



Performance of Parallel State Estimation on a High Performance Computing Platform

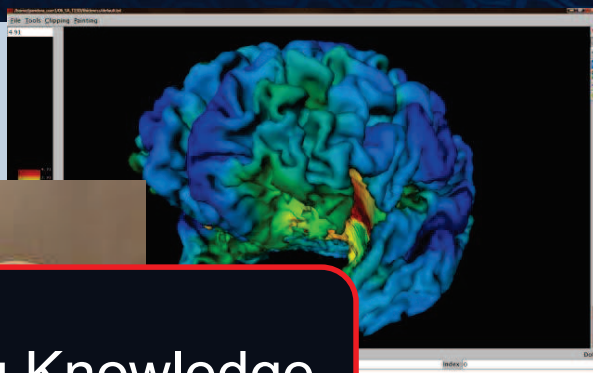
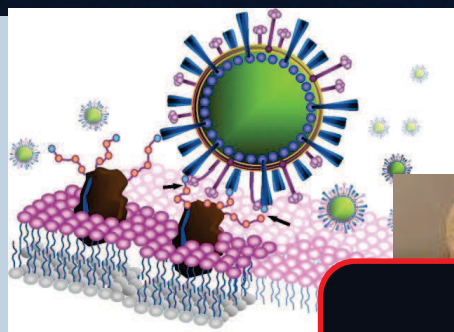
David Wallom, Oxford eResearch Centre, University of Oxford, UK

on behalf of the HiPerDNO Consortium

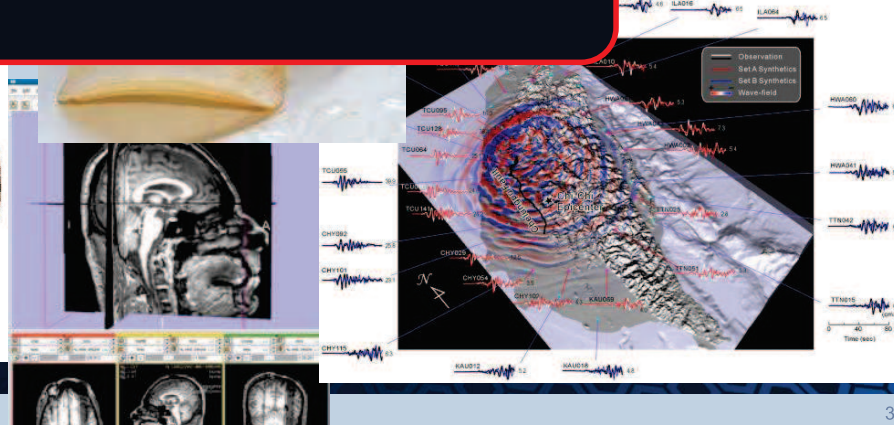
17th October 2012

- HPC and application paradigms
- An example HPC system for DNO utilisation
- Pipelines to wrap applications to simplify development

Data Deluge and the use of HPC



Extracting Knowledge

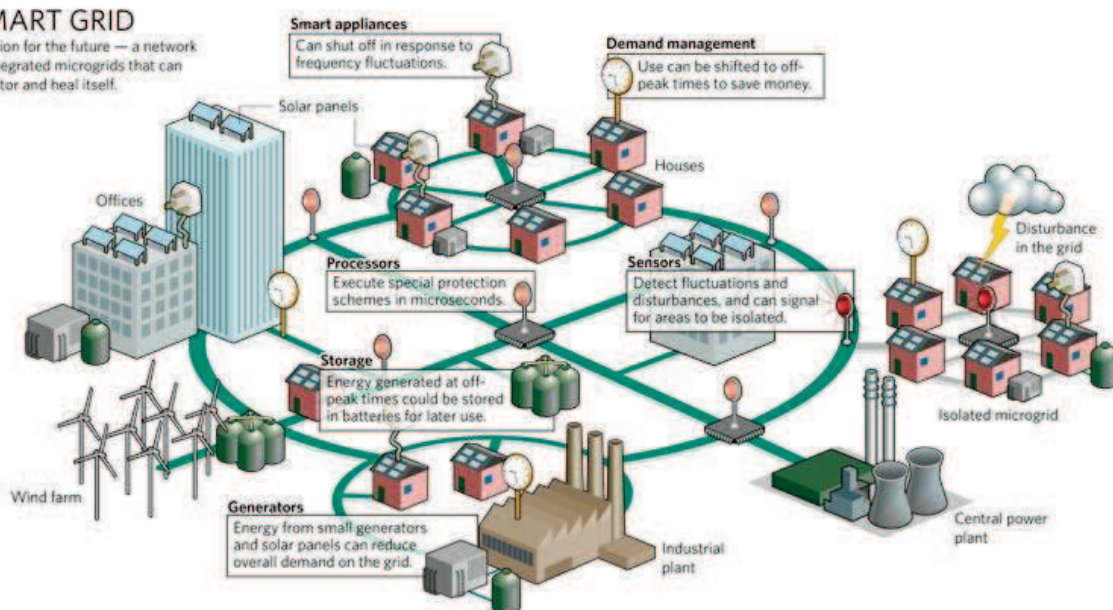


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Data Challenge of Smart Grid

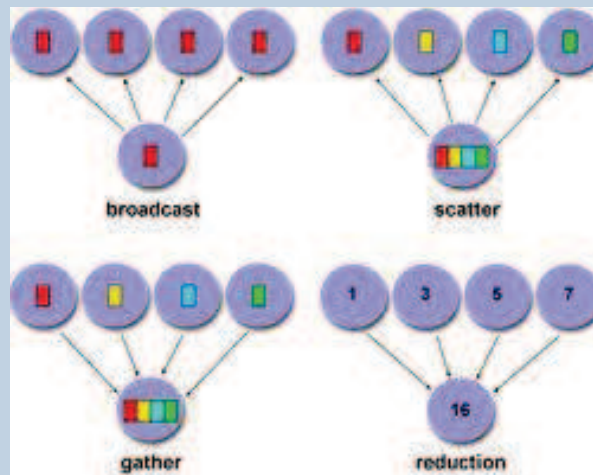
SMART GRID

A vision for the future — a network of integrated microgrids that can monitor and heal itself.



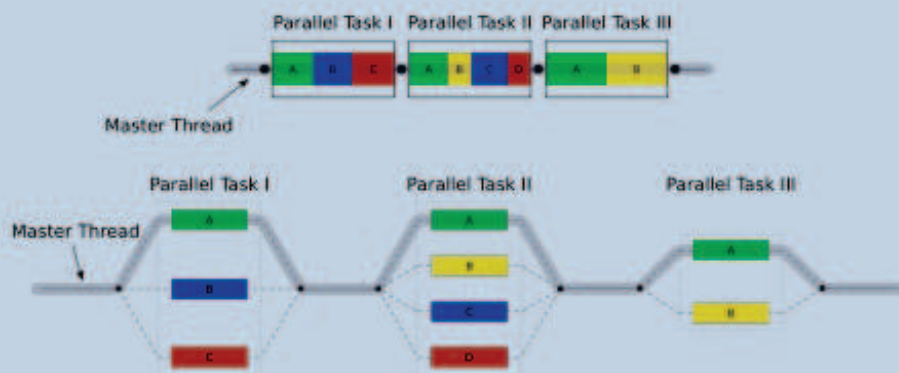
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Message Passing Interface (MPI)



- Designed to exploit the cluster
- Individual processes on separate systems

Open MP



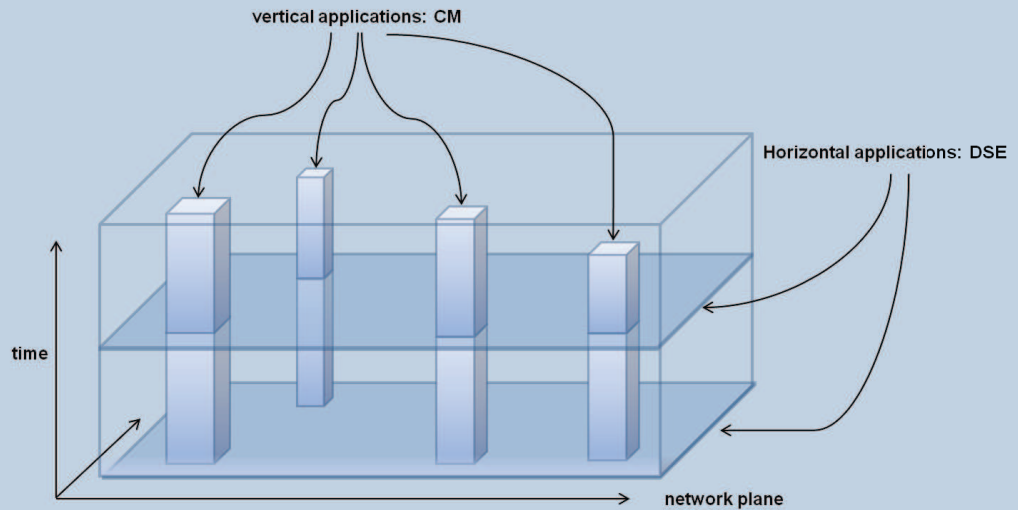
- Originally designed -> vector systems (CRAY etc.)
- Exploitation of Multi & Many core systems

Application Classification - Data

Distributed State Estimation: horizontal planes

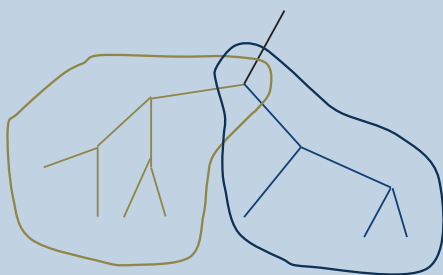
Condition Monitoring: vertical pillars

Data Mining and other applications: complex portions of data cube

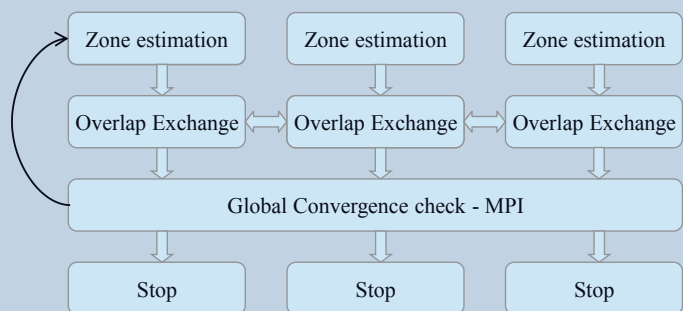


Distributed State Estimation – Overlapping Zones Algorithm

Algorithm



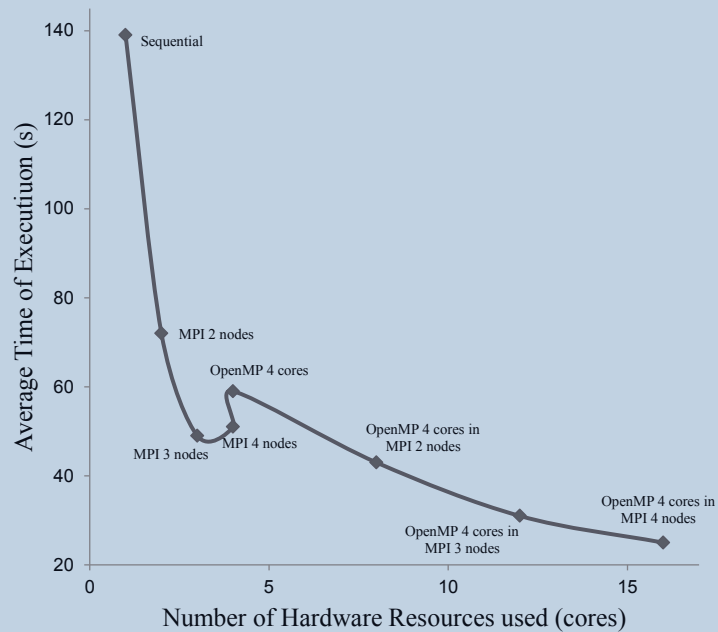
Implementation: MPI



Results

Compute Nodes	356 nodes (2 zones)	356 nodes (3 zones)	356 nodes (4 zones)	Convergence
2 nodes	416 [s]			e-07
3 nodes		202 [s]		e-06
4 nodes			103 [s]	e-05

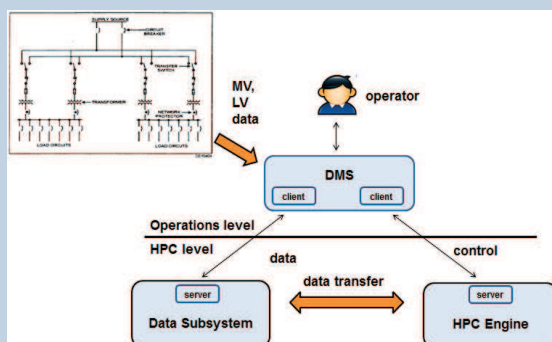
An example of application speedup in an energy relevant application



HiPerDNO HPC Platform – System Architecture

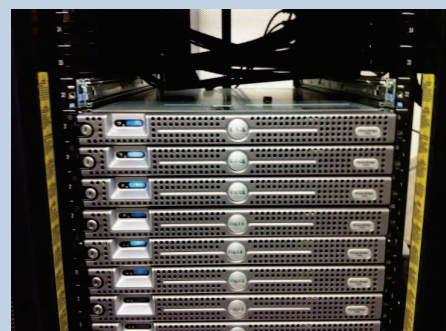
Architecture:

- Client-Server
- Separation of functions

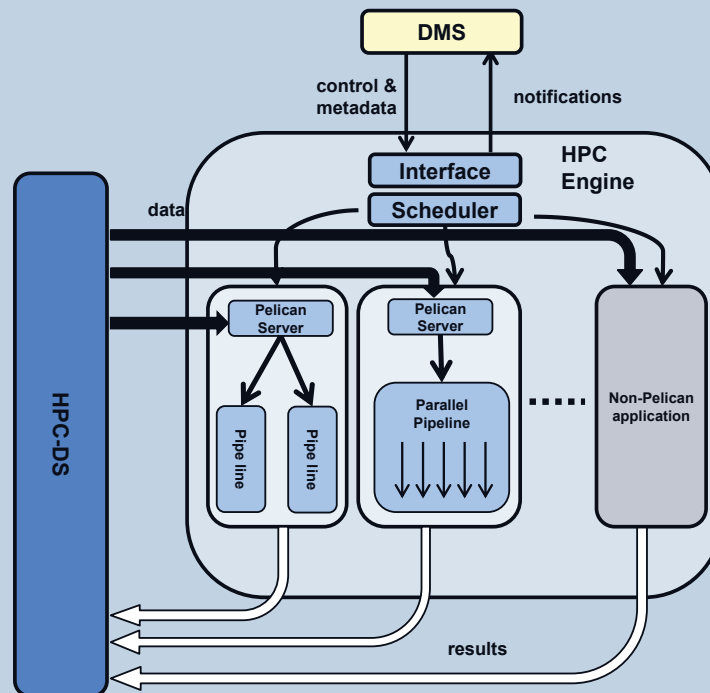


Test System

- deployed at Oxford SuperComputing Centre
- Testing and development of applications and algorithms in HiPerDNO project

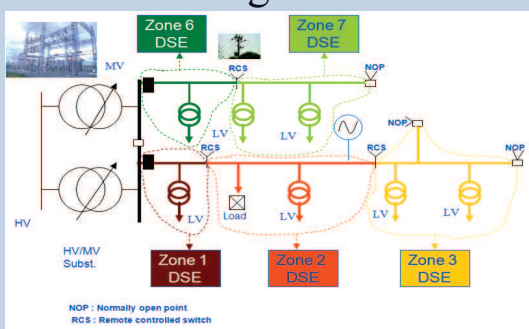


Application wrapping



Distributed State Estimation – Disjoint zones Algorithm

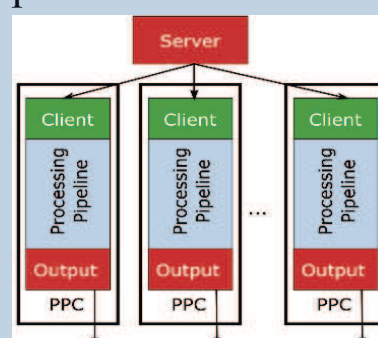
Algorithm



French – rural network

Compute nodes	3700 nodes (15 zones)	3700 nodes (74 zones)
1	103 [s]	7.8 [s]
2	93 [s]	6.3 [s]
3	88 [s]	3.9 [s]
4	88 [s]	3.6 [s]

Implementation: PELICAN



Virtual network

Compute cores	80000 nodes (440 zones)
1	1139 [s]
4	294 [s]
16	88 [s]

Summary

- Many industries already exploit the power of HPC
- Smart Grid is a data problem
- HPC is
 - incredibly powerful as a tool
 - fairly tricky to use 'out of the box'
- Wrapping applications and providing 'Computation as a Service' will increase usability by communities not used to it.