



Digital Utilities Platform

Empowering Customers
Towards Smart City Services



230 Davidson Ave, Somerset,
New Jersey, USA 08873
Phone: +1 (908) 392 8050
Email: info@greenstartech.net
web: www.greenstartech.net



INNOVATION

We deliver innovative solutions to help customers improve business efficiency, reduce and optimize their operating costs and transform into efficient and profitable digital businesses.



QUALITY

Our platform provides comprehensive, innovative and quality solutions in commercial, industrial and residential applications.





SOCIAL VALUES

Leveraging the Internet of Things, we aim to develop sustainable infrastructure, promote economic progress and social development for businesses and individuals.

OVERVIEW

Greenstar Technologies LLC provides platform as a service for digital transformation of businesses. We are at the forefront of innovation for enterprise, managed solutions, data management and real-time machine intelligence by leveraging the Internet of Things (IoT), Artificial Intelligence (AI) and Blockchain technology.





The Augmented and Autonomous Bots in Digital Utility Platform

Introduction

Digital transformation is at the forefront of the utility industry. Renewables, distributed generation and smart grids demand new capabilities and are triggering new business models and regulatory frameworks. Data collection and exchange are growing exponentially, creating digital threats but also valuable opportunities. Customer engagement is shifting to online channels. Internet of Things (IoT) promises new product and management options both for utilities and customer. Entrants from digital economy are disrupting the industrial landscape, while governments and regulatory bodies seek to encourage smarter measuring systems and greener standards for generation, distribution and consumption.

The utilities of the future will adapt to digital systems. Today's utilities will implement digital transformation to their organization and business ecosystem, improving efficiency and expanding customer base. As the transformation builds momentum, it will open deeper digital opportunities across a wide field along the power industry value chain, from generation to customer relationship management.

To realize these digital opportunities, utilities will transform operations adapting digital transformation strategies that can be successfully embedded and scaled in the organization, designed around the company's existing value drivers and strengths, including product portfolio, technical competence and customer proximity. Projects and partnerships will be designed with the linked objectives of digitizing core processes, upgrading IT platforms and conquering new business terrain.



Many utilities have launched mobile applications for bill notification and payment, as well as for outage management. Before long, mobile applications will extend to smart homes and connected buildings. Digital management of distributed energy resources, from individual sites to entire systems, has already begun. Many projects within the utility have a digital focus and are using techniques of the digital economy and business transformation.

The threats to utilities from digital pioneers such as Amazon, Google, Tesla Motors are more tangible at the customer interface, where information is more important than material assets. All the same, digital capabilities allow utilities to enter new business arenas.

Greenstar Technologies SurgeCloud digital utilities IoT platform can help transform the way utilities operates by creating a digital enterprise that can redefine their offerings and how it is delivered. As new technologies are adopted, utilities will shift from centralized suppliers and passive customer consumption to a decentralized, distributed smart energy systems.

Greenstar Technologies SurgeCloud digital utility IoT platform offers new product and management options to ease this transition. The platform can help to improve operations through analytics, accurate reporting, as well as develop new products and services and combat digital security threats. The Greenstar Technologies SurgeCloud digital utilities IoT platform enables collaboration between utilities and third-party service provider's ecosystem for enabling insights of the businesses.



IoT in Digital Utilities

The movement towards connecting every device, machine and sensor to the internet, takes advantage of two key technologies:

- Connectivity, which has become increasingly easier with recent advancements in Wi-Fi, cellular and local wireless technologies.
- Web services, like computing, storage and networking which have become a commodity resource and allows easy end-user access to data from embedded devices.

Having a network connection to a device is not a new concept, but the advancements made in these technologies have brought about new challenges for companies and original equipment manufacturers (OEMs) who have little experience in data.

It is compelling to regard IoT as a world of silicon and signals, sensors and circuits; transmitting once-obscure data to the modern databases and interfaces of our connected world. Indeed, without these technologies, IoT would not be

the multi-billion device industry it is today. However, as the end users of IoT shift from early-adopters to mass market and as hardware and connectivity become commodity assets, the value of IoT will shift.

This shift in the accessibility of technology and data has given birth to the concept of a digital twin. A digital twin is a virtual representation of a physical device that allows us to gain greater insight by combining both measured physical parameters and other digital information about the asset. This combination of physical and virtual information enables a range of new insights about an asset, including those performance, health and predictive insights about what may happen in the future. The concept of a digital twin moves manufacturers and operators closer to the ultimate goal of selling outcomes instead of products.

Greenstar Technologies SurgeCloud digital utilities IoT platform enables utilities to partner with large OEM manufacturers to enable Utility Infrastructure as a Service (UlaaS). UlaaS providers who are strategic utility infrastructure manufacturers provides critical infrastructures on policy based services delivery models and is responsible for building, owning, operating and maintaining the infrastructure equipment it provides for a client utility. Clients pay on consumption or utility service basis, thus transforming the capex based business model into a digital service based model.

Greenstar Technologies SurgeCloud digital utilities IoT platform enables the concept of a digital twin and how it can transform an IoT solution from connected data to a valuable view of a meaningful asset. This is enabled through leading edge developments in IoT cloud platforms, software development methodologies and practices and the integration of data and information ecosystems that derive new asset knowledge.

The convergence of smart connected devices and cloud computing is unleashing an age of anytime, anywhere connectivity that is fostering entirely new modes of customer interaction and service delivery. However, to realize the full potential of IoT opportunity, customers will need new tools and technologies. The existing tools that support the development of smart systems are not providing the full measure of value. We are quickly approaching analogous circumstances with the proliferation of smart connected devices. Each new device requires huge customization and maintenance just to perform basic tasks.



Edge Device Communication Protocol (EDCP)

The emergence of IoT has created dynamic challenges in the data communication arena. Open protocols such as MQTT, AMQP etc., are point to point messaging protocols which have serious limitations. They cannot deliver operational efficiencies as there is no emphasis given on the application layer characteristics such as data source discovery, synchronization and autonomous registration.

In order to address this situation Greenstar Technologies has developed the new Edge Device Communication Protocol stack. EDCP enables the deployment of large scale IoT solutions, delivering operational efficiency and data connection reliability. EDCP is a revolutionary protocol that can transform large streams of IoT data from millions of devices into Business Intelligence (BI) seamlessly by eliminating manual intervention in the data source creation, transformation and meta data management.

Greenstar Technologies Edge Device Communication Protocol (EDCP) is based on decades of connected solutions and integration knowledge, machine critical software development expertise and large-scale deployment experience. The device Software Development Kit (SDK), an Embedded Device Framework (EDF) is a software framework for creating smart gateway devices and ubiquitous IoT solutions; it enables secure device communication, filters and aggregates sensor and device data locally. EDF features include security, data acquisition and logging, data normalization, data analytics at the edge, data transmission, control, security, web services, remote management and deployment of artificial intelligence. EDF runs on a variety of hardware platforms, is flexible, scalable, lightweight and is an IT framework for adding intelligent networked devices to create IoT solutions.

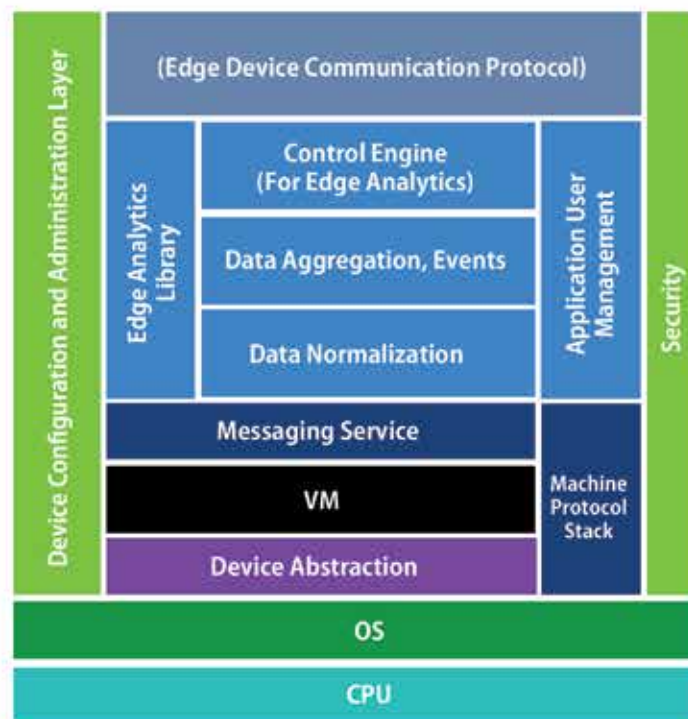


Fig 1: Greenstar Technologies Edge Device Framework and Protocol stack

The EDCP protocol is an enabler in Digital Twin Autonomous formation in the cloud.




The digital utilities echo system is more complex and vital. An asset digital twin is not enough to derive true value for the utility customer. An augmented bot is an autonomous, self-learned system agent, which combines relevant set of digital twins, utilizes Artificial Intelligence (AI) and Machine Learning (ML) models to provide true behavior model of sub systems (like substation, feeder etc.).

This paper will also discuss best practices to implement an augmented bot model for an IoT solution. A digital twin maturity model is provided that offers a roadmap on how to grow an optimized digital twin over time.



An Asset Digital Twin



“Digital twin” is the existence of a sibling; an object, asset, or thing that is being transmitted and replicated into a digital representation. In order to begin an exploration of the digital twin, it is important to first understand this sibling.

Imagine a power quality meter and energy meter installed in a distribution substation. These units exist primarily to describe the condition of a subsystem such as load on distribution transformer and the quality of the power delivered to the customer.

The “thing” we care about is not the energy meter or the power quality meter in particular, but rather the holistic integrity and health of the substation system itself. This “thing” is the asset, the sibling, will become the target of a digital twin.

Observing Non Connected Asset

Direct observation or measurement of an asset is often the most familiar, most accessible means of understanding its condition and state. Want to know the condition of a distribution transformer? Chances are, walking past it could provide some sense of its condition through direct observation of its key properties, especially if there is unusual noise, vibration, or heat. Instruments and gauges can facilitate this direct observation by quantifying what can often be sensed through observation. Note, however, that concern is not typically given to the state of the measurement device or sensor, but rather to the asset, it is measuring. This is an important distinction to make while beginning to think about connected solutions.

Greenstar Technologies Mobile Business Processor (MBP) is an enabler in collecting these historical logs, which is not in digital formats. For example, many utilities holds their transformer failure and service logs available in books and ledgers or in some cases, it is stored in databases, which is not centralized.

Greenstar Technologies MBP is an integral part of our SurgeCloud digital utilities platform enabling automation solutions for driving productivity and process efficiencies in the utility business environment. MBP is a feature-rich, web-based development platform, complete with pixel-perfect apps, process automation and powerful reporting capabilities, that lets utilities quickly build and deploy a wide variety of business applications, all without writing a single line of code. MBP allows user to build visually rich business processes, design simple or complex workflows, send automatic notifications and escalations, create impressive drill-down reports and even integrate with external systems.

For businesses, adoption of Mobile Business Processor (MBP) empower utilities:

1. Digitization of repeatable business processes
2. Digitization of operator system logs
3. Cloud-based virtual agents for anomaly detection and process compliance
4. Functional tools for virtual/remote assistance
5. No code smart mobile applications for sharing real-time data insights.

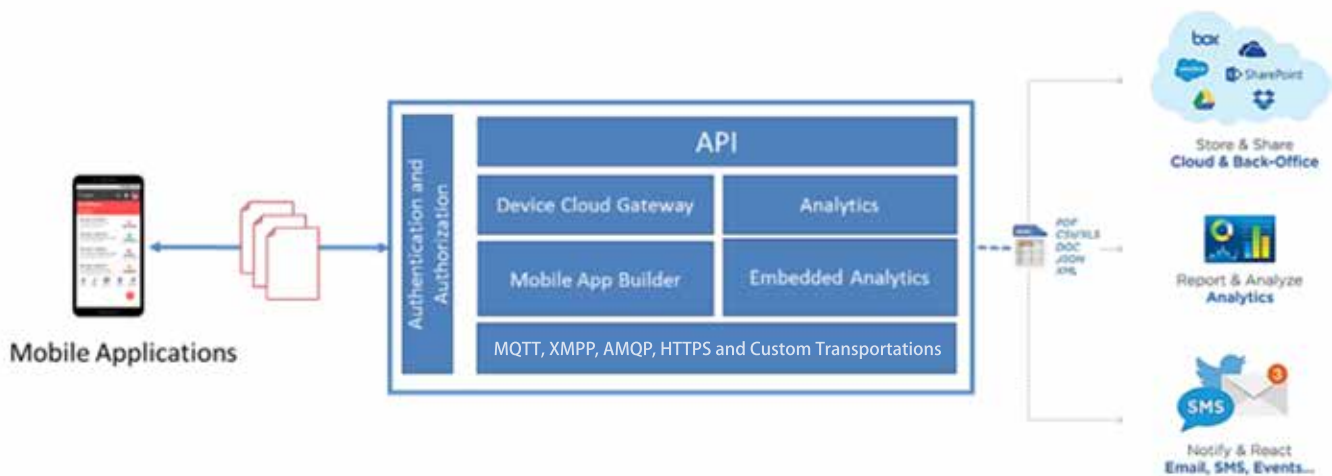


Fig 2: Greenstar Technologies Mobile Business Processor

Legacy Monitoring (SCADA)

3.2

Early condition-monitoring solutions would typically map signals from sensors to channels or memory addresses, with physical displays or user interfaces that would directly represent these values. The need for direct observation of the asset was removed, but it was up to the observer to infer or correlate these measured values with asset state, condition and maintenance records.

Greenstar Technologies SurgeCloud is a unified platform offering comprehensive conditional monitoring and predictive analytical solutions for critical assets and asset types in various business segments.

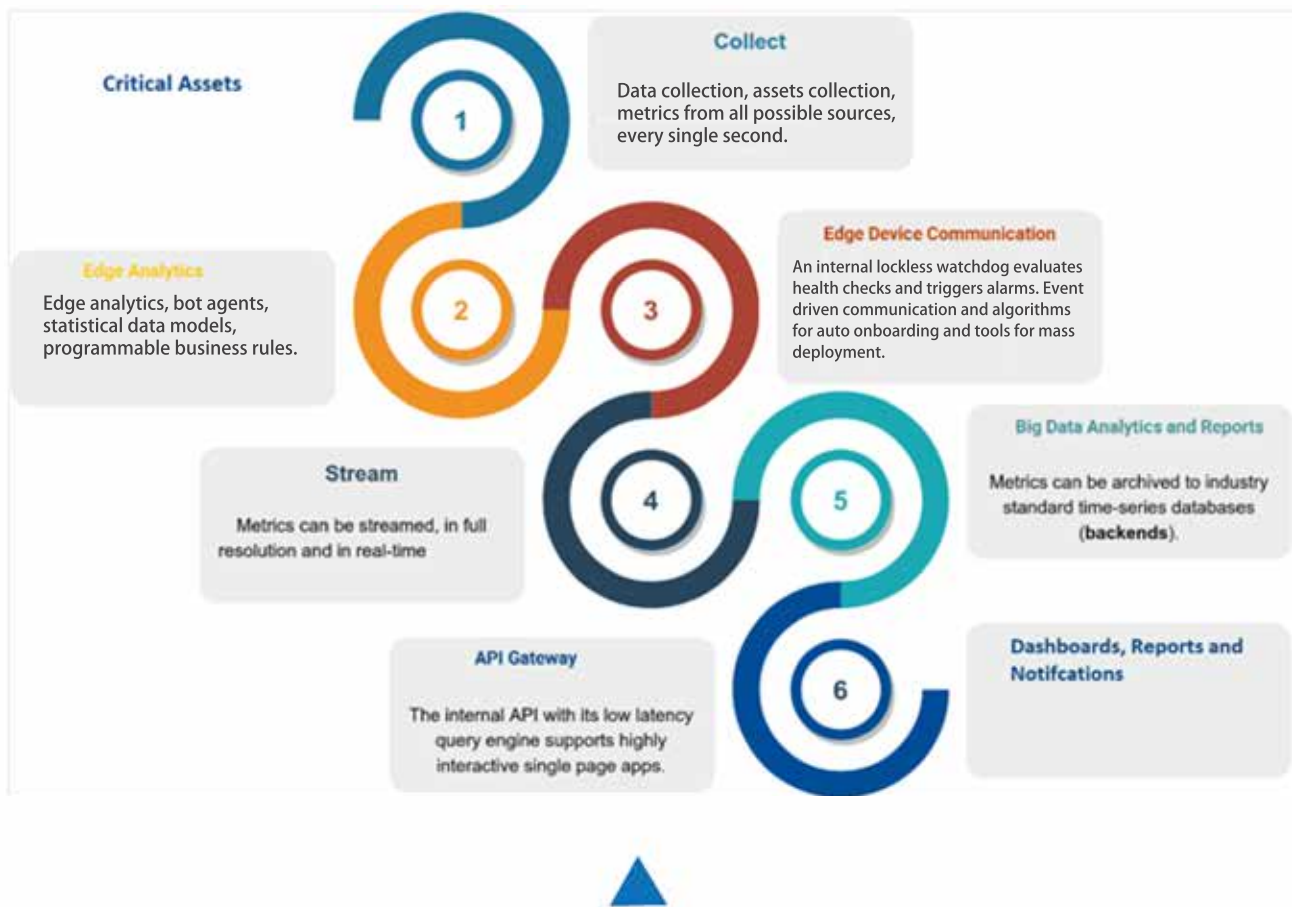


Fig 3: Greenstar Technologies Condition Monitoring Solutions



Transition to IoT

3.3

IoT solutions overlaid this local monitoring design pattern on top of internet communication protocols and software user interfaces. Database schemas and user interfaces reflected the sensor and hardware values, layout and similarly relied on user interpretation to correlate data and events, real-world conditions, maintenance records, which were often stored in a separate disconnected system.

It may seem logical to scale a first-generation IoT solution by adding sensor types and increasing the range of data captured; however, simply filling databases with streaming data from sensors leads to systems only data scientists are able to use, as most people have trouble relating to databases.

However, if this information can be presented in a meaningful model, it is possible to enable users to forget about the data and instead react to meaningful knowledge. This is the purpose of the digital twin, to transform sensor and device data into tangible asset knowledge for business users, application users, automated processes and more.



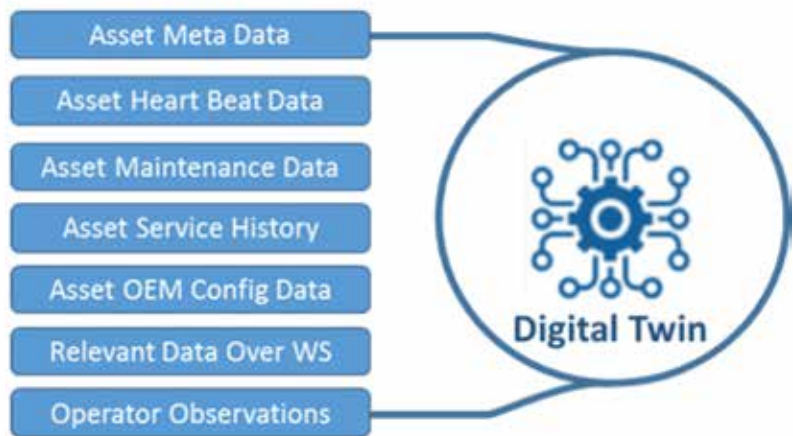
3.4

Asset Modeling with Digital Twin

In early phase of digital adoption and asset modeling in an IoT solution, it may be tempting to pick up a development board or measurement device, inspect its array of sensor outputs and reflect these attributes into the properties of a digital twin. However, instead of centering the model of a digital twin on the development board, measurement device, or sensor, think of the entire asset being measured (for instance a substation).

By thinking about digital twin in this way, it becomes natural to enhance and augment the model with further meta-data, nearby environmental conditions, maintenance data from similar equipment, service history, account information for the utility that owns it, manufacturing born-on data and related configurations and data from other web services that together can create a rich and comprehensive representation of the physical device. The digital twin reflects the current state of an asset.

Many IoT use cases also require command and control interaction with a connected device. Command and control requests should be separated from an asset model's state. This is often done with separate values for "observed" and "target" values for a data resource. Leading IoT platforms incorporate this separation inherently, allowing a digital twin to define which data resources can accept commands and maintain the correct state of the asset as commands are received, executed and confirmed.



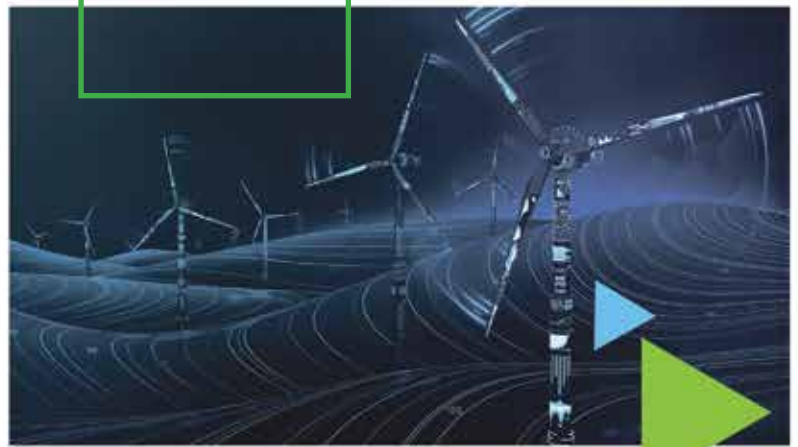
▶ Fig 4: Asset Digital Twin



Asset Modeling with Digital Twin

IoT brings challenges in representing anything that may not be as simple as one physical connected thing to one digitized thing. That is to say that the data is important as grouped topics to different people. Tactics for enabling a meaningful view of an asset model can range from simple UI layout and graphics, to more complex approaches such as derivative data and forecasting.

To fulfill this requirement, one should consider the balance between development complexity and creative freedom. Dashboard tools are an efficient way to visualize data, but can be constraining when correlating or deriving data from multiple sensors. Visualization libraries can accelerate custom charts and graphics, but require intermediate development skills and the right application-hosting environment. Leading IoT platforms offer these options and more within their capabilities, allowing a solution to mature and target specific roles and use cases.





Role of Edge Analytics in Digital Twin Maturity Model

Early condition monitoring solutions would typically map signals from sensors to channels or memory addresses, with physical displays or user interfaces that would directly represent these values. The need for direct observation of the asset was removed, but it was up to the observer to infer or correlate these measured values with asset state, condition and maintenance records.

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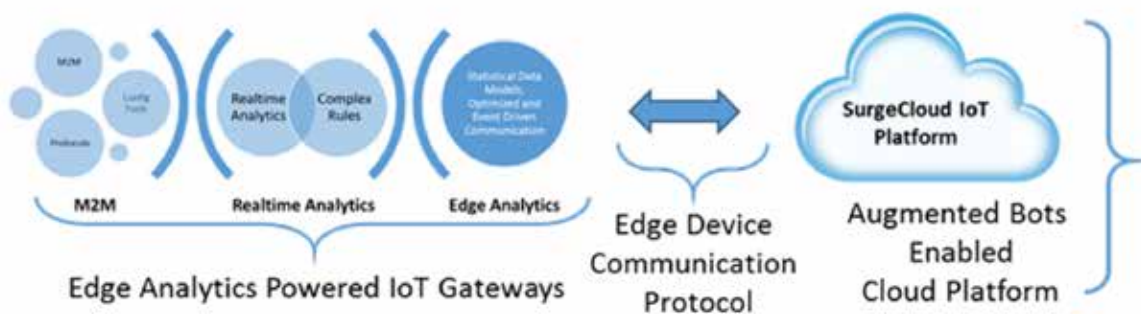


Fig 5: IoT Technology Stack



System Modeling with Augmented Bots

Greenstar Technologies augmented system bots are a set of AI/ML powered self-contained system models/agents, which observe system changes in a dynamic environment. The bot coordinates and manages one or many digital twins and models the system in a dynamic environment. These are self-learned agents, which will be groomed over time.

Fig 7: Augmented System Bots Characteristics

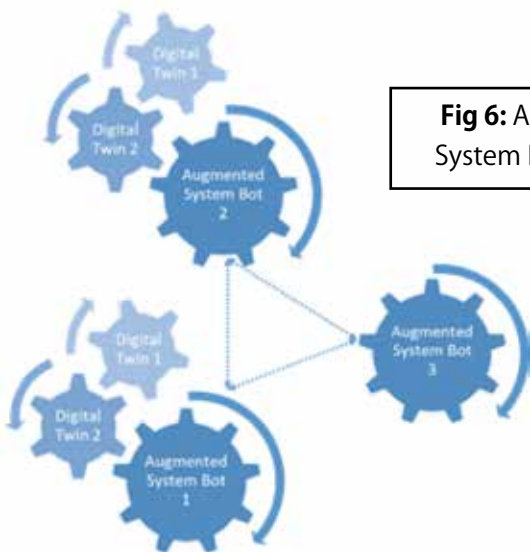
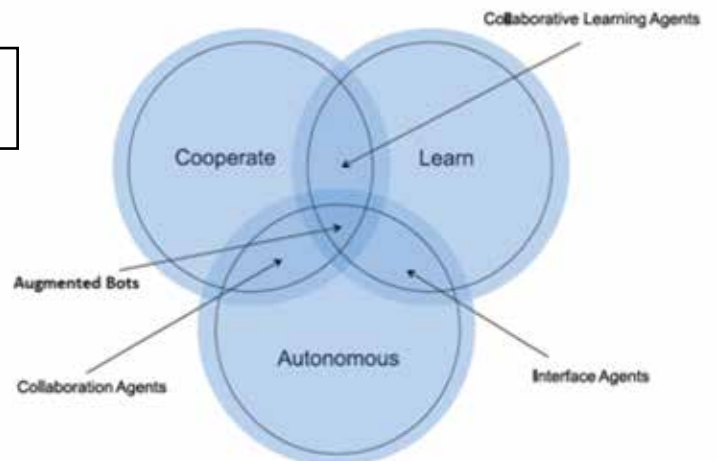
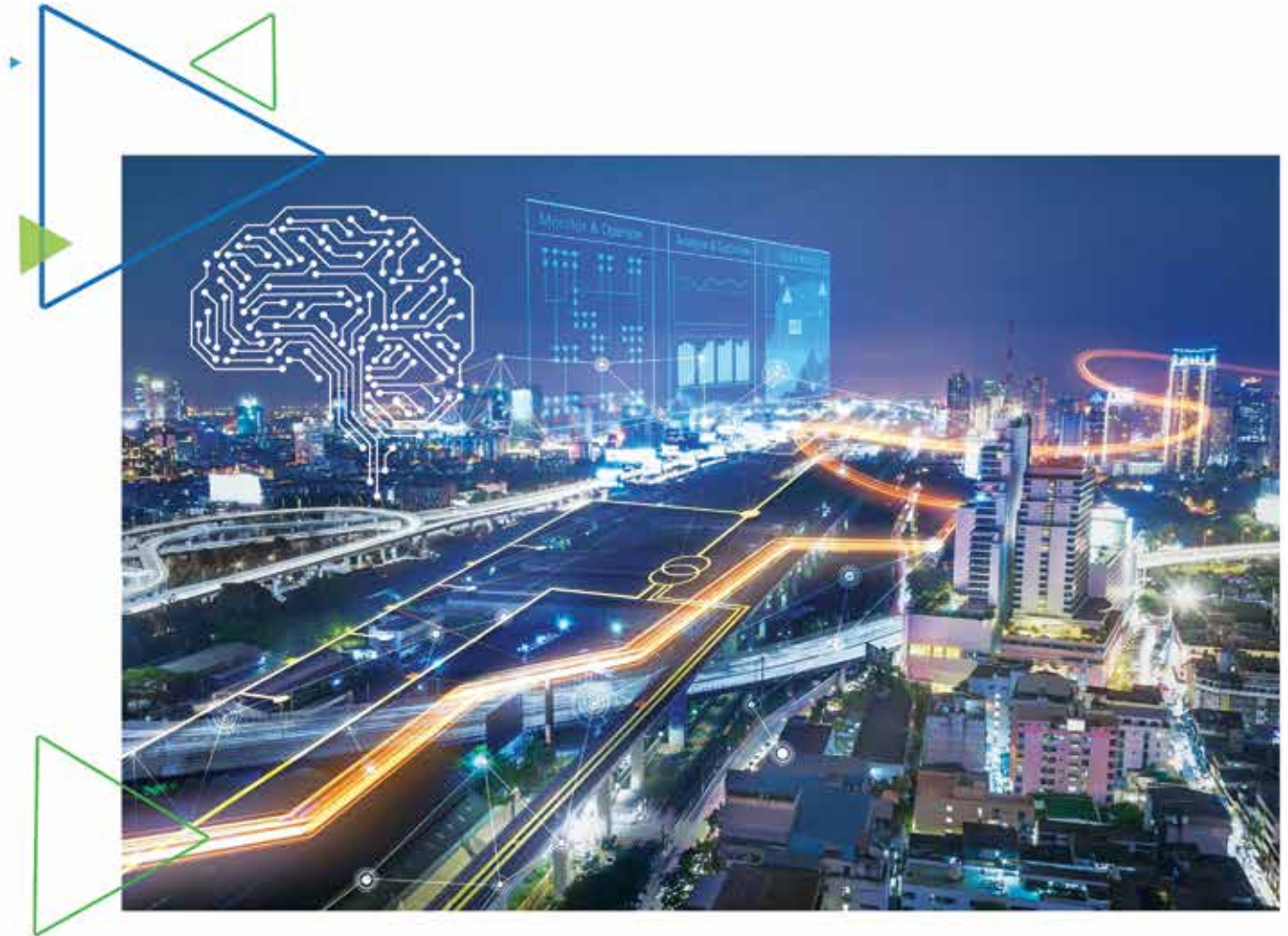


Fig 6: Augmented System Bots Model





Augmented Surge Bots Enabled With Assist Self Learning AI and ML

1

The two primary goals of augmented Surge Bots are:

Manage and optimize assets anywhere in the utilities infrastructure and to make expertise available to decision makers and facility management teams to auto diagnose and resolve problems with least manual intervention.

The primary objective of Surge Bots are to use large amounts of domain specific knowledge in solving problems through software agents by reasoning, pattern recognition, learning, or some other form of inference.

Greenstar Technologies has devised solutions that address utilities for optimizing and managing their infrastructure and providing customer services. Assisted AI / ML can be applied in intelligent problem solving, to a wide range of practical problems. Our project scientists see the typical application of this technology being implemented in utilities around the world where there are numerous innovative customer centric services to be deployed, enabling utilities to become an integral part of the customers digital life style and the smart city ecosystem.

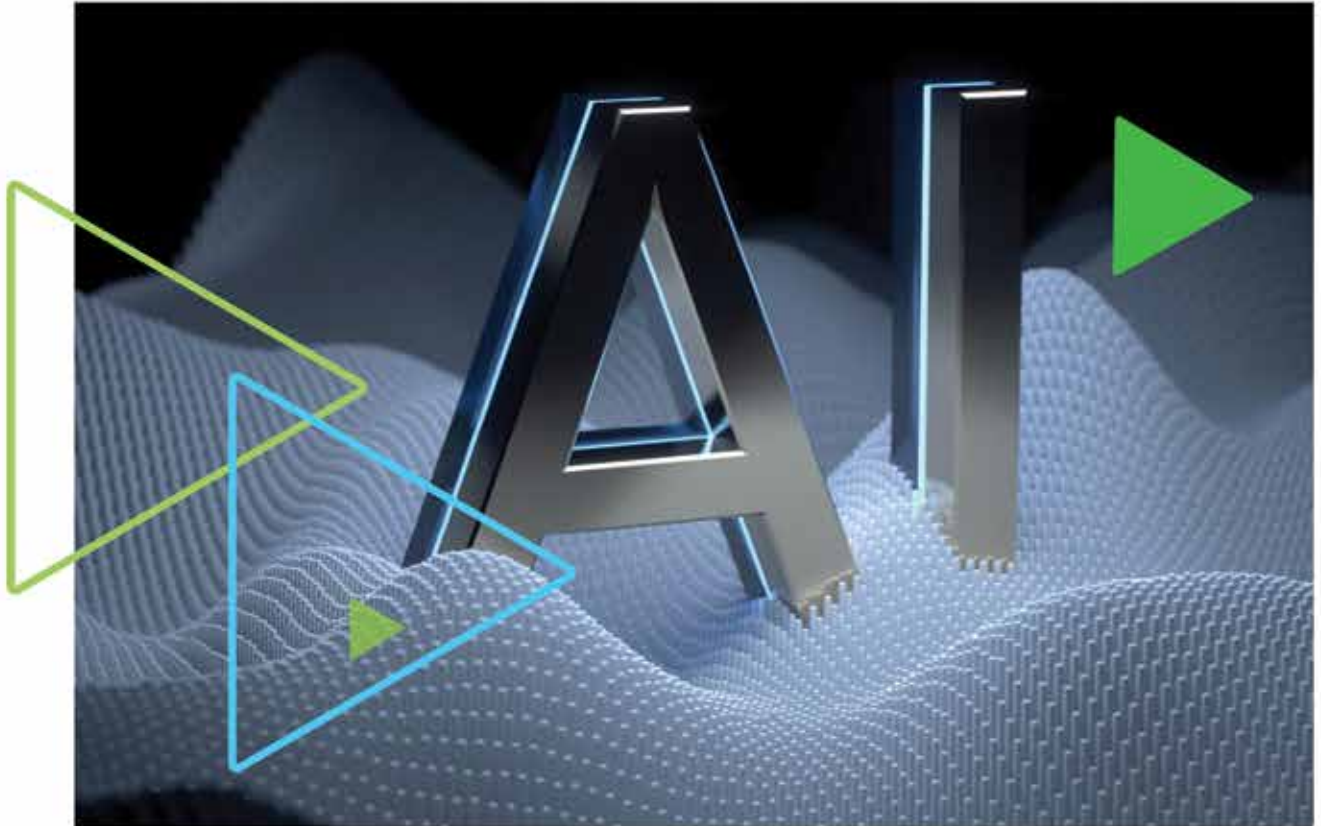
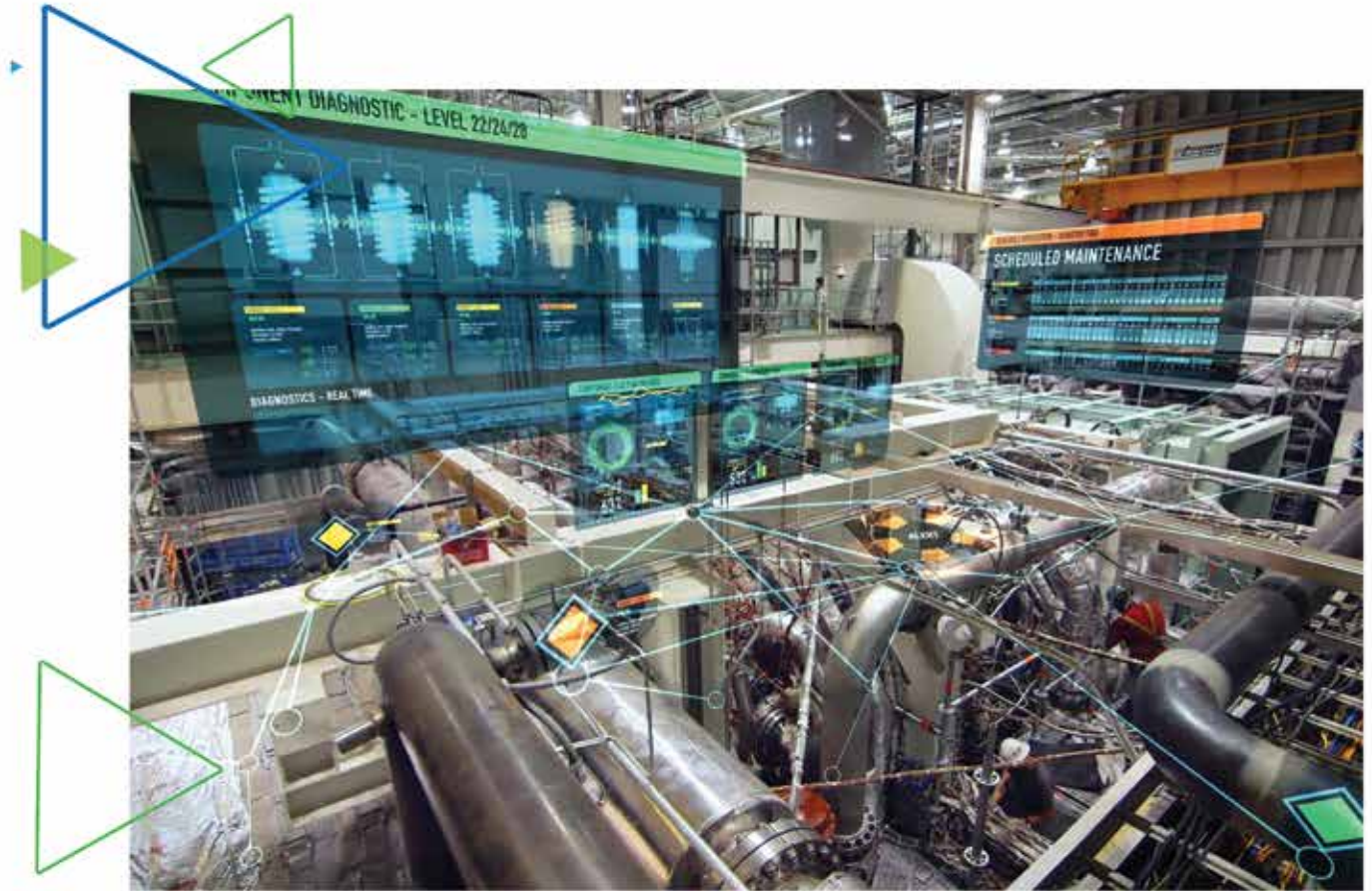


2

Enabling real time customer collaboration and facilitating the customers smart city engagement and digital lifestyle enablement. There is never enough expertise to go around solving problem at the right place at the right time. Greenstar Technologies SurgeCloud AI tools has expert-level competence in solving problems in task areas by bringing huge knowledge about specific tasks.

Surge Bots are smart agents, an autonomous entity which observes and acts upon an environment and directs its activity towards achieving goals. It successfully interacts and acts on behalf of users with different goals and motivations to cooperate, coordinate and negotiate with each other.

Surge Bots offer a new and more appropriate route to the envelopment of complex computational systems, especially in open and dynamic environments. The Surge Bots management and control system consists of a range of intelligent, analytic agents that are transported to the target device when the need arises.





AI and ML enabled system bots has got great potential and embraces utilities, deriving value out of its assets and systems. Here are some examples:

- Load forecasting
- Yield optimization
- Predictive maintenance
- Demand management
- Energy theft control
- Customer insights
- Energy trading
- Acts like virtual agents
- Supplier selection
- Consumption insights
- Many more...



Enabling digital Transformation of Utilities

Fundamental shifts in how utilities are producing and selling electricity, gas and water are taking place, with distinctive differences in each sector. Customers are becoming electric energy producers with the growing use of distributed generation systems like micro-turbines and solar panels. Across the industry, digitalization is at the top of the agenda. With the wide-scale deployment of smart meters, sensor devices and robotics, the key business issue is extracting value from the resulting deluge of data and using it to create new offerings and services to the end customer.

The traditional model for energy retailers will be obsolete, customers will become “energy experts”, “living off the grid” will be mainstream, retailers will rely on new, digital services to bolster revenue and reduce customer churn. Utility retailers will drive new partnerships with multiple industries, customers will evangelize their utility, retailers will be actively forecasting supply and demand using new digital tools and systems, privacy and security will be a growing issue for energy customers.

Greenstar Technologies have portrayed a vision of smart energy, driven by real-time with interactive communication networks that provide services adopted in a manner very similar to the evolution of the web and the internet. In this vision, customers and consumers will be able to see variable pricing changes in real time, supported by smart meters and energy management devices that read and visualize energy consumption at a high rate, leading ultimately to changes in consumer behavior. A brave new energy future where real-time energy data unleashes innovations and applications that we haven't yet thought of.

This vision of the future may sound overly optimistic. Fully integrated two-way networked smart energy management is the outcome entrepreneurs and their investors are hoping for. The reality is that the consumer piece of the smart grid will look very different for years to come. While it's significant that utilities are starting to build out smart grid infrastructure, utilities are largely opting for networks that provide connections that are far from real time and this could stifle the desired innovation.

Expanding beyond sale of power and developing energy services, places utilities at the forefront of the smart cities' opportunity.

Greenstar Technologies is at the forefront of developing digital technologies for utilities in supporting delivery of digital services for generation, transmission, distribution and consumer empowerment. Our platform is developed on Microsoft Azure stack providing a robust cloud infrastructure. The platform enables collaboration between utilities and third-party service provider's ecosystem for new insights on the business operations and customer services.

The Greenstar Technologies digital utilities platform enables the delivery of a multitude of services seamlessly allowing delivery of advanced analytics using AI and Blockchain technologies to provide the utilities and consumers the BI they need to manage their utility consumption and to offer new products, services, technologies to combat digital security threats.

Strategic maneuvers dictate utilities' role in future power systems expanding beyond sale of power. Developing services around utility infrastructure can place a utility and its ecosystem at the forefront of the smart cities opportunity. Greenstar Technologies' digital utilities platform can help transform the way utilities conduct their business and offer services to their customers.

The Greenstar Technologies SurgeCloud IoT platform offers new product and management options to ease digital transformation. Our platform can help to improve operations through analytics, accurate reporting, as well as develop new products and services and combat digital security threats.



Questions?

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