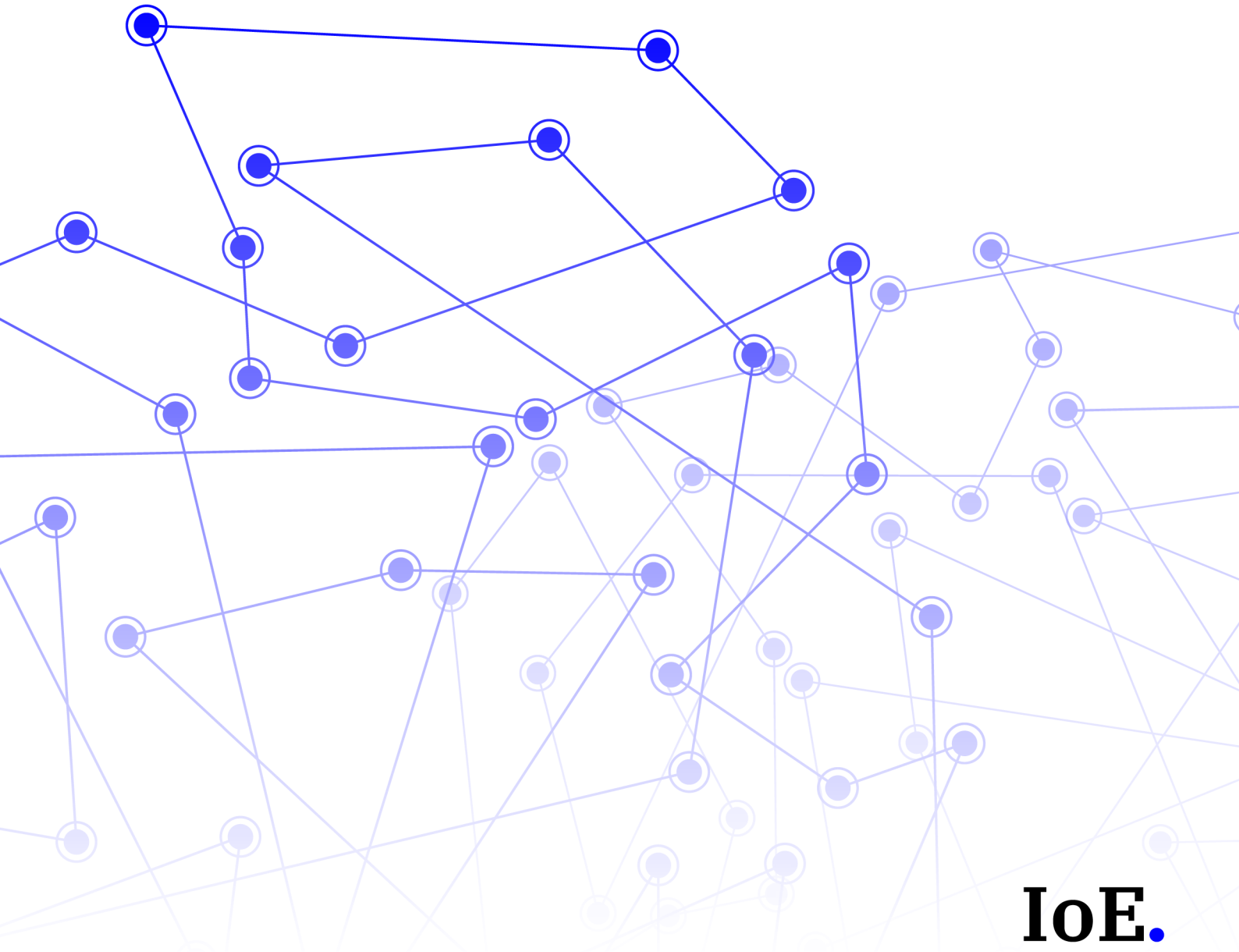
Aerospace & Defense: Sustainability a Priority



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Abstract

The Aerospace and Defense industry is entering a new phase where the physical and digital worlds are merging. A situation opening up great opportunities as technology's potential to help implement better solutions to tackle the sustainability issues set by the United Nations and offer leaner workflows is groundbreaking.

Industry 4.0 is data-driven; therefore, data management systems are a top priority for corporations to enter the physical and digital interconnectivity. Today's solutions are based on centralized systems (e.g., cloud service providers). These solutions are unsuitable for massive IoT deployments as sustainability goals and cost-effectiveness must be met.

Here you will learn how to achieve a sustainable approach for the aerospace and defense industry's data management systems. Get insights into what actions must be implemented to reduce carbon emissions and ignite workflows capable of keeping data security and privacy. Learn how the Internet of Everything Corporation can help Aerospace and Defense attain sustainable workflows and cost-effectiveness and open new horizons of opportunities in Industry 4.0.

Introduction

The United Nations' Sustainable Development Goals[1] (UN's SDGs) have set the standards on which to work for all industry verticals. Aerospace and Defense (A&D) have drawn the line, and its focus path drives it to stimulate investment in sustainable solutions on a holistic approach: economical, research and development (R&D), and eco-friendly. Representatives of this humanistic perspective toward A&D's sustainability as a priority are the U.S. Federal Aviation Administration's Continuous Lower Energy, Emissions, and Noise[2] (CLEEN) Program and the Department of Defense's (DoD) Sustainability Plan[3]. Both initiatives began in 2010.

The FAA has invested over $225 million in CLEEN Phase I and Phase II. One of DoD's FY 2022 priorities was to allocate $469 million to fund a microgrid initiative to protect mission-critical assets and reduce GHG emissions. The sustainability pledge encompasses Planet Earth's complete spectrum, indicating its importance on the well-being of our only home in the infinite universe. To this end, we introduce how the Internet of Everything Corporation can aid as a technological partner to accelerate the sustainable initiatives A&D has been building for over a decade.

In the dawn of Industry 4.0, digital transformation plays a crucial part in adjusting the workflow within non-digital corporations. Humankind is moving into a data-driven revolution. Technological advancements set us in the zettabyte era, where data generation comes from all aspects of life. A&D is no exception. But it is undoubtedly true A&D does come with exceptions, as the data generated by this industry, if accessed by bad actors, can create havoc, putting millions of lives in life-threatening situations. Unfortunately, as the current Russian-Ukraine conflict exemplifies, we don't have to go back in time to understand these risks.

In this situation, technology must rise to the challenge to present solutions that, on the one hand, are ecologically sound set to reach the UN's SDGs and, on the other hand, ensure cybersecurity at the National level. The challenge is extraordinary, as the goals for Aerospace and Defense are to keep Planet Earth and civilians safe. The Internet of Everything Corporation is ready to confront these vital issues by partnering with top industry leaders and decision-makers in the public and private Aerospace and Defense industry corporations.

Sustainability as an asset for Aerospace & Defense

The sustainability policy triggered by the UN's SDGs is proving to be not just a means to lower carbon emissions but also cost-effective. Recent research by Capgemini on sustainable product design[4] shows results of a 20% decrease in costs of Aerospace and Defense organizations. As for the primary sustainability goals, i.e., reducing carbon footprint, noise pollution, and fossil fuel burn, estimates indicate goals will be reached.

CLEEN program estimates for Phase I and II by 2050:

- Save the aviation industry 36.4 billion gallons of fuel.
- Reducing airline costs by 72.8 billion dollars.
- Lowering CO2 emissions by 424 million metric tons.
- Decrease land area exposed to noise by 14%.

The U.S. Department of Defense's priority actions toward goals in its 2022 sustainability plan includes the following:

1. 100% Carbon Pollution-Free Electricity (CFE)
2. 100% Zero-Emission Vehicle (ZEV) Fleet Acquisitions
3. Net-Zero Emissions Buildings, Campuses, and Installations
4. Reducing Waste and Pollution
5. Sustainable Procurement
6. Climate and Sustainability Focused Federal Workforce
7. Incorporating Environmental Justice
8. Accelerating Progress through Partnerships

Sustainability is a growing force in the aerospace and defense industry. Companies and organizations must embrace this transition from fossil fuels to renewables as what is at stake is the deterioration of our planet. Customers are increasingly conscious of climate change and prioritize choices based on the sustainable approach corporations present. Therefore, for aerospace and defense, sustainability isn't just about saving the planet and budget; it is also an asset for its branding.

The quicker organizations, corporations, and administrations of the industry become active players in the race to lower carbon emissions, they will be acknowledged as industry leaders in the mid-long term. There is still a long road ahead, but steps are being taken in the right direction, as CLEEN and DoD's sustainability plan show. Technology advancements are also paramount: artificial intelligence (AI), the internet of things (IoT), digital twins, and 3D printing can substantially help accelerate the process.

Technology: the defense and aerospace sustainment partner

The aerospace and defense industry encompasses an immense workforce, from metallurgic to supply chain. The process that derives into, for example, an aircraft is part of a vast puzzle of many pieces from various places. Process optimization is fundamental for the industry to keep paving the way to a sustainable future, and technological partnerships play a crucial role. But certain adjustments require prompt attention.

Digital transformation, Industry 4.0, and the fourth industrial revolution are all concepts leading to the same path - data management. Industries and societies are entering a data-driven stage where the technological innovations mentioned above, e.g., AI and IoT, produce vast amounts of data. We are leaving behind the petabytes and entering the zettabyte (10^{21}) era, a mind-boggling number that needs urgent efficient management. Today, cloud service providers manage digital data via data centers or server centers, centralized systems where all data moves to and from these storage surfaces.

Before we entered the zettabyte era, the cloud was an excellent option for corporations, private and public, as this innovative solution provided significant benefits. When the cloud entered the scene, it allowed businesses to reduce costs, eliminating the need to have on-premises data centers. With the cloud, companies could securely store their data generation on a centralized server center at a reasonable price.

The cloud opened new ways for small, medium, and large companies to take advantage of data management and have this data remotely available globally. PowerPoints, excel sheets, communication (emails, meetings, calls, etc.), and digital databases (airline reservations, production management functions, medical records, legal records of insurance companies, etc.) were all a click away, regardless of where you were in the world.

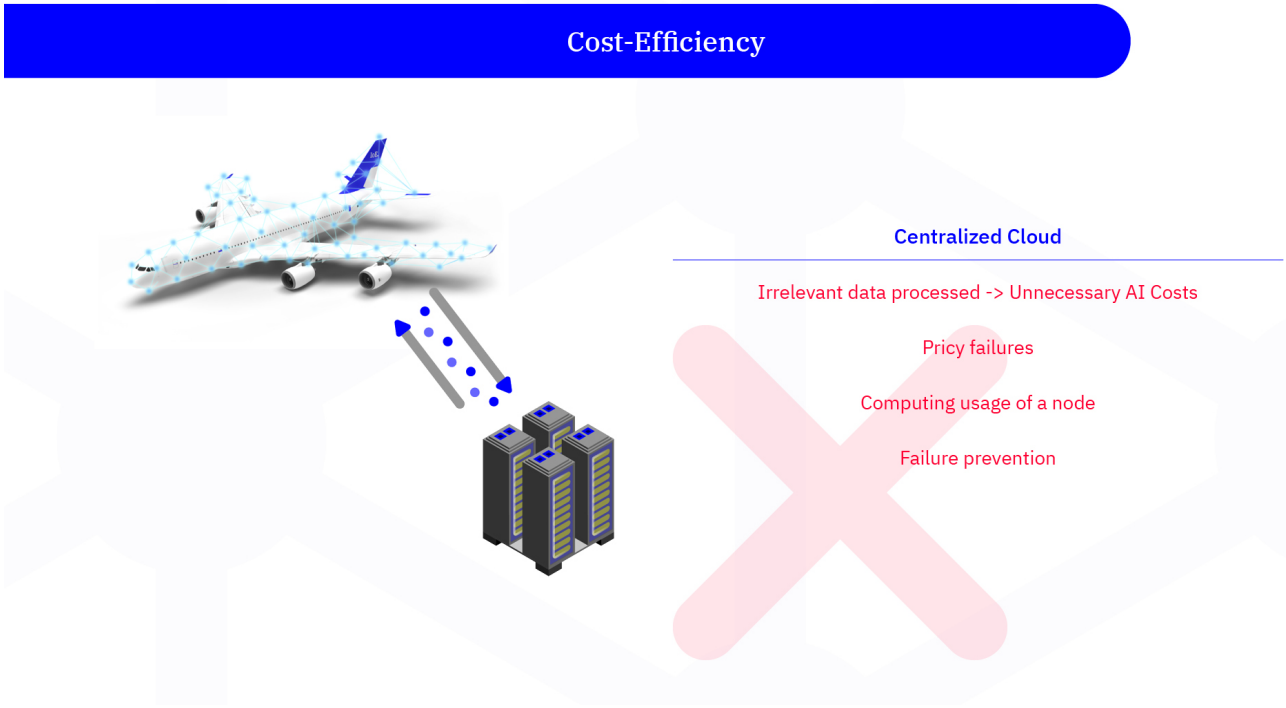


Figure 1. Data management cost-efficiency issues of centralized cloud providers

Centralization's flaws in the zettabyte era

The strains of data management via centralized solutions have been gradually growing, and the type of data generated is more sensitive. Based on these two issues, cloud service providers need help to meet the sustainability, cost-effectiveness, speed, and security demanded in massive IoT deployments. Airports, military bases, space launching sites, and airline fleets are all implementing IoT into their workflows and using analytical AI to achieve autonomous automation.

Such a reality requires IoT data management systems to ensure real-time data and cybersecurity strategies to supply decision-makers with a flux of data on demand and through secure paths. From the early years of the Cloud, latency, bandwidth bottlenecks, and data breaches have been constant. The paradigm shift opening severe flaws in current centralized solutions for data management comes from the IoT adoption of all industry verticals. In addition, AI processing costs are escalating budgets that only large multinational corporations can afford.

All these components show some hard flaws in centralized data management systems, resulting in a non-effective defense and aerospace sustainment partner (Figure1). Deficiencies that are hard to solve, costly to fix, and unsustainable solutions; today, for data centers to work on a 24/7 basis, the only option is fossil fuels. Critical services like hospitals and national infrastructure must ensure proper workflow constantly all year round. An airport's downtime or latency issue can signify mayhem and life-threatening situations. Other unwanted situations for a military base or power grid are the possibility of cyber criminals and cyber terrorists gaining network access.

Decentralization to be Defense and Aerospace's sustainment partner

The good news is that technology is constantly evolving and providing innovative solutions to cope with huma-

nity's challenges. For the already growing massive IoT deployments, decentralized networks are an excellent option as it offers the following:

- Aerospace & Defense sustainability solutions
- Cybersecurity to meet A&D requirements
- Cost-effective data management systems

Decentralization for A&D sustainability

The decentralized concept is based on moving away from remote server centers and returning to the source. Innovations in technology make it possible for the network to be formed by all the nodes that make it; thus, the need to go back to building a data center on-premises is mitigated. Blockchain technology, initially used for cryptocurrency, is evolving, and its potential to securely manage data for all industry verticals is becoming a reality.

Blockchain technology is a digital ledger sharing data equally between the network nodes (computers, sensors, devices, etc.), providing an on-premises system capable of storing, processing, and delivering data. As the information added to a block is immutable and the whole network must confirm the authenticity of a block before it can be chained, security measures are highly complex to break.

Therefore, moving into digital ledgers eliminates the costs of pushing raw data to remote centralized data centers. Latency, bandwidth bottlenecks, bandwidth costs, and reducing the carbon footprint are all reached. As centralized data centers require energy for cooling purposes which, in consequence, raises the use of fossil fuels, a decentralized network's nodes are distributed and not concentrated in one single point. A solution that does not require a complex and energy-intensive cooling system.

Decentralized cybersecurity meets A&D requirements

Aerospace and Defense security requirements must comply with the high level of sensitive and critical data generated. To achieve such levels, risks, and vulnerabilities must be reduced to practically zero; otherwise, the services provided by A&D will be constantly compromised. Such a situation is unacceptable. One primary risk and vulnerability of centralized data management systems is the data movement from the source to server centers. Keeping data at the source and moving only minimal data to the Cloud resolves this problem.

Another issue centralization presents is that a hacker can control the whole network via one access point. In contrast, a decentralized network has no central point of attack, and with the help of a blockchain, when a bad actor tries to access the system, the other nodes alert a node acting suspiciously, and as a result, it is ignored. The system can continue to work because other nodes can take over the tasks of the attacked node; this is possible via information being equally distributed throughout the network, as mentioned earlier.

Moving Aerospace and Defense data on-premises and utilizing blockchain technology drastically reduces the cybersecurity risks and vulnerabilities centralized systems present. Warfare is not just about air, sea, and land defense, but also cyberspace. The lead analyst at GlobalData, Aurojyoti Bose, states: "Cyber threats have increased multifold with critical military and civil infrastructures increasingly getting connected over the internet and at the same time making them vulnerable to cyberattacks."[5]

Cost-effective data management systems via decentralization

It is fundamental to gain a system that offers sustainability, cybersecurity, and a cost-effective way of managing data. Otherwise, the aerospace and defense industry would be doomed to enter Industry 4.0. Decentralization provides the tools to apply a cost-effective data management system. As mentioned, the costs of moving raw data to server centers are significantly reduced, keeping data at the source.

There are other advantages a decentralized network offers. For A&D, it is a vital benefit to assure real-time data, and, in addition, data-to-information refinement is extremely cost-effective. The industry works on re-

al-time data. Airports require constant information from airplanes for lift-off and landing purposes; the location on land and air must be real-time. Innovations to reduce fossil fuel energy burn require data-to-information refinement, as this will accelerate the go-to-market timeline.

Decentralization provides the data-driven market with a solution to cost-effectively store, process, analyze, and deliver data to information. It gives decision-makers useful information to proceed at any given moment. It also enables analytical AI to refine data, mitigating the current costs of centralized solutions' AI analysis which consists of processing all the data, which is extremely expensive considering the coming of the zettabyte era.

A&D sustainable maintenance

Aerospace and defense maintenance is a massive part of the workflow, as maintenance optimization reduces costs and increases consumer satisfaction. It also adds to sustainability by reducing failures and malfunctioning and acting on the required issues before they happen. The predictive maintenance approach is gaining traction as technological development offers better analytical and real-time data results to achieve this level of maintenance.

Currently, the most widely used maintenance approaches are preventive and reactive maintenance. According to the U.S. FAA, preventive maintenance is "simple or minor preservation operations and the replacement of small standard parts not involving complex assembly operations."[6] Reactive maintenance is a timeline in which a particular part of an aircraft is used to its limits, and repairs are only performed after a failure.

There are disadvantages when applying reactive and preventive techniques to maintenance; for reactive, this method can be costly and, worse, dangerous. The preventative approach offers fewer disadvantages, but it is based on determined scheduling, which can result in early maintenance, thus, impeding the total lifecycle and being too late for maintenance, causing part failures. In both cases, the outcome is extra costs.

On the other hand, predictive maintenance offers precise real-time signals to decision-makers when a part will fail. Applying predictive maintenance to workflows can

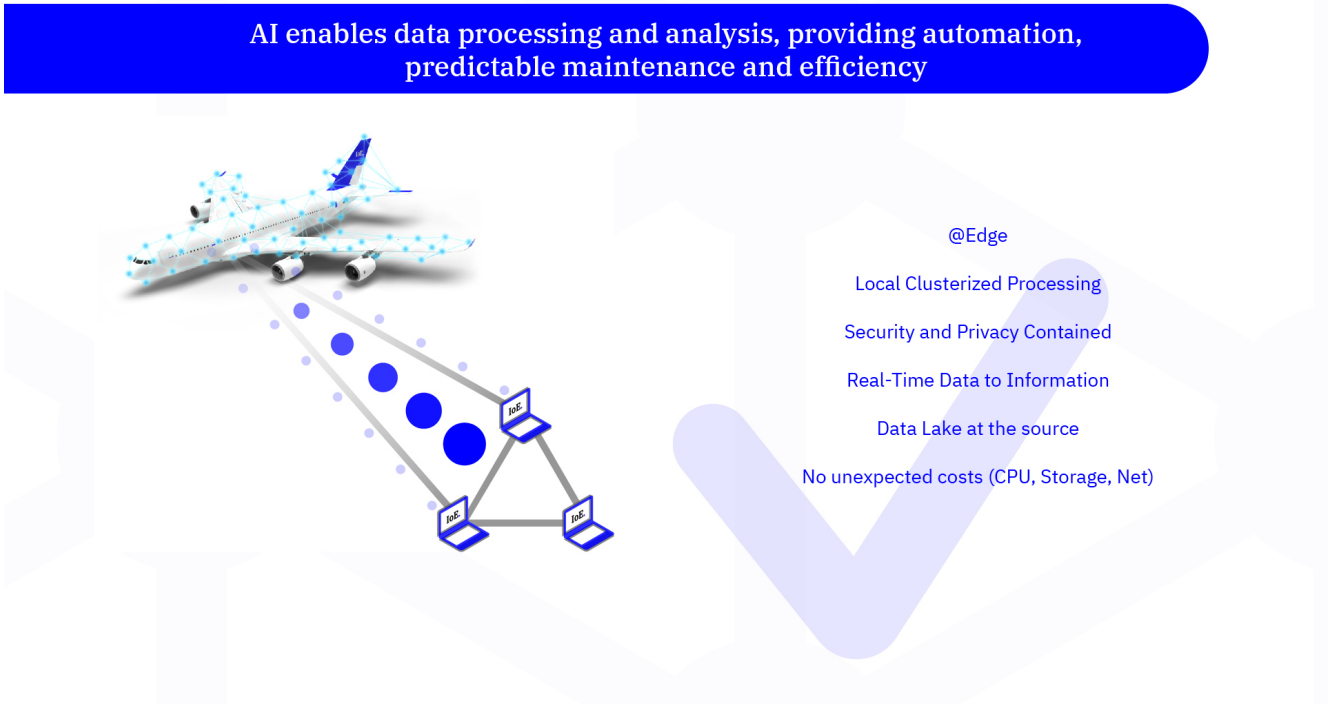


Figure 2. IoE Eden System for cost-effective aerospace & defense sustainable data management

derive, when fully utilized, a return on investment well above 100:1 or $100 for every dollar invested.[7] The issues hindering operators from investing in predictive maintenance are data management and security.

This type of technology relies on data generated by IoT devices, and findings estimate that the global fleet could generate upwards of 98 million terabytes of data annually by 2026. To sustainably manage this data is complex, and if we add AI, the situation worsens, more precisely on the ability to sync data from different sources, departments, and formats. Cyber threats are also a significant inhibitor to entirely investing in predictive maintenance, as current solutions can't assure systems cybersecurity.

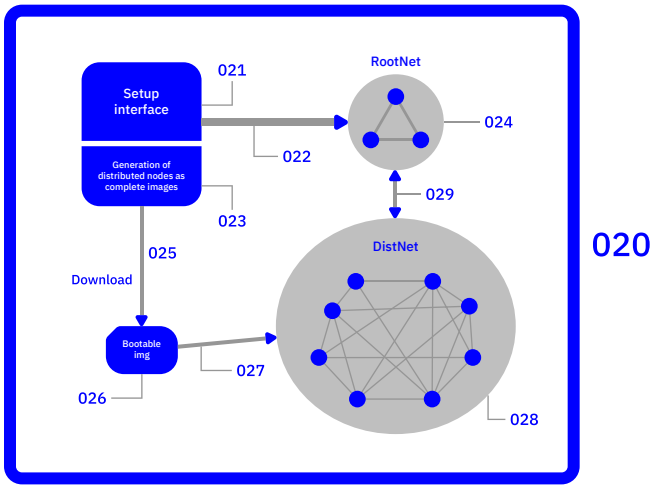


Figure 3 - The Eden system customer signup chart process for aerospace & defensedefense sustainable data management

Internet of Everything Corp's Eden

Internet of Everything Corporation (IoE Corp) has developed the Eden system designed to overcome the ongoing problems massive IoT deployments present to current centralized solutions. As the above has presented, today's data-driven industry and society can provide incredible benefits to city dwellers' standard of living. It also opens an array of opportunities for all sectors.

The final piece of the puzzle is how to manage the data tsunami that's coming in an efficient, sustainable, and cost-effective way. Eden is a decentralized model based on scalable device clustering. Data is processed to information locally in the Eden Edge Cluster so that raw data never needs to be pushed to the public cloud (Figure 2). A compute-efficient and cost-effective model by saving on bandwidth and external resources.

Eden's security protocol uses quantum-safe tunnels using polymorphic encryption keys and a consensus blockchain to verify the data moved between the nodes over the tunnels. Also, as the data is processed locally, the risks and vulnerabilities opened by the movement of data to cloud service providers are mitigated. IoE Corp creates trusted data private gardens and achieves data trust in Zero-Trust environments (Figure 3).

IoE Corp's Eden is a sustainability asset for A&D

Sustainability is an integral part of IoE Corp's Eden. As mentioned, integrating Eden into A&D's workflow eliminates the need to move raw data to remote server centers. But it also expands its sustainability into the programming language used. It has been researched, and findings indicate that some far less energy-intensive programming languages[8], available today, are not widely adopted (Figure 4).

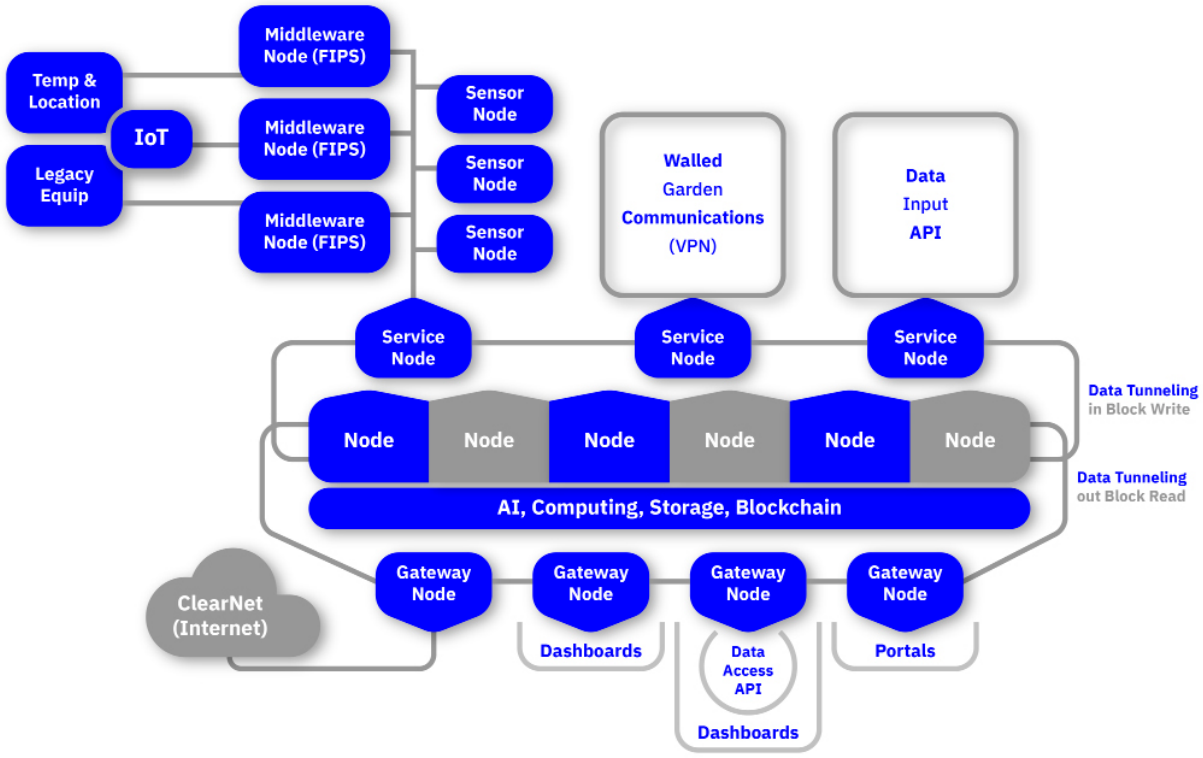
Total					
	Energy		Time		Mb
(c) C	1.00	(c) C	1.00	(c) Pascal	1.00
(c) Rust	1.03	(c) Rust	1.04	(c) Go	1.05
(c) C++	1.34	(c) C++	1.56	(c) C	1.17
(c) Ada	1.70	(c) Ada	1.85	(c) Fortran	1.24
(v) Java	1.98	(v) Java	1.89	(c) C++	1.34
(c) Pascal	2.14	(c) Chapel	2.14	(c) Ada	1.47
(c) Chapel	2.18	(c) Go	2.83	(c) Rust	1.54
(v) Lisp	2.27	(c) Pascal	3.02	(v) Lisp	1.92
(c) Ocaml	2.40	(c) Ocaml	3.09	(c) Haskell	2.45
(c) Fortran	2.52	(v) C#	3.14	(i) PHP	2.57
(c) Swift	2.79	(v) Lisp	3.40	(c) Swift	2.71
(c) Haskell	3.10	(c) Haskell	3.55	(i) Python	2.80
(v) C#	3.14	(c) Swift	4.20	(c) Ocaml	2.82
(c) Go	3.23	(c) Fortran	4.20	(v) C#	2.85
(i) Dart	3.83	(v) F#	6.30	(i) Hack	3.34
(v) F#	4.13	(i) JavaScript	6.52	(v) Racket	3.52
(i) JavaScript	4.45	(i) Dart	6.67	(i) Ruby	3.97
(v) Racket	7.91	(v) Racket	11.27	(c) Chapel	4.00
(i) TypeScript	21.50	(i) Hack	26.99	(v) F#	4.25
(i) Hack	24.02	(i) PHP	27.64	(i) JavaScript	4.59
(i) PHP	29.30	(v) Erlang	36.71	(i) TypeScript	4.69
(v) Erlang	42.23	(i) Jruby	43.44	(v) Java	6.01
(i) Lua	45.98	(i) TypeScript	46.20	(i) Perl	6.62
(i) Jruby	46.54	(i) Ruby	59.34	(i) Lua	6.72
(i) Ruby	69.91	(i) Perl	65.79	(v) Erlang	7.20
(i) Python	75.88	(i) Python	71.90	(i) Dart	8.64
(i) Perl	79.58	(i) Lua	82.91	(i) Jruby	19.84

Figure 4. Energy efficiency across programming languages: how do energy, time, and memory relate?[8]

To this reality, IoE Corp takes action and identifies the Rust programming language as the best option to provide sustainable computing in IoT. There are two options to choose from, compiled and interpreted code, and the difference between both resides in the CPU use. Interpreted code requires more CPU loops as it is interpreted as being a virtual machine that, on the fly, creates the machine code.

In other words, compiled code provides the target machine with a direct translation of the source code; in contrast, interpreting code requires an intermediary to interpret the source code. It can be understood as wanting to use a recipe written in a language you need to familiarize yourself with. Thus, to prepare the recipe, you can either find a direct translation (compiled code) or look for a translator who translates the recipe as you go, line by line (interpreted code).

Eden takes sustainability into account as a holistic approach to offer solutions to help accelerate the quest to reach the sustainable goals set by the UN. Keeping data management at the source reduces costs. Therefore, the Internet of Everything Corporation gives aerospace and defense sustainable advantages to lower GHG emissions and actions an economically sustainable plan to manage data.



How a deployed Eden Infrastructure works for aerospace & defense

Conclusion

Sustainability is a necessity, and the aerospace and defense industry is in the spotlight as fossil fuels continue to be the means to make the industry roll. But technological innovations are helping to move away from or reduce the use of fossil fuels. Data is of the essence, specifically, how data is stored, processed, analyzed, and delivered to accelerate the process.

Corporations and organizations that want to lead the way into the promising fourth industrial revolution must achieve strongholds on how their data management systems work. There are two options: continue using

cloud service providers and deal with the risks, vulnerabilities, and ever-growing costs. Or begin to move into a decentralized solution where innovative solutions are being deployed.

The paradigm shift is here. Today digital data has expanded into all aspects of industry and society, introducing what once was kept on-premises into the World Wide Web (WWW). A&D can't afford to risk critical and sensitive data being accessed by cyber terrorists, but it is what is happening. In addition, vital and sensitive data must refrain from competing for bandwidth with mundane data, e.g., Netflix streaming.

Just like there are specific public transport and ambulance lanes with sirens to move through traffic, digital data should also have this organization. But today's situation is different, as all data moves and competes for space through the same cables. A problem that, as we have presented, is creating sustainability issues and unacceptable security risks when it comes to critical infrastructure like aerospace and defense.

Internet of Everything Corporation is onboarding new partners via the Planet Partner Program. Learn more about how this partnership can help you to accelerate your sustainability goals and achieve a cost-effective digital transformation data management system.

Apply to the Planet Partner Program:

https://partners.ioecorp.com/apply-partner.

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