

# Synthetic Environment Core (SE Core)

Providing the Common Virtual Environment (CVE) correlated terrain databases for Army training systems to enable Interoperability and ensure Fair Fight The U.S. Army's Synthetic Environment Core (SE Core) Common Virtual Environment Management (CVEM) program provides fully correlated terrain databases enabling interoperability within live, virtual, constructive and gaming training systems to allow warfighters to "train as they fight."

SE Core is the U.S. Army's Program of Record (POR) under the Program Executive Office for Simulation, Training & Instrumentation (PEO STRI), delivering fully correlated, common, geospatial terrain databases; ultra high resolution cultural and common moving visual models; Common Virtual Components (CVCs); and a common Computer Generated Forces (CGF) for Training Aids Devices Simulators and Simulations (TADSS).

The SE Core program provides products to registered users and developers in the U.S. and other select customers. SE Core saves customers and developers cost and schedule time, and helps ensure that simulators and simulations correlate and interoperate across critical training platforms.

### **Army Geospatial Center (AGC)**

The SE Core program has achieved a gold level rating, as a certified co-producer for the U.S. Army Geospatial Center (AGC). The gold level rating identifies the data products are suitable for operational use and are consistent with the standards, profiles in accordance with the U.S. Army Geospatial Policy.



The AGC Co-Producer Certification Program establishes a standardized structure for U.S. Army geospatial data producing organizations (data coproducers) to be certified as Trusted Partners for U.S. Army Geospatial Enterprise (AGE) foundation geospatial data production and contribution.

## SE Core Today

Training today's warfighters requires accurate representation of the real earth environment, including geographic terrains with specific features and locations. The convergence of accuracy and interoperability is the realization of Live, Virtual, Constructive - Integrating Architecture (LVC-IA).

SE Core provides correlated, geospatial terrain databases for U.S. Army simulators, simulations and training systems to support the execution of combined arms and joint training, mission planning, and rehearsals at homestation and deployed locations. It ensures virtual compatibility with all live, constructive and gaming systems.

The SE Core CVE delivers six critical products:

- 1. Geospatial Terrain Databases
- 2. Common Cultural And Moving Models
- 3. Common Virtual Components (CVC)
- 4. Virtual OneSAF®
- 5. Simulation Standards
- 6. FAA Standard Airfield

# 1. Geospatial Terrain Databases

The SE Core program produces high-quality terrain databases to meet the U.S. Army's changing missions and theaters of operation. Using raw and processed geospatial terrain data from government, commercial and open sources, the SE Core team extracts, cleans, aligns, and correlates all source data into a consistent terrain Master Database (MDB) that is non-proprietary, industry standard, and open formats that are run-time system independent. Additionally, the MDB is readied for consumption in specific geospatial datasets and runtime formats used by specific training systems.

SE Core provides terrain databases for an expanding number of PEO STRI programs and confederates.

Six innovations distinguish SE Core's unmatched production of correlated terrain databases:

- Precision Correlation Methodology
- Four Quality Scales
- Improved Transportation Networks
- Automated Procedural Model Generation
- Procedural (Synthetic) Aerial Imagery
- Real Aerial Imagery Processing

#### **Precision Correlation Methodology**

To ensure the production of the highest quality terrain datasets for customers, the SE Core team created a managed correlation methodology to identify and quantify the measure of correlation between alternate run-time representations of a common geospatial terrain dataset.

SE Core uses Dignitas Technologies, LLC's C-nergy and GameSim's Validate correlation test tools to ensure the databases have the most consistent representation and highest fidelity to assess correlation and compatibility, and accelerate the validation and quality control of correlated terrain databases. C-nergy and Validate ingest multiple output formats such as OpenFlight, OneSAF Terrain Format, and others to perform automated and semi-automated testing with precise correlation, as well as provide a final quality control process before output and delivery to confederates and consumers.

SE Core correlation measures include; quality checks, edits and verification of terrain feature differences, such as existence, placement and attributes, as well as surface differences in elevation terrain, object tops and materials, and the collision between vertical surface variations.

#### **Four Quality Scales**

The SE Core team instituted a rigorous standard for Core Content collection based on the SE Core Environmental Data Model. Additionally the team defined feature quality standards based on four scales within the MDB including: 1:250,000; 1:50,000; 1:25,000; and 1:12,500. SE Core's Quality Content Specification is derived from the National Geospatial-Intelligence Agency (NGA) and United States Geological Survey (USGS) mapping specifications. They include:

- Foundation (1:250K Scale) Clean entire database, focusing on major geographic features, large landmarks, and transportation and hydrography infrastructure
- City (1:50K Scale) Clean and align major cities, notable landmarks, navigationally-significant features, and military installations
- Inset (1:25K Scale) –Clean, align, and digitize delineated major military training areas, airfields, and areas of operations; including all buildings and structures
- High Resolution Inset (1:12.5K Scale) Clean, align, and digitize the highest resolution urban training areas and Military Operations on Urban Terrain (MOUT) sites, with every feature recognizable in satellite source imagery, adding interiors for all buildings



#### Improved Transportation Networks

SE Core is has collaborated with Cognitics, Inc. to increase the complexity and realism of transportation networks in virtual and gaming terrain databases. The result of this collaboration includes:

- Reduced roadway undulations, elimination of small untrafficable embankments, construction of smooth shoulders, and representation of banked roads on curves
- Multi-level bridges and overpasses with realistic integration into the terrain

## **Automatic Procedural Model Generation**

SE Core has collaborated with U.S. Army's Research, Development and Engineering Command (RDECOM) and the Enterprise Data Services (EDS) program to leverage technology from the GameSim's Procedural Model Generation System (PMGS) research initiative. PMGS is GOTS software that procedurally generates fully textured 3D models. SE Core's Automatic Model Generation software uses PMGS to procedurally generate, based on the feature content of each unique database, the precise geo-typical regionalized models required. Automatic Model Generation reduces the cost of producing models simultaneously tailoring the model set for each database.

## **Procedural (Synthetic) Aerial Imagery**

SE Core Synthetic Imagery tool produces simulated full color draped imagery, simulated black and white Controlled Image Base (CIB), ground surface imagery and maps, and full fidelity material maps. The Synthetic Imagery tool supports the generation of imagery for imaginary locations, improves correlation of features in real world locations, and provides cost effective support for seasons and climate regions depictions. Synthetic Imagery has none of the negative artifacts of real aerial imagery like color variations from mosaicking, time-of-day shadows, or unwanted dynamic clutter (cars on the road). Synthetic Imagery delivers affordable generation of fully correlated aerial imagery.

# **Real Aerial Imagery Processing**

The aerial imagery processing software automatically sorts, selects, corrects and mosaics large volumes of high resolution aerial imagery using image processing heuristic rule to select the best available images.



# 2. Common Cultural and Moving Models

SE Core develops and provides hundreds of common three-dimensional (3-D) cultural and moving models in ultra-high resolution that replicate the realism of today's advanced virtual gaming worlds and next generation display.

## **Cultural Models**

- Geospecific Models, representing unique features in a specific terrain database, i.e., stadium, theme park, landmark, etc. (2300 models)
- Geotypical Models representing structures typical of a region or area in the terrain database (2250 models)
- Ultra-High Resolution Buildings (UHRB) with interior rooms and multiple stories, and fully traversable – inside and out, up and down – by OneSAF and gaming entities (1500 models)

# **Common Moving Models (CM2)**

SE Core develops realistic, common moving models to support the expanding Confederate partners including EPX, Veritas, VSB3 and Open-flight formats. These high definition models represent a vast variety of entities and placeable objects within terrain databases.

SE Core's 1,280 plus models provide wheeled and tracked vehicles, missiles, manned and unmanned aircraft and devices, all supporting simulated sensor systems, including infrared and night vision. All SE Core models are posted to the U.S. Army Model Exchange (AME) for easy download, at no cost, by AME registered users and organizations.

# 3. Common Virtual Components (CVC)

The SE Core product-line architecture features a set of CVCs that enable plug-and-play operation including:

SE Core Gateway - Provides the capability to translate and filter Distributed Interactive Simulation (DIS) Packet Data Unit (PDU) traffic between multiple programs. The SE Core Gateway is simply intended to bridge the networks to interoperate in a single virtual "environment."

- C-nergy Provides a user-friendly environment for manual and automated terrain databases inspection. C-nergy supports side-by-side (with linked camera view) and overlaid (where one is wireframe) viewing to detect visually apparent differences in datasets.\*
- SE Core Site Terrain Tool (STT) Provides the users at Warfighter's Simulation (WARSIM) fielded sites the capability to create and edit WARSIM runtime databases. The SE Core STT is fielded to Joint Land Component Constructive Training Capability (JLCCTC) sites worldwide. The SE Core STT is based on RDECOM's RUGUD tool.

# 4. Virtual OneSAF®

SE Core developed and maintains the virtual extension to OneSAF. Virtual systems now offer the ability to train simultaneously with a realistic, 3-D simulated environment. SE Core specific models, entities and units were created to support the needs of the virtual community, including CCTT, AVCATT, and the Joint Improvised Explosive Device Defeat Organization (JIEDDO).

Functionality includes; new fixed-wing aircraft and rotary-wing aircraft flight mobility models, ground vehicle mobility models, and 78 unique orderable Behaviors and Interventions. Interactions with manned modules are a main focus for the SE Core Virtual baseline. They allow SAF entities to interact with the manned module within a mixed unit as if it was fully integrated (SAF entities – Mount/ Dismount, Follow, Halt, and Occupy). Entities are indistinguishable between SAF and manned module in a 3-D environment.

Virtual OneSAF includes Dynamic Terrain (DT) features such as craters, prepared fighting positions, and concrete barriers that can be placed or created during runtime. The DT features support Obstacle Avoidance (OA), Line of Sight (LOS), and terrain that is repolygonized to include the changes to the terrain skin that the feature produces.

Virtual OneSAF supports fully integrated Transportation Tunnels including: LOS, routing through and over tunnels, collision detection (CD), and OA of tunnel walls. Virtual OneSAF also has



a common and consistent damage vulnerability model that is TRADOC Capability Manager - Virtual (TCM-V) approved with data based on AVCATT and CCTT.

# 5. Simulation Standards Virtual DIS (VDIS)

SE Core's Virtual Distributed Interactive Simulation (VDIS) protocol provides the foundation for virtual systems' interoperability and common communication to other components within the Live, Virtual, and Constructive Integrated Training Environment (ITE). It is built upon the standard DIS with a focus on the virtual environment.

### Army Model Exchange (AME)

SE Core CVEM continues to provide easy online access to all visual CM2s and 3D cultural models via the AME. SE Core is expanding AME data sharing by uploading all U.S. Army ITE terrain databases to the AME. The SE Core shareable and reusable data includes source data (imagery, cultural models, elevation, vector features) and systemspecific runtime formats. Access to SE Core terrain databases is now easier than ever.

### **Master Entity List (MEL)**

The SE Core Master Entity List (MEL) provides a list of CM2s, along with their Generation I and Generation II model names. It also provides a linking of the CM2s to Virtual OneSAF compositions, and VDIS tuples which aids in enabling interoperability. Enabling the Full Integration and Interoperability of Live, Virtual, Constructive and Gaming Training Systems

# SE Core Terrain Database Customers and Confederates:

- Aviation Combined Arms Tactical Trainer (AVCATT)
- Non-Rated Crew Member Manned Module (NCM3)
- Close Combat Tactical Trainer (CCTT)/Reconfigurable Vehicle Tactical Trainer (RVTT)/Dismounted Soldier Training Systems (DSTS)
- Live, Virtual, Constructive-Integrating Architecture (LVC-IA)
- Joint Land Component Constructive Training Capability (JLCCTC)
- One Semi-Automated Forces (OneSAF®)
- Homestation Instrumentation Training System (HITS/Liive)
- PM Gaming (VBS2)
- Longbow Crew Trainer (LCT)
- U.S. Army Central Command (ARCENT)
- Common Driver Trainer (CDT)/Call for Fire Trainer (CFFT)/Virtual Clearance Training Suite (VCTS)
- Warfighters' Simulation (WARSIM)
- Flight School XXI
- Joint Conflict and Tactical Simulation (JCATS)
- After Action Review System (AARS)
- Fire Support Simulation (FIRESIM)
- Night Vision Image Generator (NVIG)
- Virtual Battlespace 3 (VBS3)
- Joint Deployment Logistics Model (JDLM)
- Games for Training (GFT/VBS3)

# 6. FAA Standard Airfields

Federal Aviation Administration (FAA) flight simulator quality airfields with full fidelity lights and markings are include in each dataset as specified by the user requirements.

## **SE Core Program Evolution**

Since 2005, SE Core has provided CVCs that are reusable, adaptable, extensible, and interoperable to multiple training simulation systems. SE Core delivers a common network protocol, common terrain, common environment, common damage assessment, common computer-generated forces, common models, common scenarios, common sensors, common Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) interfacing and common underlying services necessary for interoperable Fair Fights.

Today the top priority is building the SE Core critical resources for the ITE. The SE Core team has been producing and delivering the next generation of constructive and gaming databases to support evolving training requirements. Going forward, this approach will ensure SE Core's training products meet the current and future U.S. Army training needs.

All SE Core components are shared with registered users and developers for use with their own tools in building products and systems that are interoperable and compatible with the U.S. Army's LVC-IA.

## The SE Core Team

Leidos is the prime contractor for the SE Core program and leads a diverse team of small and large businesses in cooperation with SE Core POR manager under PEO-STRI. Since 2005, the team has provided architecture analysis, development and technical and management support for the SE Core Architecture and Integration (A&I) initiative. In 2010, the SE Core A&I and the Database Virtual Environment Development (DVED) initiatives were combined into one program – the Common Virtual Environment Management (CVEM) program.

Today the Leidos-led SE Core CVEM team operates on the cutting edge of virtual simulation systems, providing high quality, ultra resolution databases and models as realistic and advanced as today's gaming industry standards. The team is opening up the SE Core architecture to expose the data; standardizing and continuously updating the data stores; accelerating the database production process; decoupling the system to expand the toolset within production; maximizing the use of COTS and GOTS tools and eliminating high maintenance software; and providing clean source data and cultural and moving models to customers and registered users.

## Accelerated Response to U.S. Army Changing Missions

The SE Core CVEM Program is dedicated to accelerating the delivery of common terrain databases, cultural and moving models and OneSAF to enable warfighters to train for ever-changing missions in environments around the globe. The success of U.S. Army training today and tomorrow depends on the SE Core Program.



# SE Core Terrain Database Delivery Schedule

## DELIVERED

Afghanistan East Afghan Enhanced (JIEDDO) Afghanistan Camp Buehring Camp Casey Camp Dodge Camp Grayling Camp Parks Caspian Sea Caspian Sea (D.A.T.E.) Ft. Benning Ft. Bliss Ft. Bragg	Ft. Campbell Ft. Carson Ft. Chaffee Ft. Dix Ft. Drum Ft. Hood Ft. Houston Ft. Houston Ft. Huachuca Ft. Indiantown Gap Ft. Irwin Ft. Knox Ft. Leavenworth Ft. McCoy	Ft. Polk Ft. Richardson Ft. Riley Ft. Sam Houston Ft. Sill Ft. Stewart Ft. Wainwright Germany Gowen Field Hawaii JBLM Korea Kuwait	McKenna Muscatatuck UTC Nairobi New Zealand NW/USA Pinion Canyon Sagami SW/USA Ukraine (D.A.T.E.) Vicenza West Point
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### PLANNED

Two ITE deliveries per fiscal year (e.g. Fort Drum and Fort Riley). Two large area Constructive Database deliveries per fiscal year (DATE - Pacific, Korea). Various other terrain database representation deliveries as required throughout each fiscal year.

### **ABOUT LEIDOS**

Leidos is a Fortune 500® information technology, engineering, and science solutions and services leader working to solve the world's toughest challenges in the defense, intelligence, homeland security, civil, and health markets. The company's 32,000 employees support vital missions forgovernment and commercial customers. Headquartered in Reston, Virginia, Leidos reported annual revenues of approximately \$10.19 billion for the fiscal year ended December 28, 2018.

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