Direct Component Coupling in ESMF

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Direct coupling between concurrently running ESMF Components

- ESMF Component hierarchy, Coupler and State concepts are used to transparently define inter-component coupling relationships.

- Direct coupling from within model Run() method eliminates the need to interrupt Run() method to do coupling.

- Straight forward coupling between any two Components anywhere in the hierarchy.

- Support for complex coupling dependencies between Components. Same Run() method can couple to multiple Components.
ESMF_DirectCoupling System Test
Component hierarchy

Driver
PET 0,1,2,3,4,5

ioComp
PET 0

 CPLComp
PET 0,1,2,3,4,5

modelComp PET 1,2,3,4,5

modelAComp PET 1,4

modelBComp PET 2,3,5
ESMF_DirectCoupling System Test
Data objects to be coupled
ESMF_DirectCoupling System Test
Coupling cycle
Direct Coupling
Missing Pieces

- Support for separate call into Comm methods from source / destination side.
- `StateAdd()` for RouteHandles.
- Named RouteHandles.
ESMF_DirectCoupling System Test
ioComp->modelAComp: States

Driver
PET 0, 1, 2, 3, 4, 5

ioComp
PET 0

"ioComp.arraySrc"

"ioComp.arrayDst"

ioExp

clpComp
PET 0, 1, 2, 3, 4, 5

modelExp

modelImp

modelComp
PET 1, 2, 3, 4, 5

modelAComp
PET 1, 4

"modelA.array"

modelBComp
PET 2, 3, 5

"modelB.array"

* "-2"
ESMF_DirectCoupling System Test

ioComp->modelAComp: RouteHandle
ESMF_DirectCoupling System Test
modelAComp -> modelBComp: States
ESMF_DirectCoupling System Test

modelAComp -> modelBComp: RouteHandle

Driver
PET 0, 1, 2, 3, 4, 5

ioComp
PET 0

"ioComp.arraySrc"

"ioComp.arrayDst"

cplComp
PET 0, 1, 2, 3, 4, 5

modelComp
PET 1, 2, 3, 4, 5

modelAComp
PET 1, 4

"modelA.array"

modelBComp
PET 2, 3, 5

"modelB.array"

* "-2"
ESMF_DirectCoupling System Test
modelBComp -> ioComp: States
ESMF_DirectCoupling System Test

modelBComp -> ioComp: RouteHandle
Conclusion

- Concept is not limited to Redist() - in principle all precomputed Comms with RouteHandle (e.g. SparseMatMul(), ...)

- More complex coupling possible:
  - coupling during “fractional time steps”
  - coupling to multiple components during same time step

- Available now in ESMF_3_1_0p1

- Public release ESMF_3_1_0r

- Possibility of supporting non-blocking Comms for direct coupling in future versions.