Future-proof C6ISR systems

Technology has drastically altered the nature of conflicts, and vice versa. Evolving threats such as the proliferation of different forms of terrorism and growing geopolitical tensions around the world mean C6ISR (command, control, communications, computers, cyber defense and combat systems and intelligence, surveillance and reconnaissance) capabilities are needed to improve situational awareness, provide secure and faster communications and accelerate threat detection. Allies and divisions should rely on the same information, be it map, report or live track feed for faster, more accurate decision-making. With the move to multi-domain operations (MDO) – the synchronization of air, ground and maritime forces, vehicles, satellites, systems and all sources of data – additional information can be included in the C6ISR realm. The key is to transform complex data into meaningful information.

Effective C6ISR systems require interoperable, integrated components to remain up to date and evergreen. Utilizing commercial off-the-shelf (COTS) software helps, because it is built around standards. To create these systems, Hexagon engages with organizations such as OGC and IHO and ensures compliance with ISO and STANAG standards. Making sure location information meets findable, accessible, interoperable and reusable (FAIR) standards for data formats, web services and more ensure interoperable solutions that can share data and information with other systems. Using these standards also guarantees a smooth upgrade of components in the future.

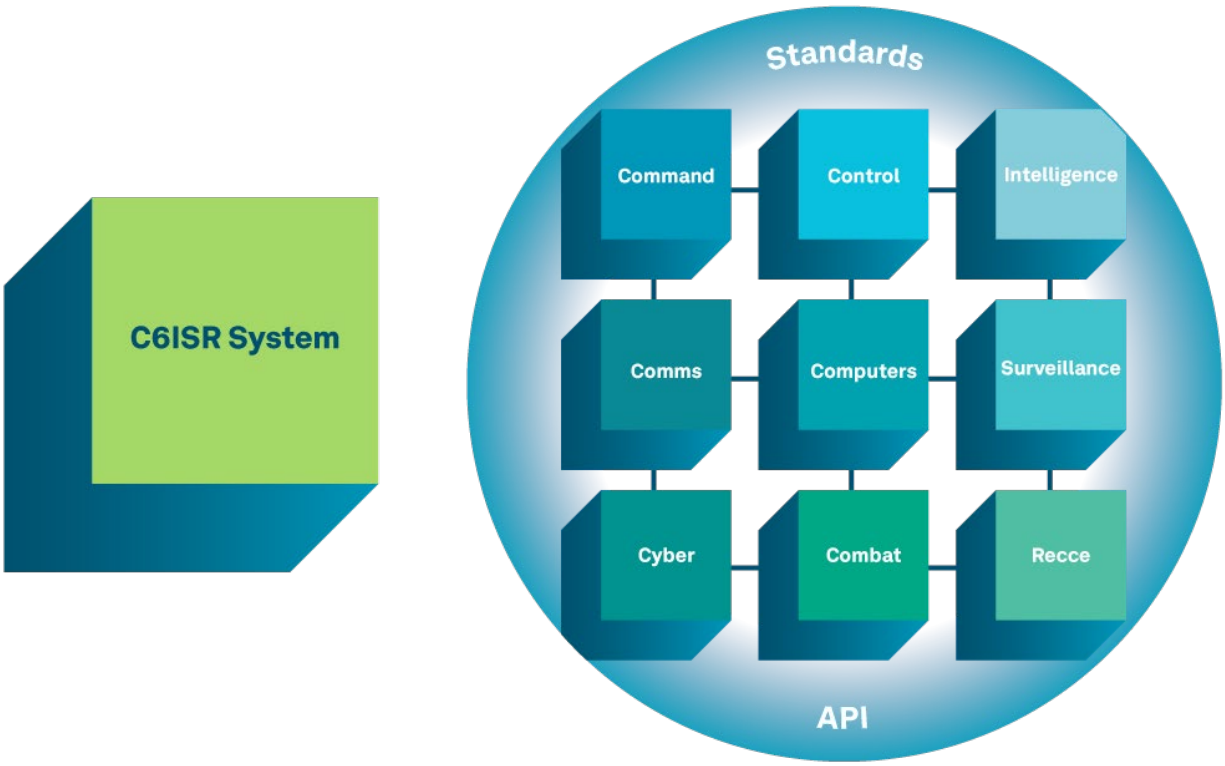

Figure 1: Monolithic C6ISR compared to interoperable, integrated and flexible components

Command

A command center centralizes information to monitor the environment and react to events, so mission-critical data must be available quickly, securely and cohesively. To make informed decisions, multiple data types should be considered, including terrain data, IMINT such as satellite imagery or streaming video imagery, live radar feeds, sensor data, flight plans and more. Ingesting and analyzing automated data shortens the time from sensor to decision.

True situational awareness can only be achieved when all data sources are analyzed and visualized in a single view or common operational picture (COP). Combining connective grid middleware such as Hexagon's Xalt | Integration, automated algorithms from Spatial Modeler and a visualization engine like Luciad can contribute to a performant command center.

Control

Control is defined as the process of verifying and correcting activity to accomplish an objective or goal of command. It implies a feedback mechanism by which an outcome is compared to a specific goal. The observe, orient, decide and act (OODA) loop is often cited in a command and control (C2) context. With defined workflows for users and AI for analyzing natural language, Hexagon technology provides decision-makers confidence in the information presented to them.

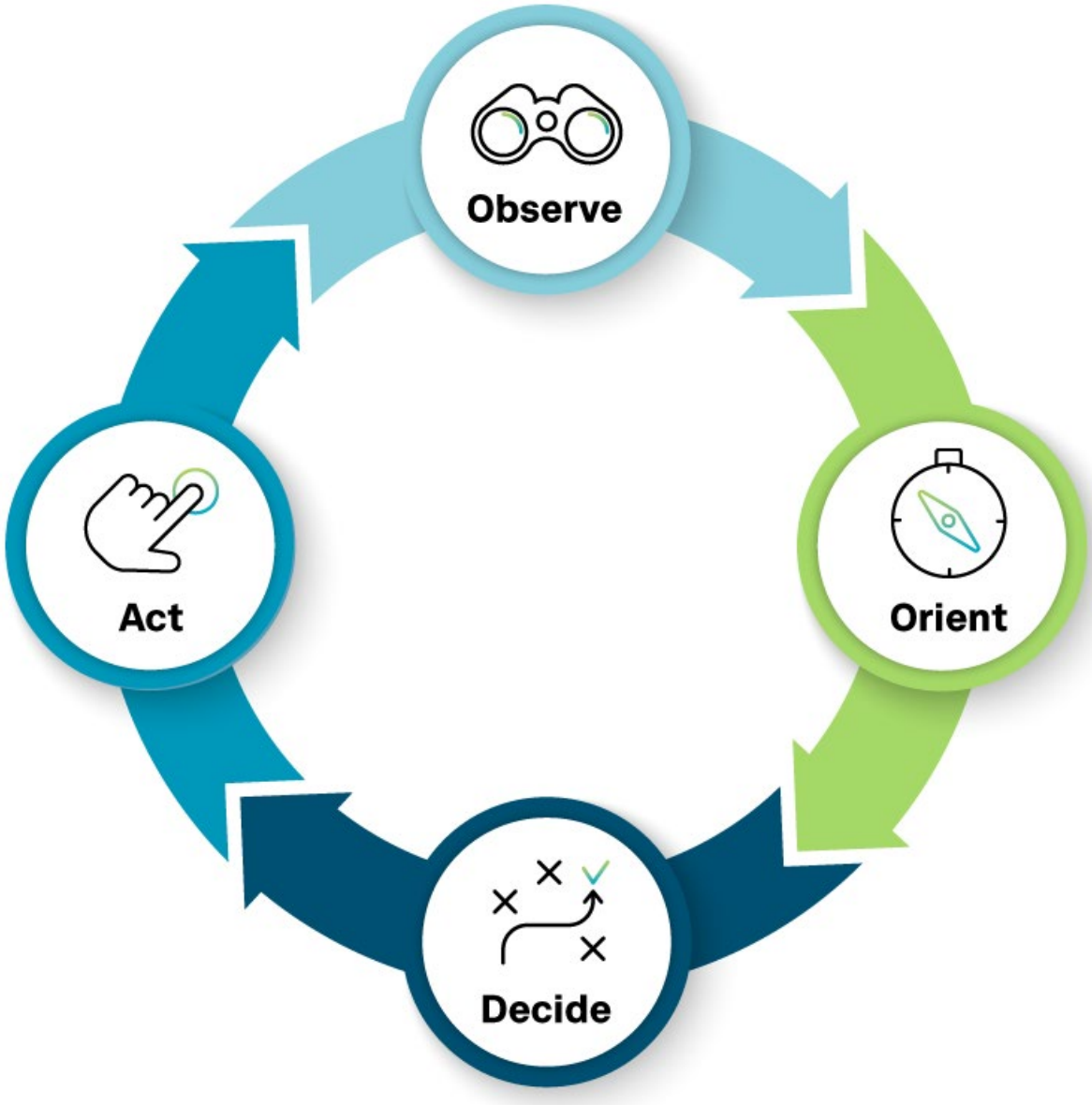

Figure 2: OODA loop in C2

Communications

It is critical for command centers to effectively communicate decisions and instructions to field troops as well as receive updates from the field. The earliest military **communications** were delivered by runners. Today, mission plans, reports and real-time intelligence can be shared with dismounted soldiers through mobile devices, with an unprecedented level of detail, including 3D visualizations, customizable military symbology and line of sight (LOS) calculations. These communication networks will only be enhanced by 5G networks. Another way to enhance communication is to provide a visual representation of information on a mobile device to frontline personnel. Software such as Hexagon's LuciadCPillar can do this, enabling visual communication of the 3D world along with annotations such as the location of friendly and enemy forces or supply routes.

Computers

When dealing with large amounts of data, **computer** data processing alleviates the burden on human analysts. Military organizations turn to automated solutions for geospatial data management to manage, fuse and serve large amounts of data to users and other systems. This allows users to manage their data intelligently, store and process a multitude of data formats and feed data to numerous applications.

Features including powerful automated cataloging and quick, easy data publication allow users to design, portray, process and set up advanced maps or data workflows in a few simple clicks. Hexagon's no-code development tools for automation workflows help maximize the use of computer processing power and minimize implementation time.

As defense adopts cloud-based solutions, browser-based client tools such as Hexagon's M.App X will become mainstream. These tools use standard web services and browser functionality to deliver a rich capability set via a thin client.

Cyber defense

Cyber defense operations refer to activities within the global information infrastructure that help protect institutions' electronic information. Data security against internal and external threats is a key element of cyber defense. Integrated data protection at the file and firewall levels can help. Fine-grained data security can be implemented to encrypt file-level data or restrict and/or allow certain users to access specific location data. Confidence in the trustworthiness of digital data and information for decision-making is paramount.

Hexagon's data catalog has role-based access control to ensure only authorized users see data in certain geographic areas or zoom scales, for example. In addition, Hexagon's ERDAS APOLLO can utilize existing directory services for security integration.

Combat systems

A combat system provides a warship, aircraft or ground vehicle with weapons and a range of sensors to identify threats. Data about potential threats is passed to the combat information center, where the situation is analyzed prior to weapons being used. The combat system's external communications equipment allows the team to exchange data with headquarters and other assets. This enables superior interoperability and information and the ability to execute highly synchronized mission operations. By nature, these systems are often mobile and detached from any network. Hexagon's Luciad API can run on mobile and on-board devices with limited operating systems and still maintain full defense symbology and analysis capabilities.

Intelligence

Intelligence is what results from the collection, processing, integration, analysis, evaluation and interpretation of available information. A significant portion of intelligence is gathered from geospatial data such as satellite images, aerial images, drone images, radar data, point clouds and more. While in the past it was often a tedious process to manually analyze large amounts of geospatial data, easy-to-use software with embedded AI can now automate this process.

Machine learning algorithms can assist imagery analysts with performing change detection, anomaly sensing, object classification and target identification from optical imagery or radar imagery. A substantial number of Earth Observation (EO) sensors, which can be fed directly into ERDAS IMAGINE remote sensing software, enables analysts to combine information from GEOINT, IMINT, OSINT and more.

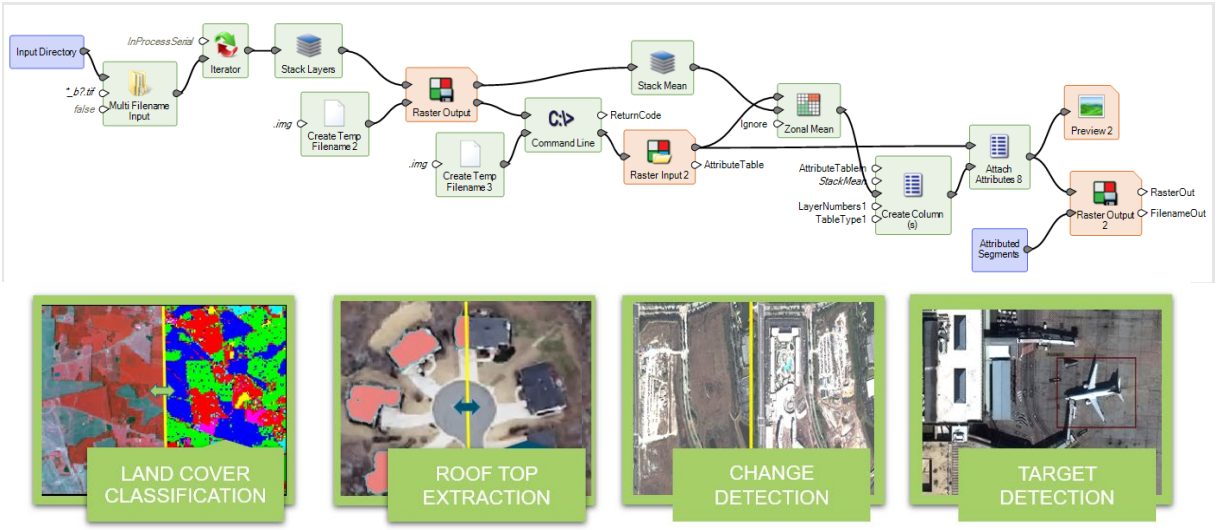

Figure 3: Machine learning algorithms in ERDAS IMAGINE can automate imagery analysis.

Surveillance

Surveillance is the systematic observation of aerospace, surface, places, persons or things by visual, aural, electronic, photographic or other means. Remote sensing technology such as LiDAR or radar sensors can help identify minute differences, even from long distances. A combination of video, thermal imaging and LiDAR in a single sensor – 3D surveillance – helps analysts discern between notifiable changes and expected changes. Employing AI and edge computing, 3D surveillance recognizes the difference between a threat and a non-threat (for example, a human intruder versus wildlife) and will automatically trigger an alert if necessary. That surveillance trigger (tip) can then be fed back to the C2 or used for further integrated analysis with other information sources.

Hexagon technologies are used within persistent surveillance solutions using SAR to spot maritime traffic anomalies, which then tip a land-based sensor, such as a drone, to investigate. This finer, real-time data can be visualized along with the SAR data to confirm the initial tip.

Reconnaissance

Reconnaissance refers to a mission undertaken to obtain information about the activities and resources of an enemy or potential enemy, or to secure data concerning the meteorological, hydrographic or geographic characteristics of a particular area. Reconnaissance identifies terrain characteristics, enemy and friendly obstacles to movement and the disposition of enemy forces and civilian populations. Unmanned aerial vehicles are often used to execute reconnaissance. Hexagon's GIS, imagery analysis and data management software helps reconnaissance teams quickly capture and extract information from recce data, or prior to the recce conduct planning based on geographic data.

As military forces generally attempt to conceal themselves and their equipment by using camouflage, reconnaissance can be particularly demanding. Fortunately, multispectral imagery can assist in vehicle/building camouflage inspection, synthetic material identification, vegetation health analysis and water depth assessment to spot changes or anomalies in the environment. SAR can detect subcentimeter changes, such as vehicle tracks, with LiDAR seeing beneath tree canopies.

Another information source often used for reconnaissance is aerial motion video. Motion video exploitation technology can detect changes between frames and direct an analyst to a specific point of interest within a video. It also enables advanced analysis by fusing aerial motion video with other intelligence sources like satellite or ground-based imagery, and sensor data with 3D modeling and simulation capabilities. This helps remove the "soda straw view" of motion video, enabling a view of the larger geographic landscape to aid intelligence gathering.

Conclusions from reconnaissance missions can be documented by adding military symbology and tactical graphics on top of a COP to digitally represent military units, equipment and installations, military operations, boundaries or other special designations. This completes the C6ISR data flow, from command to recce to command.

Figure 4: Military symbology and tactical graphics visualized in LuciadLightspeed

Conclusion

Hexagon offers scalable, adaptable COTS software for C6ISR solutions that are interoperable and easily integrated into other systems. Hexagon's mission to adhere to open standards and use component architecture gives systems integrators the flexibility to integrate and update the overall C6ISR solution.

Used widely in all aspects of C6ISR by multiple national and multinational forces, Hexagon technology helps defense personnel and systems integrators manage the data deluge to get accurate, discernable information to the right users at the right time.

To learn more about Hexagon's defense offerings, visit hexagon.com.