Application Encapsulation and Revitalization
The Pneuron Distributed Platform
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Evolving Technology to Support Enterprise Agility & Effectiveness

Many large and mid-tier businesses have accumulated many systems, applications and technologies that have evolved over time, are often isolated from each other, and rarely are leveraged beyond a narrow-focused requirement or location.

These systems often include a mix of proprietary and third-party applications, using different data and processing approaches, and deployed on different system architectures, including mainframe, client/server, web-based, and command line applications. Given the breadth of systems, close to 80% of IT budgets and resources today are focused on sustaining and managing applications, the existing integration models, and the underlying infrastructure and environments.

The enterprise is therefore increasingly faced with billions of dollars of inefficiency with:

- Inherent scalability and resilience issues in the existing systems.
- Increasing demands on the systems with an inability to execute processes effectively.
- Application limitations that prohibit deployment of existing systems in the cloud, grid, and other emerging computing infrastructures.
- Limited understanding of the existing system (original implementers are gone).
- Large heterogeneous application and vendor environments that fail to provide integrated cross enterprise business value.
- A burdensome maintenance budget and TCO for new projects that stifle innovation, transparency and competitiveness.

Given the breadth of systems, close to 80% of IT budgets and resources today are focused on sustaining and managing applications, the existing integration models, and the underlying infrastructure and environments.
Traditional approaches to transform and mitigate challenges with existing systems include:

- Adding more hardware resources.
- Re-factoring or rewriting existing applications (packaged often as “cloud enabling”).
- Developing or procuring new comprehensive solutions.
- Implementing migratory service implementations on each system to enable federation and processing of functions across the systems.
- Reliance on limited resources with ISVs for enhancements and roadmap deliverables.

These approaches are expensive, take considerable time, often lead to sub-optimal processing environments, and continue to reinforce the lack of cross-enterprise transparency challenges that undermine business effectiveness. In addition, re-factoring, new solutions, and migratory service models require management of multiple environments during the new development, migration and transition phases.

**Traditional approaches are expensive, take considerable time, often lead to sub-optimal processing environments, and continue to reinforce the lack of cross-enterprise transparency challenges that undermine business effectiveness.**
Encapsulation of Existing & Vendor Systems

Pneuron has created a unique suite of encapsulation capabilities that enable targeting of existing systems, components, libraries, and functions, easily incorporating them into a parallel and distributed computing processing model.

Existing systems of any nature can be transformed non-intrusively into highly scalable and parallel computing models with minimal or no re-factoring. This extends the lives of the systems, avoids major transformational activities and enables the enterprise to create entire virtualized businesses and operating models without traditional systems and data integration costs.

Businesses achieve immediate results, including:

- Avoidance of re-factoring or replacement costs and time.
- Avoidance of parallel environments, migration and transformation activities.
- New business project TCO at a fraction of the cost of traditional vendor or development projects. Pneuron customers are seeing close to 50% improvement in time, cost and risk metrics against traditional business cases in deployment, and 70% in reuse of existing IP.
- Ability to leverage and revitalize existing institutional knowledge of IP without large redesign, rewrite or replacement costs.
- Enable the delivery of enterprise-wide services for global access, uniformity, and interaction with other business systems.
- Flexibility to create new high-performance hybrid or compound products from existing applications, components or functions traditionally isolated or residing in diverse or difficult to leverage locations.
- Cloud enablement of legacy applications to realize global availability, resiliency and performance without rewrite or re-factoring costs.

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Pneuron provides many features to simplify the encapsulation and ongoing management of systems, including:

- Intuitive GUI for subject matter experts (SMEs) to use highly visual graphical tools to configure the target solutions.
- Runtime, distributed infrastructure that provides comprehensive workload management, clustered processing, fault tolerance, and demand elasticity for system processing.
- Built-in statistics and logging and a real-time monitoring application to continuously monitor the processing and health of the systems.
- Transparent processing across heterogeneous environments, including cloud, grid, and internal IT management systems.

This model is vastly different from traditional approaches, which are expensive, complex, time consuming, and high risk. The Pneuron approach enables rapid time-to-market for new competitive innovations at a fraction of the cost of any alternative solution through utilization of existing assets, technology, and processes.

Pneuron combines critical elements of SOA, event-driven architectures, and distributed, parallel computing, as well as application, analytical and business disciplines, aligning them into a single, configurable business-driven design. Users can leverage this powerful design to flexibly define, integrate and deploy their solution, products, process models or operating models.

Pneuron has broken the centralization paradigm that dominates most conventional architectures, and implemented a distributed model where data extraction, analytics, and logical operations are effectively processed at the source system. This focuses processing on only those subsets of information that meet specific business requirements while avoiding large scale migration, normalization, and processing of non-target data.

Pneuron offers a new design, deployment, and execution paradigm to help businesses meet today’s rapidly changing and complex information systems challenges. By distributing lightweight, fixed-function, processing objects to targeted individual source systems, Pneuron creates a powerful processing network which sidesteps the time and cost penalties of today’s centralized approaches. Using a single, integrated platform, businesses are able to iteratively build and deploy solutions which solve the challenges of distributed data, applications, and infrastructure.

Pneuron has **broken the centralization paradigm that dominates most conventional architectures**, and implemented a distributed model where data extraction, analytics, and logical operations are effectively processed at the source system.
Pneuron’s Distributed Platform™ operates similarly to how the neurons in the human brain function, with each “Pneuron” serving as part of a network of other connected Pneurons to retrieve, analyze, derive and deliver intelligence.
**Pneurons™**

Pneurons are distributed, lightweight, fixed-function, interoperable processing components positioned on individual source systems, creating a powerful processing network that sidesteps today’s time and cost penalties.

**Pneuron Design Studio™**

The Pneuron Design Studio enables design, development, integration, deployment, and management from a single visual and intuitive user interface.

**Pneuron Cortex™**

The Pneuron Cortex encapsulates multiple technologies into a lightweight, dynamic run-time server that provides six sigma level scale, availability, clustering and resiliency while re-using existing infrastructure or accessing remote capacity.

**Visualization**

Pneuron’s comprehensive intelligence visualization suite of tools provide interactive ability to perform what-if analysis and recast results instantaneously.

Pneurons can act alone as independent functions or services, be overlaid on top of existing applications or data, and encapsulate or wrap existing functions or applications. Critically, all Pneurons are uniformly interoperable and so can be connected in real time to other Pneurons, thus creating new products, workflows, or new operating models of any complexity from a single integrated user environment.
How Pneuron Encapsulates Systems and Components

The Pneuron Design Studio™ is used for all development, deployment and configuration of activities including the encapsulation, optimization, and integration of legacy or third-party applications using the Application Exoskeleton or ‘Wrapper’ Pneuron.

The Application Exoskeleton (Wrapper) Pneuron enables existing systems, components, functions or IP to be seamlessly encapsulated and represented as Pneurons – all of which are seamlessly interoperable with all others. This provides several fundamental advantages:

1. Cost of business value implementation is halved, while time to realization of value is doubled.
2. Uniform interoperability removes value isolation, enables new products, applications or operating models to be created and deployed and decouples those innovations from the need of intermediary databases or alien and abstract data models – the primary cause of project cost, delivery time lags and project failure.
3. Existing or partner assets can be leveraged to the maximum as real-time, globally accessible services.
4. Performance, availability and resiliency challenges are addressed seamlessly “off the shelf” as the target functionality is assimilated by the Exoskeleton Pneuron.
5. Leverage of legacy or third-party assets becomes merely a function of security access – for internal or external clients, anywhere.
Pneuron Encapsulation Process

1. Evaluate the Target System for Encapsulation

The target system is evaluated in terms of architecture and implementation. Evaluation involves understanding:

- **Type of program** (Java, C, C++, C#, PHP, and other)
- **Compilation format** (JAR, DLL, Script, and other)
- **Architecture** (server-based, client/server, and other)
- **Interfaces, APIs with other programs**
- **Performance and volume expectations**

The evaluation findings provide visibility into what part of the system will be encapsulated and how it will be configured. Once the evaluation is done, Pneuron identifies the best packaging model for the Exoskeleton wrapping and migration of the application. Packaging includes selecting:

- One or more callable functions
- One or more components
- One or more services
- One or more functions within the application
- The entire application

It should be noted that targeting and packaging should take into account several key criteria, including whether functions can be combined with functions from other applications to enable new products, workflows or even entirely new operating models to be created quickly and simply.
2. Configure the Exoskeleton Pneuron in Pneuron Design Studio

The Pneuron Design Studio is then used to configure the environment through a fully visual experience. A Pneuron is dragged on to the canvas and the properties are opened. The user selects the code library from the list of available libraries. After a library is selected, this dropdown will be populated with the available classes within the code library. The user then selects the class required for the Pneuron. The wrapped application is encapsulated as a compiled program and deployed within the Pneuron Platform.

Each of the Application Exoskeleton Pneurons has different properties and this depends on the specific application. Since the existing data source is used for the Pneuron, it is configured as a property.
3. Configure Cluster Network in Pneuron Design Studio

Pneuron provides innovative clustering and realm models to provide horizontal scaling and elasticity demand processing for encapsulated applications. The clustering model is configured within Pneuron Design Studio™ and enables rapid scaling and distribution of the wrapped application across multiple servers. The realm model interacts with the cloud and grid computing environments and enables automatic provisioning of new nodes based on the configured realm demand and threshold algorithms.

Clustering focuses on the receipt and processing of work requests and distribution to the wrapped application Pneurons. Realm management focuses on the organization of nodes within the cluster, evaluating node capacity levels based on the realm algorithm, and provisioning/decommissioning elastic nodes with the cloud or grid management system.

The realm model interacts with the cloud and grid computing environments and enables automatic provisioning of new nodes based on the configured realm demand and threshold algorithms.

The user creates and configures a Pneuron Network with two Dispatcher Pneurons at the beginning, followed by Pneuron sub-networks that are deployed on different nodes.

Create multiple Exoskeleton Pneurons based on the initial Wrapper Pneuron and link one to each sub-network.

Dispatcher Pneurons manage the application cluster and processing. All API requests are received by the Dispatcher Pneuron and distributed to the participating instances of the Wrapped Pneuron. Pneuron sub-networks are created and configured for each instance of the Wrapped Pneuron.
4. Configure API Request – Response Mapping

The final part of configuration is to link the existing applications and their requests – whether real-time web service or batch – to a JMS Pneuron, which precedes the Dispatcher Pneuron. Pneuron has established a generalized API for invoking and sending unit of work requests to the application. The API and external applications invoke the Pneuron API directly and the protocol support includes JMS, SOAP, and REST models.

The final configuration step involves defining the mapping between the generalized Pneuron API and the targeted Wrapper Pneuron invocation methods and parameters. Once the mapping is configured, the API requests will transform and align to the callable interface.

5. Test the Cluster and Encapsulated Application

After the cluster network and Wrapped Pneuron are configured, the encapsulation can be tested and validated. A Pneuron test harness is provided to enter API requests, log the results, and review “end-to-end” processing. The Pneuron debug and diagnostic visualization tools are used with the test harness to visualize the flow of messages between the Pneurons.

6. Deploy Encapsulated Application

Deployment is then executed through selecting ‘deploy’ in the Design Studio.
Pneuron Runtime Model for Encapsulated Applications

The runtime processing for migrated applications occurs based on the Pneuron network configuration within Pneuron Design Studio. The network may be stimulated by a previous Pneuron, an external application event, or a Schedule Pneuron. Credentialing occurs at each point of processing. All services are authenticated for request and response processing.

Requests are transmitted from external applications using either a Web Service or JMS invocation. Requests can include single and batch record sets. External web service and batch requests are marshaled from the requesting application to the Pneuron API which receives the request as XML and in the generic API format. The Pneuron API converts the requests and marshals to the targeted Pneuron application cluster.

The Dispatcher Pneuron then distributes units of work requests to one or more remote instances of the wrapped migrated Pneuron. At this point there is an interchange to conform the unit of work semantically to align to callable service invocation formats.

The wrapped migrated Pneuron starts the transaction and interacts directly with the wrapped object program, which performs all of the processing. The wrapped migrated Pneuron maintains a synchronous waiting mode until it receives a response back from the legacy program. The legacy program will interact directly with its existing data source and update information. The legacy application can also send results back to the wrapped migrated Pneuron. Upon completion of the unit of work, a Complete Message Pneuron transmits a complete notification back to the Dispatcher Pneuron, which updates the workload and distributes any pending units of work.
Pneuron has implemented Java Management Extensions (JMX) to facilitate application statistics and elasticity monitoring and notification. These resources are referenced as objects called MBeans and are dynamically loaded and instantiated during application processing. The MBean Remote Management level enables remote monitoring and management applications to access the MBean notifications. Statistics, audit logging, and the health of Pneuron application processing are continuously gathered and provided as MBean notifications to the IT management system.

Demand and processing models are continuously compared. As thresholds occur during processing, notifications are posted to a Pneuron MBean, recommending increase and decrease of nodes. The IT management system provisions the elastic nodes. Upon provisioning, Pneuron Network Configurator deploys a new worker instance to the target node. The Pneuron Dispatcher notices the change in cluster state by receiving heartbeat notifications and dynamically reforms the application cluster.

System health is continuously monitored at all processing levels. Loss of the Pneuron Dispatcher will result in a slave or secondary dispatcher taking over and transitioning work in process with no disruption. Similarly, loss of a worker instance will adjust the cluster and retransmit any work to the other workers. The following illustration depicts the Pneuron runtime processing.
Flexible Deployment Across Different Environments

Pneuron’s underlying distribution and parallel processing infrastructure and its encapsulation within a Java Virtual Machine (JVM) enables simultaneous and consistent distribution and processing across different heterogeneous environments. Deployment and process execution are consistent within each infrastructure.

### Deployment Alternatives

- **Cloud**
  - Internal or External
- **Grid**
- **Global Internal Network**
- **Cluster of Connected Servers**

### Value

- Pneuron works consistently across different computing environments
- Enables distribution and processing across heterogeneous infrastructures
- Provides connectivity and process orchestration
- Enables functions, applications, even entire operating models to be created, virtualized and distributed in real time
- Utilizes customers’ existing technology, applications and network, enabling TCO and ROI to be fractions of any alternative.
Use Case: Transforming a Legacy Application into a Highly Distributed and Globally Accessible Enterprise Class Service

Pneuron was presented with a client challenge. An existing application was performing complex pricing calculations for both real-time, web-based inquiries and batch-based processing.

All application processing occurred sequentially. Process times on large batch jobs had increased several hundred percent and were taking considerable hours to complete. The work queue management was simple and not fault tolerant.

The client revealed the following significant challenges:

- The pricing engine could not scale and processing times were escalating
- There was no fault tolerance
- Bottlenecks were occurring with no resolution
- The alternatives of rewrite or replacement were expensive and time consuming with significant cost and deployment risks
- Cost of maintenance was escalating as technology and platform was continuing to age, yet the IP within the application was considered world class
- Despite excellent IP the solution was poorly leveraged with limited accessibility globally

The customer challenge is illustrated below.
The challenge was to maintain and leverage this world class IP but without the cost or risk of whole rewrite or replacement. Using the Pneuron Exoskeleton and its immediate and seamless alignment to all other Pneuron components, the client achieved the following significant benefits:

- **Improved process time throughput of 800 percent or higher** on submitted transactions with processing bottlenecks removed.
- Multiple instances of the application could process concurrently across multiple servers.
- Comprehensive and intelligent queue management existed with durable management of all application requests and demand-based distribution to different application instances.
- Fault tolerance and resiliency were in place to ensure no disruption of the application processing and complete delivery of requests.

- Client was able to easily configure and adjust workload processing models with an intuitive GUI.
- Functionality was decoupled from silo restrictions and instead offered as a set of high performance services that are securely and constantly accessible throughout the enterprise.
- The legacy system lifetime has been increased by multiple years at a fraction of the cost of the rewrite or replacement alternatives.
- IP is protected and leveraged as services available in real-time to the entire enterprise.
- Additional functions are being added including analytics and other legacy applications (also using Pneuron Exoskeletons), expanding the functionality of the original asset.
- The project was done at around 30% of the original rewrite or replacement budget.

The summary of the Pneuron solution is illustrated below.

The entire solution from design to global deployment took six weeks with no legacy product rewrite not refactoring but a performance improvement of over 800% in the first day of testing.
Conclusion

The Pneuron solution was developed with a single uncompromising guiding principle—eliminate the historic technological barriers that prevent organizations from functioning as a cohesive, transparent enterprise.

Pneuron’s technology design delivers on this promise by removing the traditional demands and costs associated with migrating and transforming legacy applications into highly scalable, distributed processing models in the cloud, grid, and internal network environments. The very nature of the technology manifests into a deployment model that minimizes human resource hours and maximizes speed to delivery.

Combining these intrinsic delivery benefits with a deployment methodology that is as unique as its technology, Pneuron allows clients to implement application migration solutions at a fraction of the traditional costs of most enterprise deployments.

Visit our website at www.pneuron.com or email us at pneuron@ust-global.com

The Pneuron design offers our customers a “force multiplier” for:

- Reduced cost and time to market.
- Lower risk in development and deployment.
- Utilization of existing IP and technology to create new innovations, products and solutions globally.

This all occurs through an approach that includes:

- Incrementally wrapping and deploying existing applications.
- Transformation of the existing application processing models into highly distributed, parallel processing.
- Comprehensive, fault tolerant, and scalable "end-to-end" queue and workload management.
- Intuitive configuration and deployment on cloud, grid, internal, and hybrid organization infrastructures.
- Real time logging, auditing, and system health monitoring.
- Definition of transient and permanent elasticity models.