OVNI: Real-Time Power System Simulator

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Applications

- Education & Training
- Online optimum power system operation, security and control
- Real-Time equipment tester: Relays & Controllers
- Stand-alone interactive tool for power system analysis

Studies

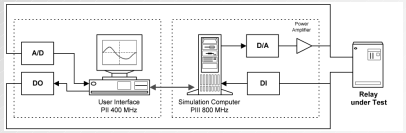
- Fast Transients: switching, faults, lightning
- Stability Analysis: machine stability, voltage stability
- Steady-state analysis: power flow, optimum power flow, wheeling.

Advantages of PC architecture

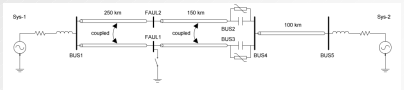
- High portability
- Easy upgradability
- Low maintenance and operational costs
- Low total cost Vs. supercomputer or hybrid architectures

Real Time Network Simulator for Relay Testing

System Architecture



Benchmark



- **33 nodes**
- **2 six-phase transmission lines**
- **1 three-phase transmission line**
- **2 source equivalents**
- **MOVs**
- **CCVTs**

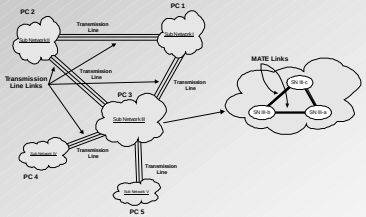
t = 30 s on Pentium II 400 MHz PC

Real Time Network Simulator with PC-Cluster

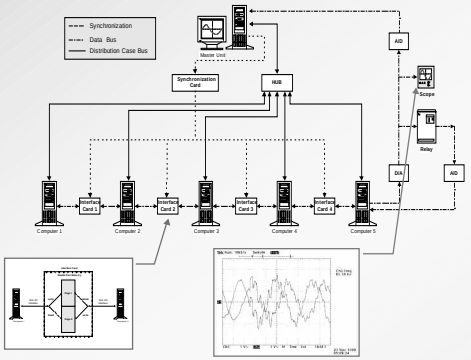
Large Networks Solution

Multi-Area Thevenin Equivalent (MATE)

- Groups separated by Transmission-line travelling time (Transmission Line Links)
- Groups clustered by similar eigenvalues (MATE Links)
- Groups of Nonlinearities (MATE Links)

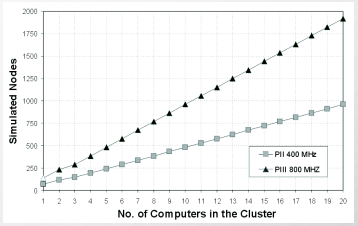


PC-Cluster Architecture

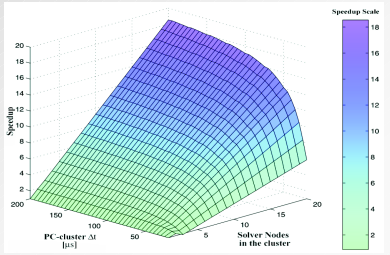


- Stable and accurate shared-synchronization between the array of computers.
- Control of the interrupt requests.
- Implementation of double port memory blocks.

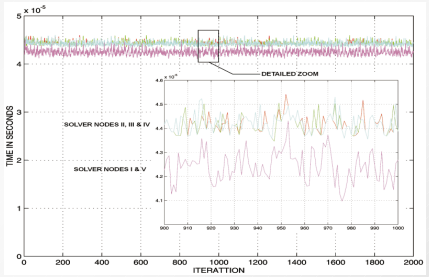
Scalability for Real Time frame of 50 s



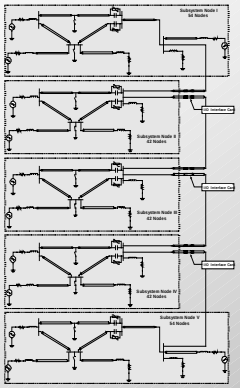
PC-Cluster Speedup, bus & ring layout



Execution Times per Iteration, Sample Case



PC-Cluster Benchmark



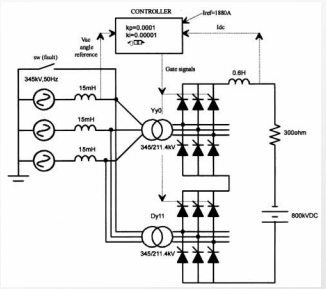
OVNI Architecture	Solution Times	Simulated Nodes
Single PC	162 s/step	234
PC-Cluster	45.9 s/step	

PC-Cluster as follows			
	Solver Node I	45.34 s/step	54
	Solver Node II	45.90 s/step	42
	Solver Node III	45.81 s/step	42
	Solver Node IV	45.85 s/step	42
	Solver Node V	45.34 s/step	54

Pentium II, 400 MHz, Bus speed 66 MHz

To achieve Real-Time performance, all the computational operations plus the communication time between all the elements in the PC cluster must be achieved within the clock time step.

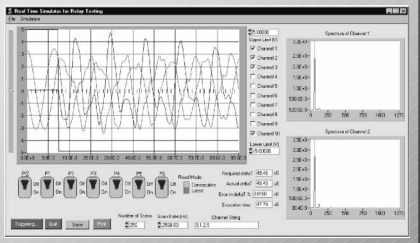
HVDC Benchmark



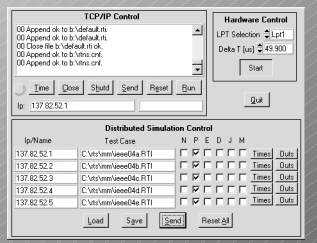
Simulator	Platform	Performance
Microtran EMTP	Pentium 400 MHz	1250 s/step
OVNI	Pentium 400 MHz	30 s/step

User Interface

- OVNI Relay Tester User Interface.



- OVNI's PC-Cluster TCP/IP controller.



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