

Region-Scale Evacuation Modeling using GPUs

National Evacuation Conference
New Orleans, LA
Feb 5, 2010

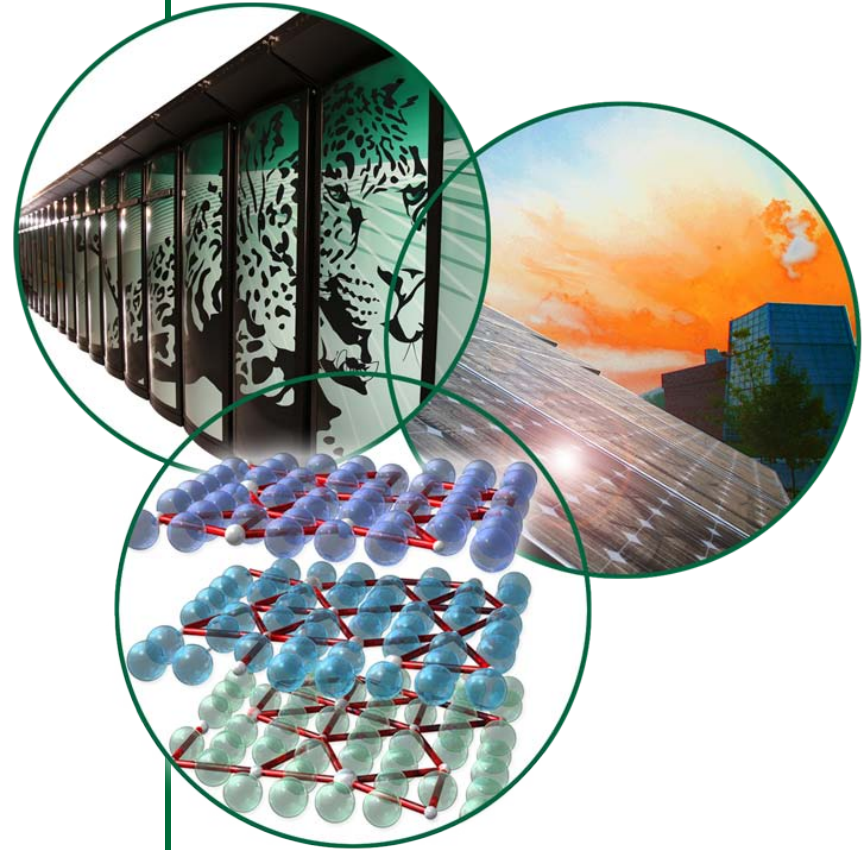
Towards Highly Interactive, GPU-based Evaluation of Evacuation Transport Scenarios at State-Scale

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Brandon G. Aaby

Srikanth B. Yoginath

Sudip K. Seal, PhD



RealSim Program at ORNL

Real-Time Data Driven Simulation System

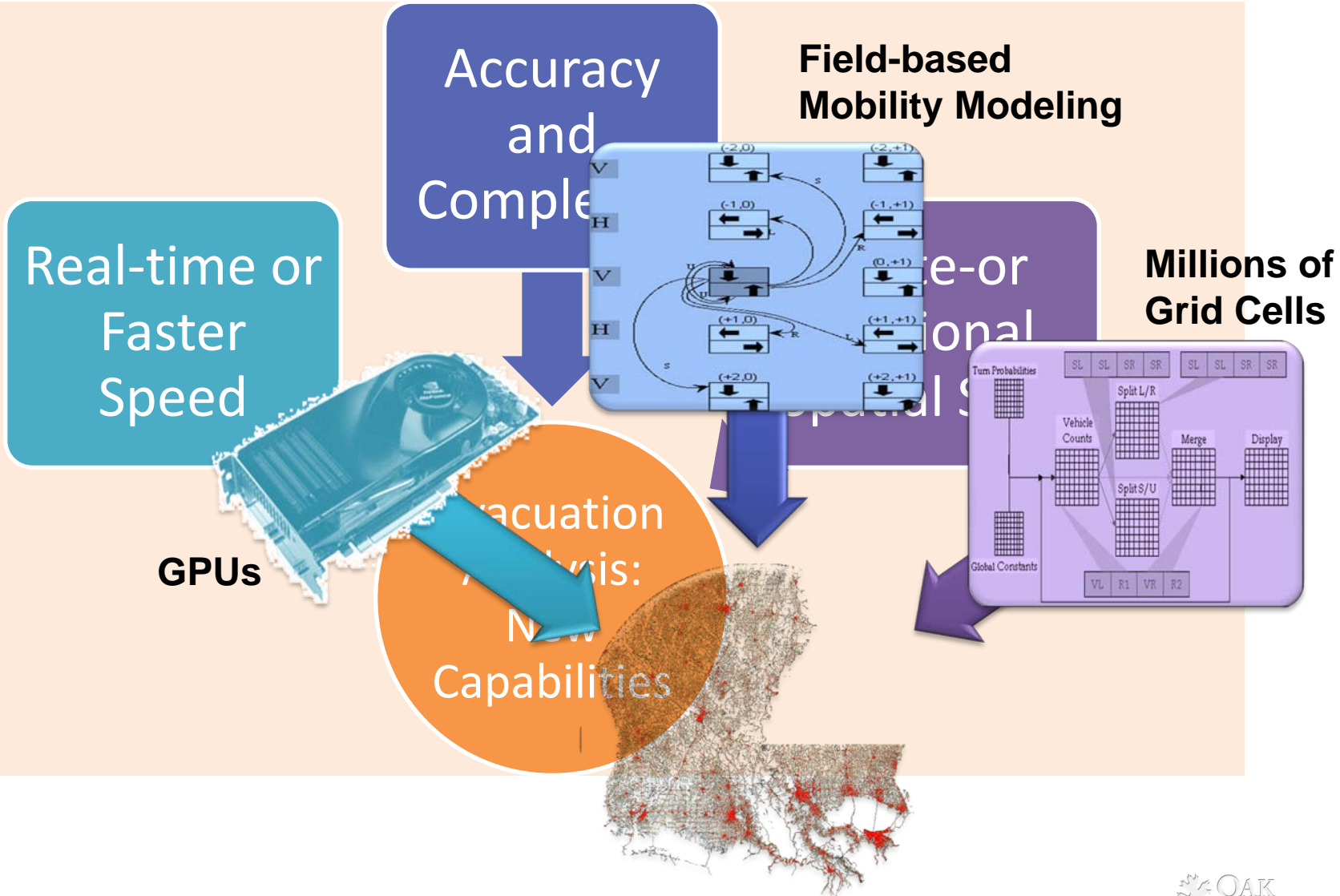
- Kalyan Perumalla, Ph.D. (PI)
- Brian Worley, Ph.D. (Director)
- Vladimir Protopopescu, Ph.D.
- Srikanth Yoginath
- Sudip Seal, Ph.D.
- Brandon Aaby
- Clayton Thurmer
- Other collaborators



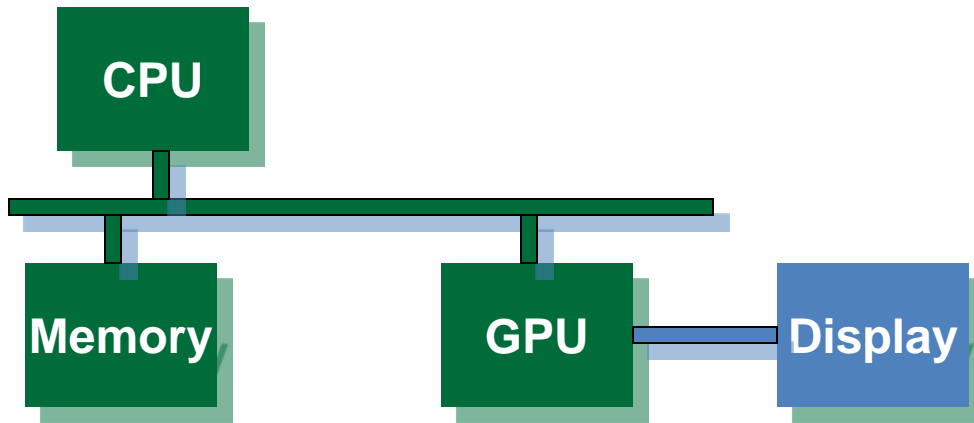
SERRI
Southeast Region
Research Initiative

Our Focus

Next Generation Computational Capability



GPU: Graphical Processing Units



➤ Affordable, off-the-shelf

➤ Desktop-based

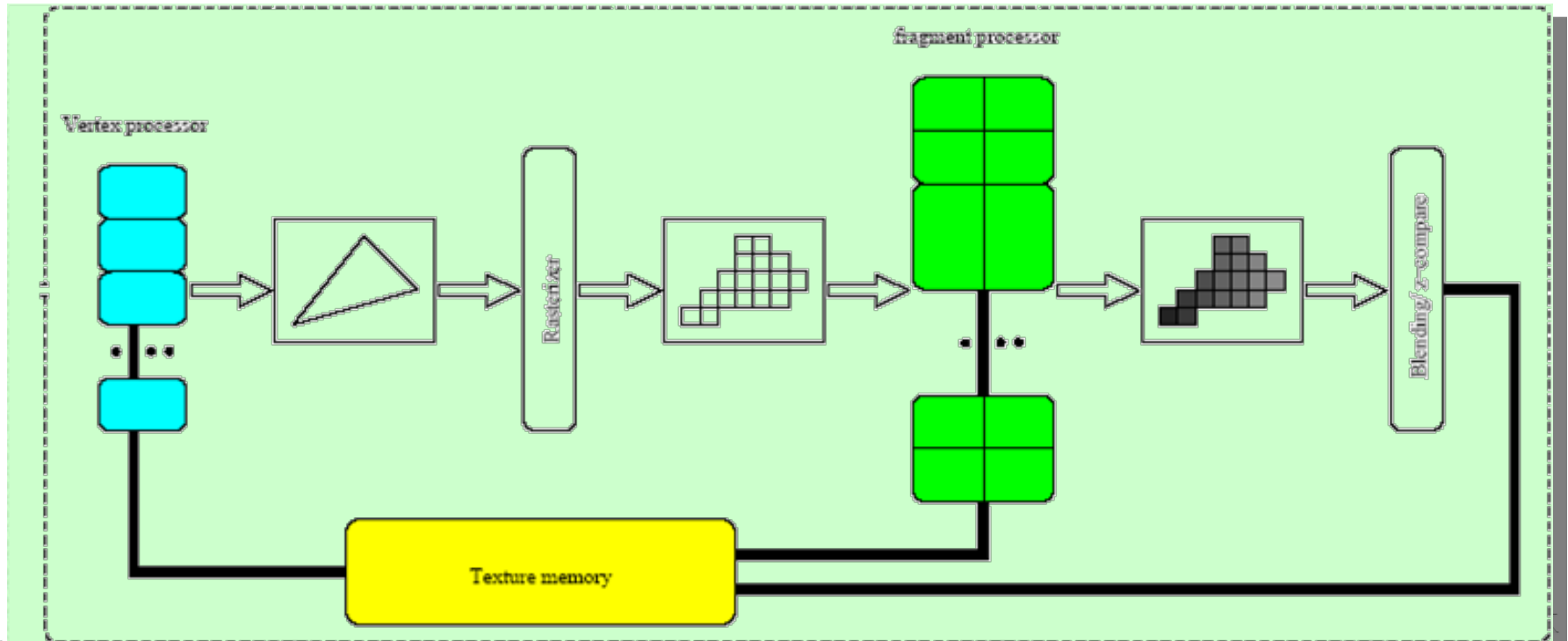
Example: NVIDIA

- Original GeForce 6000, 7000, 8000, and 9000 series
- Latest GTX 295
- Upcoming GTX 300

Graphics as Computation

Programmable graphics primitives

E.g., pixel shading such as bump mapping and patterned texture mapping



A Few other Popular Instantiations

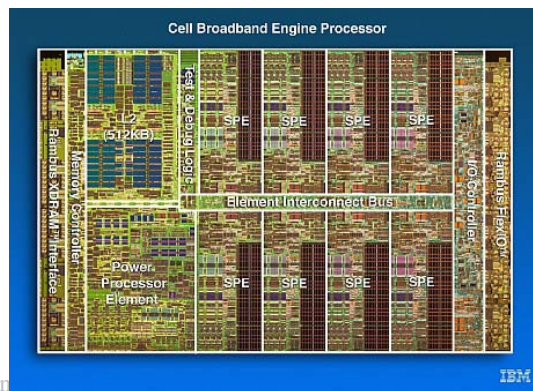
Commercial Offerings

- IBM Cell Processor
- NVIDIA GeForce, GTX
- NVIDIA Tesla



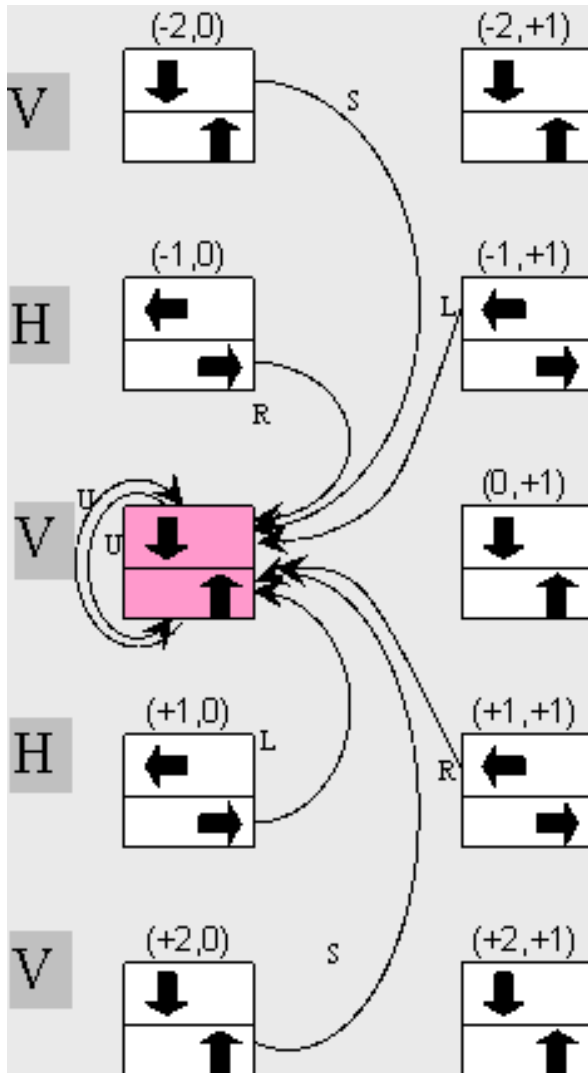
Supercomputing Scale

- LANL RoadRunner

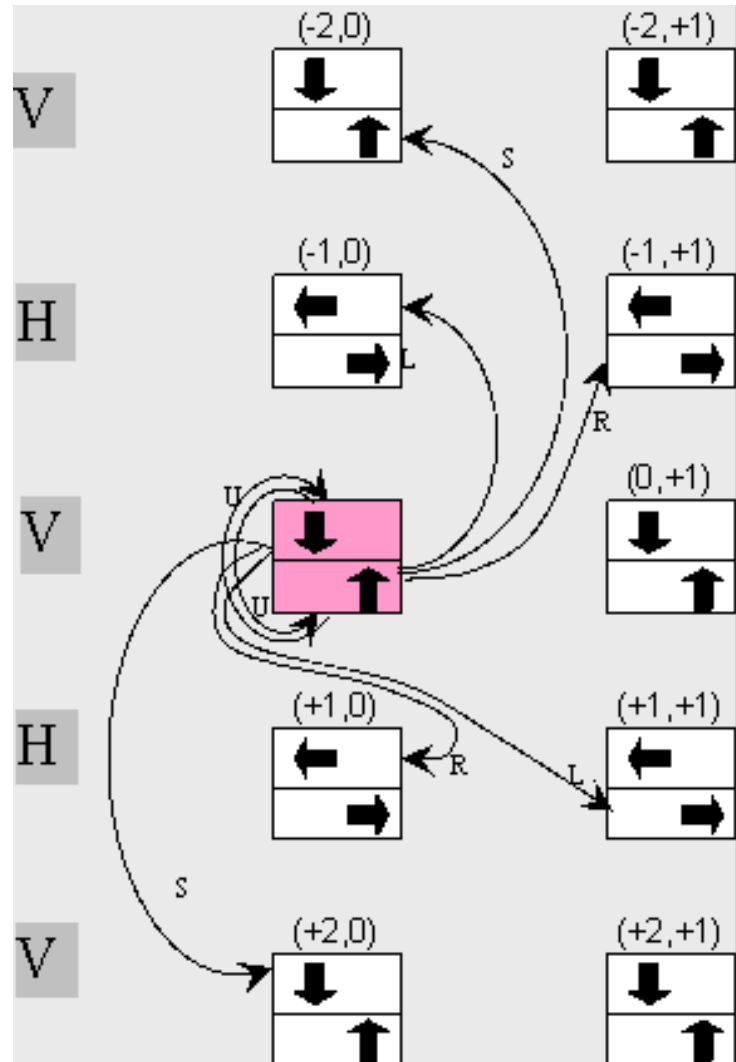


Vertical Grid Elements

Incoming

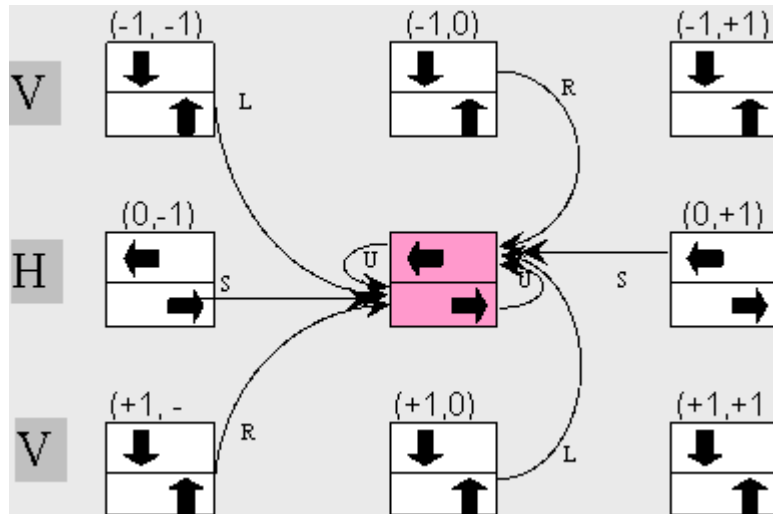


Outgoing

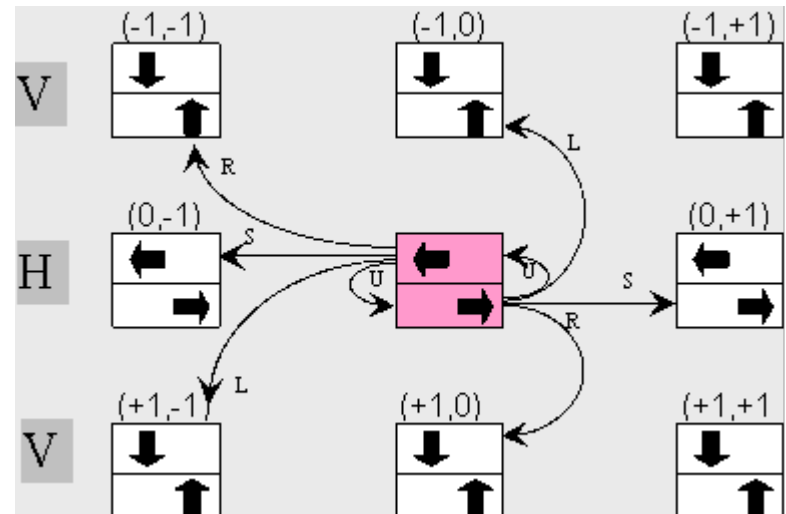


Horizontal Grid Elements

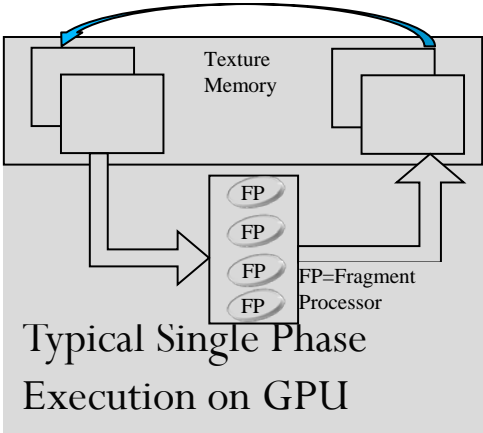
Incoming



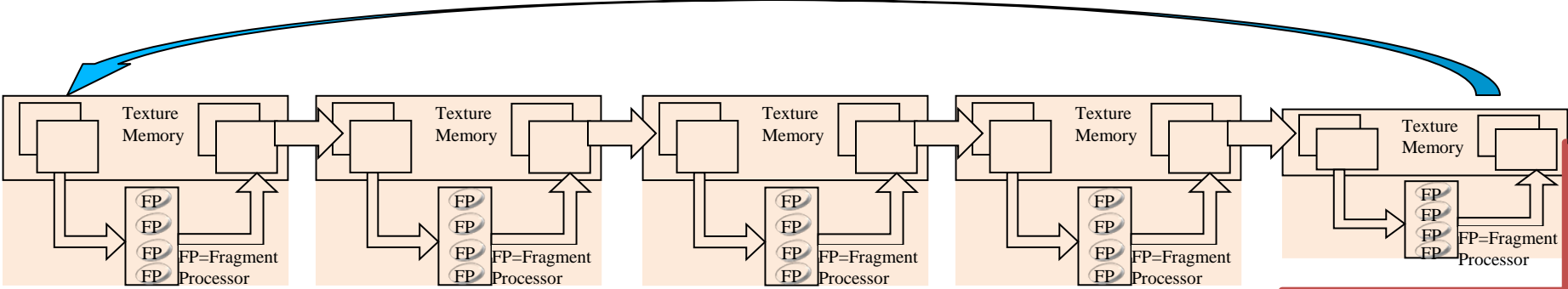
Outgoing



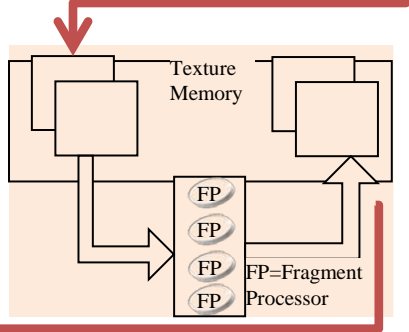
Field Model Execution Framework on GPU



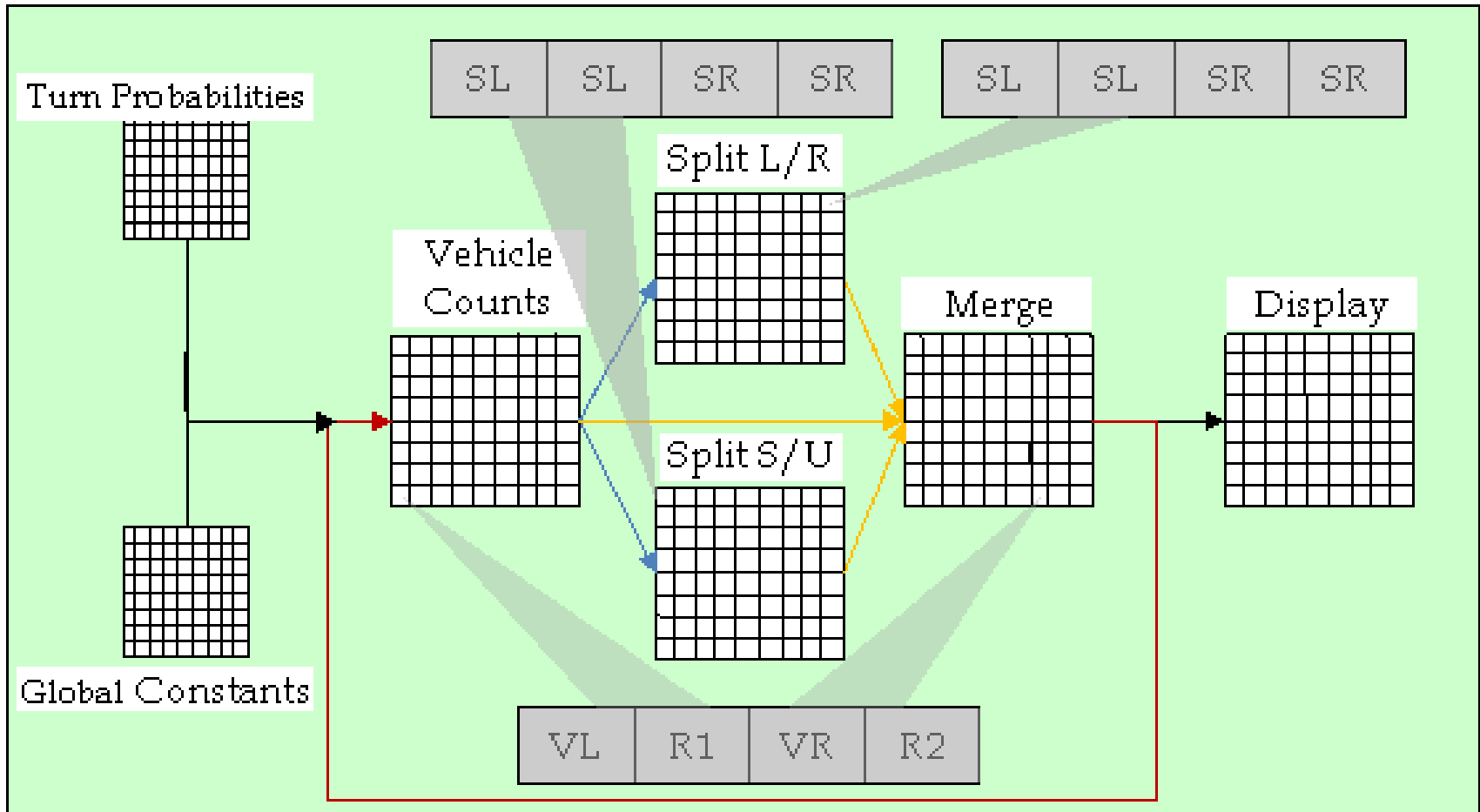
Our Multi-phase Execution Framework for Model Flexibility



GARFIELD
Configurable Display
with User
Interaction



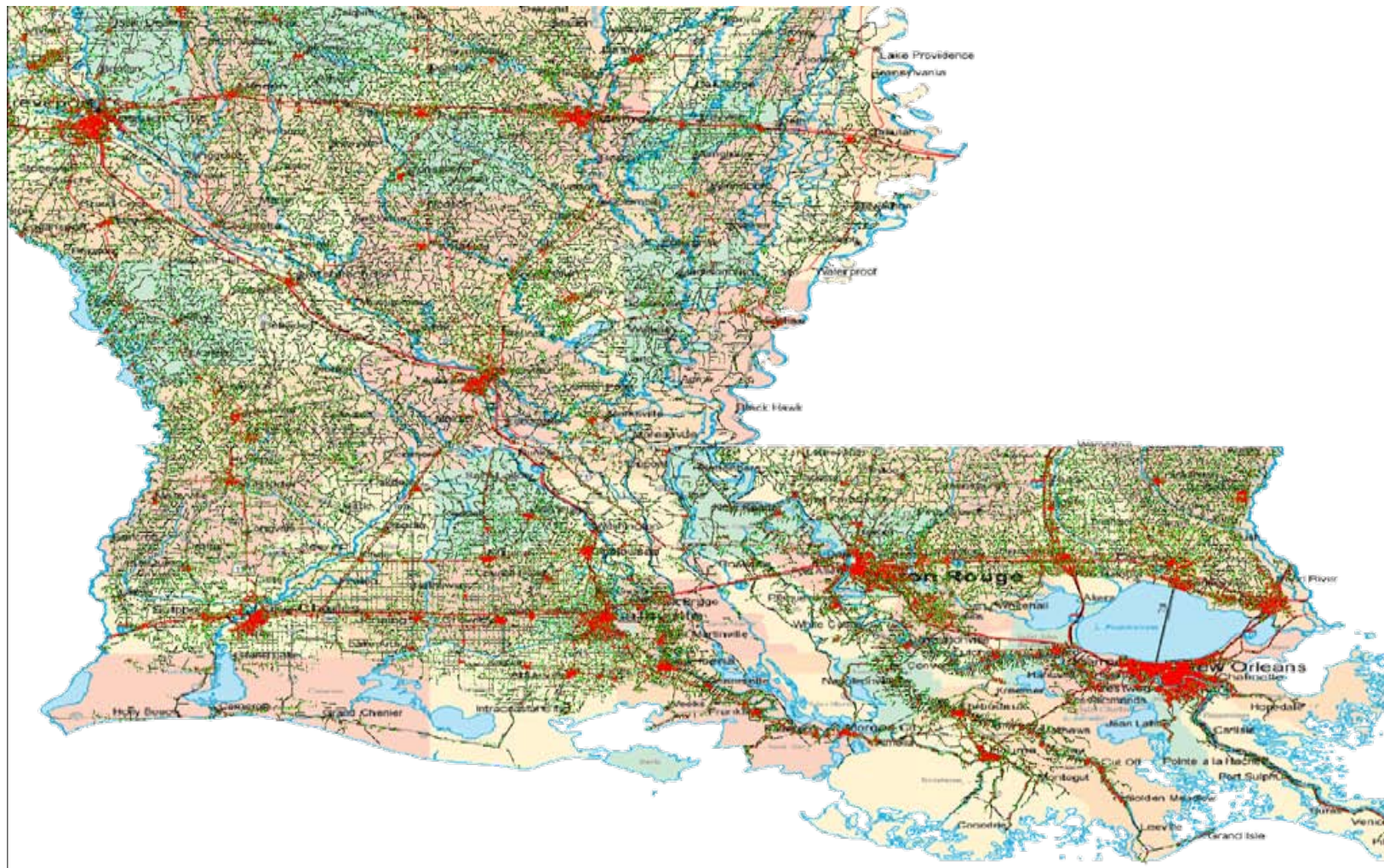
GPU Data Structures and Execution



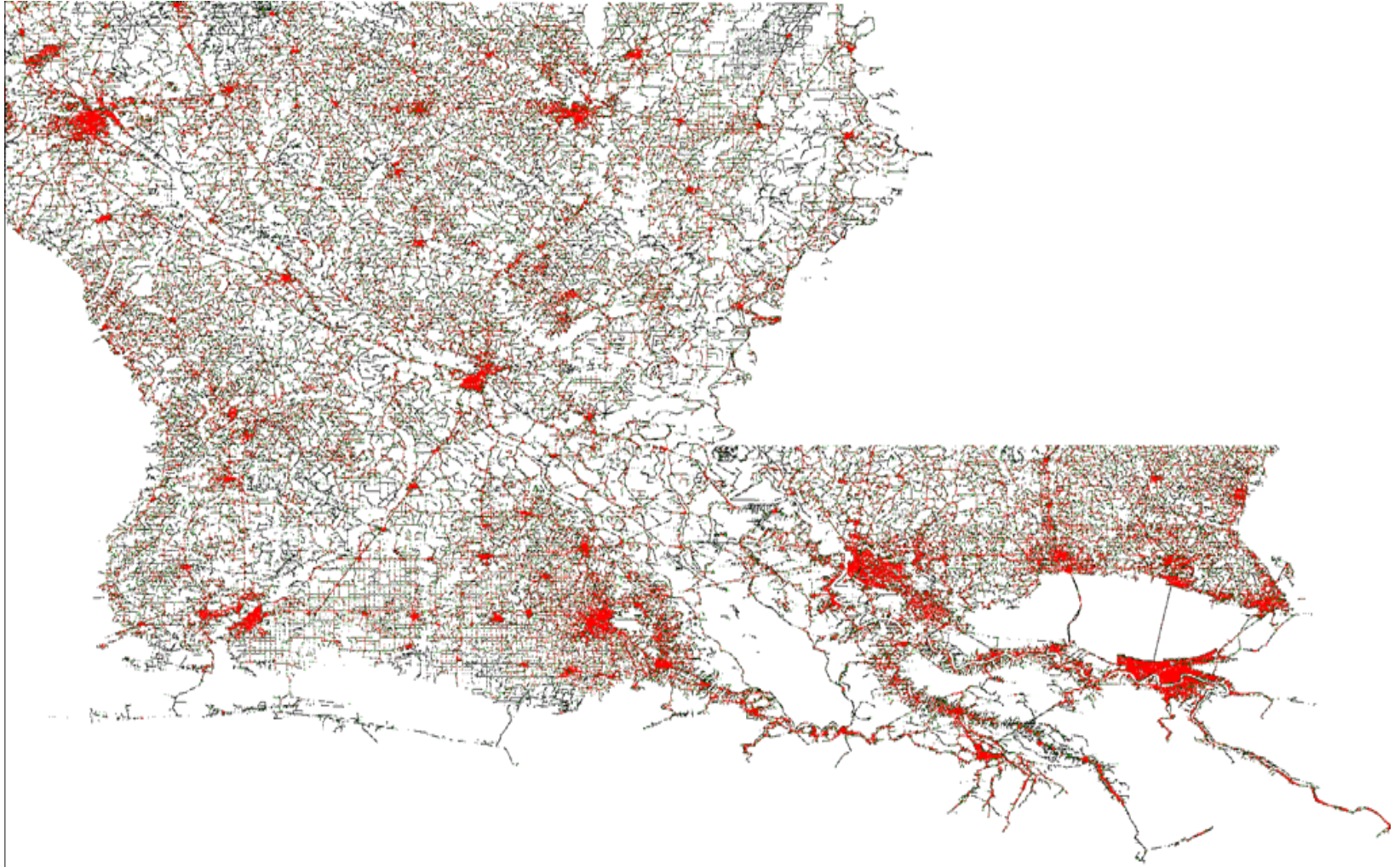
System Functional Architecture



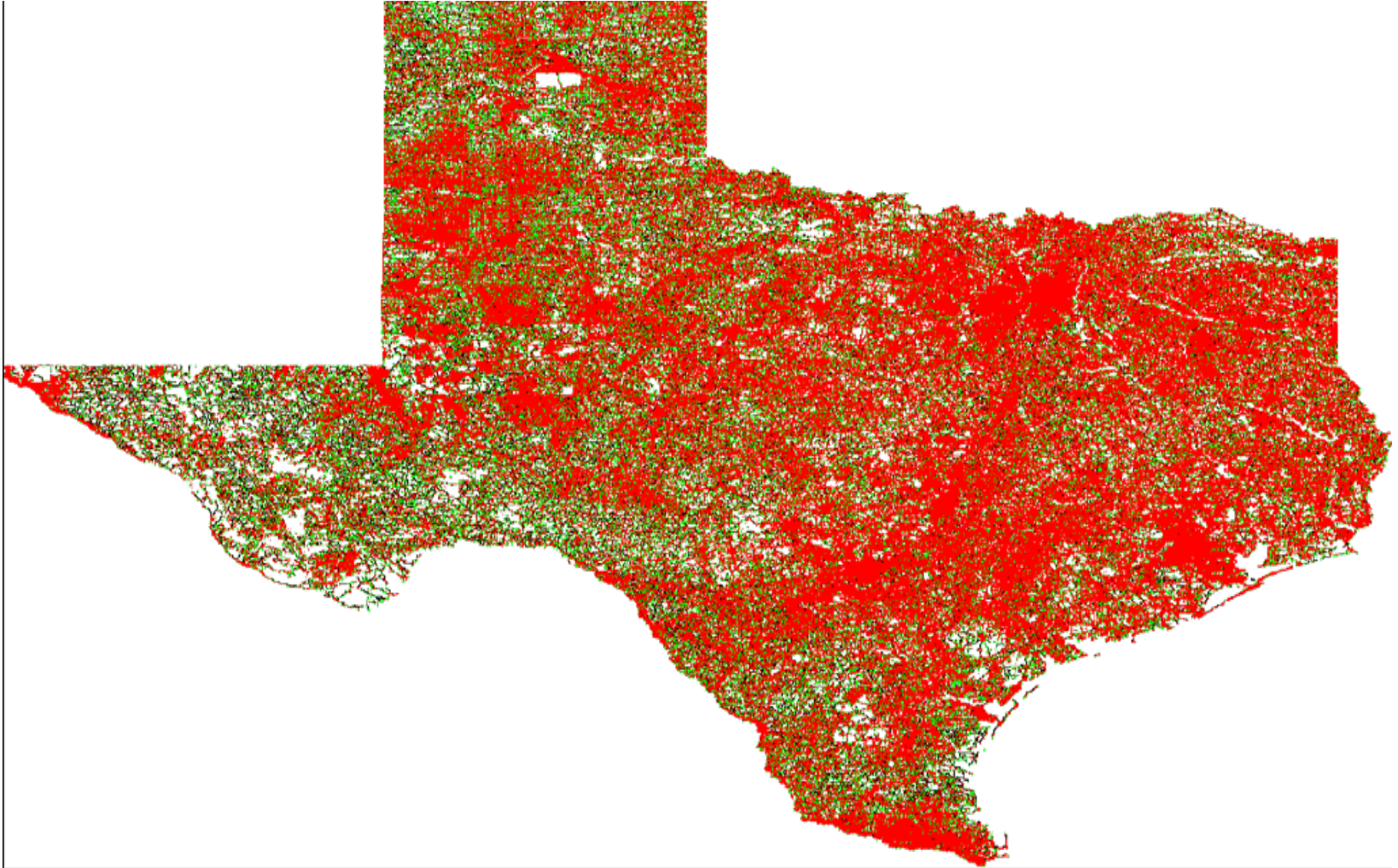
Louisiana



Louisiana (continued)



Texas



Texas (continued)



Example Timing Results

			Texture	Evac Time	Run Time
State	Nodes	Links	X×X	Hours	Sec
DC	9,559	14,884	1048576	35.20	54.90
LA	413,574	988,458	4194304	65.07	409.59
TN	583,484	1,335,586	3211264	157.91	353.89
FL	1,048,506	2,629,268	4194304	179.20	611.83
TX	2,073,870	5,116,492	3211264	217.60	777.65

New Capabilities

First multi-million node/link road network simulation

First GPU-based execution of road network simulation

First field-based mobility formulation

For additional information
and animations,
visit our
RealSim webpage at
www.ornl.gov/~2ip

