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Small Business Innovation Research(SBIR) Program - Proposal Cover Sheet

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SBIR Phase I Proposal

Proposal Number:	**F244-0001-0005**
Proposal Title:	**nForge ProTM: A Scalable Knowledge Graph with an Intelligent Interactive Editor**

Agency Information

Agency Name:	**USAF**
Command:	**AFMC**
Topic Number:	**AF244-0001**

Firm Information

Firm Name:	**Effective Automation Systems Inc (DBA nHansa)**
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UEI:	**S5YEALJFBWY7**
DUNS:	**943516443**
CAGE:	**06SL3**
SBA SBC Identification Number:	**000152255**

Firm Certificate

OFFEROR CERTIFIES THAT:

1. It has no more than 500 employees, including the employees of its affiliates.	**YES**
2. Number of employees including all affiliates (average for preceding 12 months)	**5**
3. The business concern meets the ownership and control requirements set forth in 13 C.F.R. Section 121.702.	**YES**
4. Verify that your firm has registered in the SBAS Company Registry at www.sbir.gov by providing the SBC Control ID# and uploading the registration confirmation PDF:	**SBC_000152255**

Supporting Documentation:

- SBC_000152255.pdf

5. It has more than 50% owned by a single Venture Capital Owned Company (VCOC), hedge fund, or private equity firm	**NO**
6. It has more than 50% owned by multiple business concerns that are VOCs, hedge funds, or private equity firms?	**NO**
7. The birth certificates, naturalization papers, or passports show that any individuals it relies upon to meet the eligibility requirements are U.S. citizens or permanent resident aliens in the United States.	**YES**
8. Is 50% or more of your firm owned or managed by a corporate entity?	**NO**
9. Is your firm affiliated as set forth in 13 CFR Section 121.103?	**NO**
10. It has met the performance benchmarks as listed by the SBA on their website as eligible to participate	**YES**
11. Firms PI, CO, or owner, a faculty member or student of an institution of higher education	**NO**
12. The offeror qualifies as a: [ ] Socially and economically disadvantaged SBC [ ] Women-owned SBC [ ] HUBZone-owned SBC [ ] Veteran-owned SBC [ ] Service Disabled Veteran-owned SBC [**X**] None Listed	
13. Race of the offeror: [ ] American Indian or Alaska Native [ ] Native Hawaiian or Other Pacific Islander [**X**] Asian [ ] White [ ] Black or African American [ ] Do not wish to Provide	
14. Ethnicity of the offeror:	**NON-HISPANIC**
15. It is a corporation that has some unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have not been exhausted or have not lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability:	**FALSE**
16. Firm been convicted of a fraud-related crime involving SBIR and/or STTR funds or found civilly liable for a fraud-related violation involving federal funds:	**NO**
17. Firms Principal Investigator (PI) or Corporate Official (CO), or owner been convicted of a fraud-related crime involving SBIR and/or STTR funds or found civilly liable for a fraud-related violation involving federal funds:	**NO**

Signature:

Printed Name	Signature	Title	Business Name	Date

Srini Srinivasan	Srini Srinivasan	President	Effective Automation Systems Inc (DBA nHansa)	02/08/2022

Audit Information

Summary:

Has your Firm ever had a DCAA review?	**YES** Last Audit Date: **05/01/2021**
Was your accounting system approved by the auditing agency?	**YES** Last Update Date: **05/01/2021**
Was a rate agreement negotiated with the auditing agency?	**YES** Last Update Date: **05/01/2021**
Was an overhead and/or cost audit performed?	**YES** Date of Overhead Audit: **05/01/2021** Date of Cost Audit: **05/01/2021**
Are the rates from the audit agreement used for this firms proposal?	**YES**

Firm Information:

Agency Firm:	**DEFENSE CONTRACT AUDIT AGENCY**
Address:	**2105 S. BASCOM AVENUE, SUITE 310 CAMPBELL , California 95008**
Point of Contact (POC) Name:	**Acacia Rodriguez**
POC Phone:	**(571) 448-5643**
POC Email:	**oacacia.rodriguez@dcaa.mil**

Upload a copy of the audit information:

- nHansa_DCAA_AuditLetter2021.pdf

VOL I - Proposal Summary

Summary:

Proposed Base Duration (in months):	**6**

Technical Abstract:

Modern defense systems are complex with many subsystems and components, highly distributed, separately maintained and operated, yet required to collaborate together with complex dependencies. Traditional methods including relational databases are not equipped to capture, maintain, analyze and exploit these complex relationships. We had previously demonstrated and transitioned a graph-based approach to handling such a scenario to a large U.S. Air Force program.

While our previous approach enabled import and visualization from diverse data sources and was highly scalable, it was not interactively editable. There is a need for allowing user inputs that would enhance both the current accuracy of the underlying model by capturing implicit relationships as well as allow its schema to incrementally develop in a manner beneficial to the needs of the program.

We propose to enhance nForge, our schema-based scalable graph framework to nForge Pro, to allow for interactive user inputs and incremental updates. nForge Pro shall also discover other potential changes to data or schema based on user inputs. These discovered changes will be presented to the user to approve or reject, thus allowing the incremental evolution of the embedded rule-based knowledge graph. User approved decisions will be further codified using the nForge rules engine, allowing for continuous learning.

nForge Pro will be initially demonstrated in the context of system engineering challenge involving system design and maintenance, but can be used in a wide variety of applications requiring dynamic knowledge graphs.

Anticipated Benefits/Potential Commercial Applications of the Research or Development:

The potential impact of nForge Pro extends beyond systems engineering. Many platforms within the Department of Defense, such as ships, vehicles, drones, and aircraft maintained by the Navy, Army, and Air Force, can benefit from this technology. The technology can be used to analyze the interactions and dependencies within and among of these platforms, which is critical to ensure that they operate safely and effectively. Moreover, the technology can also be applied to the analysis of commercial industrial applications such as nuclear, chemical, and mining that must operate with multiple environmental and safety considerations.

Since these systems and platforms are large, installed at several sites, and maintained over several decades, even small improvements in understanding and analysis will result in significant cost savings over the lifetime of the programs. In addition, the increased efficiency and accuracy of analysis can help reduce the risk of accidents, which can have significant economic and human costs.

Attention:

Disclaimer: For any purpose other than to evaluate the proposal, this data except proposal cover sheets shall not be disclosed outside the Government and shall not be duplicated, used or disclosed in whole or in part, provided that if a contract is awarded to this proposer as a result of or in connection with the submission of this data, the Government shall have the right to duplicate, use or disclose the data to the extent provided in the funding agreement. This restriction does not limit the Government's right to use information contained in the data if it is obtained from another source without restriction. This restriction does not apply to routine handling of proposals for administrative purposes by Government support contractors. The data subject to this restriction is contained on the pages of the proposal listed on the line below.

Addition:

Enter the page numbers separated by a space of the pages in the proposal that are considered proprietary:

List a maximum of 8 Key Words or phrases, separated by commas, that describe the Project:

Dynamic Knowledge Graph, Interactive Digital Engineering, Adaptive Data Modeling, Data Analysis, Big Data Analytics, Graph Database, Adaptive Schema, Intelligent Recommendation Engine

VOL I - Proposal Certification

Summary:

1. At a minimum, two thirds of the work in Phase I will be carried out by your small business as defined by 13 C.F.R Section 701-705. The numbers for this certification are derived from the budget template. To update these numbers, review and revise your budget data. If the minimum percentage of work numbers are not met, then a letter of explanation or written approval from the funding officer is required. Please note that some components will not accept any deviation from the Percentage of Work (POW) minimum requirements. Please check your component instructions regarding the POW requirements.	**YES**
Firm POW	**100%**
Subcontractor POW	**0%**
2. Is primary employment of the principal investigator with your firm as defined by 13 C.F.R Section 701-705?	**YES**
3. During the performance of the contract, the research/research and development will be performed in the United States.	**YES**
4. During the performance of the contract, the research/research and development will be performed at the offerors facilities by the offerors employees except as otherwise indicated in the technical proposal.	**YES**
5. Do you plan to use Federal facilities, laboratories, or equipment?	**NO**
6. The offeror understands and shall comply with export control regulations.	**YES**
7. There will be ITAR/EAR data in this work and/or deliverables.	**NO**
8. Has a proposal for essentially equivalent work been submitted to other US government agencies or DoD	**NO**

components?	
9. Has a contract been awarded for any of the proposals listed above?	**NO**
10. Firm will notify the Federal agency immediately if all or a portion of the work authorized and funded under this proposal is subsequently funded by another Federal agency.	**YES**
11. Are you submitting assertions in accordance with DFARS 252.227-7017 Identification and assertions use, release, or disclosure restriction?	**YES**
12. Are you proposing research that utilizes human/animal subjects or a recombinant DNA as described in DoDI 3216.01, 32 C.F.R. Section 219, and National Institutes of Health Guidelines for Research Involving Recombinant DNA of the solicitation:	**NO**
13. In accordance with Federal Acquisition Regulation 4.2105, at the time of proposal submission, the required certification template, "Contractor Certification Regarding Provision of Prohibited Video Surveillance and Telecommunications Services and Equipment" will be completed, signed by an authorized company official, and included in Volume V: Supporting Documents of this proposal. NOTE: Failure to complete and submit the required certifications as a part of the proposal submission process may be cause for rejection of the proposal submission without evaluation.	**YES**
14. Are teaming partners or subcontractors proposed?	**NO**
15. Are you proposing to use foreign nationals as defined in 22 CFR 120.16 for work under the proposed effort?	**NO**
16. What percentage of the principal investigators total time will be on the project?	**50%**
17. Is the principal investigator socially/economically disadvantaged?	**NO**
18. Does your firm allow for the release of its contact information to Economic Development Organizations?	**YES**

VOL I - Contact Information

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Volume 2: Technical Volume (Standard Topics)

1. Identification and Significance of the Problem or Opportunity

Graph databases have proven very useful in a wide variety of applications ranging from social networks to large scale systems engineering and operation. Modern commercial off-the-shelf (COTS) and open-source graph databases have been shown to be highly scalable in deployment. For example, Netflix's recommendation engine relies heavily on graph databases to construct a knowledge graph. By utilizing a knowledge graph consisting of billions of nodes, it can analyze the relationships between users and movies, and suggest content tailored to individual preferences.

In our prior nForge project[1], working in collaboration with the System Integrator, Lockheed Martin, we successfully demonstrated and transitioned nForge to the F-35 Air Force Program. nForge uses a schema layer, appropriate for systems engineering, on top of an open-source graph database (Apache Tinkerpop). Using nForge, we demonstrated constructing, traversing and querying knowledge graphs with nodes representing elements of a large-scale system and edges representing their relationships. The high-level goal is illustrated in Figure 1, while a more detailed summary of the goals, approach and results of the nForge project is included in Attachment A.

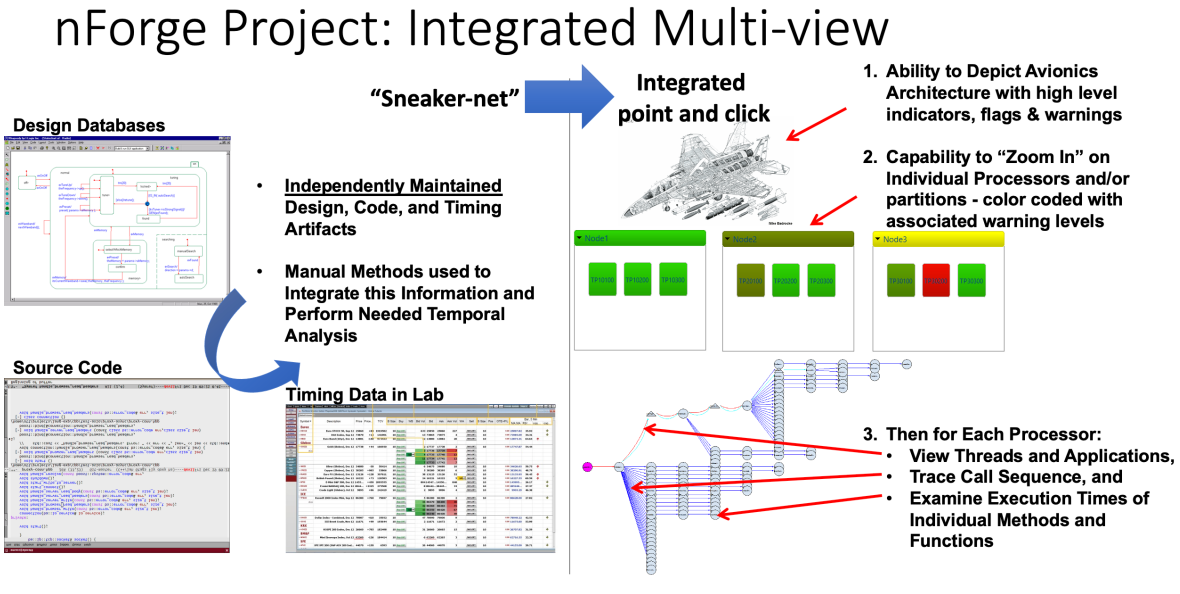


Figure 1: nForge Goal

[1] AF SBIR Topic AF141-056, Program Manager: Steve Drager, AFRL, Rome NY

Some representative elements in our demonstrated database were: hardware components (chassis, boards, networks), software components (subsystems, modules, libraries, call graphs), interconnect data (signal databases, system level events), test results and much more. We also developed a system engineering database generator that generates representative databases, models, and even C++ code representative of the program's at-scale data for testing and demonstration.

nForge project focused on the automated import of data from a wide variety of data sources, and the construction, querying and visualization of a knowledge graph. It answered important questions during the Technical Review sessions related to systems engineering, integration testing and performance evaluation. To increase its usefulness, and fully realize its potential, the following are needed:

- additional ***interactive user-defined data overlays to make the graph more useful to a wider variety of data analysis***; ***based on user interaction, automated changes should be suggested***, such as – additional relationships, tagging of information gaps and conflicting information
- ***as the system design and the corresponding data evolve, allow the user to make incremental changes, resulting in automated suggestions***. nForge currently requires a re-import of data, and sometimes a redefinition of the underlying schema

Specifically, nForge Pro shall ***allow user interaction and facilitate intelligent editing***. This capability is highly valuable for knowledge graphs, rendering them highly dynamic and responsive to intelligent user customization, resulting in significant time savings in the construction of complex queries.

In the context of systems engineering and systems analysis, nForge Pro interactive editing capability is needed to enable the following, resulting in significant cost benefits to the program:

- Allow interactive definition of end-to-end system events, spanning multiple system elements; based on user interaction, identify additional events. Once such events are defined, perform worst-case and average case response time analysis
- Enable interactive experimentation of software to hardware binding to create multiple alternative system configurations to be considered and evaluated in parallel. Conduct speed and spare-capacity trade-offs of such configurations
- Enable the definition of multiple system tests, and managing the test configuration, execution and results collation. Evaluate system robustness under stress, and detection of abnormal events
- Enable resource dependency analysis – e.g., identify bottlenecks at networks or memory cache (in a multi-core configuration) by allowing the user to tag explicit and implicit dependencies

For system deployment and operation scenarios widely encountered in DoD applications, nForge Pro knowledge graph editing capability can:

- Enable an effective situational awareness and threat detection capability, by tagging explicit and implicit sequences of system events (CONOPS 2.2 in Section 2)
- Allow tagging of deviations from "normal" behavior, thus enabling a more robust automation of Pattern of Life (PoL) analysis (CONOPS 2.1 and 2.2 in Section 2)
- Enable the interactive and automated definition of triggers or responses across system elements, thus improving targeting operations (CONOPS 2.1 in Section 2)

2. Phase I Technical Objectives

Our Phase I technical objectives are to:

(a) define the technical requirements

(b) develop a preliminary design

(c) both of the above shall be based on a rapid prototype demonstration in the context of chosen Concept of Operations (CONOPS), relevant to the Program

(d) identify a suitable challenge problem for Phase 2 demonstration

(e) incorporate feedback from the Project Manager into all of the above deliverables

We have extensive prior experience with knowledge graphs in designing and developing nForge, and successfully applying nForge to a large-scale U. S. Air Force program. This experience coupled with focused nature of the proposed nForge Pro project will significantly increase the chance of accomplishing our technical objectives. We will also utilize our automated data generator to generate representative data for the challenge problem, enabling an at-scale demonstration.

nForge Pro will enhance the capabilities of nForge. In Phase I of the proposed project, we will explore, design and demonstrate technical approaches to enable editing of knowledge graphs, as well as allowing for automated suggestions and execution of those suggestions based on user changes.

In this section, we will identify the two Concept of Operations (CONOPS) for the proposed nForge Pro capabilities that will result in a prototype demonstration during Phase 1. The two CONOPS have been chosen in order to outline our initial thoughts on the requirements and preliminary software design; this will result in high confidence that our design and technical approach is well equipped to handle the following generic scenarios of knowledge graph editing:

- updating the graph's underlying ontology/schema,
- inferring additional edges between nodes,
- highlighting conflicting information in the graph,
- highlighting information gaps, and
- suggesting additional changes to the graph because of the user's modifications
- codifying rules from above and embedding them in the graph for future use

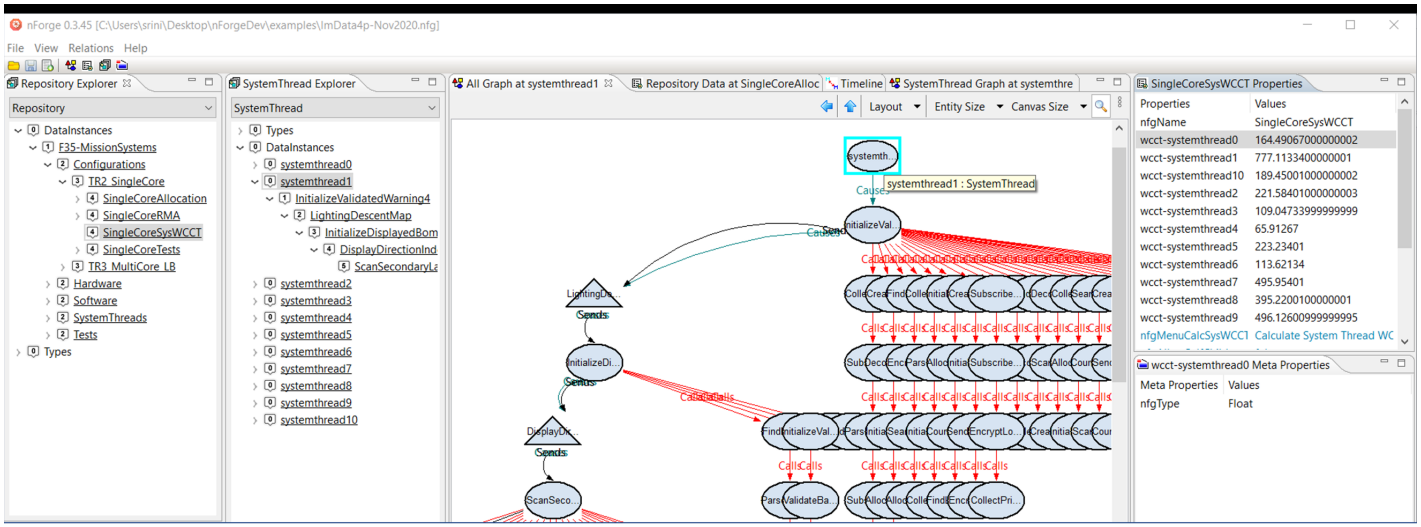
2.1. Concept of Operations: Define and analyze end-to-end system response to a trigger

This scenario occurs in many DoD systems, ranging from systems engineering to threat detection and targeting operations.

In a Systems Engineering context, the user may interactively identify a causality graph through systems elements representing system response; anomaly detection to counter-measure deployment. Once such a path through system elements has been defined by the user, several performance analyses could be conducted through the query of the resulting knowledge graph: worst-case and average response times, resource utilization, redundancy and failure recovery etc. Data needed for these analyses could also be tagged, with data sources specified and automatically imported. We demonstrated this CONOPS in the nForge project (shown in Figure 2), importing all the required data from the program's database files.

In System Operations context, a similar path could be identified through System of Systems representing a causality graph from threat detection to targeting operations. In this CONOPS, the nodes in the graph could be very diverse system elements – ranging from SIGINT elements, human operators and

autonomous systems. Knowledge graph queries could span different types of concerns: from response times, failure recovery to risk profiles – including collateral impacts.



- System Threads are system level metrics (e.g., sense-to-shoot response time) that may span multiple software and hardware subsystems
- Typically, about a dozen Technical Performance Measures (TPM's) may be of interest during system delivery and acceptance tests
- They can be modeled independently across software elements, but measured/reported for each configuration
- The results from worst case individual resource response times plus network and bus delays (which may be a function of network loads and message lengths) can be used to compute the overall worst-case response times – analytically
- Above demo featured 10 system threads, showing one path through the software graphically (and as a hierarchy), and its WCCT (worst-case-completion-times) the inspector on the right
- Response times can be compared across multiple system configurations, as shown in the table below – generated from an graph query, comparing a single-core and multi-core configs

Graph | SystemThreadAnalysis(AllConfig) Data at Configurations | Timeline

ick to reset Columns-->	wcct-systemthread0	wcct-systemthread1	wcct-systemthread10	wcct-systemthread2	wcct-systemthread3	wcct-systemthread4	wcct-systemthread5	wcct-systemthread6	wcct-systemthread7	wcct-syste
MultiCore_LB_SysWCCT	28.3287	33.3333	94.2380	68.7760	73.6433	36.2227	90.4200	40.4693	86.1840	87.1760
SingleCoreSysWCCT	164.4907	777.1133	189.4500	221.5840	109.0473	65.9127	223.2340	113.6213	495.9540	395.2200

Figure 2: Example End-to-End Event in a Knowledge Graph

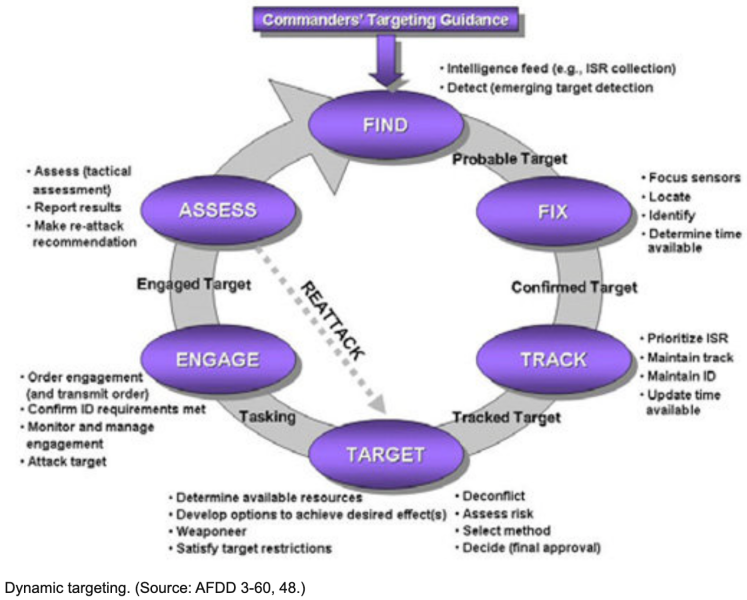
Initial thoughts on the requirements and interface design for this CONOPS:

- nForge Pro shall allow user to interact with the a populated 'million-node' knowledge graph, to define 'virtual overlays' of flows through the system elements.
    - User should be able to edit underlying data model or data instance
- There shall be an option to 'start' and 'stop' recording and therefore learning the changes so that similar changes can be automatically inferred.
    - We shall explore latest advancements in interfaces that incorporate automated suggestions in documents (Copilot) and code (Cursor). Although these the specific tools are based on Artificial Intelligence while our approach is primarily rule-based, much inspiration can be drawn on the interfaces they employ to simplify user interactions.
- nForge Pro shall also recommend changes to the underlying model to simplify changes and can enable faster graph traversals
- Once a path has been defined, representative analysis (e.g., average response time) can be demonstrated using statistical techniques and embedded data. For example, user may be interested in average response time of a sense to shoot time response that takes into account signal propagation delays, resource contention delays etc.

2.2 Concept of Operations: Improve situational awareness with enumeration of modes

Mode is an important abstraction in the understanding of system operation, and contributing to improved situational awareness. Knowledge graphs are especially well suited to describe and analyze deeper understanding of the system operating modes. Modes play an important part on DoD systems, ranging from individual platforms such as aircraft and ships to System of Systems.

In the context of Systems Engineering for a sophisticated air platform, such as F-35, it is important that modes (e.g., Takeoff, Landing, Drill, Recon) and the transition between them should be handled correctly and understood well. They can then be designed, developed, tested and verified.



Dynamic targeting. (Source: AFDD 3-60, 48.)

Figure 3: Dynamic Targeting (Air Force Defense Doctrine)

In the context of System Operation, modes and sub-modes may represent a large number of required collections of internal states for the system sub-components. For example, as shown in Figure 3, Dynamic Targeting consists of six distinct steps (or system modes): find, fix, track, target, engage, and assess (F2T2EA) as explained in AFTTP 3-2.3, Multi-Service TTP for Dynamic Targeting. This method referred to as F2T2EA or colloquially as the "kill chain." A deeper understanding of the modes in terms of internal system component states and the steps required to transition between them is essential for robust system operation.

Initial thoughts on the requirements and interface design for this CONOPS:

- nForge Pro shall allow user to define a knowledge graph representing modes and associated system component states. The nodes and connection types (and instances of those types) can be defined by the user, allowing for maximal flexibility in the definition of modes.
- For any pair of modes, a transition action can be defined; this shall represent a sequence of actions; such actions can have precedence constraints, conditional branching or independent parallel paths that may join or split.
- Additional fields for record keeping such as error counters and statuses that may represent observed anomalies can be added to the transition action and their constituent steps.
- This demonstration shall be conducted using a well populated at-scale knowledge graph

3. Phase I Statement of Work (SOW)

3.1 Scope

During the Phase 1 effort, we shall define the requirements and design of the workbench, nForge Pro, the scalable knowledge graph with interactive, intelligent editor. We shall also implement an initial prototype and identify a challenge problem to be used during Phase 2. These activities are designed to lay a strong foundation and build a roadmap for the Phase 2 effort.

3.2 Task Outline

The Phase I work will be divided into the following subtasks:

Task 1. Requirements Specification of Major Capabilities

We shall specify the requirements of the proposed workbench. The result will be a Requirements Document, identifying the concepts of operation (CONOPS). This document shall be submitted for review to the Program Manager.

Task 2. Design of Major Capabilities

We shall design the proposed workbench. The result will be a Design Document, identifying major tools and technologies used as well as the data and control flow. This document shall be submitted for review to the Program Manager.

Task 3. Identification of Challenge Problem

We shall study suitable avionics programs and identify the specific subsystems and data artifacts to be used in Phase 2 demonstration. The result will be a Challenge Problem Specification Document. This document shall be submitted for review to the Program Manager.

Task 4. Initial Prototype

We shall implement an initial prototype of the proposed workbench with chosen software components. The prototype implementation shall be demonstrated to the Program Manager.

Task 5. Incorporate Feedback

We shall incorporate any revisions and Program Manager feedback into the results of tasks 1,2,3 and 4.

Task 6. Preparation of Final Report

We shall prepare a final report documenting the Phase 1 experiences, including final revisions of all Phase 1 documents and outlining a proposed roadmap for Phase 2.

3.3 Technical Milestone Schedule

The milestones and deliverables are shown in the task schedule in Figure 2 below.

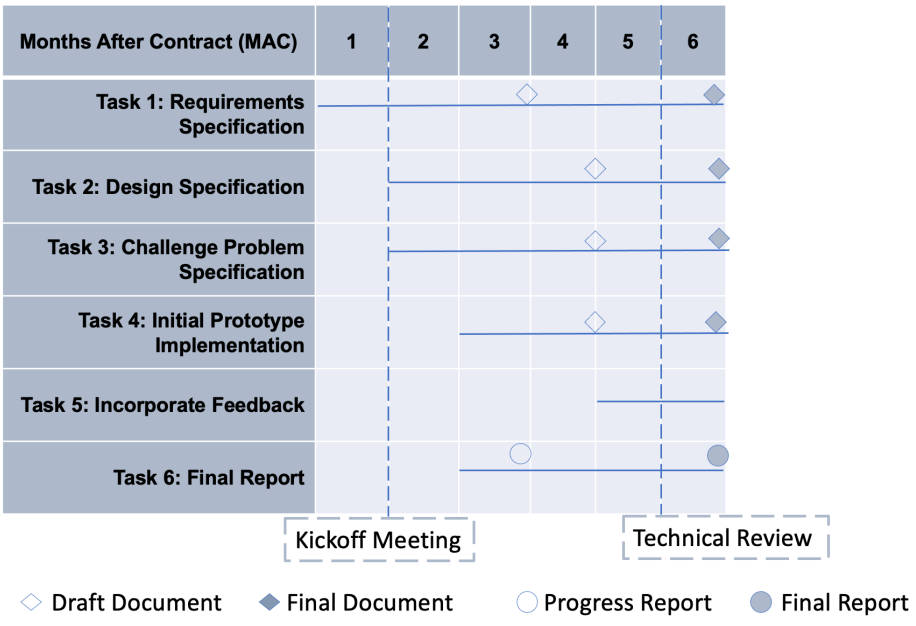


Figure 4: Proposed Task Schedule

3.4 Deliverables and Milestones

The due dates for all of the Phase I deliverables and milestones are listed below:

ID	Description	Due Date
D1	Kickoff meeting	1 MAC
D2	Progress Reports	3,6 MAC
D3	Technical Review	4 MAC
D4	Requirements Document V1	3 MAC
D5	Design Document V1	4 MAC
D6	Challenge Problem Specification Document V1	4 MAC
D7	Initial Prototype Demonstration	4 MAC
D8	Phase I Final Report with SF 298	6 MAC

4. Related Work

4.1 Our prior work with knowledge graphs and U.S. Air Force applications

nForge: A Graph-Based System Engineering Workbench

This prior project was funded under a SBIR program, and successfully developed and transitioned the nForge tool to the F-35 program during Phase 1, 2 and subsequence Phase 2 Enhancements. nForge is a generalized data repository, with layered, scalable, customizable tool architecture. nForge includes a set of facilities to keep multiple data sources and models complete and consistent with each other. These facilities enable:

- Seamless import/export with popular, widely used tools
- Proven scalability from supporting infrastructure for distributed teams with large and diverse data sets
- Unifying semantics, represented by a simple yet powerful data model, onto which multiple models can be mapped

These facilities have been demonstrated to implement an "integrated multi-view" vastly improving current ad-hoc practices.

nForge was developed in partnership with Lockheed Martin Aeronautics, and funded by the U.S. Air Force. nForge was tested and demonstrated using a sanitized subset of the F-35 program dataset.

This demonstration included importing and navigating the C++ code base; importing, constructing and navigating multiple models of: messaging, call graphs, multi-threading, hardware-to-software allocation, execution time test results, schedulability analysis, end-to-end system thread analysis, interactive allocation and re-allocation of software to hardware, studying its impacts, quantitative modeling and incorporation of memory cache interference when using modern multi-core architectures and more. nForge features include:

Enhanced Modeling

nForge enhanced modeling improves the system development and sustainment operations by

- capturing and enforcing constraints and rules within models and datasets
- capturing and enforcing consistency of overlapping concepts across models and datasets using rules
- presenting one unifying reality

Programmable Adapters

nForge maintains its own Graph model, onto which multiple datasets and models are mapped via adapters. Adapters have been deployed for C++ source code, Microsoft Excel sheets, XML format files, as well as nVision, nTrace and nLoad datasets. Experimental adapters for UML, SysML and AADL and corresponding tools exist, and we are seeking motivated customer funding. Custom adapters can be created using nForge API.

Queries and Visualization

nForge includes an Application Programming Interface (API) using which powerful custom queries and visualizations can be created. nForge API can be programmed in Java, Javascript, Groovy, Python, or nForge Language. In addition, the nForge API makes the entire **Apache Gremlin** graph traversal language available, using which highly scalable graphs can be created, manipulated and visualized.

The screen image below is representative of an "integrated view" created by parsing C++ source code, importing signal databases, lab test results, and allocation strategies. This data is still all maintained in separate Excel and XML files, but has been made highly navigable.

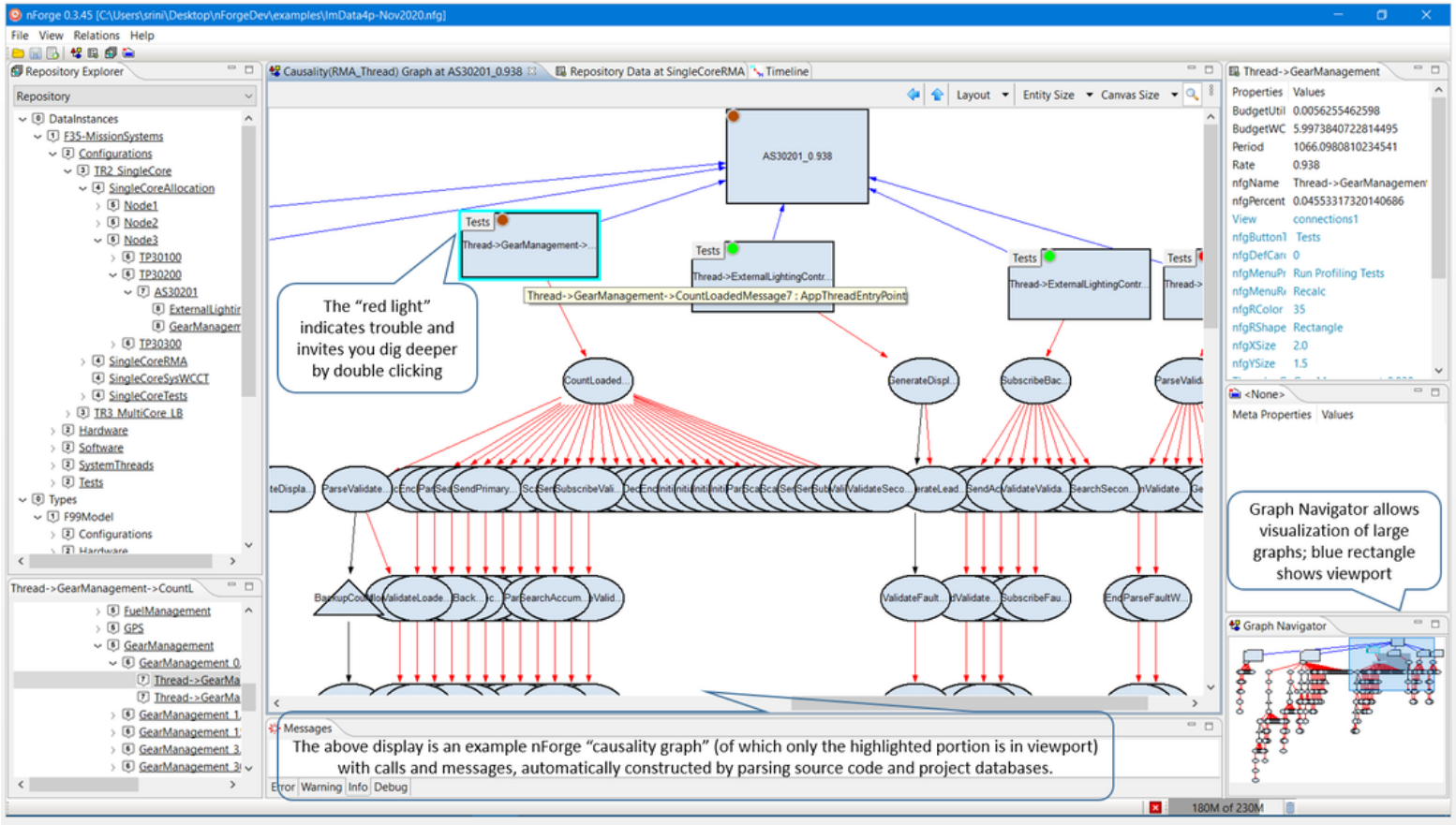


Figure 5: nForge System Engineering Knowledge Graph

4.2 References on Graph comparison and Graph editing

In this section, we will highlight a few sources of technical inspiration for our approach. These references can be classified as graph comparison/navigation and graph editing/automation.

Graph comparison/navigation: Yan Yuchen[2] proposed a family of algorithms (DINGAL) for **knowledge graph alignment**, addressing how to efficiently update entity embeddings for an evolving graph. This algorithm could be useful in both the CONOPS (end-to-end events, modes) we identified earlier. We shall explore how the semantics of the user edits can be maintained even as the underlying graphs continue to evolve.

Nechasky[3] proposed an approach to knowledge graph visual exploration based on the concept of shareable and reusable visual configurations. A visual configuration comprises domain specific views on

[2] Yan, Yuchen et al. "Dynamic Knowledge Graph Alignment." Proceedings of the AAAI Conference on Artificial Intelligence, vol. 35, no. 11, 2021, pp. 10112–10119.,

[3] Nechasky, Martin, and Stepan Stenchlak. "Interactive and iterative visual exploration of knowledge graphs based on shareable and reusable visual configurations." International Journal of Human-Computer Studies, vol. 163, 2022, pp. 102839.,

a knowledge graph which define operations such as node detail or expansion. Once again, this approach may be highly applicable to both our CONOPS outlined earlier. We shall explore how to automatically simplify the navigation and presentation of our large graph (consisting of millions of nodes) along events and modes, for example.

Graph edit and automation: There aren't many existing tools for editing very large graphs and diagramming tools. Existing diagramming tools (like Microsoft PowerPoint, Visio) work well with small, specialized diagrams. Large graph visualization tools (including our own nForge), do not handle interactive editing well. yEd[4] from yWorks is a graph editing product. Some of the features it supports include: automatic graph layout (already supported by our nForge), large graph visualization, custom visualization and graph analysis (already supported by nForge). We will investigate the unsupported features and adopt them into nForge Pro as appropriate.

Cursor[5] is a code automation editor built on VS Code with advanced AI capabilities. It uses GPT-4 and other AI models to understand and generate code, offering code completion, error correction, and natural language commands. It works with multiple languages, e.g.: JavaScript, Python, and TypeScript. Cursor analyzes the codebase for context and can use natural language processing for plain English commands to provide smart code completion and generation. We will draw inspiration from Cursor interface to implement knowledge graph edit ***automation*** based on user edits and guidance.

[4] https://www.yworks.com/editors
[5] https://www.cursor.com/

5. Relationship with Future Research and Development

5.1. Anticipated Results

The anticipated results of our proposed research and development are summarized in Table 1.

Table 1 – Anticipated Results of Proposed Research and Development

Phase I	Phase II

• Phase I Final Report, documenting:
  • requirements
  • technical approach
  • high-level design
  • lessons learned
• Initial proof-of-concept prototype with:
  • Demo software/CD
  • Major software components prototyped
	• Production-ready software
	• Ongoing demonstrations
	• Final release within Phase II period
	• User documentation including
	  • tutorials and sample problems
	• Demonstration
	  • Scalability, openness and automation
	  • Development of DoD relevant challenge problem and data artifacts
	  • Demonstration in the context of the challenge problem
	• Phase II Final Report

5.2. Phase I as a Foundation for Phase II Research and Development

During Phase I, we propose to firmly establish the proof-of-concept of the editable knowledge graph (nForge Pro) that can be used to construct, edit and maintain knowledge graphs representing systems and modeling and analysis.

The Phase 1 project is designed to identify and mitigate the risks in the overall project and to provide evidence to the sponsors that the overall project is extremely likely to meet its requirements outlined above. In Phase 1, we will develop the requirement specifications and technical design of the framework, develop and demonstrate a rapid prototype and, specify a DoD-scale challenge problem and data artifacts to be used in Phase 2 demonstration and validation. This effort will greatly reduce the risk during development and commercialization performed in Phase II.

Additionally, during Phase I, we will put necessary business agreements in place and obtain the necessary organizational clearances to enable Phase II demonstrations with a DoD-relevant challenge problem with associated data artifacts. We already have business relationships with Lockheed Martin Aeronautics established during the collaborative development and transition of the nForge project.

Successful completion of milestones during Phase 1 will therefore enable us to put the necessary agreements in place for further collaboration, and explore further opportunities within the relevant organizations during Phase 2 and Phase 3 industrial application.

6. Commercialization Strategy

6.1. Commercialization Roadmap

nHansa has a long, reputable history of serving our clients under the name of Effective Automation Systems Inc. We have recently re-focused as nHansa Inc., a solutions provider for all systems design analysis needs. Being a small, and a newly refocused company, we maintain our technological leadership through rapid response to emerging market opportunities and customer requirements in design analysis, by continuing to conduct research and development that will enhance the commercial viability of our technologies. We have considerable expertise in the design, development, commercialization, sales, and marketing of products for the high-performance systems analysis marketplace. We plan to build on this with an aggressive commercialization roadmap leveraging the results of the proposed research on this program.

Function	Phase I	Phase II Months after Contract				Phase III Months after Contract			
		6	12	18	24	30	36	42	48
Engineering	Proof-of-concept prototype	Proto-type v1.0	Prototype v2.0, Alpha	Prototype v3.0, Beta	Product Release, V 1.0	Product maint-enance	On-going product develop-ment	Product Release 2.0	On-going product develop-ment
Product Support			Draft product manuals	Technical support staffing	Final product manuals; Product training	Updated product manuals	On-going technical support	Updated product manuals and Training	On-going technical support
Business Develop-ment	Phase II proposal	BD plan	Govt. project #1	Commercial project #1	Govt. project #2	Commercial project #2	On-going BD	On-going BD	On-going BD
Marketing		Phase II Press release	Market-ing plan	Partners/ alliances	Collateral; Tradeshow demos	Press releases	On-going marketing	On-going marketing	On-going marketing
Sales			Sales plan	Beta test users	Product sales campaign	Refine Sales plan	On-going sales	On-going sales	On-going sales

6.2. Target Markets and Expected Results

nHansa's strategy is to provide comprehensive solutions for the design analysis of high-performance systems with the most user-friendly features and thereby become the *de facto* tool. In the U.S. defense segment, we have long-standing relationships and reputation for our unique expertise in real-time systems analysis. Through our PI's entrepreneurial activities over the years as well as continuing advisory and investor activities in the San Francisco Bay Area, we also have a number of relationships in the automotive, industrial controls, consumer products, and medical devices markets.

Our strategy is to establish a clear beachhead in one application domain (defense/aerospace) during Phase 2 and early Phase 3. It is important that we demonstrate the viability of our approach with profitable, commercial results in one high-probability, low-risk domain before engaging in other application domains. Upon successful demonstration for our beachhead domain of defense/aerospace we will be well positioned to expand our results to the other application areas mentioned above.

7. Key Personnel

Srini Srinivasan will serve as the Principal Investigator for this project. He will be supported by an advisory team consisting of senior nHansa researchers, as well as a senior software engineer.

KEY PERSONNEL SUMMARY				
Name, Title	**Org**	**Qualifications**	**Foreign National (Y/N)**	**Recent Publication**
Srini Srinivasan, Principal Investigator	nHansa	PI for prior nHansa SBIRs in advanced technologies; entrepreneurial experience	N	S. Srinivasan *et al*., "Empirical Bounds for Multicore Cache Interference" *2019 IEEE/AIAA 38th Digital Avionics Systems Conference (DASC)*, San Diego, CA, USA, 2019, pp. 1-10, doi: 10.1109/DASC43569.2019.9081787
Technical Advisory Board				
Mark Gerhardt, Technical Advisor	nHansa	Extensive DoD domain experience; expert in systems architecture	N	
Russell Kegley, Technical Advisor	nHansa	Prior Lockheed Martin Fellow; experience transitioning and R&D into DoD applications	N	
Rich Hilliard, Technical Advisor	nHansa	MBSE expert; actively participates in standards	N	
Technical Support Team				
Software Engineer	nHansa	Rapid prototyping	N	

Srini Srinivasan – Principal Investigator and CTO of nHansa, Inc. (U. S. Citizen)

Srini has over thirty-five years of experience with advanced technology development and commercialization. Srini led the development and transition of nForge (SBIR Phase 1 and SBIR Phase 2 and beyond) to the Air Force's F-35 program, in partnership with Lockheed Martin Aeronautics Company located in Fort Worth, TX; he is actively involved in its Phase 3. He is a contributing member of the AUTOSAR Safety and System Test Working Groups which are responsible for the safety standard for automotive platforms. Previously, he was the Principal Investigator in our nVision toolset project (SBIR Phase 1 and SBIR Phase 2), which analyzed and optimized the performance of the C2I subsystem of the NAVY DDG 1000 platform, collaborating with Raytheon and Lockheed Martin; and, the Control Oriented Adaptive Transport (COAT) project, which focused on wireless network optimization strategies. Previously, he led the technical proposal efforts for Lockheed Martin Advanced Technology Labs' (Cherry Hill, NJ) DARPA SAPIENT program, and participated in the DARPA BICA program.

Srini was a co-founder and CEO of TimeSys Corporation, http://www.timesys.com, and developed TimeSys to be the worldwide leader in real-time system software, a technology with extensive application in Defense systems. He secured nearly $25 M in funding for TimeSys, including $5 M in sponsored research projects (from DARPA, BMDO, Air Force, and Navy) and $20 M in venture capital funding. Under his leadership, TimeSys became a 70-person company with 8 locations worldwide. Srini was a regular presenter and speaker at the Embedded System Conferences and the Software Technology Conferences in Salt Lake City, Utah. Before TimeSys, Srini led the online Automatic Testing Software (ATS) for the world's first fully automated safety system for a nuclear power plant, in Sizewell B power station in the UK. Later he led the safety certification team for Westinghouse Electric, addressing and resolving findings from a formal for the nuclear safety system.

Srini holds Masters and Bachelor's in Engineering from the University of Houston, and the Indian Institute of Technology (IIT) Madras; and an MBA from the Wharton School at the University of Pennsylvania.

A detailed resume is included in the Attachments to this proposal.

Mark Gerhardt – Chief Scientist of nHansa, Inc. (U. S. Citizen)

Mark Gerhardt will be an advisor for the nForge Pro tool architecture design. He is currently a Chief Architect at nHansa, Inc., and led the architecture activities for the nForge tool. He has been involved for over 35 years in the conception, construction, and deployment of large and complex mission-critical and high-performance software-based systems. Previous positions include software engineering laboratory deputy director at Loral Mission systems, chief software scientist at ESL, Inc., and involvement in many radar, sonar, and EW products at Raytheon, Lockheed, Boeing, and TRW. He was previously also a Chief Scientist at TPSI Inc. and a Chief Architect at TimeSys Inc., both vendors of schedulability and performance analysis tools.

During his career, Mark has designed and built numerous real-time systems for signal and radar processing, computer architectures, and fault-tolerant systems. He also designed and implemented major embedded software applications including C3I and early-warning receivers. Mark's interests include software and system engineering methods, system and software architecture, object-based languages, and Ada. Mark is the Past Chair of ACM SIGAda and was a Distinguished Reviewer for Ada95. He is also involved in the IEEE 1471/ISO 42010 work for the recommended practice on how to capture architecture.

Mark received his Bachelor of Electrical Engineering degree Magna Cum Laude from the City College of New York and his Master of Science in Engineering (Computer Science) from Princeton University.

Russell B Kegley – Application Engineering, nHansa Inc. (U. S. Citizen)

Russell will be the Application Engineering Advisor for the proposed project. Russell has worked in operating systems development in the distributed systems area since 1978, beginning with kernel development for the Unisys 1100 series of mainframe computers, the first generally available symmetric multiprocessor family. Before nHansa, Russell was a Fellow at Lockheed Martin Aeronautics in Fort Worth TX. At Lockheed, he has worked on a long series of avionics architecture thrusts, including leading the first application development on the Carnegie-Mellon real-time distributed Alpha operating system. His other experiences at Lockheed Martin include the development of schedulability analysis frameworks for the F-22 and F-35 fighter programs, internal consulting in advanced design techniques, and leading multiple IRAD efforts investigating schedulability tools, middleware architecture, multiprocessor use in avionic systems, and cache contention modeling and remediation. He provided leadership and technical support in multiple university research efforts, including complexity reduction with the University of Illinois Urbana-Champaign, with a particular focus on the transition of university-developed technologies into program use. Russell received a Bachelor of Science degree with Honors from Mississippi State University in 1977, with a double major in Mathematics and Computer Science, and a Master of Science in Computer Science in 1985 from the same university.

Rich Hilliard – Model-Based Systems Engineering (MBSE), nHansa Inc. (U. S. Citizen)

Rich Hilliard will contribute his expertise in MBSE standards and practices and his knowledge of constraint-based and rule-based systems to the nForge Pro design and implementation. Rich Hilliard advised the nForge team on MBSE best practices for the nForge product. Concurrently, Rich is project editor of ISO/IEC/IEEE 42010, *Systems and software engineering — Architecture description*, the internationalization of IEEE Standard 1471:2000. He is vice-chair of IFIP Working Group 2.10 on Software Architecture; invited expert for The Open Group Architecture Framework next version; member of the IEEE Computer Society and the Free Software Foundation and visiting research scientist at MIT's Experimental Study Group.

8. Foreign Citizens

nHansa Inc. does not plan to use any foreign citizens in this effort.

9. Facilities/Equipment

nHansa has a well-equipped office and extensive networked computing facilities consisting of several high-performance computers and workstations to carry out this project. We have access to the conference, data center, and lab facilities as needed at key locations within the Silicon Valley area. We make use of collaborative software, enabling the use of home offices and flexible working conditions. nHansa is a Small Business and is organized as a Pennsylvania sub-chapter S Corporation.

10. Subcontractors/Consultants

nHansa Inc. does not plan to use any subcontractors or consultants in this effort.

11. Prior, Current, or Pending Support of Similar Proposals or Awards

nHansa did not/does not have any prior, current or pending support for the proposed work.

Attachment 1. nForge (a prior related project) High-Level Summary

Under a prior nForge project, we developed a suite of products for system engineering and performance analysis. These products have been demonstrated on a scaled-up and sanitized avionics dataset, representative of a large avionics program (F-35). Several use-cases were transitioned to the program. Several other use-cases are ready to be transitioned, with a potential to automate and support engineering activities. The use-cases represent high-value checkpoints in certification, upgrades and sustainment activities. The following products were developed:

- nForge: a rule-based model-integration framework (UI)
- nLoad: stress test generation and interference estimation
- nTrace: real-time, low-overhead, portable profiling library
- nVision: Rate-Monotonic Analysis
- nIO: PCIe/Net stress generation and interference estimation
- nAppGenerator: scaled-up avionics problem generator
- nGeneratedApp: instances of scaled-up avionics challenge problem

nForge is a Model Integration Framework that seamlessly integrated the above tools, and many other project specific tools and databases. nForge is a Systems Engineering Platform with a rule-based database, and a set of tools to keep multiple models complete and consistent with each other, allowing navigation using browser-like rendering and plugins. The goal is to improve the system development and sustainment operations by

- capturing and enforcing constraints and rules within models and datasets
- capturing and enforcing consistency of overlapping concepts across models and datasets using rules
- presenting one unifying reality

The nForge platform includes mechanisms to define and enforce enhanced model semantics – either incrementally, or on-demand in a batch-mode. These facilities enable:

- Seamless import/export with popular, widely used tools
- Scalability for distributed teams with large and diverse data sets
- Unifying semantics onto which multiple models can be mapped

nForge was demonstrated initially for Performance Analysis, but applicable to other Domains as well. nForge Catalogs (of predefined Types and Actions) can be added to the nForge platform and provide a reusable and extensible basis for domain semantics.

The following screen images with overlaid annotations attempt to provide a summary of nForge capabilities.

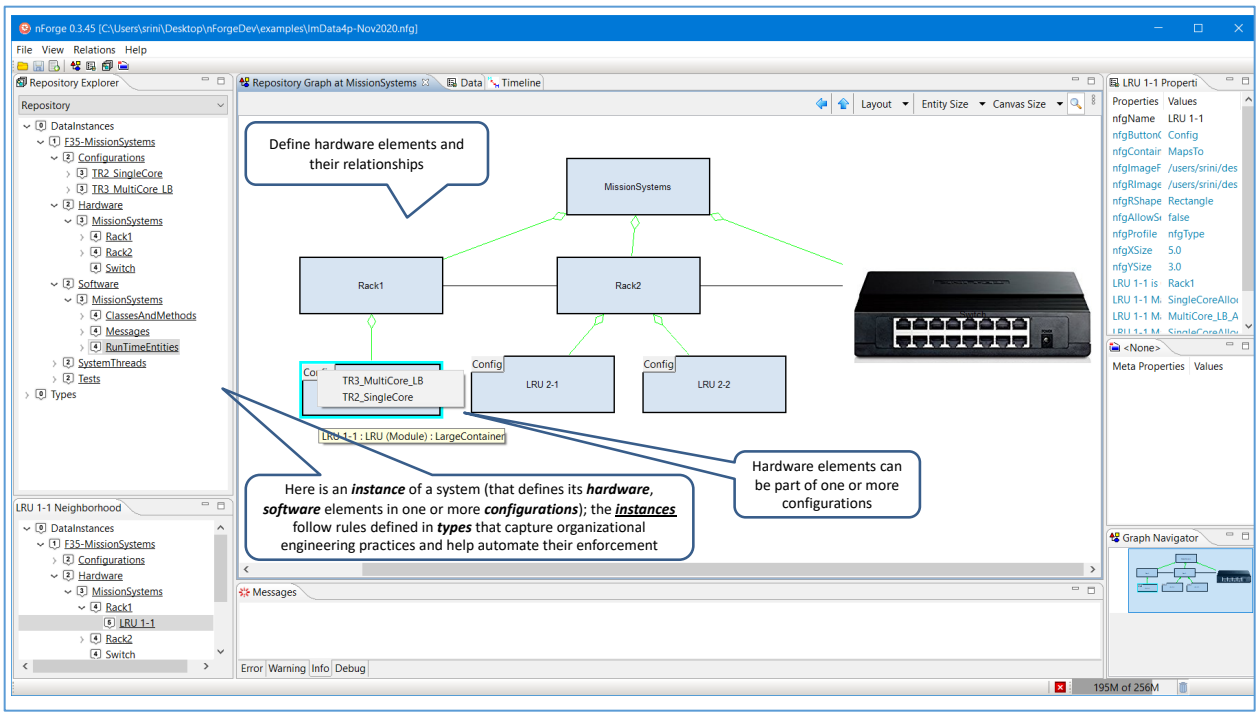


Figure A-6: Hardware Architecture Definition with nForge

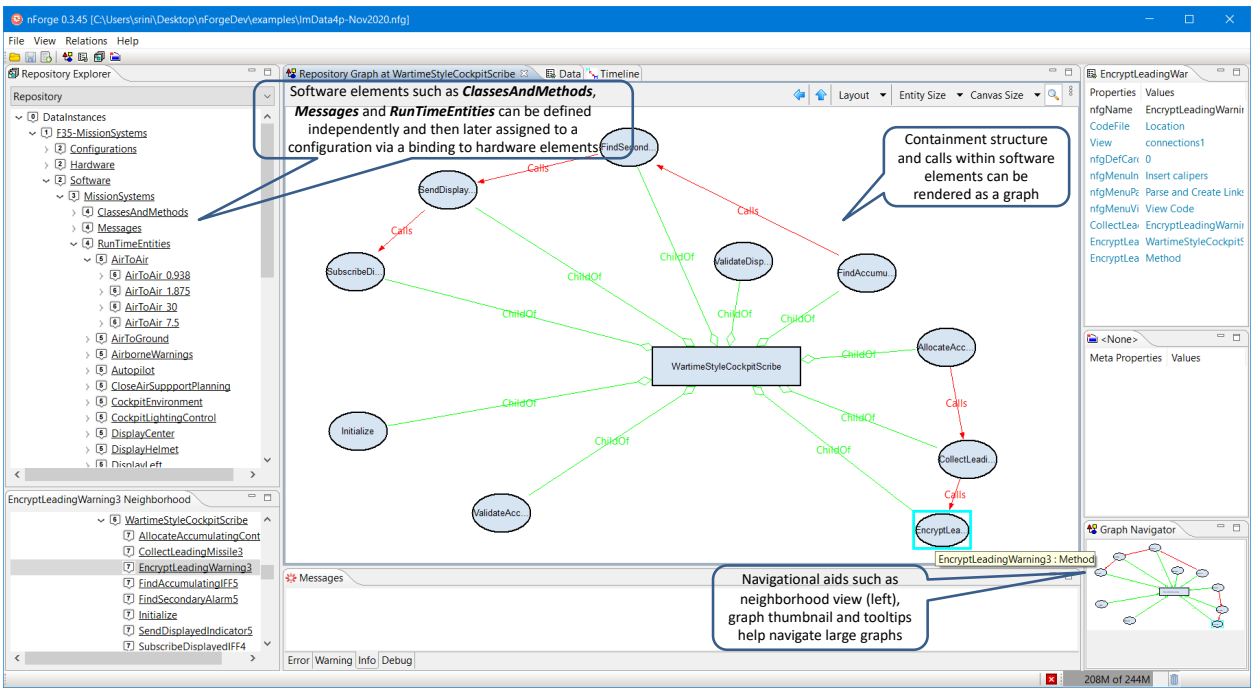


Figure A-7: Software Architecture Definition with nForge

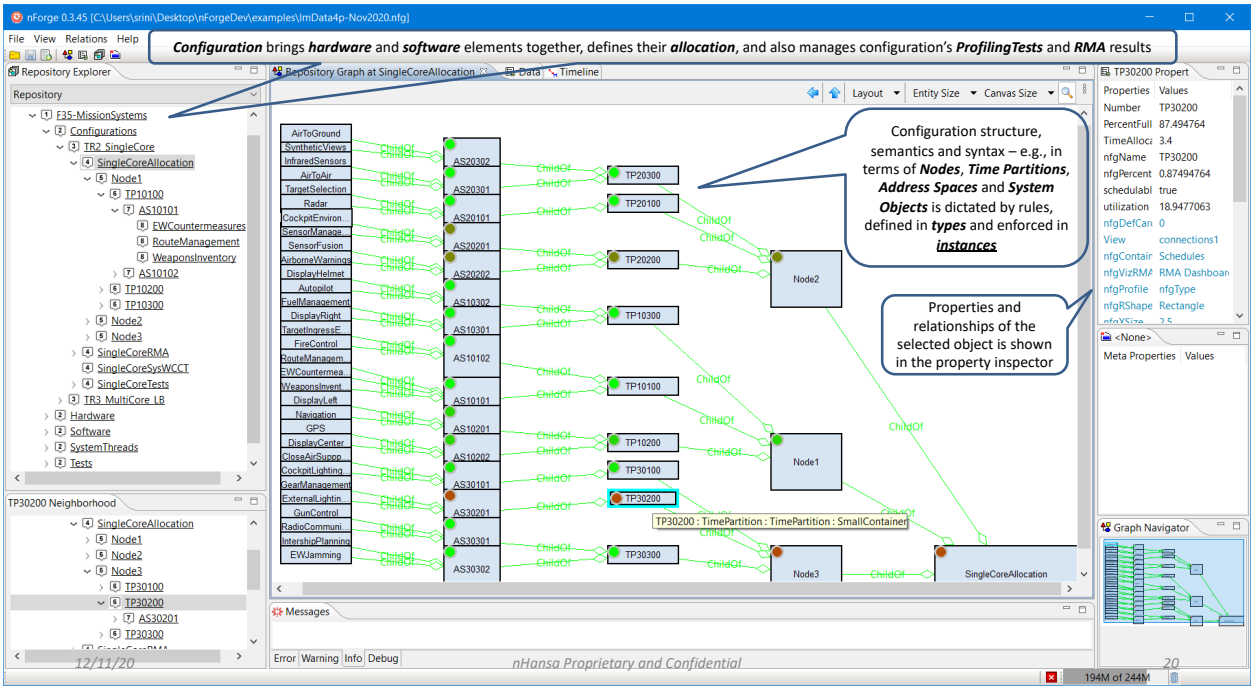


Figure A-8: Configuration Hierarchy in nForge

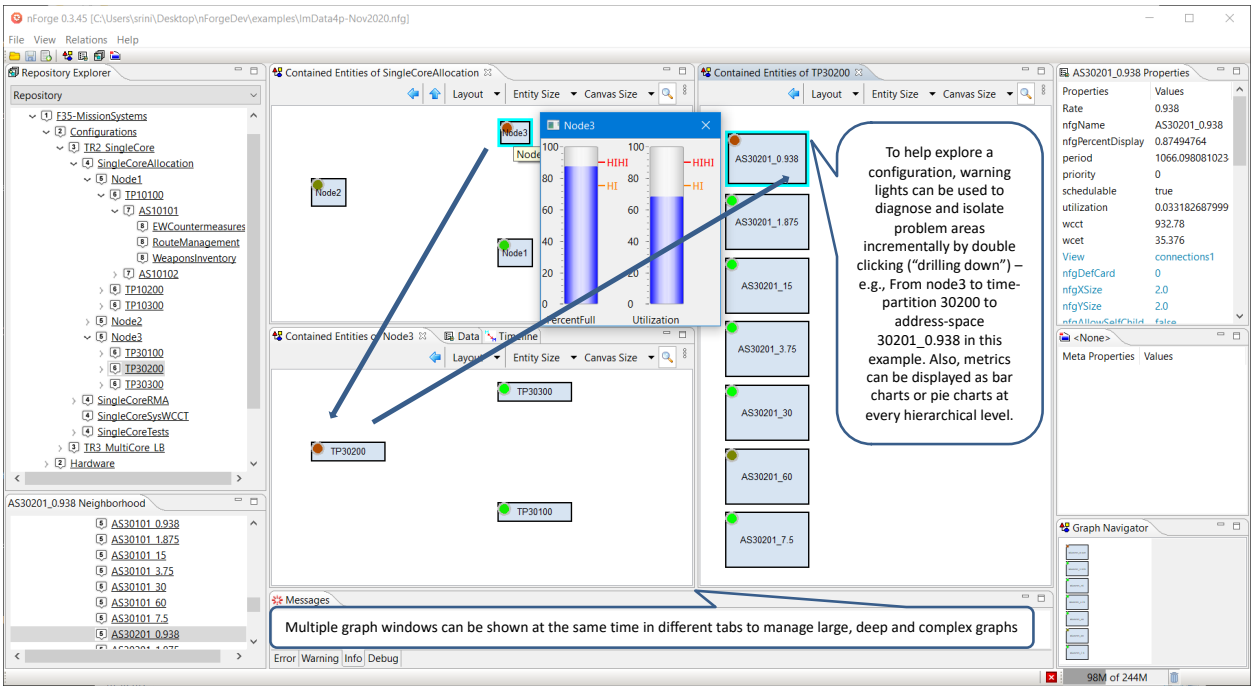


Figure A-9: Dashboard navigation with nForge

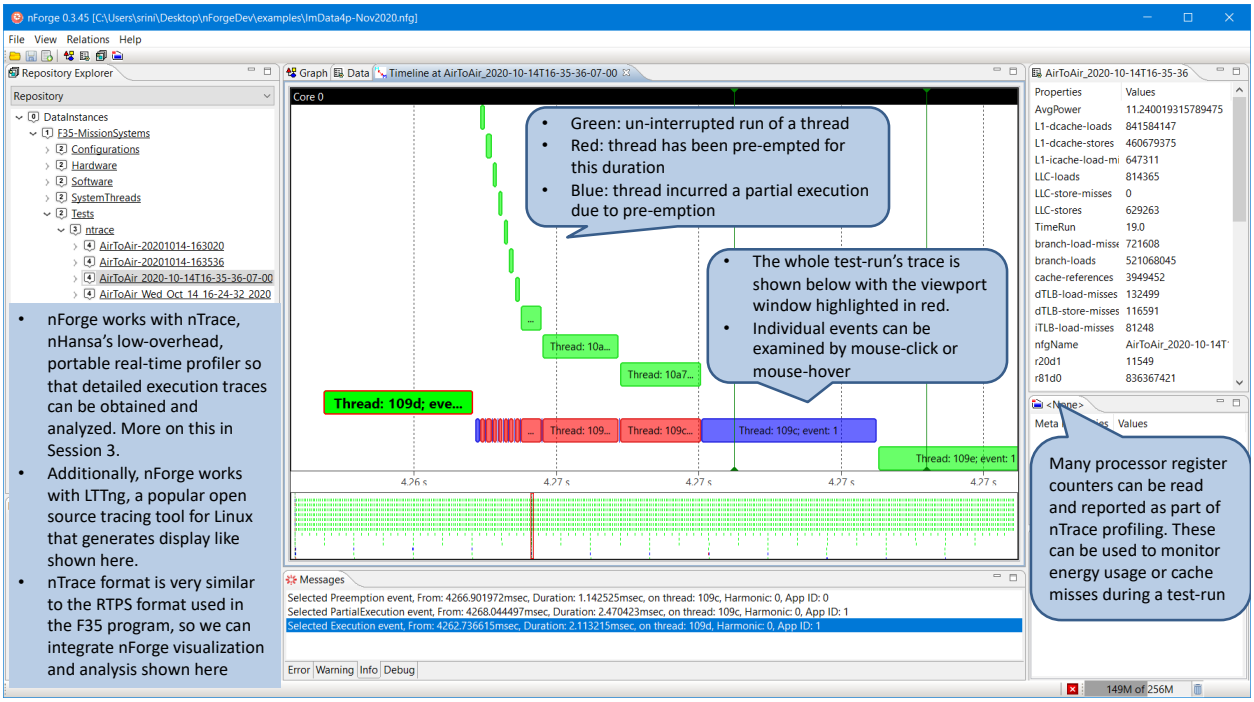


Figure A-10: Profiling Data integrated with nForge

nForge Architecture

nForge is designed with a layered, scalable, customizable tool architecture, shown in the figure below.

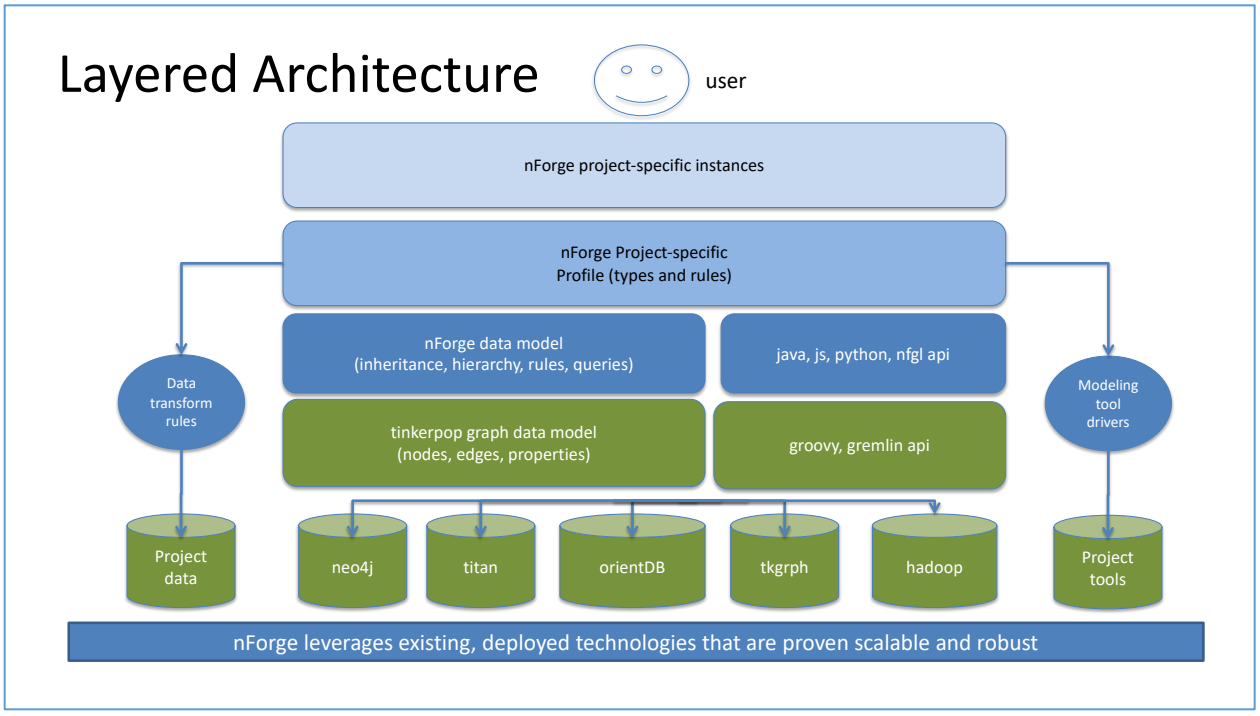


Figure A-11: nForge Layered Architecture

nForge uses graph databases, with a standard Apache Gremlin/Tinkerpop query interface, offering Groovy, Java and Python programming interfaces. These "standard" elements are shown in the bottom two green layers of the above Figure.

nForge's own data-model and API, shown in the third layer from below in the Figure, supports the type definitions contained in catalogs; catalogs can be developed per project. This catalog (or type) layer also defines rules and queries that can be used in the data layer. Project-specific data instances are then supported by the type definitions.

Drivers can also be developed and integrated as plugins to nForge to support data import/export to widely used data formats (e.g., Excel) and widely used modeling tools (e.g., Rhapsody with MARTE annotation, AADL/OSATE).

Attachment 2. Srini Srinivasan Resume

Summary

Srini Srinivasan has over 35 years of experience in developing and managing early-stage technologies, start-ups, and advanced engineering projects in a wide variety of roles: customer development and support, product management, marketing, sales, engineering, finance and general management. His experience spans diverse domains of advanced electronics, software, data analytics, advanced materials, Internet, networks, control systems, consumer and financial markets.

While leading nHansa on safety and performance in autonomous transportation systems, he is also serving as an adviser for various bay area start-ups. Previously, he was the founder of EASI, which provided analytics products for wireless networks and embedded real-time systems. He was the founding CEO of TimeSys, a leader in the embedded Linux market with applications in industrial automation, telecommunications, networking, consumer devices, aerospace and defense. Earlier in his engineering career, for Westinghouse Electric, he co-led an engineering team that delivered an automated online tester for the world's first digital safety system for a nuclear power plant.

Srini holds an MBA in Entrepreneurial Management and Finance from the Wharton School at the University of Pennsylvania, and Masters and Bachelors of Engineering respectively from the University of Houston and the IIT Madras in India.

Experience

nHansa
CEO and CTO
September 2015 - Present
San Jose, CA
Currently in product development and initial customer application - an integrated systems engineering solution for software intensive, performance-

and safety-critical avionics applications. Product is being demonstrated with performance and safety analysis in support of air-worthiness certification for a large avionics system, but generalizes to many other types of analysis and also to other verticals, e.g., safety analysis and certification of computing infrastructure used in autonomous automotive and drone systems. We have also developed a unique approach to the design and certification of predictable systems that need to use modern multi-core processors.
Previously, participated in a computational materials R&D program. Idea was to significantly reduce the time-to-market for advanced materials made from carbon fiber reinforced plastics, via integrated operation of various design and simulation software from Autodesk, Convergent and other Abaqus tools.

Sand Hill Angels
Member and Investor
August 2013 - Present
Palo Alto, CA
Sand Hill Angels is a group of successful Silicon Valley executives and accredited investors that are passionate about entrepreneurialism and the commercialization of disruptive new technologies.

DabKick Inc
Advisor
April 2014 - Present
Cupertino, CA
DabKick focuses on the social aspect of media consumption - in home and on the move. Adviser on technology and corporate strategy.

Effective Automation Systems Inc
President
August 2002 - August 2015
San Jose, CA
Won and executed 3 advanced R&D projects from the US Navy and US Air Force in the area of performance analysis of real-time systems and wide-area wireless networks.
Also, as a consultant for Lockheed Martin Advanced Technology Labs in

Cherry Hill, NJ:
- in a product management role, led the the core execution team for the SPRUCE project, which is both a social network and a virtual laboratory for the Computer Science research community.
- in a business and technology development role, led and secured the pursuit for a DARPA funded early stage technology development program in advanced mobile networking and machine learning
- in a technology development role, contributed to the development of various applied software engineering technologies - in the areas of model integration and service-oriented architectures

In parallel,
- Took entrepreneurial pursuits to various stages of prototype development, business plan generation, initial team formation and venture capital exploration for a variety of concepts: (i) a mobile local search service using automated voice servers, (ii) a voice and web portal for organizing and disseminating customer feedback on local businesses, (iii) data analysis and classification for commodity and financial futures via machine learning, and (iv) a micro-fluidic platform for rapid drug discovery

Golden Mile Solutions
Co-founder and Advisor
August 2013 - July 2015
San Jose, CA
Our management consulting offering focuses on business problems and results; we leverage organization's data, experience and our own access to various technologies and experience to deliver what matters most - business results and actionable insights.

ThinkOptics
Advisor
May 2005 - May 2012
San Jose, CA
Direct pointing and navigation for digital media

TimeSys

Co-Founder, CEO
July 1996 - July 2002
Greater Pittsburgh Area
Co-founded, developed and positioned the company as the leading global provider of embedded, real-time Linux and Java
-- Led overall corporate strategy, formulated and executed the overall business and marketing plan
-- Developed flagship software product, actively sold it initially; participated in industry conferences, standards
-- Built an initial customer base with major telecom, mobile, consumer device, industrial control and defense vendors
-- Formulated world-wide product distribution strategy and oversaw its execution
-- Recruited and managed an executive team assembled one of the strongest real-time technology teams world-wide
-- Instrumental in completing three rounds of venture funding
-- Initiated and managed contacts with venture capital organizations and corporate investors across the country
-- Negotiated and completed key distribution agreements, strategic investments
-- Responsible for investor/board relations, finance/budgeting and other day-to-day operational issues

EASI
President and Consulting Engineer
August 1992 - July 1997 (5 years)
Built and led a team providing engineering consulting solutions to Westinghouse Electric Corp (in Industrial Control Software), the US Department of Energy (in Image Processing) and Carnegie Mellon University (in Operations Management).
Developed friendly software to accompany an MBA text in operations management for CMU - Heuristic Scheduling Systems: With Applications to Production Systems and Project Management (Wiley Series in Engineering and Technology Management) - Thomas Morton and David Pentico - http://www.amazon.com/Heuristic-Scheduling-Systems-Applications-Engineering/

dp/0471578193

SAIC
Systems Engineer
February 1991 - July 1992 (1 year 6 months)
Engineering development for a real time image acquisition and image processing system for medical and industrial applications
Responsible for software development and customer satisfaction, completed projects on time for the Department of Energy

WTI Advanced Technology LTD
Senior Engineer
April 1988 - February 1991 (2 years 11 months)
Developed a microprocessor based real time nuclear plant control software for Westinghouse Electric Corporation
Co-Led a technical team of seven engineers with hands-on work and project management and schedule responsibility

Shaw Wallace & Co Ltd
Engineer
June 1986 - April 1988 (1 year 11 months)
Copenhagen Area, Denmark and Chennai, India
Software development for a distributed industrial control system

Education
University of Pennsylvania - The Wharton School
MBA, Entrepreneurial Management and Finance · (2002 - 2004)

University of Houston
MS, Chemical Engineering · (1985 - 1986)

Indian Institute of Technology, Madras
B.Tech, Chemical Engineering · (1980 - 1985)

DSIP Defense SBIR/STTR Innovation Portal

Cost Volume

SBIR Phase I Proposal

Proposal Number	F244-0001-0005
Topic Number	AF244-0001
Proposal Title	nForge ProTM: A Scalable Knowledge Graph with an Intelligent Interactive Editor
Date Submitted	10/23/2024 01:51:36 PM

Firm Information

Firm Name	Effective Automation Systems Inc (DBA nHansa)
Mail Address	1014 Narciso Ct -, San Jose, California, 95129
Website Address	http://www.nhansa.com
UEI	S5YEALJFBWY7
Duns	943516443
Cage	06SL3

Total Dollar Amount for this Proposal	$139,966.73

Base Year	$139,966.73
Year 2	$0.00
Technical and Business Assistance(TABA)- Base	$0.00
TABA- Year 2	$0.00

Base Year Summary

Total Direct Labor (TDL)	$125,994.00
Total Direct Material Costs (TDM)	$0.00
Total Direct Supplies Costs (TDS)	$0.00
Total Direct Equipment Costs (TDE)	$0.00
Total Direct Travel Costs (TDT)	$0.00
Total Other Direct Costs (TODC)	$0.00
G&A (rate 5.8%) x Base (TDL+TOH)	$7,307.65
Total Firm Costs	$133,301.65
Subcontractor Costs	
Total Subcontractor Costs (TSC)	$0.00
Cost Sharing	-$0.00
Profit Rate (5%)	$6,665.08
Total Estimated Cost	$139,966.73
TABA	$0.00

Year 2 Summary

Total Direct Labor (TDL)	$0.00
Total Direct Material Costs (TDM)	$0.00

Total Direct Supplies Costs (TDS)	$0.00
Total Direct Equipment Costs (TDE)	$0.00
Total Direct Travel Costs (TDT)	$0.00
Total Other Direct Costs (TODC)	$0.00
G&A (rate 5.8%) x Base (TDL+TOH)	$0.00
Total Firm Costs	$0.00
Subcontractor Costs	
Total Subcontractor Costs (TSC)	$0.00
Cost Sharing	-$0.00
Profit Rate (5%)	$0.00
Total Estimated Cost	$0.00
TABA	$0.00

Base Year

Direct Labor Costs

Category / Individual-TR	Rate/Hour	Estimated Hours	Fringe Rate (%)	Fringe Cost	Cost
Computer Systems Analyst/ Principal Investigator (Srini Srinivasan)	$85.00	750			$63,750.00
Computer Systems Analyst/ Advisor	$80.00	60			$4,800.00
Software Developer/ Software Engineer	$65.00	350			$22,750.00

Subtotal Direct Labor (DL)	$91,300.00
Labor Overhead (rate 38%) x (DL)	$34,694.00
Total Direct Labor (TDL)	**$125,994.00**

G&A (rate 5.8%) x Base (TDL+TOH)	$7,307.65
Cost Sharing	-$0.00
Profit Rate (5%)	$6,665.08
Total Estimated Cost	$139,966.73
TABA	$0.00

Year 2

Direct Labor Costs

Category / Individual-TR	Rate/Hour	Estimated Hours	Fringe Rate (%)	Fringe Cost	Cost
Computer and Information Research Scientist/ Principal Investigator (Srini Srinivasan)	$85.00	0			$0.00

Subtotal Direct Labor (DL)	$0.00

Labor Overhead (rate 38%) x (DL)	$0.00
Total Direct Labor (TDL)	**$0.00**

G&A (rate 5.8%) x Base (TDL+TOH)	$0.00
Cost Sharing	-$0.00
Profit Rate (5%)	$0.00
Total Estimated Cost	$0.00
TABA	$0.00

Explanatory Material Relating to the Cost Volume

The Official From the Firm that is responsible for the cost breakdown

Name: Srini Srinivasan
Phone: (408) 480-7707
Phone: srini@nhansa.com
Title: Proposal Owner

If the Defence Contracting Audit Agency has performed a review of your projects within the past 12 months, please provide: Yes
Audit Agency Name: DEFENSE CONTRACT AUDIT AGENCY
Audit Agency POC: Acacia Rodriguez
Address: 2105 S. BASCOM AVENUE, SUITE 310 , CAMPBELL, California,95008
Phone: (571) 448-5643
Email: oacacia.rodriguez@dcaa.mil
Select the Type of Payment Desired: Partial payments

Cost Volume Details

Direct Labor

Base

Category	Description	Education	Yrs Experience	Hours	Rate	Fringe Rate	Total
Computer Systems Analyst	Principal Investigator	Master's Degree	35	750	$85.00		$63,750.00
Computer Systems Analyst	Advisor	Master's Degree	40	60	$80.00		$4,800.00
Software Developer	Software Engineer	Master's Degree	10	350	$65.00		$22,750.00

Are the labor rates detailed below fully loaded? **NO**

Provide any additional information and cost support data related to the nature of the direct labor detailed above.
Previously justified and negotiated labor rate for the geographical location, adjust for modest total 5% inflation over the last 3 years. Fringe benefits are included in the overhead rate

Direct Labor Cost ($): $91,300.00

Year2

Category	Description	Education	Yrs Experience	Hours	Rate	Fringe Rate	Total
Computer and Information Research Scientist	Principal Investigator	Master's Degree	40	0	$85.00		$0.00

Are the labor rates detailed below fully loaded? **NO**

Provide any additional information and cost support data related to the nature of the direct labor detailed above.
Fringe rate is include in overhead rate

Direct Labor Cost ($): $0.00

Sum of all Direct Labor Costs is($): $91,300.00

Overhead

Base

Labor Cost Overhead Rate (%)	**38**

Overhead Comments:
Fringe rate is include in overhead rate

Overhead Cost ($):	**$34,694.00**

Year2

Labor Cost Overhead Rate (%)	**38**

Overhead Comments:
Fringe rate is include in overhead rate

Overhead Cost ($):	**$0.00**
Sum of all Overhead Costs is ($):	**$34,694.00**

General and Administration Cost

Base

G&A Rate (%):	**5.8**
Apply G&A Rate to Overhead Costs?	**YES**
Apply G&A Rate to Direct Labor Costs?	**YES**

Please specify the different cost sources below from which your company's General and Administrative costs are calculated.

G&A Cost ($):	**$7,307.65**

Year2

G&A Rate (%):	**5.8**
Apply G&A Rate to Overhead Costs?	**YES**
Apply G&A Rate to Direct Labor Costs?	**YES**

Please specify the different cost sources below from which your company's General and Administrative costs are calculated.

G&A Cost ($):	**$0.00**

Sum of all G&A Costs is ($):	**$7,307.65**

Profit Rate/Cost Sharing

Base

Cost Sharing ($):	**-$0.00**

Cost Sharing Explanation:
None

Profit Rate (%):	**5**

Profit Explanation:	

Total Profit Cost ($):	**$6,665.08**

Year2

Cost Sharing ($):	**-$0.00**

Cost Sharing Explanation:
None

Profit Rate (%):	**5**

Profit Explanation:	

Total Profit Cost ($):	**$6,665.08**

Total Proposed Amount ($):	**$139,966.73**

SBIR Company Commercialization Report

EFFECTIVE AUTOMATION SYSTEMS, INC

Total Investments:	Total Sales:	Total Patents:	* CAI:
$0.00	$200,000.00	0	0

**This CAI is calculated at the time of submission. CAI is calculated 1st of every month for all the organizations. This might change your firms CAI. Please visit our company dashboard on SBIR.Gov to view the most recent CAI for your organization.*

Company Information

Address: 1014 Narciso Ct, San Jose, CA, 95129-3027

SBC Control ID: SBC_000152255 **Company Url:** http://www.nhansa.com

Company POC

Title:

Full Name: Srini Srinivasan

Phone: 4084807707

Email: srini@nhansa.com

Commercialization POC

Title: President and CEO

Full Name: Srini Srinivasan

Phone: (408) 480-7707

Email: srini@nhansa.com

Additional Company Information

% Revenue for last fiscal year from SBIR/STTR funding:	Total revenue for last fiscal year:
99.0%	$500 - $999,999
Year Founded:	**# Employees Currently:**
1992	5
Year first Phase I award received:	**# SBIR/STTR Phase I Awards:**
2003	4
Year first Phase II award received:	**# SBIR/STTR Phase II Awards:**
2005	2
# Employees at first Phase II award:	**Mergers and Acquisition within past 2 years:**
3	No
Spin-offs resulting from SBIR/STTR:	**IPO resulting from SBIR/STTR | Year of IPO:**
No	No | N/A
Patents resulting from SBIR/STTR | #Patents:	**List of Patents:**
No | N/A	
Woman-Owned:	**Socially and Economically Disadvantaged:**
N	N
HUBZone-Certified:	**SBC majority-owned by multiple VCOC, HF, PE firms | By what percent (%):**
N	No | 0.00%

Additional Investment From (Year over Year)

	2019	2020	2021
DoD contracts/DoD subcontracts	$0.00	$0.00	$0.00
Angel Investors	$0.00	$0.00	$0.00
Venture Capital	$0.00	$0.00	$0.00
Self Funded	$0.00	$0.00	$0.00
Private Sector	$0.00	$0.00	$0.00
Other Federal Contracts/Grants	$0.00	$0.00	$0.00
Other Sources	$0.00	$0.00	$0.00
Additional Investment	$0.00	$0.00	$0.00
Total Investment	$0.00	$0.00	$0.00

Last Updated On: *01/18/2021*
Last Updated By: *rsrinivasan1*

Phase III Sales To (Year over Year)

	2019	2020	2021
DoD or DoD prime contractors	$200,000.00	$200,000.00	$200,000.00
Private Sector	$0.00	$0.00	$0.00
Export Markets	$0.00	$0.00	$0.00
Other Federal Agencies	$0.00	$0.00	$0.00
Additional commercialization by 3rd Party Revenue	$0.00	$0.00	$0.00
Other Customers	$0.00	$0.00	$0.00
Additional Sales	$0.00	$0.00	$0.00
Total Sales	$200,000.00	$200,000.00	$200,000.00

Commercialization Narrative

Commercialized Awards

nForge: A Multi-Model Framework for System Designers 1 of 2

Agency/Branch: Department of Defense/Air Force
Program/Phase/Year: SBIR/Phase II/2015
Topic #: AF141-056
Contract/Grant #: FA8750-15-C-0275
Achieved a cost saving or cost avoidance?: Yes
a. Agency/End user: Lockheed Martin Aeronautics
b. System/Program: F-35
c. Cost Savings: $5,100,000.00
d. Cost Savings Type: life-cycle
e. Explanation: o Cost benefit ROM's (Estimates based on SME inputs), total over 10 years

 $1.6M in direct analysis costs (interference effects)
 $150K per year in touch labor avoidance, each of the 10 years
 $200K point savings, certification evidence architecture, each of the 10 years
 TBD anomaly avoidance, scrap and rework, implicit, not included
 TBD Airworthiness test automation, implicit, not included

Manufacturing related No | N/A
Subsidiaries N/A
Other contributing SBIR/STTR awards N/A
Used in Federal or acquisitions program? Yes
a. Primary Agency: Air Force
b. System/Program: F-35 Joint Program Office
c. Phase III Contract #: Imminent

Additional Investment From		Phase III Sales To	
DoD contract/subcontract:	$0.00	**Dod or DoD prime contractors:**	$0.00
Other Federal contract/grants:	$0.00	**Other Federal Agencies:**	$0.00
Angel Investors:	$0.00	**Private Sector:**	$0.00
Venture Capital:	$0.00	**Export Market:**	$0.00
Self-Funded:	$0.00	**3rd Party Revenue:**	$0.00
Private Sector:	$0.00	**Other Customers:**	$0.00
Other Sources:	$0.00		
Investment Total:	**$0.00**	**Sales Total:**	**$0.00**

nVision-TM: An Toolset for the Modeling, Analysis and Simulation of Complex Architectures

Agency/Branch:	Department of Defense/Navy	**Manufacturing related**	No | N/A
Program/Phase/Year:	SBIR/Phase II/2005	**Subsidiaries**	N/A
Topic #:	N04-069	**Other contributing SBIR/STTR awards**	N/A
Contract/Grant #:	N00024-05-C-4168	**Used in Federal or acquisitions program?**	No
Achieved a cost saving or cost avoidance?:	No		

Additional Investment From		**Phase III Sales To**	
DoD contract/subcontract:	$0.00	**Dod or DoD prime contractors:**	$200,000.00
Other Federal contract/grants:	$0.00	**Other Federal Agencies:**	$0.00
Angel Investors:	$0.00	**Private Sector:**	$0.00
Venture Capital:	$0.00	**Export Market:**	$0.00
Self-Funded:	$0.00	**3rd Party Revenue:**	$0.00
Private Sector:	$0.00	**Other Customers:**	$0.00
Other Sources:	$0.00		
Investment Total:	**$0.00**	**Sales Total:**	**$200,000.00**

CERTIFICATE OF COMPLETION

THIS CERTIFICATE IS PRESENTED TO

Srini Srinivasan, Effective Automation Systems Inc (DBA nHansa)

FOR SUCCESSFULLY COMPLETING FRAUD, WASTE AND ABUSE TRAINING AND MEETING ALL REQUIREMENTS SET FORTH BY THE OFFICE OF SMALL BUSINESS PROGRAMS

Oct 02, 2024
COMPLETION DATE

Oct 02, 2025
EXPIRATION DATE