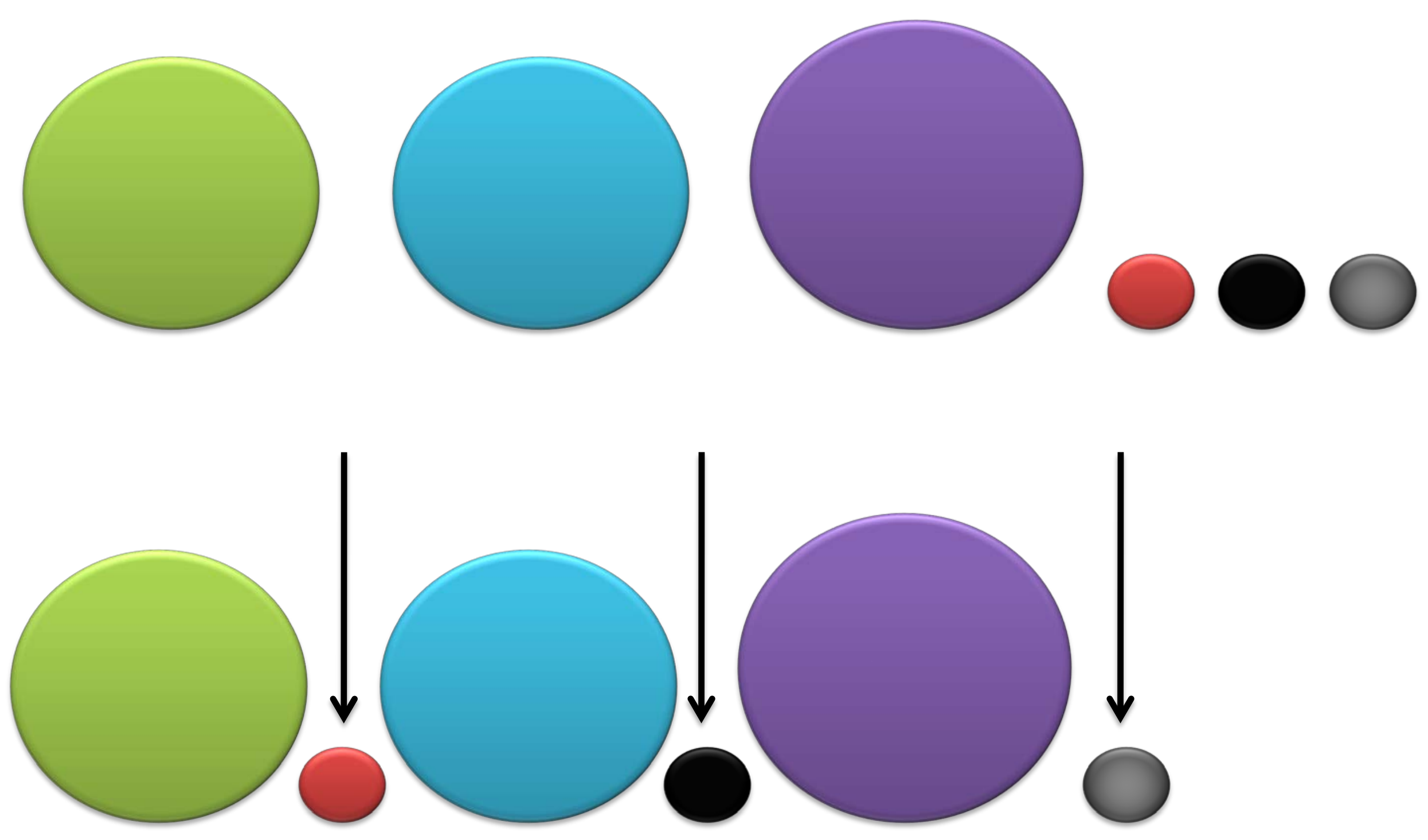
•Use specialized communication libraries in place of MPI
•Better use of network capabilities

Code Motion for Overlap Window Expansion

•Move non-blocking, data transfer initiation calls to beginning of code
•Move transfer termination calls towards end of code

MPI Collective Call Decomposition

•Software-based collective calls are implemented as sequence of point-to-point operations
•Compiler can optimize this sequence inlined into program by overlapping individual transfers with computation



Poster: Marcos Portnoi