Case Study:
Machine Learning on the Edge with AWS Snowballs

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AWS Services Used: AWS Snowball (GPU), EC2, S3

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About Ampsight

Ampsight, a pioneer in cloud, cyber security and machine learning solutions, has created new possibilities that were only a dream a decade ago. Cloud alone has revolutionized how organizations build software and shared data with both security and agility extending to the tactical edge. Cloud and cyber security have joined forces creating new opportunities in artificial intelligence and machine learning. In each industry, Cloud, Cyber and Machine Learning, Ampsight offers a comprehensive solution that is easily customized, adaptable, and scalable to our customers missions. With our advanced AWS Partner Status, our team has migrated over 300 applications to the cloud, secured countless programs from attacks and continuously monitor for new ones, explore geospatial detection and much more. Ampsight combines our insights, and ability to seek challenges that will create new possibilities that will shape the future.

Challenge

The Government needs to provide machine learning services for a wide range of disciplines and missions in all environments globally to include Edge locations such as expeditionary, mounted (e.g., maritime, vehicles, aircraft), dismounted, operating bases, fixed ground stations, and garrison headquarters.

The Edge is a critical extension of the cloud that supports worldwide usage for various disconnected, intermittent, limited (DIL) environments. Edge computing is a distributed computing paradigm, which brings computation and data storage closer to the location where it is needed, to improve response times and save bandwidth.

> ***"The benefit to decentralizing computing power is placing it closer to the point where data is generated."*** **– DoD Edge Definition**

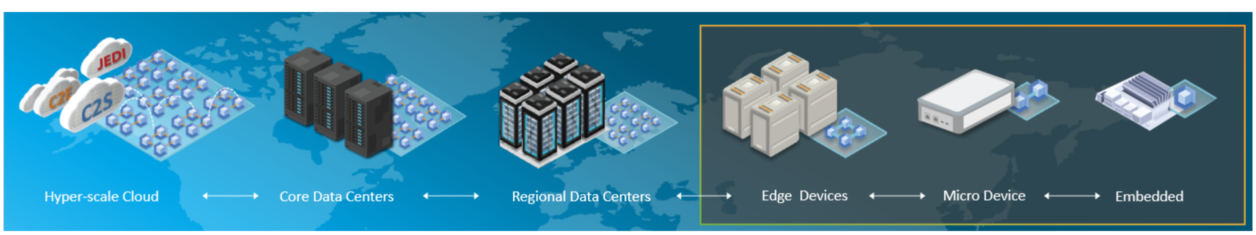

Figure 1: Decentralized Computing using Edge Computing

The tactical Edge consists of platforms, sites, and personnel operating at lethal risk in a battle space or crisis environment characterized by:

1) dependence on information systems and connectivity for survival and mission success,

2) high threats to the operational readiness of both information systems and connectivity, and

3) users who are fully engaged; highly stressed; and dependent on the availability, integrity, and transparency of their information systems.

Figure 2: Edge Snowball Cluster

Tactical Edge nodes are tailored specifically for austere, autonomous, and/or disconnected mission scenarios. Future tactical Edge nodes will be designed for enterprise interoperability, while ensuring needed GEOINT capability is available with or without enterprise connectivity. Tactical Edge environments require more ruggedized and mobile solutions that are not suited for traditional data centers. There are numerous tactical Edge environments that may include: forward operating base down to individual vehicle (ships, planes, trucks, etc.). The tactical Edge requires small form-factor modules for compute, storage, and networking functions that meet military-standard size, weight, and power (SWaP) limitations. Figure 3. is an example of a tactical Edge device on the CS2 contract.

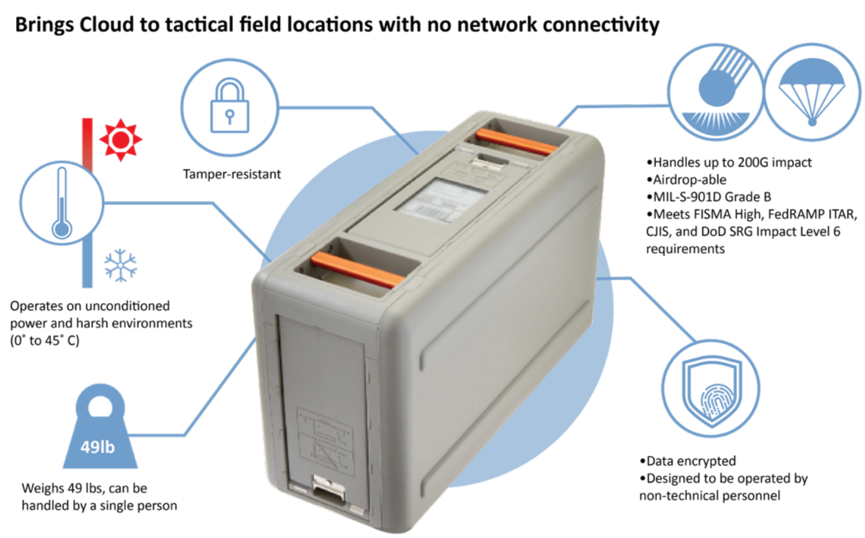

Figure 3. Example Tactical Edge Device on the C2S Contract

With the spectrum of Edge computing, all five layers must interoperate in a distributed, mesh pattern. Each level—from hyperscale computing to the tactical Edge—may communicate directly with other levels. Currently, micro devices communicate with an aggregation level such as tactical Edge node following an Internet of things (IoT) pattern. However, as technology evolves and standards emerge, these micro-devices may communicate to different levels simultaneously.

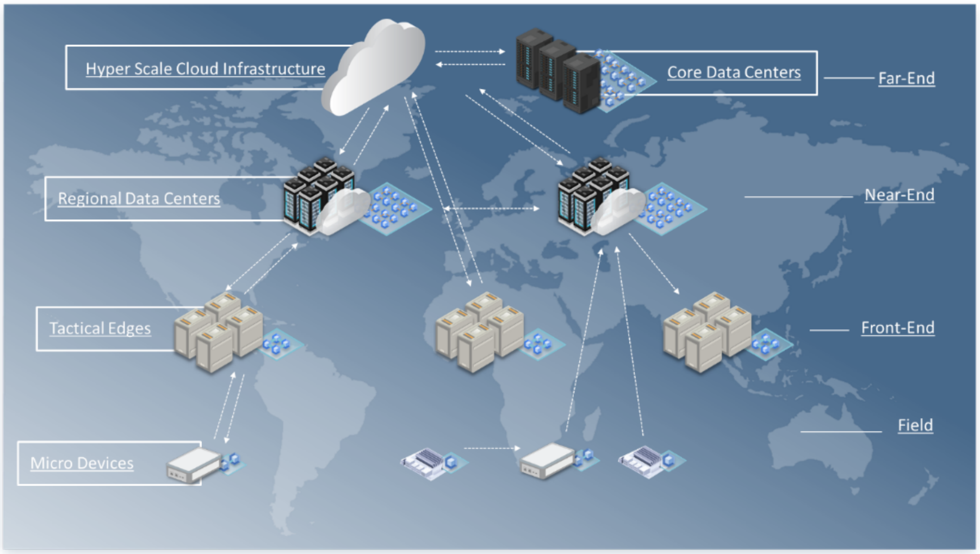

Figure 4. Edge Devices can interconnect to better serve tactical field locations

ML at the edge would run pre-trained Machine Learning (ML) at the Edge to produce inferences. Examples are object classifiers and anomaly detection to process tactical ISR imagery to produce secondary data that reveals trends and statistical revelations focused on areas of interest or beyond. This ML solution will be run to discover correlated insights as new data is ingested regardless of AOI. Advanced AAA scenarios include training object classifiers on top of pre-trained models.

Solution

Our solution uses AWS Snowballs to ML models on edge to automate the target signature detection and reduces the big data problem inherent in persistent ISR caused by multimodal collection and the increasing latency resulting from legacy PED systems. It's a capability that provides autonomous target detections for airmen enabling greater efficiency and effectiveness of tactical missions globally.

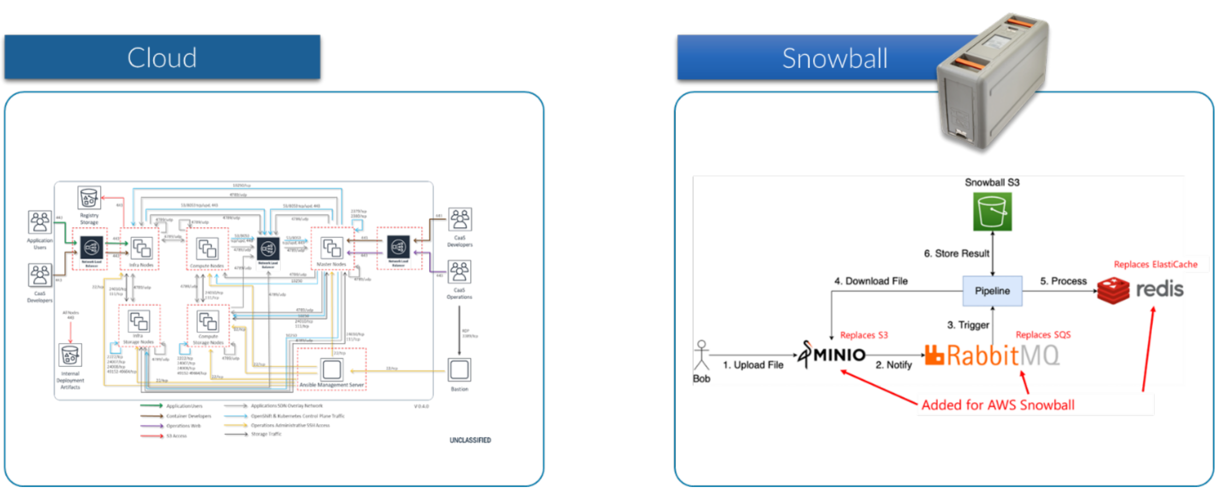

Figure 5: Edge devices simplify complex cloud solutions

Our solution performs real-time PED processing on FMV, WAMI, MTI, aerial and LEO SAR, EO/IR Imagery, and signals data. It applies deep learning algorithms to the data in parallel to detect TOI from live data streams. These detections are disseminated to groups of users and external systems via a subscription that specifies the delivery methods. Algorithms apply many factors based on the types of images or video provided, including varying resolutions and look angles. Our solution adapts advanced object detection and tracking algorithms to achieve state-of-the-art performance in detecting vehicles and dismounts with confidence scoring in full motion video. We've deployed Tensorflow and PyTorch frameworks with specific libraries developed on top of these frameworks, including the Tensorflow Object Detection API and Detectron2.

Figure 6: Ingest full motion video live streaming data to identify and track vehicles or objects dynamically

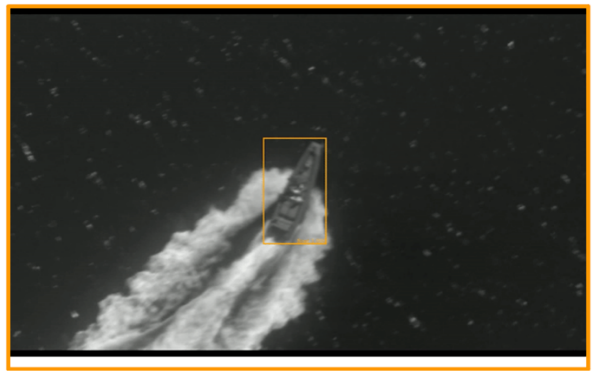

Figure 7: ML algorithms can be used to automate object detection, and remove redundant manual processes

Figure 8: Generate queryable geospatial object catalogs for activity-based intelligence (abi) projects & forensic research projects

Our solution also applies deep learning for identifying ships and wakes in SAR. Our solution mitigates the challenges in pre-processing SAR such as converting the non-linearly-distributed SAR pixels into linearly-distributed pixels that are used with modern deep learning algorithms by making our algorithms more robust to those changes.

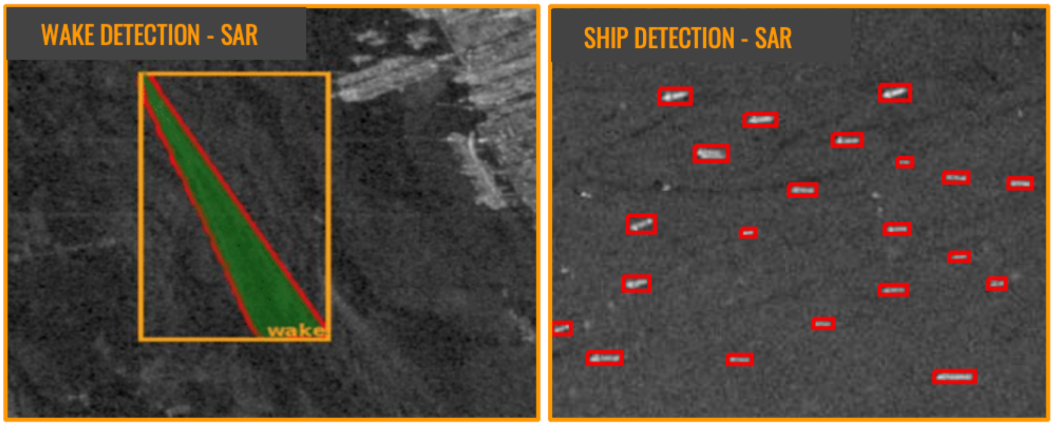

Figure 9: Using sar models at scale has the potential to quickly identify ships using wakes alone or anomalies in jungle canopy.

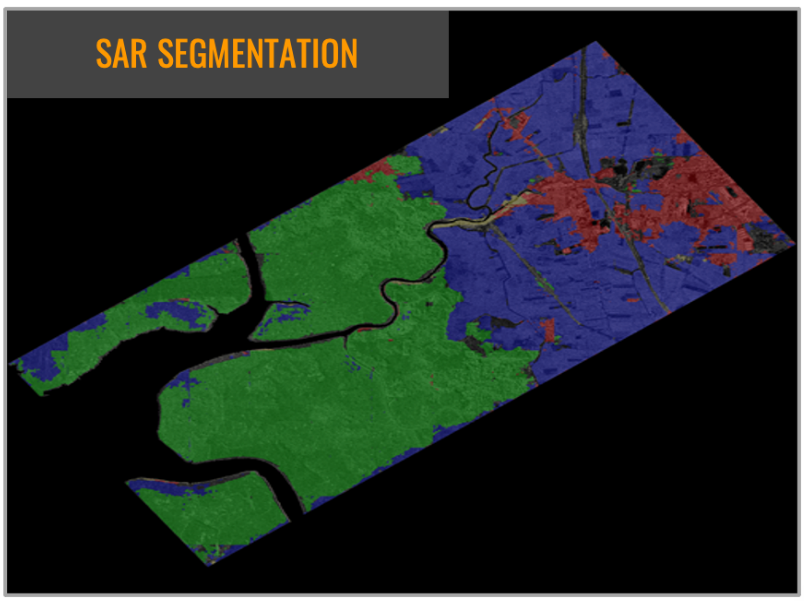

Figure 10: SAR Models developed on aerial and satellite imagery can identify patterns in complex imagery, that would otherwise go undetected

Results and Benefits

Our solution reduces the need for analysts to watch video and imagery feeds and the human error in monitoring for EEIs. It automates the PED, detection of targets and activities, and notification process so analysts are cued to the target and activity of interest to accelerate and improve the quality of finished reporting. The use of proven commercial stream processing and analytics processes and analyzes sensor data in real-time reduces latency by 68% over legacy PED systems. ML on the Edge also deploys on one or more AWS Snowballs for edge operations.