



NewToolsNeeded 06/26/17



*Not everyone
needs the same tools*

*Which are you using?
&
What do you need?*





***Are you building Skyscrapers
Or
Dog Houses?***



A Disruptive Solution to the HPC (Parallel Processing) Problem



Disruptive Solution To HPC (PARALLEL PROCESSING)



MEASURABLE GOALS:

- **Provide multiple orders of magnitude improvement in application run-time speed;**
- **Provide an order of magnitude reduction in the time and cost to develop software;**
- **Allow application experts to design, build, and test software directly ;**
- **Allow newcomers to a project to quickly learn and understand complex software ;**



Disruptive Solution To HPC

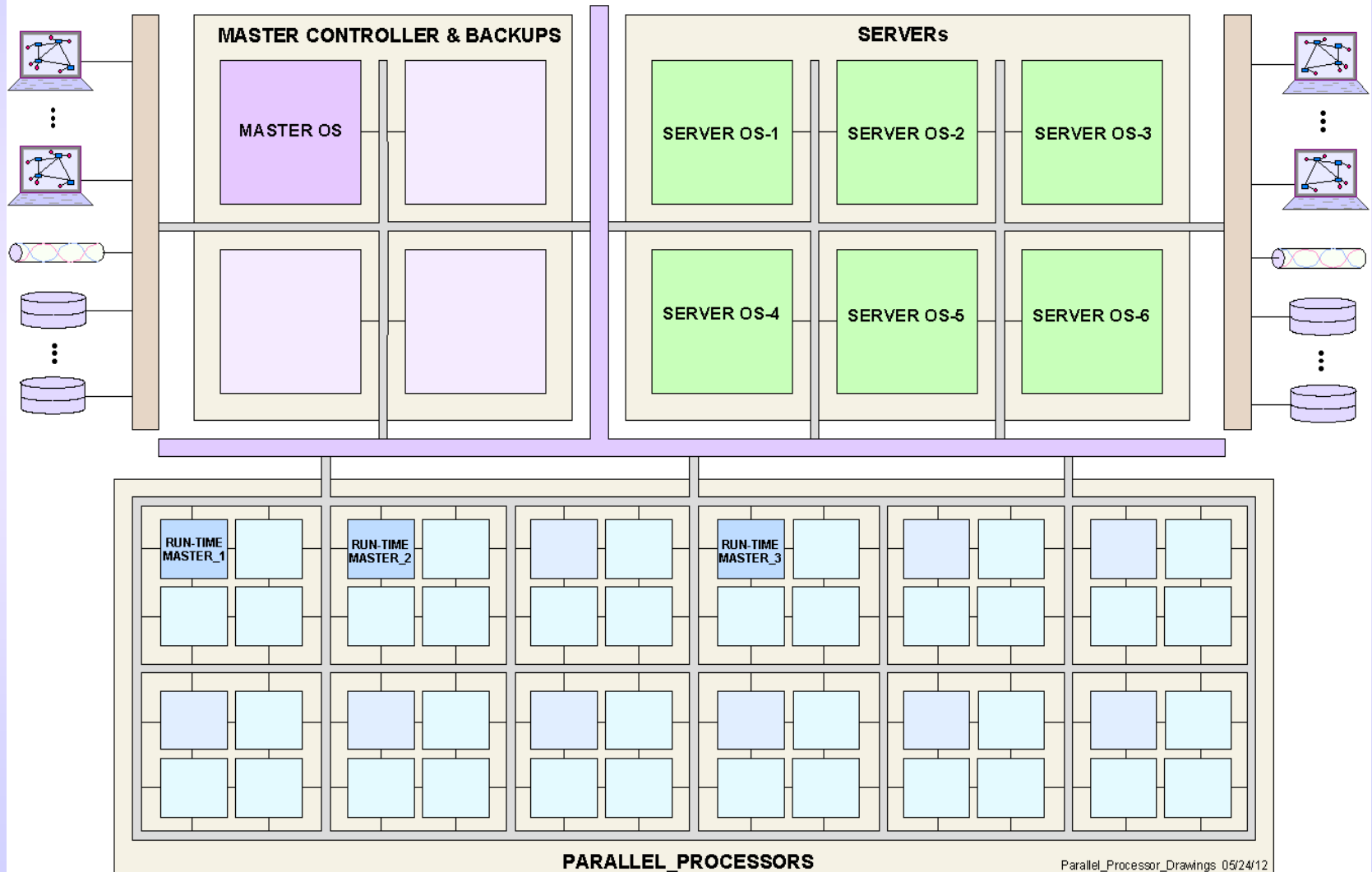


REPRESENTATIVE APPLICATIONS:

- **Adaptive Control of Large Groups of Autonomous Moving Platforms**
- **Human Body Organ simulation**
- **Global Climate prediction**
- **Fluid Flow simulation**
- **Biological Particle simulation**
- **Chemical - Molecular structure simulation**
- **Scanning, sorting, and correlating massive databases (Big Data)**
- **Weather prediction in mountainous terrain**
- **Power distribution simulation**
- **Electro-magnetic wave simulation**
- **Global HF power transmission**
- **Global Military Planning - Multiple moving platform simulation**



MUST DISTINGUISH BETWEEN SERVERS & PARALLEL PROCESSORS



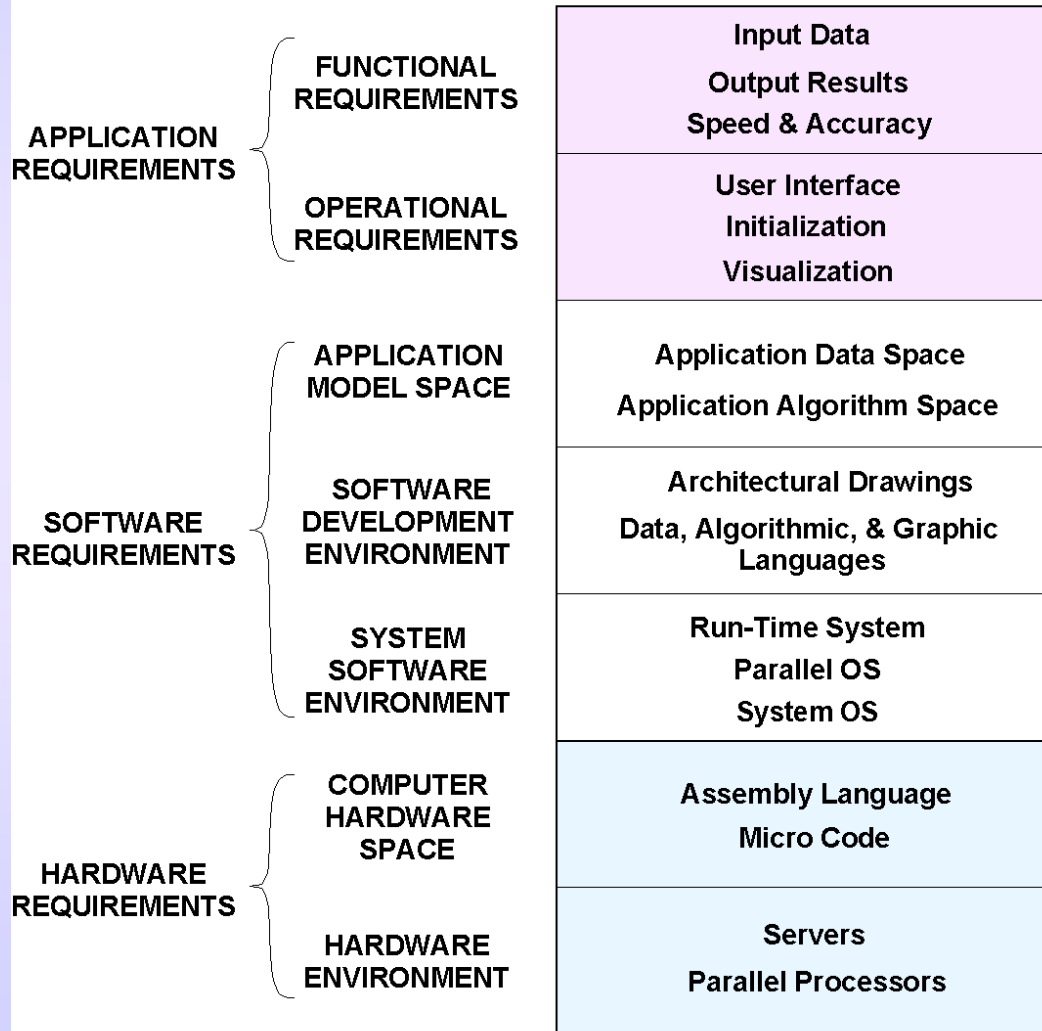
Parallel_Processor_Drawings 05/24/12



Disruptive Solution To HPC



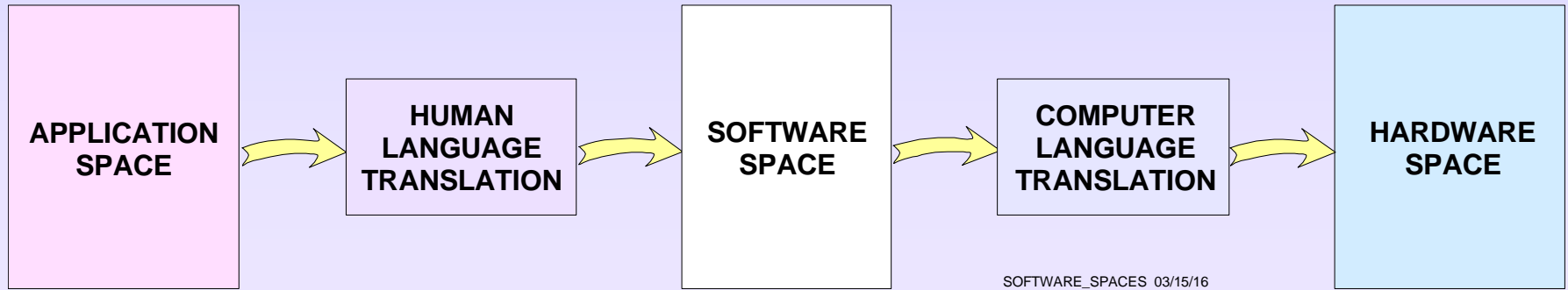
Seven Layer Model for Computer Technology



SEVEN_LAYER_MODEL 11/07/16



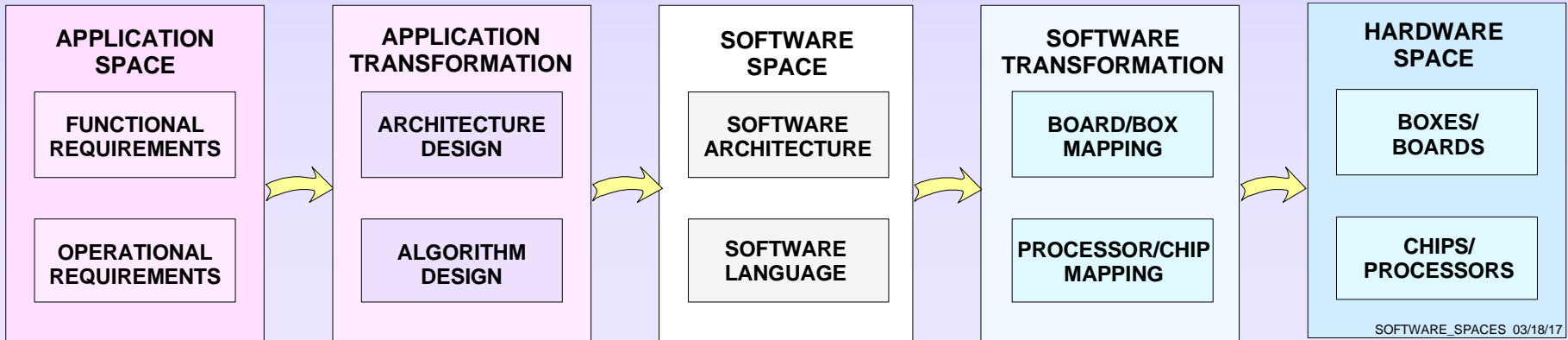
Disruptive Solution To HPC



Spaces for Translation of Application Requirements into Software & Hardware



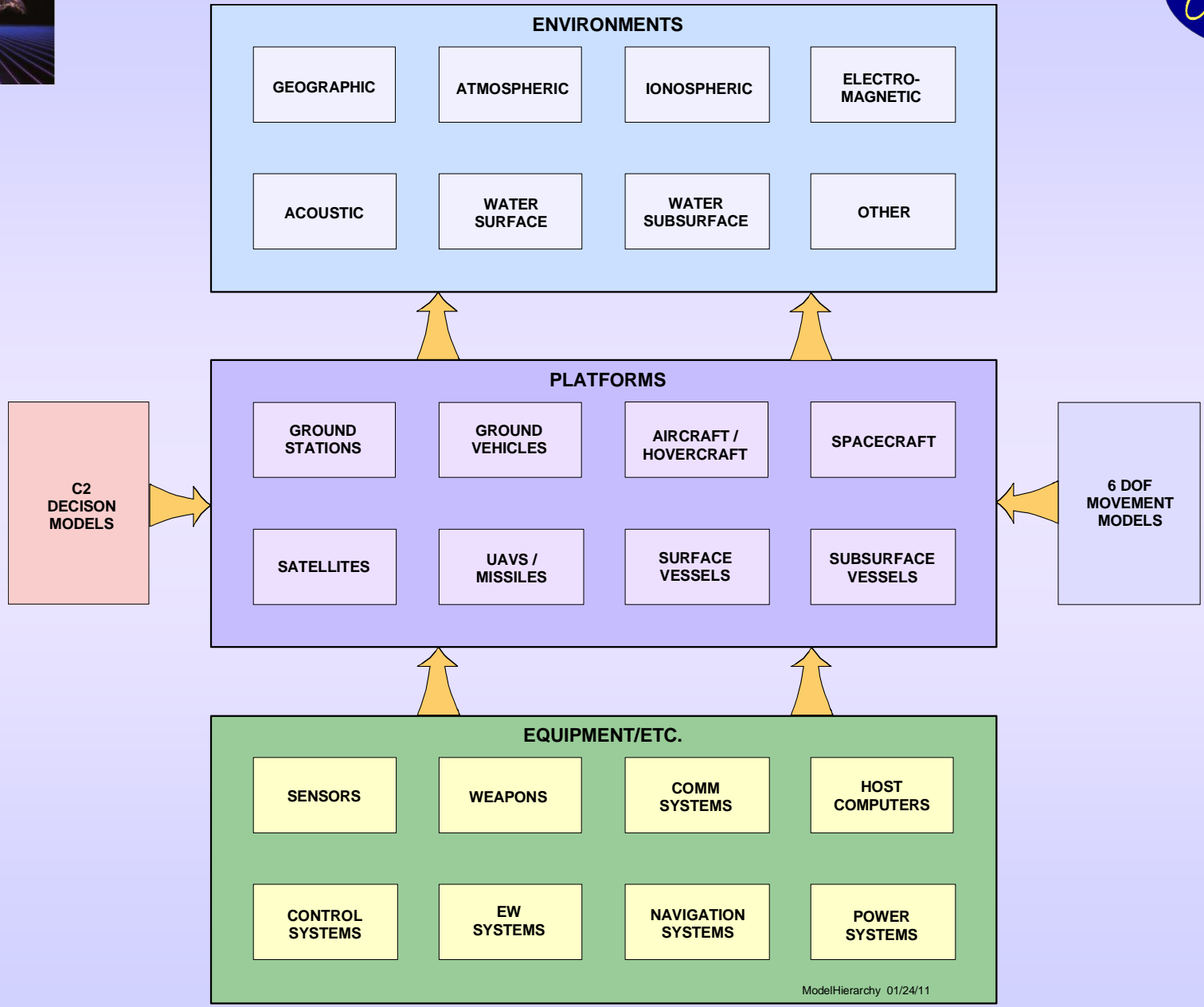
Disruptive Solution To HPC



Spaces for Translation of Application Requirements into Software & Hardware



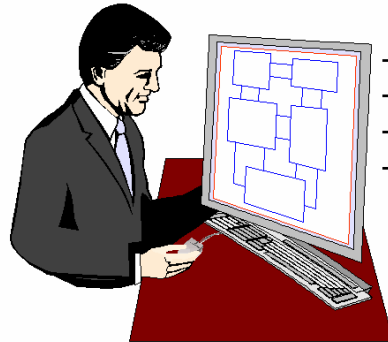
MODEL SPACE HIERARCHY



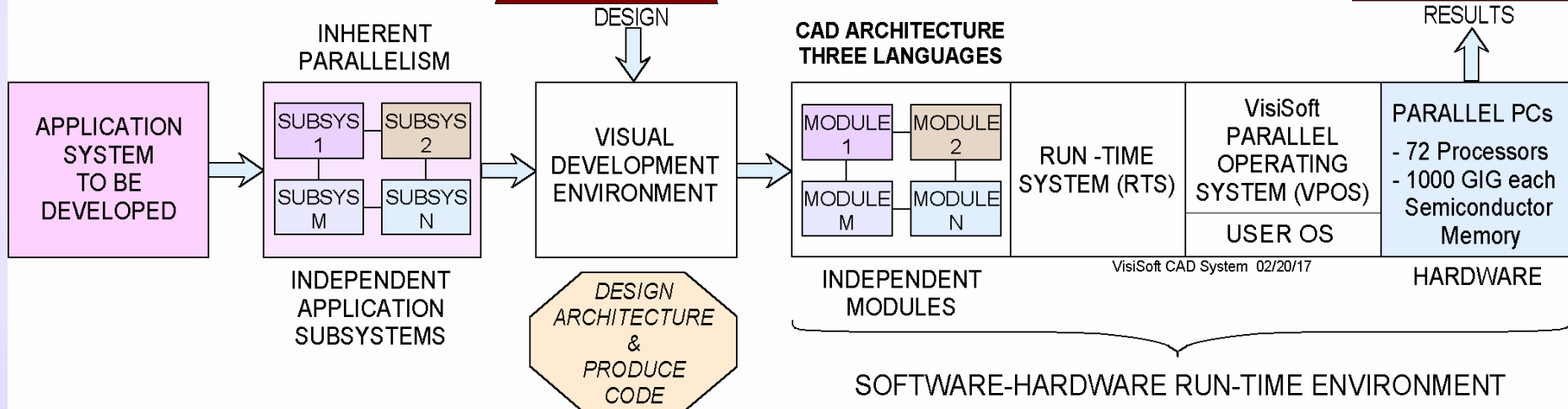
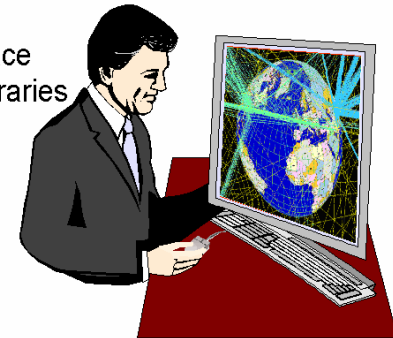
ModelHierarchy 01/24/11



Disruptive Solution To HPC



- APPLICATION EXPERTS USE
- CAD GUI
 - Engineering Drawings
 - Natural Language
 - Large Libraries
 - Graphical User Interface
 - Large Geographic Libraries
 - Interactive Facilities



Visual Software Engineering Using A CAD System For Building Complex Software



Disruptive Solution To HPC



RESOURCE: TRANSCEIVER		INSTANCES: TRANSMITTER RECEIVER	
GENERAL PARAMETERS			
1	TRANSMITTER_POWER	REAL	INITIAL_VALUE 100
1	RECEIVER_THRESHOLD	REAL	INITIAL_VALUE 120
RADIO			
1	TRANSCEIVER	STATUS	TRANSMITTING RECEIVING IDLE OFF
1	LOCATION		
2	X_POSITION	REAL	
2	Y_POSITION	REAL	
2	ELEVATION	REAL	
1	ANTENNA_HEIGHT	REAL	
1	ANTENNA_GAIN	REAL	
RECEIVER CONNECTIVITY VECTOR			
1	POWER_AT_RECEIVER	REAL	
1	TOTAL_NOISE_POWER	REAL	
1	CONNECTIVITY_MATRIX		
2	PROPAGATION_LOSSES		
3	TERRAIN_LOSS	REAL	
3	FOLIAGE_LOSS	REAL	
3	TOTAL_LOSS	REAL	
2	SIGNAL_POWER	REAL	
2	SIGNAL_TO_NOISE_RATIO	REAL	
2	LINK_DELAY	REAL	
2	LINK	STATUS	GOOD FAIR POOR
TRANSCEIVER RULES			
1	TRANSCEIVER_PROCESS	RULES	GOOD_RECEPTION CONFLICTING_RECEPTION CONFLICTING_BROADCAST

A Space - Data Structure (a RESOURCE)



Disruptive Solution To HPC



```
PROCESS: RECEPTION                                RESOURCES: TRANSCEIVER
INSTANCES: TRANSMITTER                           MESSAGE_FORMATS
           RECEIVER                               TRANSMITTER_OUTPUT
```

```
START_RECEPTION
  IF TRANSCEIVER IS IDLE
    EXECUTE GOOD_RECEPTION
  ELSE IF TRANSCEIVER IS RECEIVING
    EXECUTE CONFLICTING_RECEPTION
  ELSE IF TRANSCEIVER IS TRANSMITTING
    EXECUTE CONFLICTING_BROADCAST .

GOOD_RECEPTION
  IF SIGNAL_TO_NOISE_RATIO IS GREATER THAN RECEIVER_THRESHOLD
    SET TRANSCEIVER TO RECEIVING
    ADD SIGNAL_POWER TO TOTAL_POWER_AT_RECEIVER .
    CALL DECODE_MESSAGE .

    IF MESSAGE_TYPE IS FORMAT_A
      AND SYNC_CODE IS VALID
      AND LAST_SYMBOL IS A_TERMINATOR
        EXECUTE SEND_ACKNOWLEDGEMENT .

CONFLICTING_RECEPTION
  IF POWER_AT_RECEIVER IS GREATER THAN SIGNAL_POWER
    SCHEDULE ABORT_RECEIVE NOW .

CONFLICTING_BROADCAST
  CANCEL END_RECEIVE NOW
  SCHEDULE START_RECEIVE IN EXPON(0.83) MILLISECONDS
  WITH PRIORITY 80

SEND_ACKNOWLEDGEMENT
  MOVE ACKNOWLEDGEMENT TO TRANSMIT_MESSAGE_BUFFER
  IF DESTINATION IS BROADCAST
    SEARCH LINK_CONNECTIVITY_VECTOR OVER RECEIVER
    EXECUTING TRANSMISSION
    WHEN LINK IS GOOD
  ELSE EXECUTE TRANSMISSION .

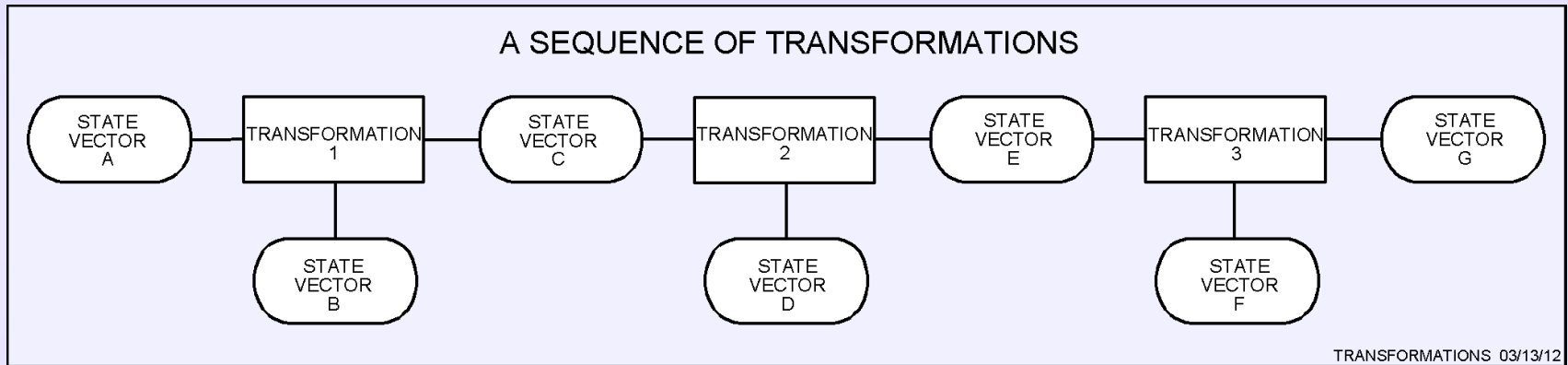
TRANSMISSION
  SCHEDULE LINK_RECEPTION
  IN LINK_DELAY MICROSECONDS
  USING TRANSMITTER, RECEIVER
```



Disruptive Solution To HPC



Spaces for Translation of Application Requirements into Software & Hardware



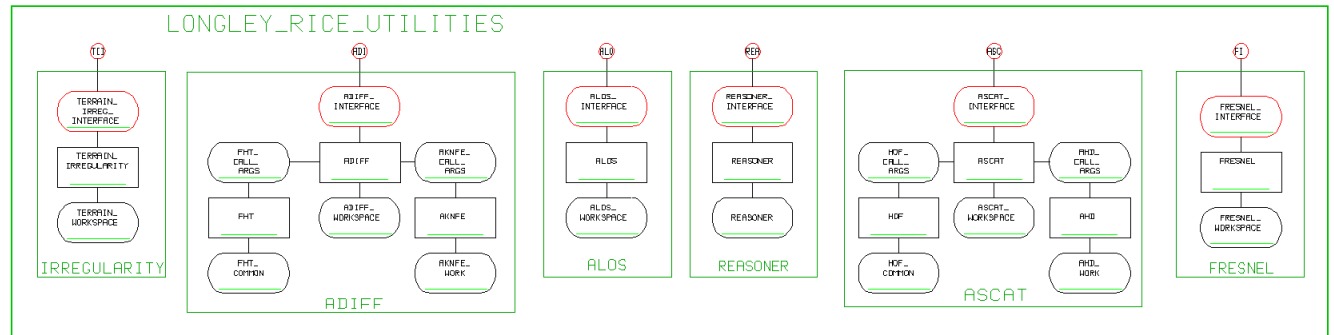
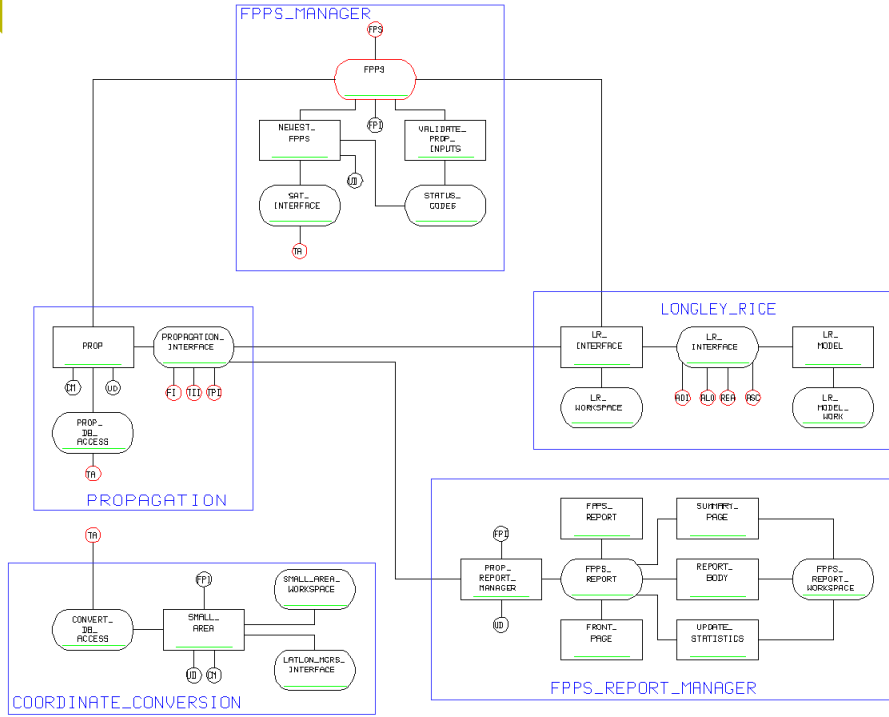
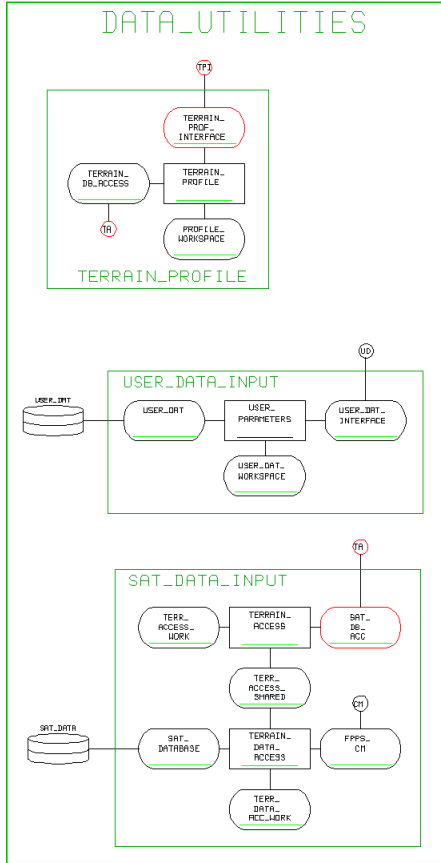
Connecting Resources & Processes to Create a Sequence of Transformations



Disruptive Solution To HPC



PROPAGATION_PREDICTION



FPPS 08/26/07

Create a Hierarchy of Software Modules



Disruptive Solution To HPC

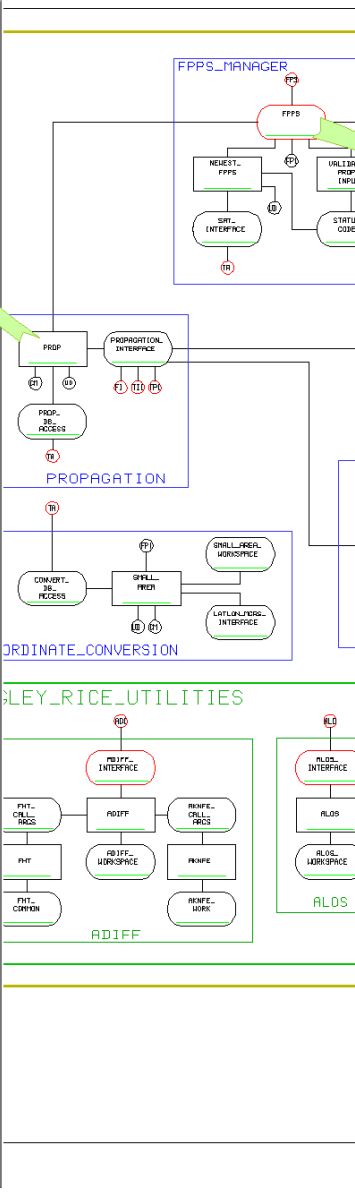


```

[C:\S\LIBS\FPPS_VERSIONS\FPPS\PROP_FOR_PICTURE.PRO]
Search View Format Column Macro Advanced Window Help
FILE PRO

1 PROPAGATION MODEL
2 IF USER_DATA_STATUS IS NOT INITIALIZED
3 MOVE USER_DAT_INTERFACE TO USER_DATA
4 EXECUTE FOLIAGE_HEIGHT_INPUT .
5
6 IF SYSTEM_ACTION IS PROPAGATION_CALC
7 OR SYSTEM_ACTION IS EQUAL TO LOS
8 EXECUTE COMPUTE_SECTION
9 ELSE
10 IF SYSTEM_ACTION IS RECOMPUTE
11 EXECUTE RECOMPUTE_SECTION .
12
13 IF ERROR_CODE IS NOT DETECTED
14 AND REPORT_SELECTION IS OPEN
15 CALL PROP_REPORT_MANAGER .
16
17 FOLIAGE_HEIGHT_INPUT
18 IF PROCESS_FOLIAGE_FLAG IS SET
19 MOVE USER_DAT_INTERFACE AVER_BUILDING_HEIGHT
20 TO FOLIAGE_HEIGHT .
21
22 COMPUTE_SECTION
23 CALL VALIDATE_PROP_INPUTS
24 IF ERROR_CODE IS DETECTED
25 EXIT THIS RULE .
26
27 EXECUTE COMPUTE_COORDINATES
28 EXECUTE COMPUTE_ANTENNA_HEIGHTS
29 EXECUTE CALCULATE_FREESPACE_LOSS
30 EXECUTE BUILD_TERRAIN_PROFILE
31
32 IF PATH_PROFILE_ONLY_FLAG IS SET
33 EXIT THIS RULE.
34
35 CALL TERRAIN_IRREGULARITY
36 IF PROCESS_FOLIAGE_FLAG IS SET
37 EXECUTE INVOKE_FOLIAGE_MODEL .
38
39 EXECUTE CALC_EFF_ANT_HEIGHTS
40 EXECUTE INVOKE_TERRAIN_MODEL
41 EXCESS_PATH_LOSS = EXCESS_PATH_LOSS + FOLIAGE_LOSS
42
43 RECOMPUTE_SECTION
44 EXECUTE CALCULATE_FREESPACE_LOSS
45 IF PROCESS_FOLIAGE_FLAG IS SET
46 EXECUTE INVOKE_FOLIAGE_MODEL .
47
48 EXECUTE INVOKE_TERRAIN_MODEL
49
50 COMPUTE_COORDINATES
51 START_X = (XMTR_REL_X + DBASE_SCALE) / DBASE_SCALE
52 START_Y = (XMTR_REL_Y + DBASE_SCALE) / DBASE_SCALE
53 END_X = (RCVR_REL_X + DBASE_SCALE) / DBASE_SCALE
54 END_Y = (RCVR_REL_Y + DBASE_SCALE) / DBASE_SCALE

```



```

Ultraedit-32 - [C:\S\LIBS\FPPS_VERSIONS\FPPS\FPPS.RES]
File Edit Search View Format Column Macro Advanced Window Help
FPPS.RES

1 FPPS INPUT DATA
2 SYSTEM_PARAMETERS
3
4 2 SYSTEM ACTION
5 ALIAS VALID_SYSTEM_ACTION VALUE 'C','R','X','Y'
6 ALIAS INITIALIZATION VALUE 'I'
7 ALIAS TRANSFORMATION VALUE 'X','Y'
8 ALIAS PROPAGATION_CALC VALUE 'C','R','P'
9 ALIAS REPORT VALUE 'T'
10
11 2 ALGORITHM_CHOICE
12 ALIAS VALID_ALG_CHOICE VALUE 6,7,8,9
13 ALIAS GET_ELEVATION VALUE 1
14 2 PATH_PROFILE_ONLY_FLAG
15 ALIAS SET VALUE 'Y'
16 2 LOS_ONLY_FLAG
17 ALIAS SET VALUE 'Y'
18 2 PROCESS_FOLIAGE_FLAG
19 ALIAS SET VALUE 'Y'
20 2 REPORT_SELECTION
21 ALIAS VALID_RPT_SELECTION VALUE 'F','S','M'
22 ALIAS OPEN VALUE 'F','S'
23 ALIAS FULL VALUE 'F'
24 ALIAS SUMMARY VALUE 'S'
25 2 PAD
26 ALIAS SET VALUE 'S'
27
28 1 COORDINATE_SYSTEM
29 ALIAS VALID_COORD_SELECTION VALUE 'I','M','L'
30 ALIAS LATION VALUE 'L'
31 ALIAS MGRS VALUE 'M'
32 ALIAS INTERNAL VALUE 'I'
33
34 1 XMTR_POSITION
35 2 XMTR_REL_POSITION
36 3 XMTR_REL_X REAL
37 3 XMTR_REL_Y REAL
38 3 XMTR_REL_Z REAL
39 2 XMTR_MGR_POSITION
40 2 XMTR_GEO_POSITION
41 3 XMTR_LAT REAL
42 3 XMTR_LON REAL
43 2 XMTR_ANTENNA_HEIGHT REAL
44 2 XMTR_ANTENNA_REFERENCE CHAR 1
45 ALIAS VALID_REFERENCE VALUE 'S','G'
46 ALIAS SEA VALUE 'S'
47 ALIAS GROUND VALUE 'G'
48
49 1 RCVR_POSITION
50 2 RCVR_REL_POSITION
51 3 RCVR_REL_X REAL
52 3 RCVR_REL_Y REAL
53 3 RCVR_REL_Z REAL
54 2 RCVR_MGR_POSITION
55 2 RCVR_GEO_POSITION
56 3 RCVR_LAT REAL
57 3 RCVR_LON REAL
58 2 RCVR_ANTENNA_HEIGHT REAL
59 2 RCVR_ANTENNA_REFERENCE CHAR 1

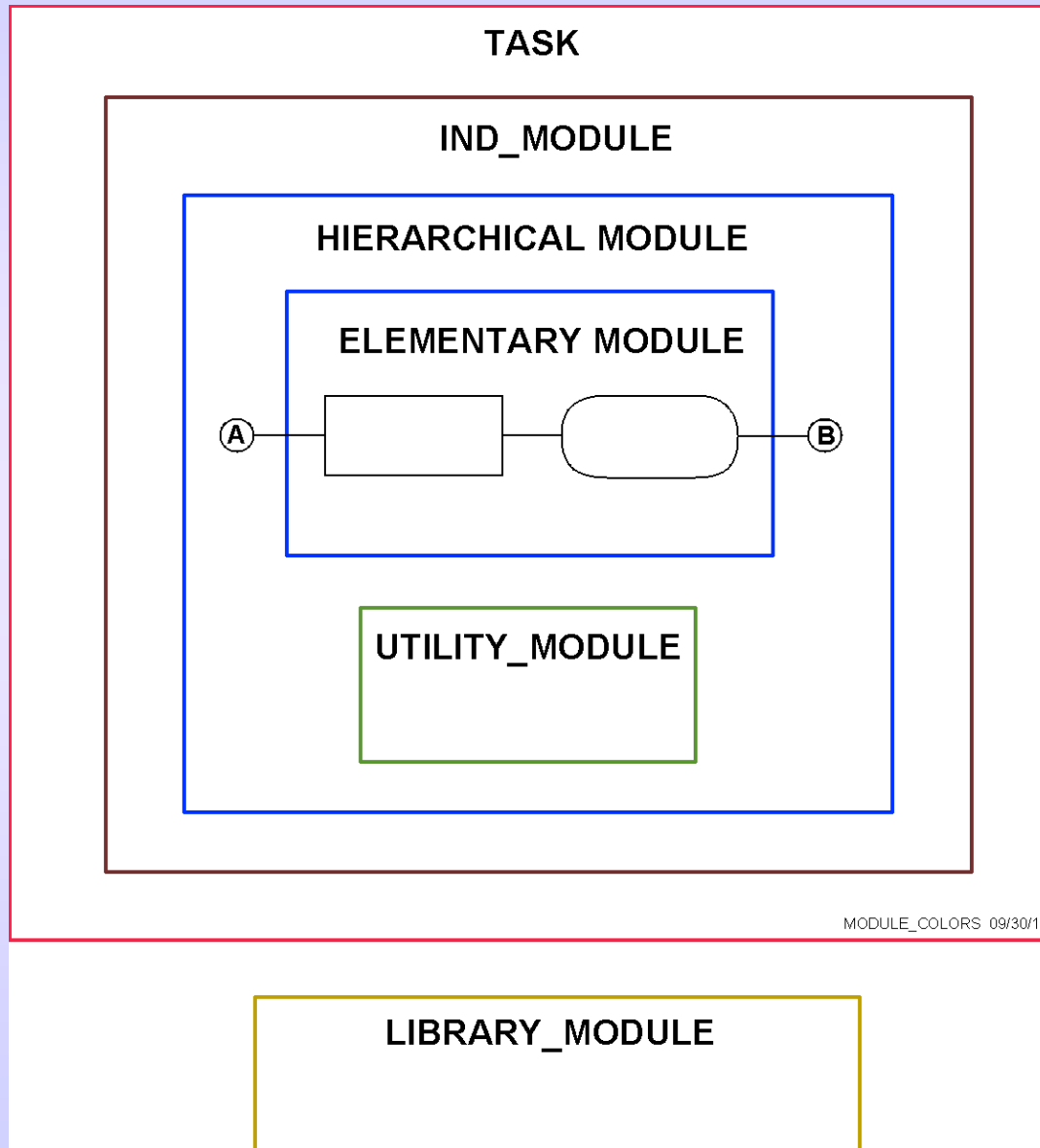
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Double Click To Edit The Code



Disruptive Solution To HPC

TYPES OF MODULES





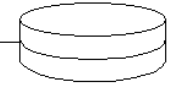
Disruptive Solution To HPC



TYPES OF RESOURCES

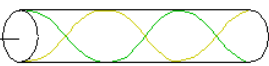
SHARED_RESOURCE	SHARED BETWEEN PROCESSES
SHARED_ALIAS	SHARED BETWEEN MODULES UTILITIES & LIBRARIES
LOCAL_INTERTASK	SHARED BETWEEN FAMILIES OF TASKS
GLOBAL_INTERTASK	SHARED BETWEEN GLOBAL TASKS
INTER_PROCESSOR	SHARED BETWEEN PROCESSORS
IP_ACCESS	ACCESS TO IP RESOURCES
PANEL_RESOURCE	SHARED WITH PANELS
FILE_RESOURCE	ACCESS TO FILES
CHANNEL_RESOURCE	ACCESS TO CHANNELS

FILE_NAME



ACCESS TO FILES

5004



192.168.0.10

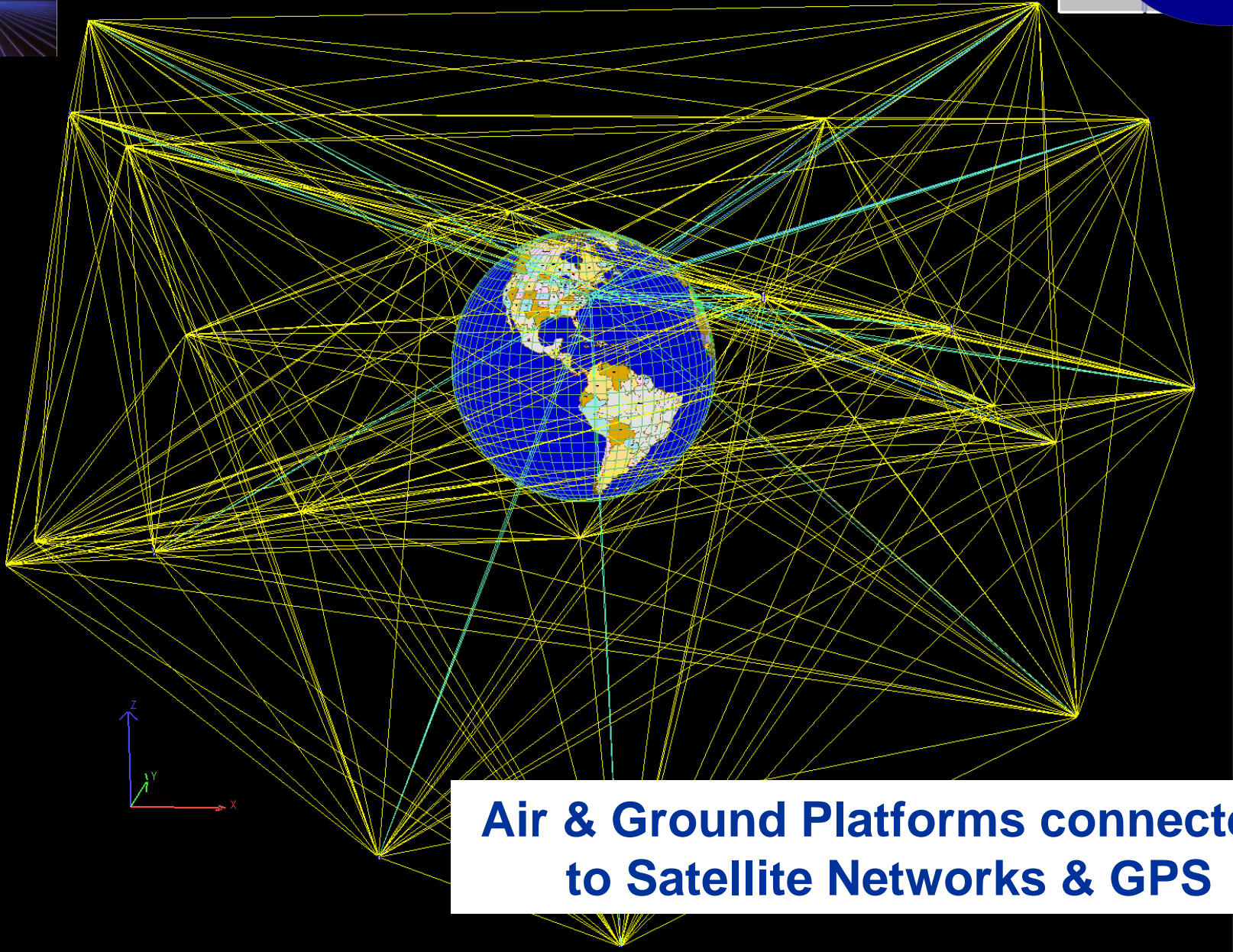


Disruptive Solution To HPC

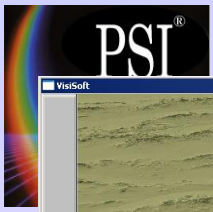


Time Graphics(RTG)

View from



Air & Ground Platforms connected to Satellite Networks & GPS



Disruptive Solution To HPC



View from BUTTONS

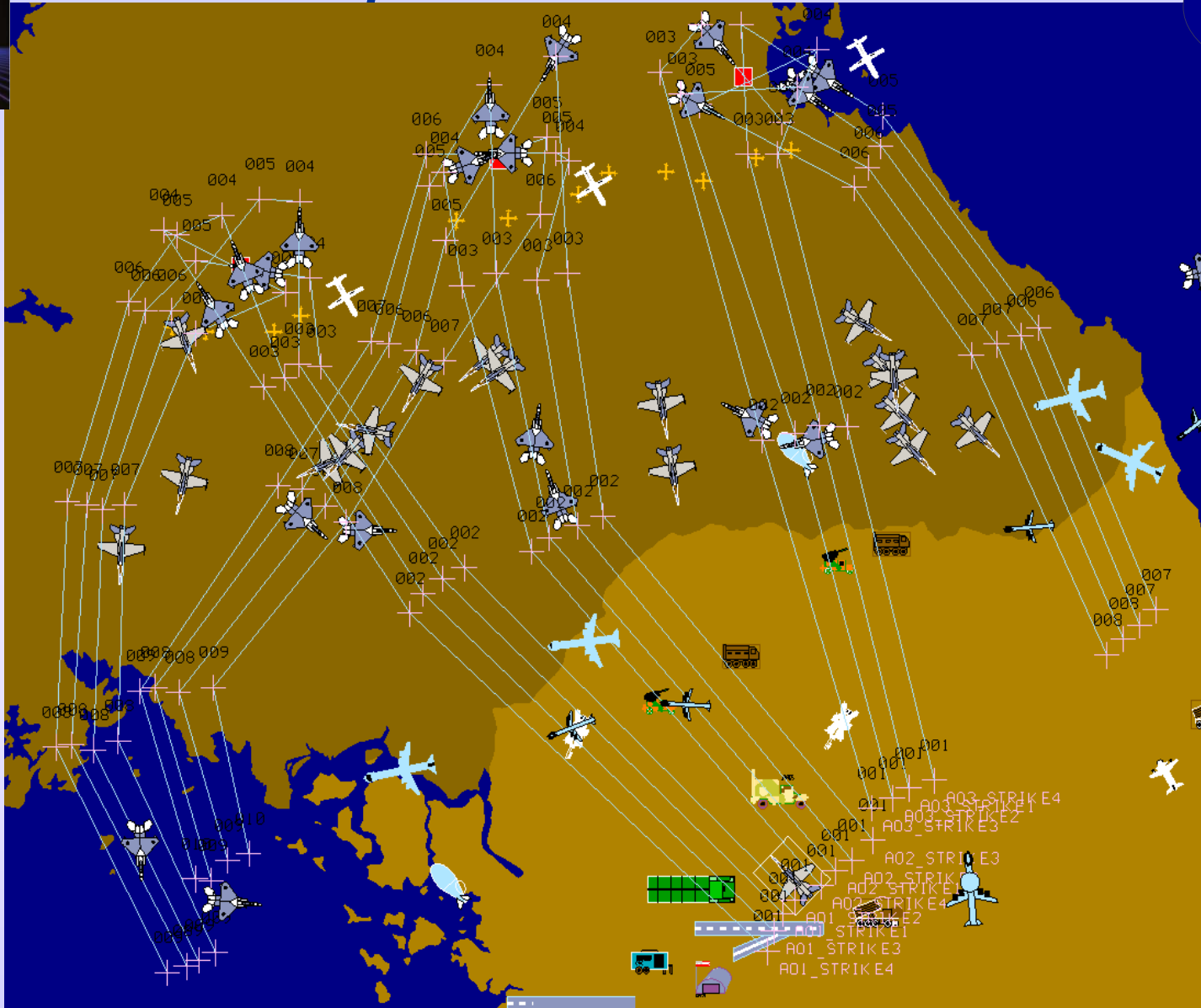
Tgl path
Tgl link
Golopath
Launch
Attach
Lst plot
Lbs off
Switch
Return
Up
Vrt
Cine
Map
Mesh

SIM 1
JAN 01 1

Escape Resume Stop Start Delete Copy Paste Undo Attach Detach Print Home Zoom Help Exit Move Show Open Merge Split

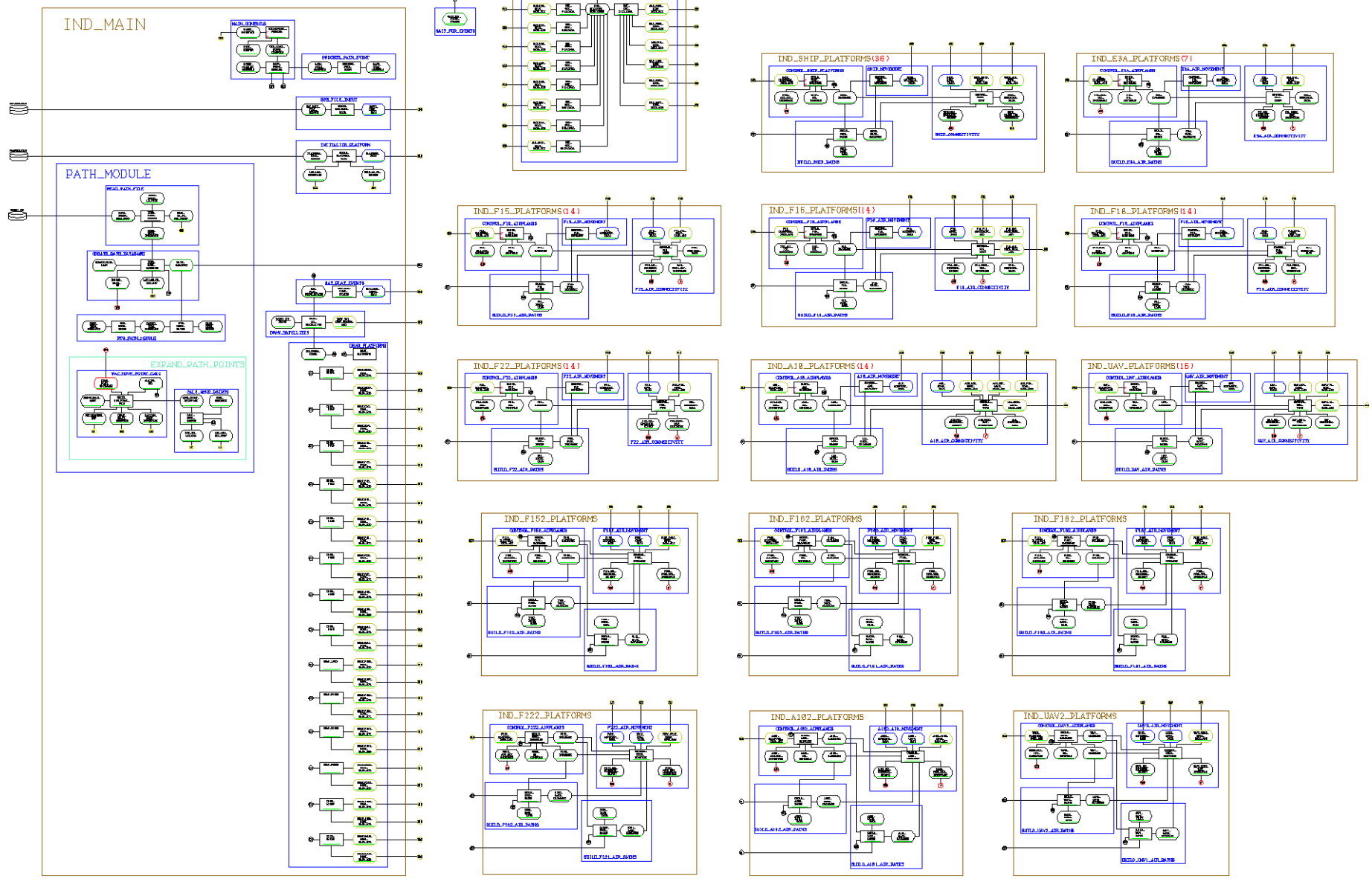


Disruptive Solution To HPC



Must be able to create complex scenarios - fast!

GLOBAL_PLANNER



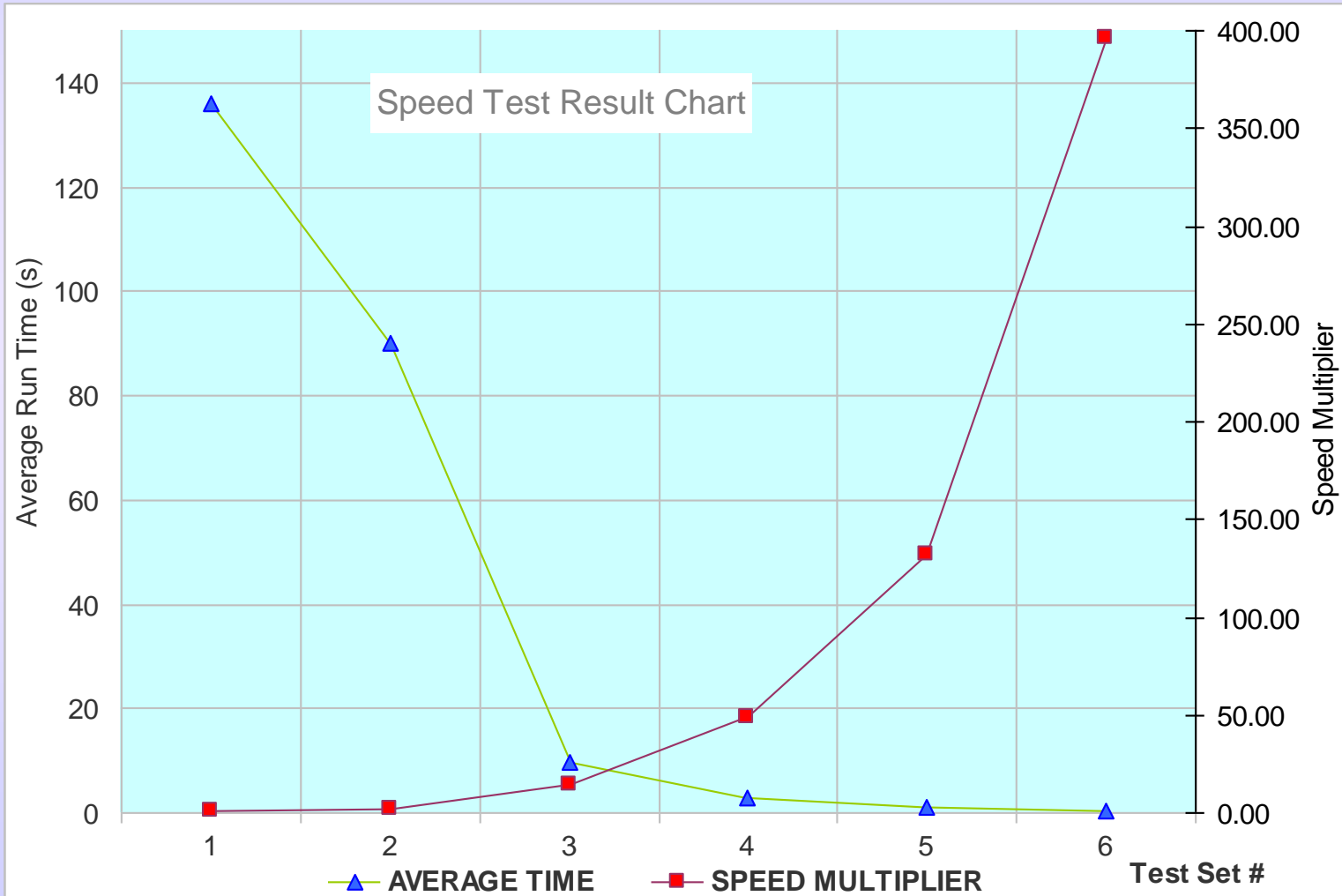


*If you use **VisiSoft** to build complex
Real-Time Control Systems & Simulations
on Parallel Processors
you can save many orders of magnitude
of time and money!*



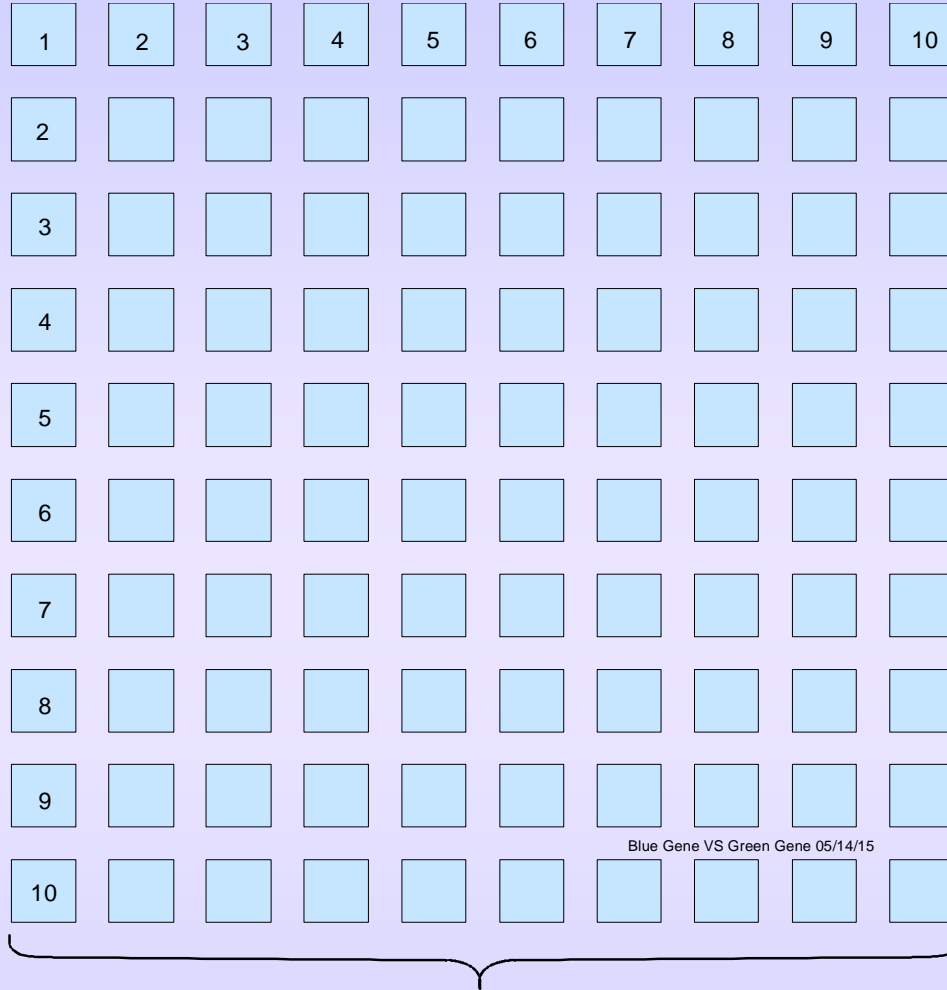
SINGLE PROCESSOR SPEED COMPARISONS

- GAIN 100+ X SPEED WITH VISISOFT PRINCIPLES





GO FROM 100 RACKS TO 1 RACK



The IBM Blue Gene - Using Standard Languages - 100 Racks - 1,638,400 Processors
5,000 Sq Ft. - 8,000 KW

Versus



The Green Gene Machine - Using VisiSoft - 1 Rack - 2300 Processors
16 Sq Ft. - 32 KW



***What does that do to
memory boundary crossing delays?***

***What about 1 to 2 additional
orders of magnitude?***



It doesn't stop there!

***We can shrink it more
with our architectural drawings of software!***

***What about a total of 4 to 6
orders of magnitude?***

Know what that does to energy utilization?



And, it doesn't stop there!

We can shrink it even more – using our hierarchical data structures to support fast heterogeneous models (time & space).

What about a total of 6 to 8 orders of magnitude* ?

Know what that does to the computer field?

****Depends on the application***



It still doesn't stop there!

We can make it even faster!

***Separate Parallel Processor design
from Server design.***

Get rid of DMA Channel Comm-Routing

***And use Direct Memory Access
between PC boxes.***



And still - not finally,

***Use VPOS - a tailored
Parallel Processing OS.***

And get rid of big time wasters, e.g.:

- Cache Coherency***
- Thread Synchronization***
- Stacks***
- Etc.***



Improving Speed to get Accuracy



REVIEW OF HOW THIS LEVEL OF SPEED IS ACHIEVED

- VisiSoft SINGLE PROCESSOR SPEEDS vs C++, ..., Fortran
 - Gain 2+ Orders of magnitude (already tested)
- CAN MATCH 100 RACKS WITH 1 RACK
 - Gain 2+ Orders of magnitude (obvious distances/comm)
- VisiSoft PARALLEL PROCESSOR SPEEDS
 - Gain \approx 2 Orders of magnitude (includes PUE - already tested)
- USE HETEROGENEOUS CELL SIZES
 - Gain \approx 1 Order of magnitude (already tested)
- USE HETEROGENEOUS TIME STEPS
 - Gain \approx 1 Order of magnitude (already tested)

VisiSoft - CAN BEAT REAL SPEED REQUIREMENTS BY
- 6 TO 8 ORDERS OF MAGNITUDE - ON PARALLEL PROCESSORS



NewToolsNeeded 03/14/11



*Not everyone
needs the same tools*





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Disruptive Solution To HPC



QUESTIONS