Department of Defense

Computing Infrastructure (CI)

Brief

NCOIC

Stakeholder Outreach Working Group

6 December 2007

CIO/NII Enabling Net-Centric Operations

DoD Computing Infrastructure (CI)

- **Overview:**
  - All automated IT resources used in the secure acquisition, storage, manipulation, management, control, and display of data or information with a primary emphasis on DoD hardware, software operating systems, and hardware/software operating systems support, which are identified as, and made discoverable and accessible for Net-Centric Operations.
  - Facilitate Global Information Grid (GIG) to Net-Centric Environment (NCE) transformation that provides more assured, robust, agile dynamic, resilient, responsive, service-oriented, distributed computing processing and data storage capabilities and adaptive hosting environments; which enable data and information sharing and improve operational outcomes DoD-wide to the tactical Edge.

- **Stakeholders/Partners:**
  - DoD Components
  - JNO CPM, EIEMA, DISA, JCS / JS J6
  - Acquisition Community: CAEs, PEOs, PMs
  - DoD Mission Area Portfolio Managers
  - DoD ICP Managers

Establishment of the DoD CI Domain (CID)

- **DoD CIO Memo 14 July 2004, Subject: EIEMA Domain Owner Designations**
  - Established EIEMA as DoD Portfolio of programs, projects and systems that deliver and assure the enterprise information environment
  - Four Domains established: Information Assurance (IA), Core Enterprise Services (CES), Communications (Comms), and Computing Infrastructure (CI)
  - Director, Architecture & Interoperability, OASD (NII) / Deputy DoD CIO (DCIO), assigned as CID Owner

DoD CIO Direction to the CID

- Develop and manage the CID Portfolio
- Use existing JCIDS, PPBES, and DAS
- Use integrated architectures, engineering analysis, and transition plans
- Support establishment of Computing COIs
- Facilitate information sharing
- Establish and maintain CID governance process
- Ensure representation of Service components and other appropriate bodies

DoD CI Transformation from the GIG to the NCE
Projected Performance Improvements

- Filling an existing DoD CIO void in the publication of key DoD CI strategy / vision, policy, and technical guidance regarding the design, acquisition, deployment, and operations of current and future DoD CI resources and capabilities.
- Providing portfolio management governance and oversight to DoD Components, the Acquisition Community, and DoD Portfolio Managers in planning and programming for DoD CI capabilities and investments.
- Facilitating the shift from program-centric, “stove-piped” CI to dynamic, shareable, net-centric CI across the DoD Enterprise; i.e., from CONUS to the Theater.
- Providing the ability to dynamically adapt DoD CI to meet the operational demands of Net-Centric data and information sharing and distributed functionality to the tactical environment.

DoD CI Transformation

CURRENT	FUTURE
▪Location-dependent	▪Location-independent, grid computing
▪Isolated workers	▪Knowledge-based, collaborative worker
▪Local information	▪Enable information shared
▪"Silos" of data	▪Cross-Domain data integration & information sharing
▪No Common Architecture	▪CI Domain Architecture
▪Stand alone applications that lack interoperability	▪Enabler of net-centric, distributed applications
▪Redundant systems; capability gaps	▪Optimized capabilities
▪Utility limited to individual programs	▪Strategic value to the entire DoD

DOMAIN GOALS

- Provide Networked, Available, Dependable Information
- Deliver New, Dynamic, Networked Information Sources
- Deny Enemy Advantages and Exploit Weaknesses
- Support Information Sharing and Collaborative Capabilities
- Increase efficiency/effectiveness; reduce costs
- Enable, Develop, and Implement Net-Centric Concepts and Capabilities
- Establish Metrics and Measure Progress Toward Defense Information Strategy Net-Centric Goals
- Overcome Impediments to Net-Centricity

CIO/NII Enabling Net-Centric Operations

Defining Grid Computing in the DoD NCE

Grid computing is an approach to distributed computing that spans not only locations but also organizations, machine architectures and software boundaries to provide unlimited power, collaboration and information access to everyone connected to a grid.
[Speaker Note: Ref (a)]

Grid technologies enable:
(a) on-demand access to computing capabilities; and
(b) the federation of distributed resources and the management of those distributed resources to meet end-user requirements.
[Speaker Note: Ref (b)]

Grid computing is increasingly being viewed as the next phase of distributed computing. Built on pervasive Internet standards, grid computing enables organizations to share computing and information resources across department and organizational boundaries in a secure, highly efficient manner.
[Speaker Note: Ref (c)]

Grid computing has emerged as a new field, distinguished from conventional distributed computing by its focus on large-scale resource sharing, innovative applications, and, in some cases, high-performance orientation.
[Speaker Note: Ref (d)]

DoD NCE Grid Computing:
The Net-Centric Environment (NCE) "grid" is envisioned as a federation of distributed computing resources available over local and wide area networks that appear to an end user or application as one large virtual computing system. NCE Grid Computing will be built on pervasive services oriented internet standards which will allow the DoD to share computing and information resources across departmental and organizational boundaries in a secure, highly efficient manner.

CIO/NII Enabling Net-Centric Operations

CIO/NII Enabling Net-Centric Operations

Industry Examples of Grid Computing Business Approaches & Technology Solutions

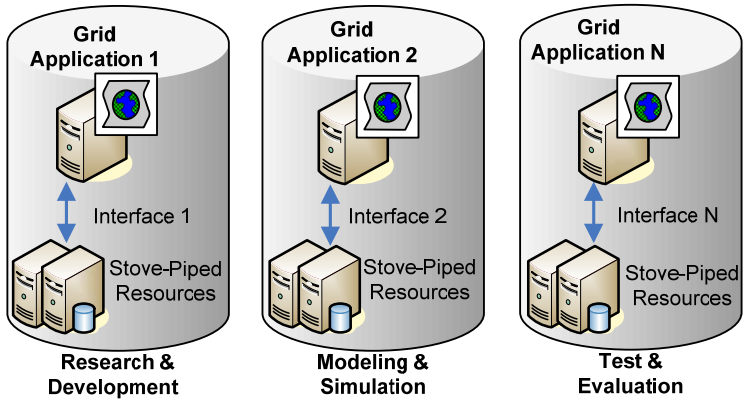
Several business approaches and technology solutions are often misrepresented as synonymous with grid computing. Grid computing does however provide the foundational elements and underlying technologies supporting the examples below.

Business Approaches / "Models"	Technology Solutions
Utility Computing: A service provisioning model in which a service provider makes computing resources and infrastructure management available to the customer as needed, and charges them for specific usage rather than a flat rate. The services offered by the service provider are also known as managed services.	**Clustering:** Collections of computers in fixed configuration designed to be operated and managed as a unified, high-performance machine.
Autonomic Computing: A computing model in which an autonomic computing system would control the functioning of computer applications and systems without input from the user. Automates complex systems and reduces undue human intervention.	**Cycle Harvesting:** Identifying unused on-line computing capacity and making it available.
On-demand Computing: An enterprise model in which computing resources are made available to the user as needed.	**Server Virtualization:** Provides the ability to deploy a discrete number of "virtual machines" on a single hardware platform.
	Storage Virtualization: Pooling of physical storage from multiple network storage devices into what appears to be a single storage device that is managed from a central console.

*** This table includes a non-exhaustive list of grid computing business approaches and technology solutions.**

DoD Enterprise Grid Computing: Current/Future Approaches

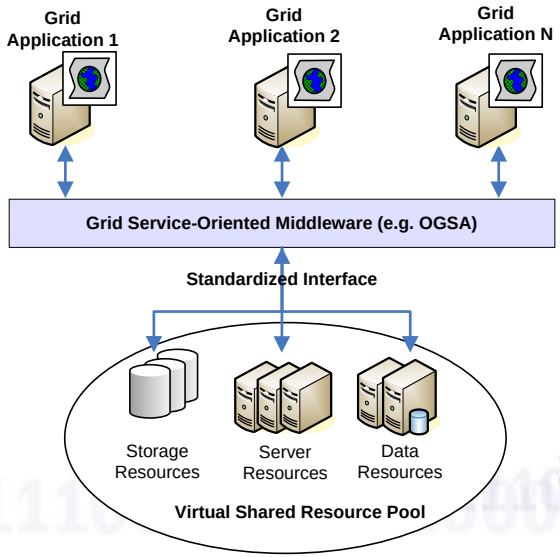
Current Approach (Before DoD Enterprise Grid Computing)



"Siloed" architecture:

Current **proprietary** implementations of DoD Grid Computing are developed for specific DoD functional communities (e.g. Research and Development). This **stove-piped** environment prevents net-centric interoperability, information sharing and collaboration. Limited opportunity exists for resource pooling cost efficiencies.

Future Approach (After DoD Enterprise Grid Computing)



"Virtualized" architecture:

Future DoD Grid Computing **promotes interoperability, information sharing, and collaboration** by creating a **virtual shared resource pool** from resources distributed across the Net-Centric Environment. Service-Oriented Grid Computing Middleware allows all users to integrate and utilize the shared resources through a **standardized service oriented interface** thereby decreasing engineering and development efforts. This environment offers a dynamic and highly available grid computing capability.

Projected DoD NCE Grid Computing Capabilities

DoD NCE Grid Computing will be realized through **Infrastructure** and **Functional** capabilities. **Infrastructure capabilities** provide a set of core elements necessary to share computing resources across distributed, heterogeneous environments. **Functional capabilities** extend underlying infrastructure capabilities to optimize and enhance user facing DoD enterprise functions such as search, situational awareness, and information sharing.

Current 2007 Capability

RDT&E/M&S Implementations	Proprietary implementations of Grid Computing currently exist in Research, Development, Test, and Evaluation (RDT&E) as well as Modeling & Simulation (M&S) communities. These communities take advantage of high performance computing (HPC) resources and Central Processing Unit (CPU) cycle harvesting technologies to conduct complex calculations and large volume data analysis. This capability will evolve beyond 2006 to standardize grid computing approaches for RDT&E and M&S communities across the DoD at an enterprise level.

Projected 2010 Capabilities

Utility Computing	Data centers, housing thousands of computing infrastructure resources, (servers, OSs, storage, processors, etc) implement clustering and virtualization technologies to reduce management costs and increase resource utilization. A service provider makes computing resources and infrastructure management available to the customer as needed, and charges them for specific usage rather than a flat rate. The services offered by the service provider are also known as managed services. [Infrastructure]
Grid NetOps Capability	This capability will enhance and accelerate the collaborative, integrated monitoring and management of computing infrastructure resources in the distributed, heterogeneous GIG environments contributing to a shared situational awareness as described in the GIG NetOps CONOPS. [Functional]
Grid SOA Infrastructure	Grid services will be developed based on a service-oriented architecture, which will provide the common underlying functionality to support functional grid capabilities. Examples of functions provided by the Grid SOA Infrastructure include execution management, resource management, data access/movement/update, and security services. [Infrastructure]

Projected DoD NCE Grid Computing Capabilities

CIO/NII Enabling Net-Centric Operations

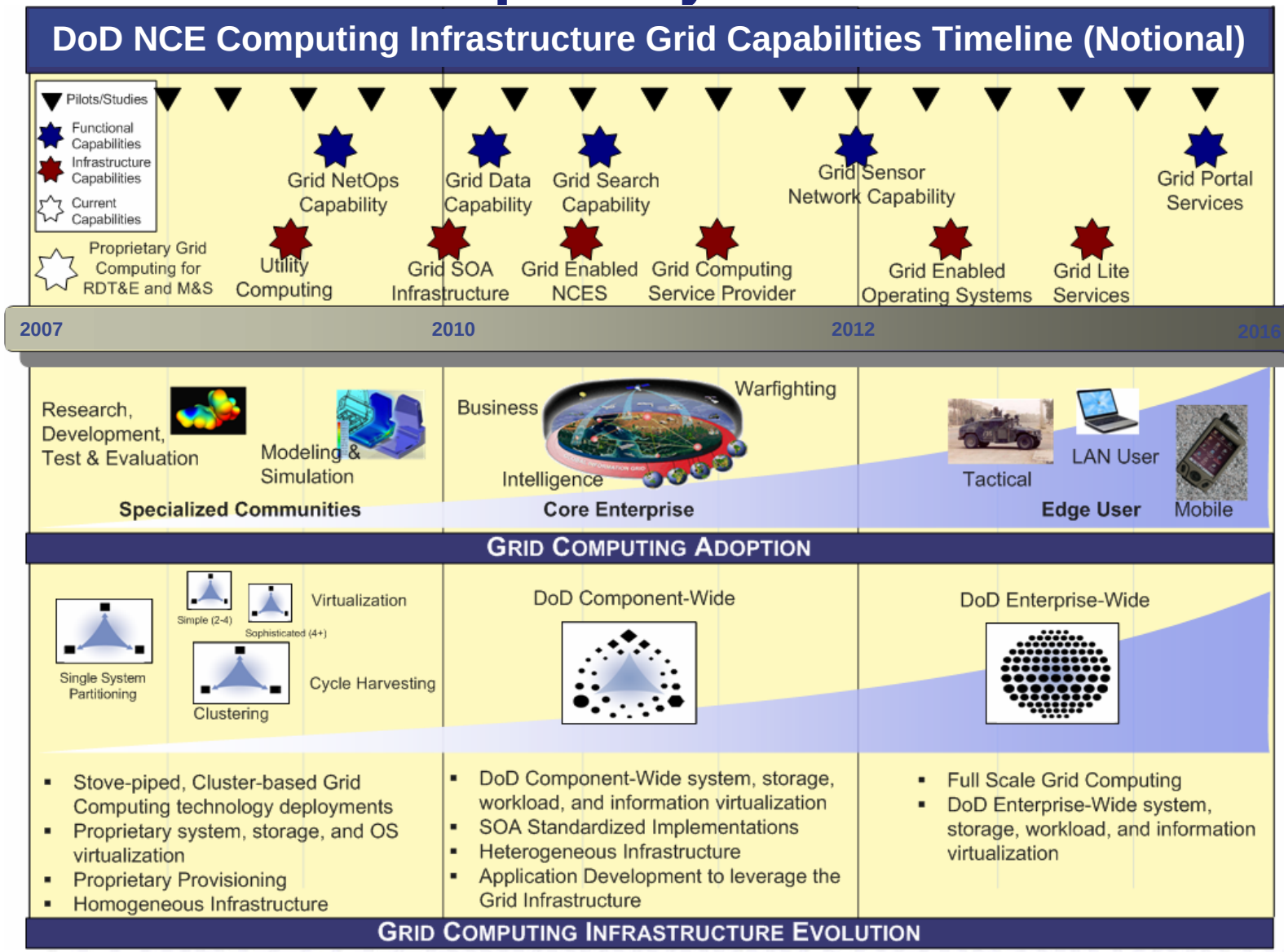
Projected 2012 Capabilities

Grid Enabled NCES	Net-Centric Enterprise Services are common services which will be used by numerous functional applications across the DoD. In order to satisfy peak capacity requirements, NCES services will be enabled to take advantage of on-demand grid computing resources. [Infrastructure]
Grid Computing Service Providers	Grid computing service providers will extend the utility computing capability by implementing standards-based service-oriented approaches to providing grid computing services. [Infrastructure]
Grid Data Capability	This capability will provide optimized storage and retrieval of data and information in DoD NCE shared space (e.g., catalogs, web sites, registries, document storage, and databases) . This capability will supporting CoI collaboration as described in the DoD Net-Centric Data Strategy. This capability will make use of the Grid SOA Infrastructure capability. [Functional]
Grid Search Capability	Search engines process queries by reading hundreds of megabytes of data and consuming tens of billions of CPU cycles. Supporting peak request streams of thousands of queries per second requires different queries to be run on different processors. The grid search capability is a functional capability that will supply the computing resources necessary to optimize search query results to the end-user. As an example, Google partitions its data index so that a single query can use multiple processors. This capability will make use of the Grid SOA Infrastructure capability. [Functional]
Sensor Network Capability	Grid computing will optimize collection, storage, and fusion of real-time data and information from sensor networks to inform time sensitive decision making. This capability will make use of the Grid SOA Infrastructure capability. [Functional]

Projected 2016 Capabilities

Grid Enabled Operating Systems	Grid modules will be included in server and PC operating systems. Internet accessible servers and PCs will both contribute to and consume grid resources over standards based protocols. [Infrastructure]
Grid Lite Capability	The capability extends the use of grid capabilities to small devices (PDAs, cell phones, firewalls, etc) and identifies a set of essential services that enable the device to be part of the grid. [Infrastructure]
Grid Portal Capability	Grid portals will provide an end-user view of the grid resources available. Authorized end-users will be able to access, configure, and use grid resources. This capability will make use of the Grid SOA Infrastructure capability. [Functional]

Projected DoD NCE Grid Computing Capability Blocks



CIO/NII Enabling Net-Centric Operations