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OneSAF/WARSIM/SVDR Global Terrain Generation

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ABSTRACT: *OneSAF Objective System (OOS) is the army's next generation model for brigade and below training, research, development and acquisition and for analysis and has been selected as the embedded training driver for Future Combat System (FCS) to include support for the terrain representations. There are two extreme views of procurement strategies OneSAF could employ to field a terrain database generation capability for the broad range of capabilities OOS must supplant. OneSAF could organically develop a "custom" solution or else could look to the broader range of military systems to participate in developing a more generic solution.*

The custom solution is expensive (beyond OneSAF means) and generally locks the system into tools and investments very hard to back away from. There tends to be a reluctance by other systems to utilize custom solutions developed for specific systems, so the developer is generally locked into a role as sole provider for high life cycle maintenance costs. Custom solutions tend to become "stove-pipe" solutions.

The cooperative development approach is risky for programs with hard requirements due to the dependency on external agencies. The Army Modeling and Simulation Office (AMSO) has formed the Environmental Database (EDB) IPT with the purpose of defining and implementing this community standard solution. This IPT has been the driving force behind the realization of the Common Data Modeling Framework (CDMF) and several Science and Technology Objectives (STO) also hold promise though funding is scarce and unreliable.

The OOS technical approach for Environmental Database Generation (EDGE) for terrain lies between the extremes. The technical architecture described in this paper defines the key components to initially provide an organic OOS capability that is somewhat customized. The "stove-pipe" effect is mitigated by integration agreements for common terrain representation between OneSAF, WARSIM, Combined Arms Tactical Trainer (CATT), Combat XXI and other systems that will benefit. In parallel with the development of the organic EDGE system being defined, OneSAF continues to cooperate with the EDB IPT and RDEC to ensure that OOS can leverage incremental advances by these organizations and embrace the community standard solution if it materializes.

1. Introduction

OneSAF Objective System (OOS) is the army's next generation model for brigade and below training, research, development and acquisition and for analysis. OOS has been selected as the embedded training driver for Future Combat System (FCS) to include support for the terrain representations. There are two extreme views of procurement strategies OneSAF could employ to field a terrain database generation capability for the broad range of capabilities OOS must supplant. OneSAF could organically develop a custom solution or else could look to the broader range of military systems to participate in developing a more generic solution.

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The cooperative development approach is risky for programs with hard requirements due to the dependency on external agencies. The Army Modeling and Simulation Office (AMSO) has formed the Environmental Database (EDB) IPT with the purpose of defining and implementing this community standard terrain generation solution. This IPT has been the driving force behind the realization of the Common Data Modeling Framework (CDMF) and several Science and Technology Objectives (STO) also hold promise though funding is scarce and unreliable.

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The key components of the EDGE technical architecture are defined in this document. The technical approach outlined provides the flexibility to incrementally integrate capabilities developed by the EDB IPT as they become available. Ideally, if the EDB IPT fields a community standard process, OOS can transition onto this system and eliminate support for the organically developed capability.

2. Background.

OneSAF Objective System (OOS) was defined as a series of software components within a Product Line Architecture Framework and Specifications (PLAF/PLAS). Development for these components has been contracted through a series of task orders under the STRICOM Omnibus Contract (STOC).

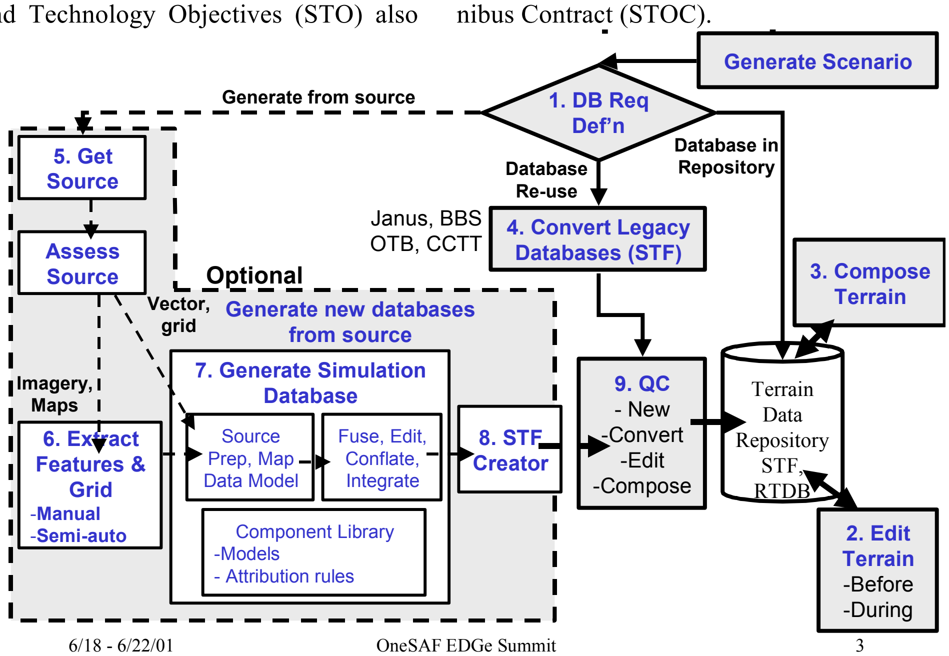

Figure 1. OneSAF Terrain Data Operational Concept

At the inception of OOS in 2000, there was not a clear technical approach identified by which the Operational Requirements Document (ORD) requirements for terrain generation could be developed and so a team of industry experts was assembled to try and identify a solution. During 2001, this team of experts developed the Terrain Data Operational Concept summarized in Figure 1. Unfortunately, the team was unable to identify a viable approach meeting the technical requirements within the program constraints and the results were limited to a series of recommendations for incremental capabilities documented in the EDGE Technical Report (1).

Since then, the government team has been seeking to identify a viable technical approach and has documented the results in the OneSAF EDGE System Technical Note (STN) for Terrain (2). The EDGE STN for terrain maps the components from the Terrain Concept of Operations (figure 1) to the EDGE technical architecture (figure 2). The EDGE STN outlines a strategy for implementing these components to provide the OOS EDGE capability for terrain for Block B.

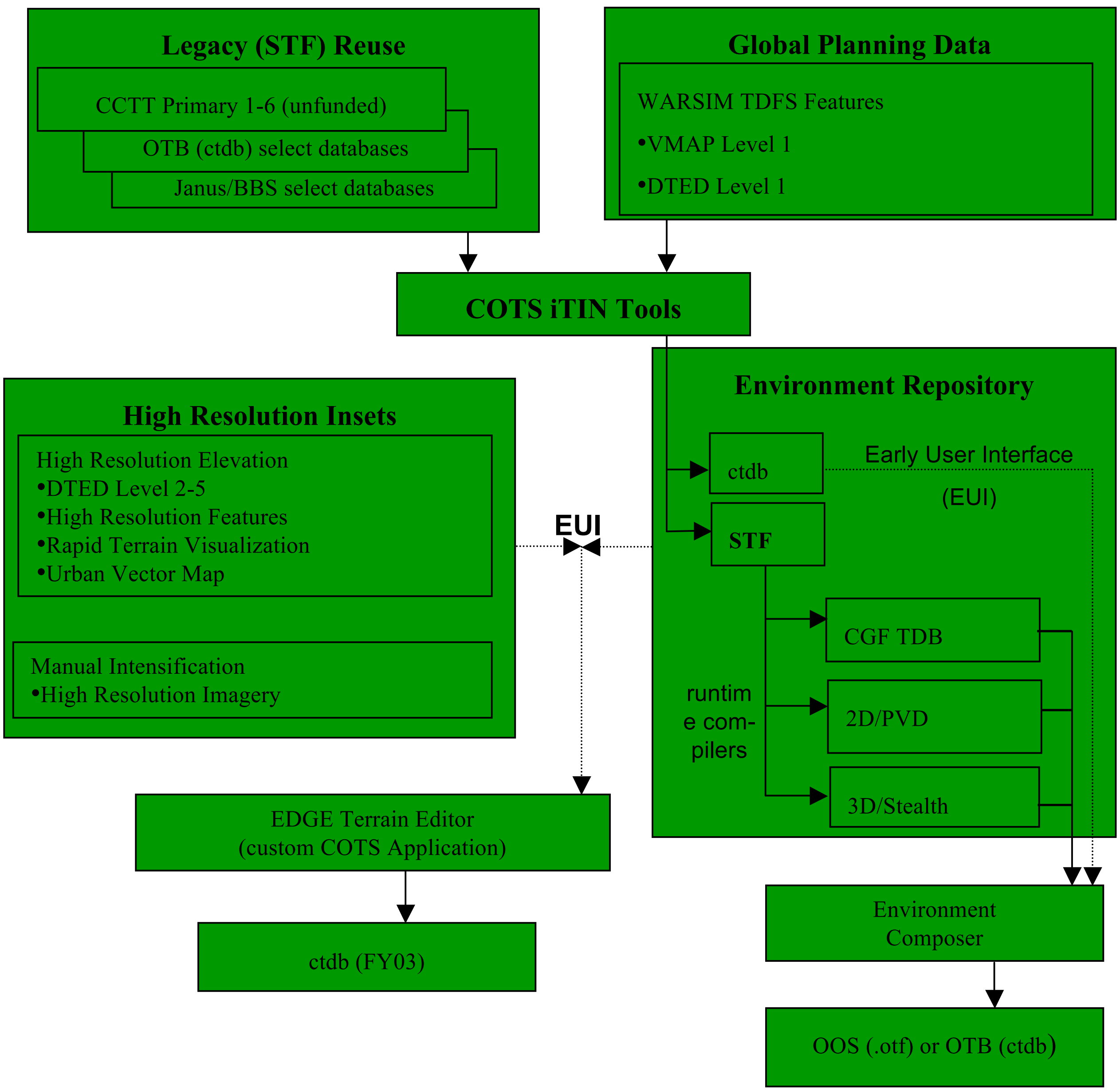

Figure2. EDGE Technical Architecture for Terrain

3. EDGE Technical Architecture

The EDGE technical architecture for terrain is illustrated in (figure 2). Key components include

- The Environment Repository is the core of the EDGE process. The repository provides the physical storage and the processes to store and retrieve environmental databases. RDEC's Synthetic Natural Environment (SNE) STO has agreed to fund SAIC's SNE Virtual Data Repository (SVDR) team to add support for OneSAF databases in support of EDGE Early User Interface (EUI) during 2003. Higher levels of automation for Configuration Management (CM) and Quality Assurance (QA) still need to be addressed.
- The Environment Composer is the end user's public interface to the environment repository. Composer provides OOS user access to archived source database (SEDRIS Transmittal) for editing and to runtime databases for Environment Runtime Component (ERC) and 3-D visualization (stealth). The composer permits the user to browse available data for a given geographic region at the requested resolution and format. The prototype composer being integrated by SVDR supports these capabilities.
- The runtime database compilers transform the OOS STF into ERC and stealth runtime databases to populate the repository. These OOS task orders are funded to develop and extend the respective runtime database compilers and deliver them to the government to build the runtime databases.

Terrain Database Generation consists of several levels of capability:

- Global Planning Data is derived from NIMA VMAP Level One and DTED Level One via the WARSIM Terrain Data Fusion System (TDFS). COTS Integrated Triangulated Irregular Network (iTIN) tools are used to transform TDFS data into SEDRIS Transmittal Format (STF) compliant with the OOS compilers and Environmental Data Model (EDM). The TDFS process being executed by government engineers with global coverage planned by Final Operational Capability (FOC) in 2005. The global planning resolution data serves as a quick start support for contingency planning operations. This data also serves as the backdrop for providing context to manual editing and for integration of high resolution datasets as demonstrated in the Block A (2002) Joint Requirements Training Center (JRTC) prototype database.
- Legacy Reuse provides processes for converting select databases to OOS STF format and for building runtime databases to populate the repository with required high-resolution databases. CCTT Primary One through Six will be converted via COTS iTIN tools to meet the ORD required high-resolution databases. Utilities will be provided to convert select OneSAF Test-bed Baseline (OTB) and Janus databases.
- The Terrain Editor functionality is provided through a suite of customized Commercial Off-the-Shelf (COTS) applications. Multiple providers for this COTS capability are being sought to guard against sole source dependencies. These tools permit field users with reasonable terrain experience to download source STFs from the repository for manual editing against high-resolution imagery backdrop. These applications are the means by which field users will eventually be permitted to import and integrate high-resolution vector data-sets into the source STF. During Block A (2002) a prototype multi-resolution database was constructed by integrating DTED 5 and 1:5000 scale feature data from the Rapid Terrain Visualization (RTV) program into the medium resolution STF covering the Joint Requirements Training Center (JRTC).

The defined EDGE technical architecture is constructed to meet all OOS ORD requirements in a framework built around broad coverage of medium resolution OOS STFs and legacy reuse high resolution STFs. These STFs will be housed in the environment repository along with the runtime databases.

The end objective for EDGE is compliance with a community standard process for terrain generation should such a capability materialize. The EDGE architecture supports incremental integration of community standard utilities as they become available. The up front investments are low enough that OOS will be able to adopt the community standard processes wholesale if and when a community standard process becomes available.

4. Auxiliary Data Sources

Database construction is limited by the ability to locate appropriate data. In most cases, the quantity, quality, and types of data used varied based on size of the database, intended use and production lead time. With greater broadband availability, searchable repositories and high-speed availability of quality data will permit greater flexibility in the way databases can be created.

Two key repositories that allow the quick access to geospatial data include the NIMA Extranet, www.nima.extranet,mil, and the US Army's Topographic

Engineering Center's (TEC) repository system. Both of these systems provide methods to search and download data electronically. Available products include Arc Digitized Raster Graphics (ARDG), Vector Smart Map (VMAP), Controlled Image Base (CIB) and Digital Topographic Elevation Data (DTED).

In addition to the OneSAF terrain databases, the SNE Virtual Data Repository (SVDR) provides the ability to search and retrieve required building and vehicle models. The Public Key Infrastructure (PKI) class 3 security interface allows users anywhere in the world to quickly access the repository data via internet.

5. Additional Work

The OOS EDM is comprised of three related but independent components defining the environmental content for Terrain, Ultra-High Resolution Buildings (UHRB) and Atmosphere, Ocean and Space (AOS). The EDGE system must provide EDM compliant databases for each of these domains. The EDGE STN for terrain addresses the first of these three domains.

DMSO's Ocean Atmosphere and Space Environmental Server (OASES) system is being integrated into OneSAF and provides a front end capability for Environmental Data Ingestor (EDI) to import AOS data and transmit it via Environmental Data Server (EDS). Imported data includes AOS data produced from the Environmental Scenario Generator (ESG) system providing rudimentary AOS databases assumed to be adequate for initial OneSAF testing and fielding (EDM compliant at appropriate granularity and fidelity).

Since OOS ERC treats UHRBs as reference models, the UHRB database generation process can be defined and developed independently of the EDGE for terrain. The COTS terrain editors each possess some level of capability toward this end and so the EDGE solution for terrain is extensible. A similarly "open" process will be defined and similar standards initiatives will be pursued to reduce risk and to encourage the trend toward community standard processes for EDGE for UHRBs. An agreement has been reached with the Waterways Experimentation Station (WES) and Military Operations in Urban Terrain Focus Area Collaborative Team to focus the developmental "Rapid Building Generator" capability on the evolving OOS UHRB format in conjunction with funded MOUT FACT projects.

The environment repository (and by extent, the composer) is relevant for all OOS environmental data. The SVDR already houses data-sets for UHRB (3D models) though formats are currently incompatible. AOS data will likely be reposed in the Master Environmental Library (MEL). Additional STNs will be developed to define the specific technical approaches for EDGE for AOS and UHRB.

6. Summary

In June 2001, the EDGE IPT defined all the required functions the EDGE must support but was unable to achieve consensus on an affordable approach by which these functions could be implemented. By mapping these functional requirements to the PLAF and PLAS, a realistically attainable technical architecture has emerged that meets all OOS ORD requirements.

The Environmental Database IPT is working toward a community-standard database generation process. The end objective for EDGE remains compliance with a community standard process for terrain generation should such a capability materialize. Significant progress has occurred over the past few years and almost all of these advances are already integrated into the defined technical architecture. Progress toward the community standard solution will likely continue to be piece-meal with incremental progress in focus areas due to limited resources. Close coordination with the EDB IPT will continue and the EDGE architecture will continue to support incremental integration of community standard processes (principally utilities), as they become available. The "up front" investments for EDGE are low enough that OOS will be able to adopt the community standard process should it materialize.

7. References

(1) Technical Report for the OneSAF EDGE System, Contract Number 61339-00-D-0707, T.O. 0002, 27 July 2001.

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8. Author Biographies

Clark D. (Dan) Stevens, LCDR USN, RET, is a former Naval Aviator and Aeronautical Engineering Duty Officer with over ten years experience as an ASW Mission Commander flying the S-3 Viking. He is a graduate of the Naval Postgraduate School (M.S., Computer Science, 1993), the Naval War College (1988) and the Advanced Program Management Course (2000). He served as the STRICOM SNE Team Leader for development of WARSIM/JSIMS SNE from June 1996 to April 2000 and has served as the OneSAF Environment Lead since then.

Douglas Todd Kohler is a Principal Investigator, and Science and Technology Manager for the Research, Development and Engineering Command's Simulation

Technology Center in Orlando, FL. He has over fifteen years of experience with various defense programs for the Air Force, Navy and the Army. Currently Mr. Kohler is responsible for the Rapid Construction of Urban Terrain Databases for Training Science and Technology Objective (STO) for the Synthetic Natural Environments (SNE) research efforts. Mr. Kohler holds a Bachelor of Science degree in Electrical Engineering from University of Central Florida and a Bachelor of Science degree in Industrial Technology from the University of West Florida.

Bruce Robbins is lead engineer for WARSIM Synthetic Natural Environment. Mr. Robbins holds a Bachelor of Science from Emery Riddle University.

Chan Huynh worked as an intern on the OneSAF program and currently supports the Simulation C4I Interface program. Ms. Huynh holds a Bachelor of Science degree in Computer Engineering from the University of Central Florida and is currently pursuing a Master of Science degree in Computer Engineering.

Dzung Doan has worked as an intern for the OneSAF program and is currently supporting the Live Training Division at PEOSTRI. Ms. Doan holds a Bachelor of Science degree in Computer Engineering from the University of Central Florida and is currently pursuing a Master of Science degree.

Captain Neushul is a Marine Communication Officer and is currently earning a Master's Degree in Computer Science at the Naval Postgraduate School in Monterey California. His previous duty station was with 7th Communication Battalion, IIIMEF, Okinawa Japan. He served as a Data Communication Platoon Commander, Radio Platoon Commander, and Detachment OIC for the 31st Marine Expeditionary Unit Communication Detachment, and Joint Task Force Enabler, and Assistant Operations Officer for 7th Communication Battalion. During his three year deployment in Okinawa, Captain Neushul gained experience in every level of operational communications, in support of all command levels. While serving on the 31st MEU, Captain Neushul learned how the Navy Marine Corps team operates in its most forward role.