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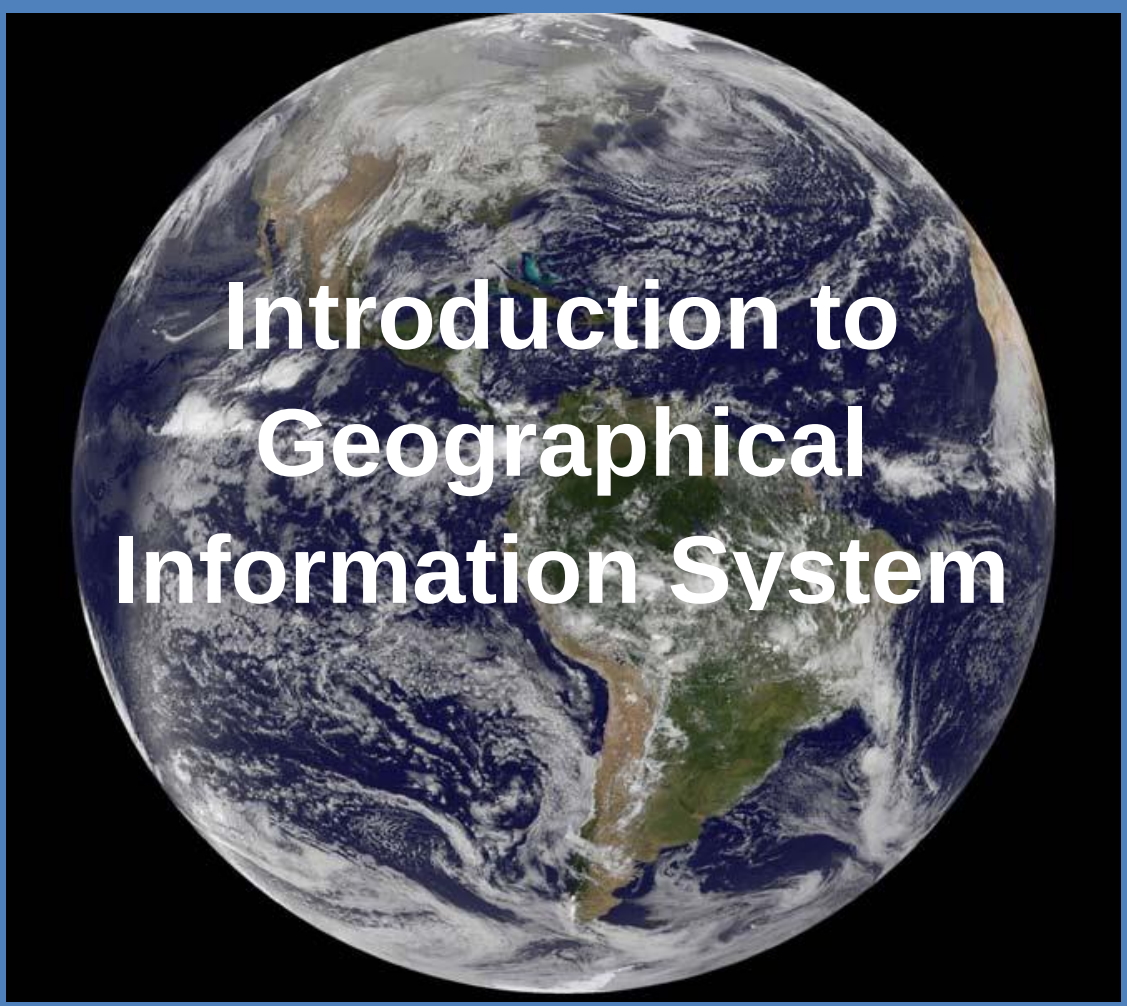

Introduction to Geographical Information System

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News from the Front
Introduction to Geographical Information System

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Introduction to Geographical Information System (GIS)

The intent of this article is to the share basic knowledge on the development of the Geographical Information System (GIS) used during the Conference of American Armies (CAA), by the Permanent Executive Secretariat of the Conference of American Armies Communications Offices (PESCAA), at the culmination of the two year, 32nd Cycle CAA. It provides a combination of introduction, distribution, operation, and lessons learned on the GIS.

During the 2017 CAA Commanders' Conference, the graphical information application version 5 (V-5) was distributed to the following countries: Antigua & Barbuda, Argentina, Brazil, Canada, Central American Armed Forces Conference (CFAC), Chile, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Paraguay, Peru, Trinidad & Tobago, United States, Uruguay, Barbados, Guyana, Jamaica, and Spain.

CAA 32nd Cycle Achievements

Some of the achievements during this cycle was on the execution of an interagency exercise utilizing the GIS as the main decision making tool and allowing a common operational picture (COP) among participants in Chile. Upon completion of this exercise it was determined:

- Members of the CAA voted unanimously to implement the Geographical Information System, Conference of the American Armies (GIS-CAA), with the condition that each army is able to decide whether or not to implement the application in accordance to their armies network security policies.

- The creation of a technical team composed of CAA members for the development, training, and operation of the GIS-CAA.

- The system will be made available to all CAA armies, who can in turn distribute it to governmental or non-governmental bodies in their respective countries as they see fit.

What is the GIS and why is it relevant to the CAA?

The GIS is an application used for the management, analysis, and visualization of geographic knowledge which is structured in different sets of information. It provides situational awareness that facilitate and expedite the decision making process.

For example, the technical area of the GIS facilitates situational awareness and the management of information during peacekeeping operations (PKO) and disaster relief operations (DRO). The GIS provides a common operational framework and supports a Command and Control system that captures, stores, analyzes, presents, and anticipates data linked to physical locations.

However, GIS technology must be understood as a system made up of technicians, methodologies, processes, software, hardware, remote sensors, and communication devices. All require support during the GIS' life cycle.

The CAA promotes developing and standardizing the GIS to provide the American Armies with a powerful decision-making tool. This system may be employed in the planning and simulation of exercises, or supporting PKO and DRO under a United Nations (UN) mandate.

Additionally, it enables the international community to operate in an organized method during PKO and DRO. Figure 1 shows the typical structure of the GIS' architecture and how its technology provides situational awareness which in turn helps in the web-based/centered decision-making process.

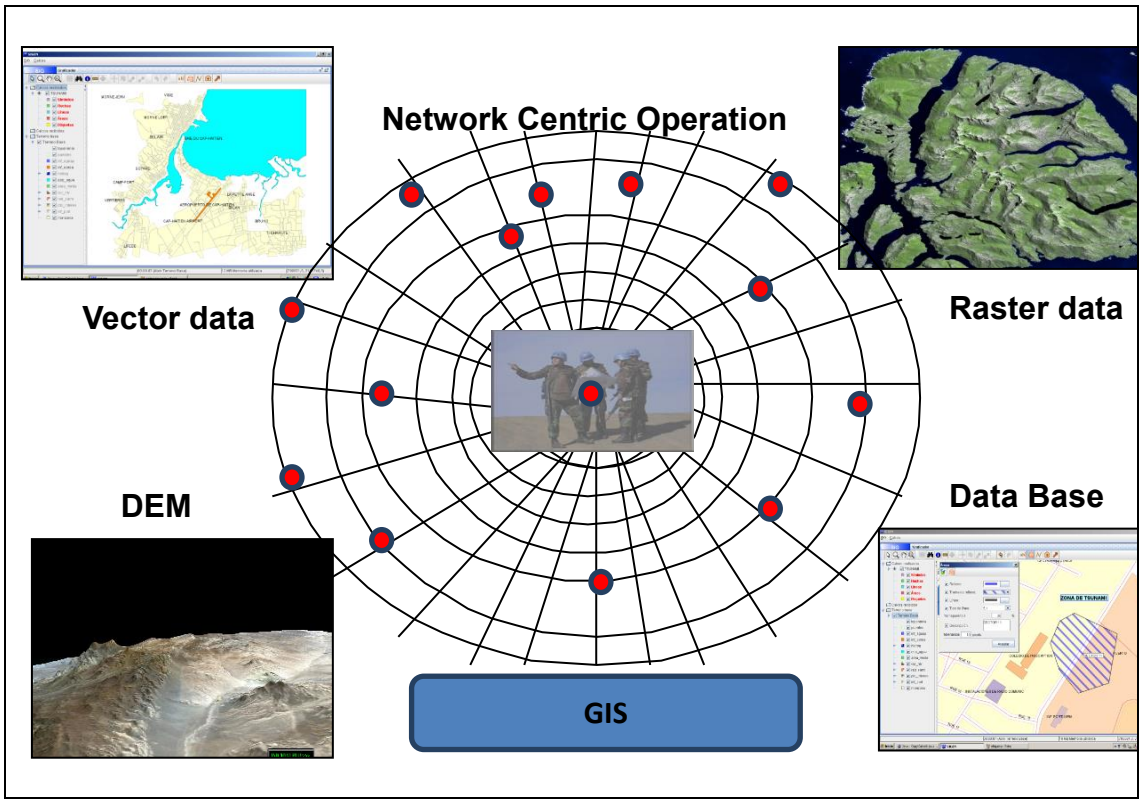


Figure 1-1. Geographic Information System Architecture

What can the GIS provide to the CAA?

By means of a collaborative effort on GIS technologies, CAA member nation armies could, in a relatively short amount of time, establish a positive impact in three main areas:

1. Instruction and Training. GIS technology can be implemented from exercise planning to the After Action Review (AAR). Its composite digital capabilities provide numerous data points on the operational environment. This level of information may well serve to both challenge and improve the organizational behavior of each army during bilateral or multilateral exercises and other training.

2. Disaster Relief Operations. GIS technology can support the tasks that each army carries out, in their respective countries, when facing hazardous natural events. Additionally, this tool will provide a COP to better manage all foreign assistance.

3. Peacekeeping Operations. GIS technology provides a digital, on-line, geographic platform at the moment of arrival of Coalition forces. The aim of this coordination is to support future CAA deployment and sustainment operations across a myriad of projected mission sets.

Leveraging GIS technology and incorporating capabilities into operations may contribute to saving lives. However, this will require a coordinated CAA effort carried out jointly with other military and civilian organizations.

How will GIS be used?

The primary sources of data for developing a GIS are the digital features that represent objects on the ground and the associated attributes corresponding to their features. This enables an ability to identify three types of digital data:

- Objects which are stored in a vector data base (points, lines, and poli-lineal).

- Attributes which are stored in a relational database.

- Raster database (pixel sets coming from aerial or satellite sources).

Generally, countries' policies focus more effort on developing a vector database to be used during catastrophic events. Thus, these vectors are the basis for the printing of charts in a scale of 1:50.000, usually covering the entire country. In some cases, incorporating data in a scale of 1:25,000 for specific, mainly urban, zones.

The attributes' database implies that vector data must be associated to the particular characteristics of the feature; such as a bridge's weight, type of route, airport's characteristics, soil quality, and so forth.

Most of the countries have institutions whose names relate to a "National or Military Geographic Institute" for developing a vector database. The objective is to update their cartography, which is commercially distributed in analog and digital format. Usually, these geographic organizations maintain an additional raster database to update the vector features by means of digital or analog processes.

It is difficult to link the attributes' database with the features of the elements. This is due to the dynamic changes of the terrain and because a great deal of effort is required for collecting the data. An appropriate and useful approach for linking vectors and attributes is the association of cartographic data to the country's census database. But, this action needs a focused strategy and extensive technical coordination before collecting the data.

The use of algorithms over the raster images' database enables the updating of the vector database and some of the terrain's attributes. Of note, these methods are costly, time consuming, and in most cases belong to GIS' international

companies. The raster data is obtained from sensor devices located in aerial or satellite platforms.

Additionally, the Digital Elevation Model (DEM) database are byproducts of either vector or raster data. They provide the altitude and an excellent visual representation of terrain.

Other remote sensors, placed on vehicles and aerial platforms, are used for collecting features and attributes. We now refer to ground vehicles with a Global Positioning System (GPS) and lesser technology for collecting elevation data.

According to capabilities and analysis of these geographic focused organizations for processing and developing algorithms within the GIS, classifying the digital national geographic infrastructure of organizations from CAA member countries result in three types:

- Level 3: A digital geographic infrastructure based on a national standard, an automated process, and a set of remote sensors that captures exploration data. Census database is linked to the vectors. Countries with level 3 infrastructures have developed a set of image algorithms and vectors for identifying significant features and geographic patterns. Most of these applications can be found in local commercial GIS software.

- Level 2: This geographic infrastructure is based on a national standard with vector and features' data linked to make cartography. Main vector data are of the scale 1:50.000 and only a few charts are published in scale 1:25.000. The GIS is developed for academic and commercial purposes.

- Level 1: These organizations have a digital geographic infrastructure, based on international cartography, with a reduced capability to update vector and related databases.

The previous descriptions show the lack of common standards in the organizations that belong to the armies of the CAA for gathering the primary data which corresponds to the vectors' associated attributes and raster information.

Considering the applications of the GIS software, this lack of standardization and interoperability may impact future CAA member armies' effectiveness and efficiency in PKO and DRO. Additionally, there is a lack of common doctrine which precludes CAA member armies to operate among each other within a network. Operating on a common network may improve planning, training, exercises, experiments, execution under field conditions, and enhance AARs.

In fact, when this multinational military community conducts PKO and DRO exercises with troops, and because there is a lack of a standardized GIS, most of the time "Google Earth" and "Bing Mapping" is used for analyzing what took place.

By using a collaborative platform named Sistemas Integrados de Communicaciones de la Conferencia de los Ejercitos Americanos (SICOCEA) (Spanish), or in English, Integrated Communication System of the Conference of American Armies (ICOSCAA) web portal it will be possible to test and validate a real situation by providing geographic information management solutions. This will enable CAA's organizations and communities to be better prepared for and respond to disasters. This web portal provides a viable interoperability tool to manage documents, orders, notices, calendars, and others.

What are the benefits of a GIS working group?

The GIS working group will be responsible for identifying and recommending the adoption of a set of minimum standards, such as the International Organization for Standardization (ISO) 19100 series, Open Geospatial Consortium (OGC) web service standard, and other models including the Multilateral Interoperability Programmer (MIP), to enable for the interoperability among all the member armies of the CAA. Immediate requirements include:

- Seek CAA approval to conduct analysis aimed at identifying technologies and procedures available to better enable interoperability.

- Propose to armies already having GIS technologies, as well as, those that do not, to adopt a series of GIS' minimum sets of standards. It will be the responsibility of the working group to recommend a series of minimum sets of standards, as well as, the implementation of the selected GIS.

- The GIS working group will provide computer software to those armies that do not yet have a specific tool implemented.

- Immediate focus for the working group to increase knowledge across CAA member armies:

    - Begin with a laboratory prototype

    - Implement a solid and robust GIS to be used in land component exercises

    - Use in real-life disaster relief and peacekeeping operations

- Direct the working group to provide recommendations on cost-efficient solutions, such as open source and academic alternatives. Based on observations of the U.S. PESCAA S6, consider the following:

- GVSIG: A geographic information system (GIS) desktop application designed for capturing, storing, handling, analyzing, and deploying any kind of referenced geographic information in order to solve complex management and planning problems

- GEOSERVER: An open-source server written in Java that allows users to share, process, and edit geospatial data. Designed for interoperability, it publishes data from any major spatial data source using open standards.

- GEONETWORK: A free and open source for cataloging applications for spatially referenced resources. It is a catalog of location-oriented information.

- Request the working group formulate a plan to reach the objectives of standardization and provide technical advice on how to better achieve interoperability on a geographic solution for those armies who do not have a GIS.

- Request the working group evaluate the operational costs of implementing the plan required to achieve the interoperability objective.

- Propose to CAA member armies to conduct field and laboratory training exercises to validate the standardization and geographic solution.

- Propose to have the GIS connected with public data such as geological, climate, and statistical information to provide situational awareness.

- Recommend the GIS working group design the parameters of interoperability, methodology, and specific computer software to accomplish the interoperability objective.

- Benefits of establishing a CAA GIS working group includes promoting the development of intelligent (smart) technology in less time saving money and other resources.

What is the way ahead?

- This GIS initiative will improve the CAA's interoperability through standardized processes and formats.

- The GIS technologies may contribute to saving lives during natural disasters and in support of PKOs. A coordinated CAA effort will improve the tools available to the armies to support local and international tasks.

- The system will provide its users with access to the development of emergency information. It will allow contact with the corresponding authorities to seek and provide resources, improving performance in cases of national, regional, provincial, and/or municipal emergencies.

- The CAA's GIS web application has already been implemented as a prototype at: http://sigcea.sytes.net).

- All member armies will enjoy the following benefits:

    - Collaborative and cooperative environment

    - Receive updated status letter

    - Advise on the management of geo-reference information

    - Unrestricted data structures

    - Support for early warnings

    - Communication between participating institutions

    - Access to external source of information

    - User friendly interface

The CAA member armies will benefit from the technological improvements. This includes saving money by adopting cost-free GVSIG Def software. Worthy of note, for similar software armies would pay a $50,000 (U.S. dollars) fee per computer on which the software is loaded. Implementing the GIS Working Group proposal significantly reduces costs to an estimated 5% for each user. Additionally, the proposal will allow each army to create its own package according to its geographic requirements. The decision to integrate GIS-CAA into other similar systems used in each country is a choice made by each army pursuant to the current legal framework in each country.

The GIS software has proven to be an exceptional tool that captures, manages, analyzes, and displays all forms of geographically referenced information. This allows the user to view, understand, question, interpret, and visualize operations in ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts. With these tools on hand, the CAA will be empowered to reach a level of multinational interoperability and decision making like never before. It is critical for future hosts of the CAA to continue the implementation and standardization of the GIS by establishing a robust technical working group that will continue with the development, implementation and education of this application.

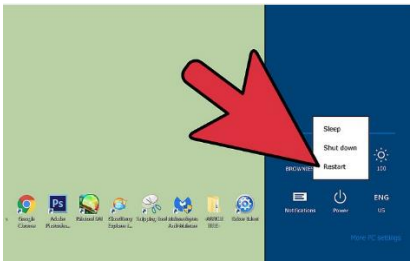
Annex A: Operating Instructions

Booting from an external hard drive on your computer is useful when you want to repair disks or partitions, troubleshoot problems, format your computer, or reinstall your entire operating system. You can boot from an external hard drive using any Windows or Mac computer.

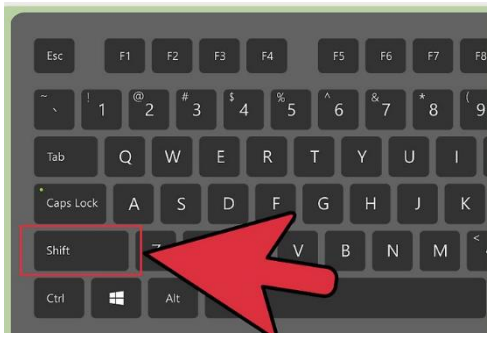
In order to open the CAA GIS application you must use the following steps:
Step 1: Swipe in from the right side of your screen and tap on “Settings.” •If using a mouse, point to the lower right corner of your screen, move the mouse pointer upward, then click on “Settings.”

Step 1:

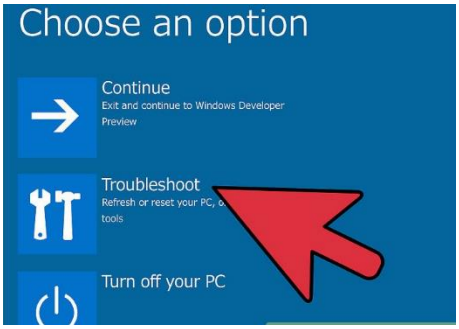
Step 2: Tap or click on “Power,” then select “Restart.”



Step 3: Press and hold down the “Shift” key as your computer restarts.

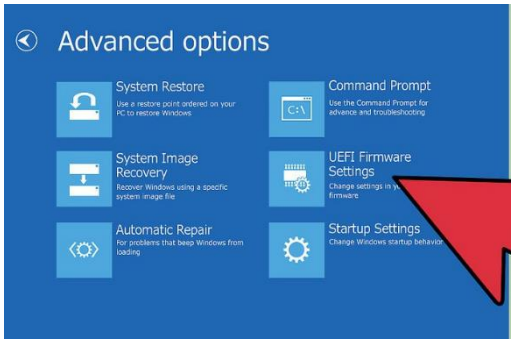


Step 4: Tap or click on “Troubleshoot” when Windows 8 prompts you to choose an option.

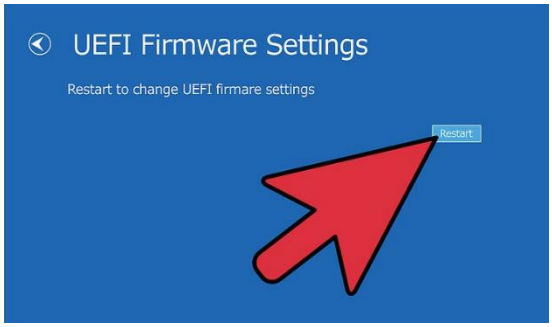


Step 5: Tap or Click on Advance Options.

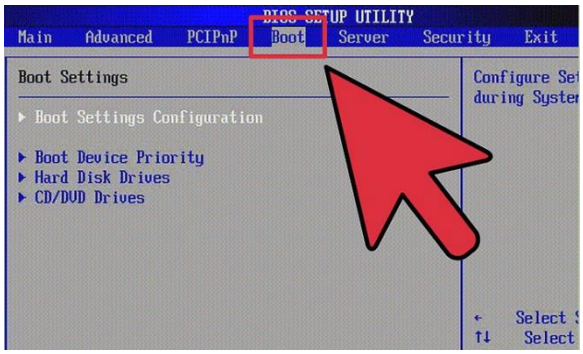
Step 6: Tap or click on UEFI Firmware Settings.



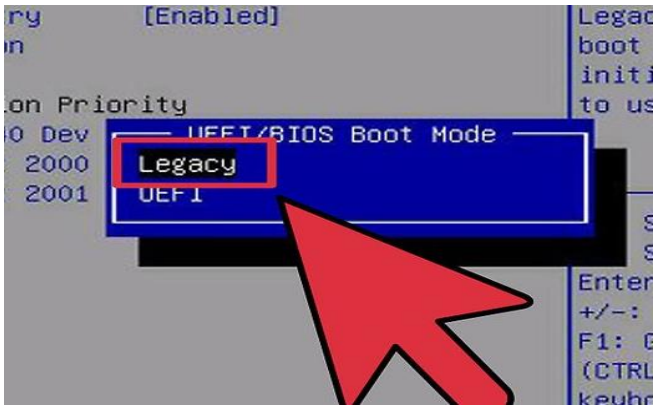
Step 7: Click on “Restart.” The Advanced BIOS Setup menu will display on-screen.



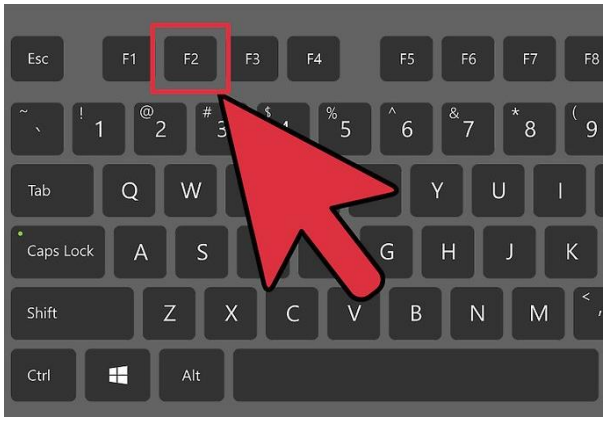
Step 8: Use the arrow keys to highlight “Boot.”



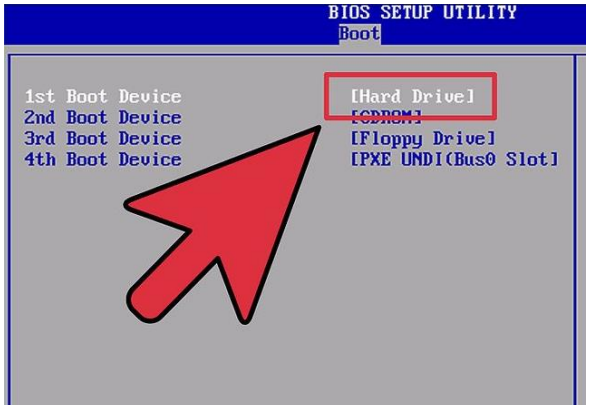
Step 9: Change “UEFI” to “Legacy” in the Mode field.



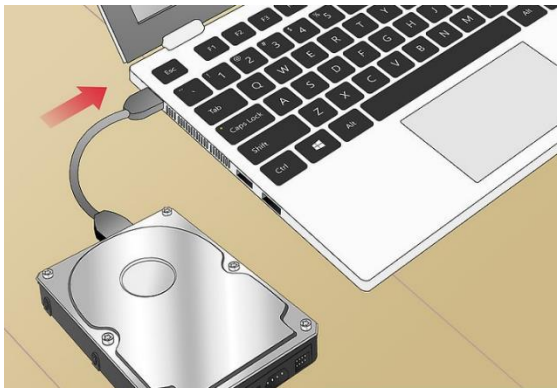
Step 10: Select the option to restart your computer, then quickly press F2 to enter the BIOS Setup menu once again. The keystroke required for entering BIOS setup may vary depending on your computer's manufacturer. For example, you may be instructed to press F12 or F5 instead of F2.



Step 11: Use the arrow keys to highlight "Boot," then change Boot Order settings so the name of your external hard drive is set as the default boot option.



Step 12: Connect your external hard drive to the computer using a USB port.



Step 13: Restart your computer. Your Windows 8 computer will now boot up from your external hard drive

Upon completion of these steps above, you will be able to reach the external hard drive and open the SIG CEA Applications and Services.

Annex B: Definitions

AAR: After Action Review

CAA: Conference of American Armies

CFAC: Central American Armed Forces Conference

Common Operational Picture: COP

DEM: Digital Elevation Model

DEF: Design Exchange Format

DRO: Disaster Relief Operations

GEONETWORK: A free and open source for cataloging applications for spatially referenced resources. It is a catalog of location-oriented information

GEOSERVER: An open-source server written in Java that allows users to share, process, and edit geospatial data. Designed for interoperability, it publishes data from any major spatial data source using open standards.

GIS: Geographical Information System

GIS-CAA: Geographical Information System-Conference of American Armies

GPS: Global Positioning System

GVSIG: Generalitat Valenciana Sistema de Informacion Gerografica (Spanish) A geographic information system (GIS) desktop application designed for capturing, storing, handling, analyzing, and deploying any kind of referenced geographic information in order to solve complex management and planning problems

ICOSCAA: Integrated Communication System of the Conference of American Armies

PKO: Peacekeeping Operations

SICOCEA: Sistemas Integrados de Communicaciones de la Conferencia de los Ejercitos Americanos (Spanish) (GVSIG in English)